



MARINA COAST WATER DISTRICT

A1/A2 RESERVOIRS AND B/C ZONE BOOSTER PUMP STATION PROJECT

CIP NO. GW-0112

December 2020

CONTRACT DOCUMENTS FOR
A1/A2 RESERVOIRS AND B/C ZONE BOOSTER PUMP STATION PROJECT

CIP NO. GW-0112

Marina Coast Water District
11 Reservation Road
Marina, California 93933

Board of Directors

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Submitted 
Andrew A. Sterbenz, P.E.
Schaaf & Wheeler Consulting Civil Engineers



Approved _____
Michael Wegley, P.E. – District Engineer

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- B. Permit Applications
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 - b. CSUMB Construction Right of Entry
- C. Geotechnical Investigation, MCWD A1/A2 Reservoirs and B/C Booster Pump Station, 8th Street and 6th Avenue, Marina, California, prepared by Cornerstone Earth Group, 2020

END OF DOCUMENT

MARINA COAST WATER DISTRICT
MARINA, CA
CIP # GW-0112, A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION

INVITATION TO BIDDERS

Sealed Bids for the construction of the **A1/A2 Reservoirs And B/C BOOSTER PUMP STATION Project** will be received by the Marina Coast Water District (herein after referred to as MCWD), at 11 Reservation Road, Marina, CA 93933, until **2:00 p.m.** local time on **Wednesday, February 24, 2021**, at which time the Bids received will be publicly opened and read. The Project consists of constructing two 1.6 MG steel water tanks, a new booster pump station with seven pump bays, approximately 4,000-LF of pipelines and modifying the existing wellfield chlorination system.

Bids will be received for a single prime Contract. Bids shall be on a lump sum and unit price basis, with additive alternate bid items as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is: MCWD Engineering Office, 920 Second Avenue, Suite A, Marina, CA 93933, point of contact: **Stephenie Verduzco, (831) 883-5929**.

Prospective Bidders may examine the Bidding Documents at the Issuing Office on Mondays through Thursdays between the hours of 8:00 a.m. to 5:00 p.m., and may obtain copies of the Bidding Documents online at www.mcwd.org.

Bidding Documents also may be examined at the Central Coast Builder's Exchange Plan Room, 242 E Romie Ln, Salinas, CA 93901 (831) 883-3933. Hard copies of the Bidding Documents are not available for purchase; the Bidding Documents are only available as a free download from the Issuing Office website at www.mcwd.org. Neither Owner nor Engineer will be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than the Issuing Office.

A pre-bid conference will be held at **10:00 a.m.** local time on **Wednesday, January 27, 2021** via a video-teleconference. An addendum will be issued to the plan holder's list with the login credentials prior to the pre-bid conference. A site visit will be conducted at 11:00 a.m. on Thursday, January 28, 2021 for areas not publicly accessible. Attendance at both the pre-bid conference and site walk is mandatory. A representative must be present for each portion of the pre-bid conference if the pre-bid conference includes a site visit.

Bid security shall be furnished in accordance with the Instructions to Bidders.

The right is reserved, as the interest of MCWD may require, to reject any or all bids, to waive any informality in bids, and to accept or reject any items of the bid. If the Contractor's bid is accepted, the MCWD will execute the Contract as governed by Public Contract Code 22030 through 22045. The award of the contract, if it is to be awarded, will be to the lowest responsible bidder whose proposal complies with all the requirements prescribed. Such award, if made, will be made within 60 days after the bid opening, unless an extension is agreed to by the lowest responsible bidder.

The bidder and any of his subcontractors must be licensed as a **Class A General Engineering** Contractor with the Contractors State License Board of the State of California Department of Consumer Affairs. Bids will not be considered from contractors not licensed as a **Class A General Engineering** Contractor unless they hold a specialty license for the specific classification(s) to be performed.

To be qualified to bid on, be listed in a bid proposal or engage in the performance of any public work contract subject to Labor Code section 1720, contractors and subcontractors must be registered with the Department of Industrial Relations. Please see <http://www.dir.ca.gov/PublicWorks/PublicWorks.html> for more information. No contract will be entered into without proof of the

contractor's and subcontractors' current registration with the Department of Industrial Relations to perform public work. If awarded a contract, the bidder and its subcontractors, of any tier, shall maintain active registration with the Department of Industrial Relations for the duration of the project.

Public Works projects exceeding \$1,000.00 require the payment of the general prevailing rate of per diem wages, copies of which are on file at the State of California, Department of Consumer Affairs Office. (Labor Code 1770, et seq.).

The MCWD contact person assigned to this project is: Brian True, Senior Engineer. All inquiries regarding the project shall be directed to MCWD at (831) 883-5937 (phone), (831) 384-0197 (fax), or btrue@mcwd.org (e-mail). Requests for information will be received in writing until 4:00 p.m. on **Wednesday, February 17, 2021.**

Owner: **Marina Coast Water District**

By: **Michael Wegley, PE**

Title: **District Engineer**

Date: **January 7, 2021**

+ + END OF INVITATION TO BIDDERS + +

INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

- A. *Issuing Office* – The office from which the Bidding Documents are to be issued, which is the MCWD Engineering Office, 2840 4th Avenue, Marina, CA 93933.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:

- A. Evidence of Bidder's authority to do business in the state where the Project is located.
B. Bidder's state or other contractor license number, if applicable.
C. References from other completed projects of similar scope.

3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.
- B. Easements for new facilities are shown on the Drawings. Work and permit restrictions are included in the Specifications.

4.02 Existing Site Conditions

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions
1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
 2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
 3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or adjacent to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 Site Visit and Testing by Bidders

- A. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. A portion of the Work is within the existing Intermediate Reservoir site. Coordinate with the owner for access to the locked yard.
- C. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- D. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations,

investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.

- E. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- F. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such

information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A mandatory pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are required to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Owner in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven calendar days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 10% (ten percent) of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.

- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be substantially completed, and completed and ready for final payment, are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 12 – SUBCONTRACTORS AND OTHERS

- 12.01 A Bidder shall be prepared to retain specific Subcontractors or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor or other individual or entity against which Contractor has reasonable objection.

12.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner qualifications information for the Subcontractors proposed for the following portions of the Work: steel tank fabrication, construction and coating; SCADA programming; pipeline welding.

If requested by Owner, such qualifications information shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors or other individuals or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

ARTICLE 13 – PREPARATION OF BID

13.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.

13.03 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The partnership's address for receiving notices shall be shown.

13.04 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the firm's address for receiving notices shall be shown.

13.05 A Bid by an individual shall show the Bidder's name and address for receiving notices.

13.06 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture's address for receiving notices shall be shown.

13.07 All names shall be printed in ink below the signatures.

- 13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.09 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.10 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 Base Bid with Alternates

- A. Bidders shall submit a Bid on a lump sum basis for the total base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.

14.02 *Unit Price*

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.03 *Allowances*

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.
- B. If the Owner includes reimbursement allowances, the allowance value will be pre-entered in the Bid Form.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.

- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to Marina Coast Water District, 11 Reservation Road, Marina, CA 93933, ATTN: District Engineer.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
 - B. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors proposed for those portions of the Work for which the identity of Subcontractors must be submitted as provided in the Bidding Documents.
- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors.
- 19.06 Bid Protests
- A. Any bid protest must be in writing and received by District's District Engineer at 11 Reservation Road Marina CA 93933 at or before 4:00 p.m. (California time) two (2) working days after bid opening (the "Bid Protest Deadline") and must comply with the following requirements:
 - B. General. Only a bidder who has actually submitted a bid is eligible to submit a bid protest against another bidder. Subcontractors are not eligible to submit bid protests. A bidder may not rely on the bid protest submitted by another bidder but must timely pursue its own protest. For purposes of this Section 1.1, a "working day" means a day that District is open for normal business, and excludes weekends and holidays observed by District. Any untimely protest or protest submitted without the requisite bid protest fee will be returned to the protestor without further action.
 - C. Non-refundable Bid Protest Fee. The protesting bidder must submit the following non-refundable fee via cashier's check made payable to "Marina Coast Water District" to reimburse its costs to administer the bid protest:
 - 1. Five Hundred Dollars (\$500), where the protesting bidder's bid is less than \$1,000,000;
 - 2. One Thousand Dollars (\$1,000), where the protesting bidder's bid is \$1,000,000 or more but less than \$5,000,000;
 - 3. Two Thousand Dollars (\$2,000), where the protesting bidder's bid is \$5,000,000 or more.

This applicable fee must be submitted to District no later than the Bid Protest Deadline, unless otherwise specified in the District's bid solicitation documents. Failure to make timely payment shall result in the bid protest being rejected as being incomplete.
 - D. Protest Contents. The bid protest must state (a) all of the specific grounds for the protest, (b) the specific facts that support each ground, including but not limited to the specific provision(s) of the bid solicitation documents and the specific portion on the face of the bid being protested that are the basis of the protest, and (c) must provide all supporting

- documentation. Additional grounds and supporting facts for the bid protest and documentation submitted after the Bid Protest Deadline will not be considered. The protest must include the name, address, email address, and telephone number of the person representing the protesting bidder. The protest must be signed and submitted under penalty of perjury.
- E. Copy to Protested Bidder. The protesting bidder must be concurrently transmitted by fax or by email or by personal delivery by or before the Bid Protest Deadline, a copy of the protest and all supporting documentation to the bidder whose bid is being protested ("protested bidder") and to any other bidder who has a lower bid than the protesting bidder.
 - F. Response to Protest. The protested bidder may submit a written response to the protest, provided the response is received by District at or before 4:00 p.m., within two working days after the Bid Protest Deadline or after actual receipt of the bid protest, whichever is sooner (the "Response Deadline"). The response must include all supporting documentation. Documentation submitted after the Response Deadline will not be considered. The response must include the name, address, email address, and telephone number of the person representing the protested bidder. The response must be signed and submitted under penalty of perjury.
 - G. Copy to Protesting Bidder. A copy of the response and all supporting documents must be concurrently transmitted by fax or by email or by personal delivery, by or before the Response Deadline, to the protesting bidder and any other bidder who has a lower bid than the protesting bidder.
 - H. Exclusive Remedy. The procedure and time limits set forth in this section are mandatory and are the bidder's sole and exclusive remedy in the event of bid protest. A bidder's failure to comply with these procedures will constitute a waiver of any right to further pursue a bid protest, including filing a claim pursuant to the California Government Code or initiation of any other legal proceedings.
 - I. Right to Award. The District Engineer will review the bid protest for completion within a reasonable amount of time prior to the bid award. The District has the authority to issue a final determination on all bid protests. Possible actions by the District on any bid protest include (a) upholding the protest and awarding the bid to the next lowest responsible bidder, (b) rejecting the protest and awarding to the lowest responsible bidder, or (c) rejecting all bids. Nothing in this section shall be construed as a waiver of the District's right to reject all bids.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days

thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 22 – SALES AND USE TAXES (NOT USED)

ARTICLE 23 – RETAINAGE

23.01 Provisions concerning Contractor's rights to deposit securities in lieu of retainage are set forth in the Supplemental Conditions.

ARTICLE 24 – PREVAILING WAGE

24.01 Prevailing wage requirements are set forth in the Supplementary Conditions.

END OF DOCUMENT

BID FORM

A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

Marina Coast Water District

11 Reservation Road

Marina, CA 93933

ATTN: District Engineer

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	Mobilization/Demobilization	LS	1		
2	Sheeting, Shoring and Bracing	LS	1		
3	Traffic Control	LS	1		
4	Yard Piping, Sitework, Paving and Fencing	LS	1		
5	1.6 MG Steel Water Tank A1	LS	1		
6	Booster Pump Station Building	LS	1		
7	Booster Pump Station Mechanical	LS	1		
8	Booster Pump Station Electrical	LS	1		
9	75 HP Pump and Motor	EA	3		
10	150 HP Pump and Motor	EA	3		
11	Relocate and Install 600 KW Generator	LS	1		
12	24-inch DIP in Imjin Parkway	LS	1		
13	24-inch DIP, BPS to 6 th Ave.	LS	1		
14	18-inch DIP, BPS to 6 th Ave	LS	1		
15	16-inch DIP, BPS to B-Zone Tie-In	LS	1		
16	28-inch HDPE Sanitary Sewer	LS	1		
17	HDPE Storm Sewer in 5 th Ave.	LS	1		
18	Chlorine System Modification	LS	1		
19	Replace 300 KW Generator at Intermediate Reservoir	LS	1		
20	SCADA Integration Allowance	ALW	1	\$75,000	\$75,000
21	Permit Allowance	ALW	1	\$15,000	\$15,000
Total of All Unit Price Bid Items					\$

ALW=Allowance, CF=Cubic Foot, CY=Cubic Yard, DY=Day, HR=Hour, LF=Linear Foot, LS=Lump Sum, SF=Square Foot, SY=Square Yard

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Total of Lump Sum and Unit Price Bids = Total Bid Price \$ _____

5.02 Alternate Bid Item(s):

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A1	12-inch DIP, BPS to 5 th Ave	LS	1		
A2	1.6 MG Steel Water Tank A2	LS	1		

Total of Alternate Item Bid Prices: \$ _____

Base Bid Price: \$ _____

Total of Base Bid Plus Alternate Items \$ _____

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The items listed in Document 00 43 93, Bid Submittal checklist, are submitted with and made a condition of this Bid.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By: _____
[Signature]

[Printed name]
 (If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's Contractor

License No.: _____

(where applicable)

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

Marina Coast Water District
11 Reservation Road
Marina, CA 93933

BID

Bid Due Date:

Description: A1/A2 Reservoirs and B/C Booster Pump Station. Marina, CA

BOND

Bond Number:

Date:

Penal sum

_____ \$ _____
(10% (ten percent) of the Total Bid Value, in Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

*Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.*

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

BID SUBMITTAL CHECKLIST

All information required by the terms of the Bid Documents must be furnished. Important items to be submitted are including, but not limited to, those listed below:

ARTICLE 1 - SUBMIT WITH BID

	Form Number	Form Name
<input type="checkbox"/>	00 41 00	Bid Form
<input type="checkbox"/>	No form included	Certificate of Contractor's License
<input type="checkbox"/>	00 43 00	Bid Bond (or Bid Security)
<input type="checkbox"/>	00 43 93	Bid Submittal Checklist (this page)
<input type="checkbox"/>	00 45 12	List of Project References
<input type="checkbox"/>	00 45 14	Designation of Subcontractors
<input type="checkbox"/>	00 45 16	List of Manufacturers
<input type="checkbox"/>	00 45 18	Designation of Insurance Agent or Broker
<input type="checkbox"/>	00 45 20	Stop Notice Information
<input type="checkbox"/>	00 45 22	Non-Collusion Statement
<input type="checkbox"/>	00 45 24	Prevailing Wage Statement
<input type="checkbox"/>	00 45 26	Public Works Contractor Registration Certification
<input type="checkbox"/>	00 45 28	Local Hiring for Public Works
<input type="checkbox"/>	00 45 30	Iran Contracting Act Certification

ARTICLE 2 – SUBMIT PRIOR TO OWNER'S EXECUTION OF CONTRACT (After Notice of Award)

<input type="checkbox"/>	00 52 00	Agreement
<input type="checkbox"/>	00 61 00	Performance Bond
<input type="checkbox"/>	00 61 50	Payment Bond
<input type="checkbox"/>	No form included	Insurance Certificates

END OF DOCUMENT

LIST OF PROJECT REFERENCES**A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION***SUBMIT WITH BID*

The Bidder shall provide three projects that they have successfully completed in the last ten years of like nature and equaling \$15,000,000 in total value. The Bidder shall provide the project name, owner representative and phone number. The projects listed shall be of similar scope and type as the project identified in this document.

	Project Name	Owner Representative	Owner Phone # and E-Mail	Contract Amount
1				
2				
3				

END OF DOCUMENT

DESIGNATION OF SUBCONTRACTORS

A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION

SUBMIT WITH BID

In compliance with the provisions of Sections 4100-4113 of the Public Contract Code of the State of California, and any amendments thereof, and, if applicable, with the requirements of County relating to projects for the construction, improvement or repair of Public Works, the undersigned bidder has set forth below the name and location of the place of business of each subcontractor who will perform work or labor or render service to the undersigned in or about the construction of the work, and each subcontractor who, under subcontract, will specially fabricate and install a portion of the work or improvement according to detailed drawings contained in the plans and specifications, for such work to be performed under the Contract Documents to which the attached bid is responsive, and the portion of the work which will be done by each subcontractor and for each subcontract in excess of one half of one percent of the undersigned's total aggregate bid.

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Name of SUBCONTRACTOR: _____

Division of Work: _____ Phone: _____

Location (address, city, zip): _____

Contractor License No.: _____ DIR Number: _____

Attach additional sheets, as needed.

COMPANY NAME: _____

By: _____

Bidder's Signature

Date: _____

END OF DOCUMENT

LIST OF MANUFACTURERS**A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION***SUBMIT WITH BID*

	Manufacturer	Product
1		Vertical Turbine Pumps
2		Low Voltage Motors (for pumps)
3		Welded Steel Water Tanks
4		Motor Control Centers / Panelboards
5		Ductile Iron Pipe and Fittings

END OF DOCUMENT

DESIGNATION OF INSURANCE AGENT OR BROKER

A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION

SUBMIT WITH BID

It is proposed that the following insurance agent/broker and insurance company will provide policies of insurance or insurance certificates as required by the bid documents.

Insurance Agent or Broker: _____

Street: _____

City, State and Zip: _____

Telephone: _____

Name of Insurance Company
Providing Coverage _____

Best's Key Rating Guide of at least A VII? Yes _____ No _____

It is proposed that the following bonding agent or surety will provide payment and performance bonds as required by the bid documents.

Bonding Agent or Broker: _____

Street: _____

City, State and Zip: _____

Telephone: _____

Name of Surety Company
Providing Bonds: _____

1. Admitted in California? Yes _____ NO _____

OR

Current Treasury Listed Surety (Federal Register)? Yes _____ NO _____

AND

Current A.M. Best BBB or better rating? Yes _____ NO _____

2. (in lieu of 1)

An admitted surety insurer which complies with the provisions of the code of Civil Procedure, Section 995.660*.

California Code of Civil Procedure Section 995.660 in summary, states that an admitted surety must provide 1) the original, or a certified copy of instrument authorizing the person who executed the bond to do so; 2) a certified copy of the Certificate of Authority issued by the Insurance Commissioner, 3) a certificate from county Clerk of Monterey County that Certificate of Authority has not been surrendered, revoked, canceled, annulled or suspended; 4) a financial statement showing the assets and liabilities of the insurer at the end of the quarter calendar year, prior to 30 days next preceding the date of the execution of the bond.

OR

- 3. In lieu of 1 and 2, a company of equal financial size and stability that is approved by the MCWD Insurance/Risk Manager.

By signing below, the bidder certifies that:

The above comply with the MCWD standards for liability insurers and sureties pursuant to Article 6 of the General and Supplementary Conditions: Yes _____ NO _____. If "No", your bid is subject to rejection.

COMPANY NAME: _____

BY: _____
(Bidder's signature)

DATE: _____

END OF DOCUMENT

STOP NOTICE INFORMATION

SUBMIT WITH BID

PROJECT NAME: A1/A2 Reservoirs and B/C Booster Pump Station

CONTRACTOR'S NAME AND ADDRESS: _____

Reference: California Civil Code, Division 3, Part 4, Title 15, Chapter 4

The following is provided for the information of contractors, subcontractors and suppliers of labor, materials, equipment, and services under MCWD contracts, and is not intended as legal advice. Advice of legal counsel should be obtained to ensure compliance with legal requirements relating to public works stop notices.

WHERE TO FILE: All original stop notices and preliminary-20 day notices (if required by California Civil Code 53098) must be filed with the Marina Coast Water District, 11 Reservation Road, Marina, CA 93933.

STOP NOTICE CONTENTS: See California Civil Code 3103. written notice, signed and verified by the claimant and including information such as the kind of labor, equipment, materials or service furnished or agreed to be furnished by the claimant; the name of the person/entity to or for whom the same was done or furnished; the amount in value of that already done or furnished and/or agreed to be done or furnished. Blank stop Notice forms are commercially available.

WHO MAY SERVE STOP NOTICE: See California Code 53181. All persons furnishing labor, materials, equipment or services to the job (except the original contractor) and persons furnishing provisions, provender or other supplies.

HOW THE STOP NOTICE IS SERVED: See California Code S3103. Served by personal service, registered mail, or certified mail.

TIME FOR SERVICE: See California Civil Code 3184. Stop notices must be served before the expiration of 30 days after the recording of a Notice of Completion (sometimes referred to as a Notice of Acceptance) or Notice of Cessation, if such notice is recorded or if no Notice of Completion or Notice of Cessation is recorded, 90 days after actual completion or cessation.

NOTICE OF PUBLIC ENTITY (OWNER): See California Civil Code 3185. Provided that a stop notice claimant has paid to the Clerk of the Board of Supervisors the sum of \$2.00 at the time of filing a stop notice, the Clerk shall provide each stop notice claimant with notice of filing of a Notice of

Completion or after the cessation of labor has been deemed a completion of a public work or after the acceptance of completion, whichever is later, to each stop notice claimant, by personal service or registered or certified mail.

RELEASE OF STOP NOTICE: See California Civil Code 3196 and following. A stop notice can be released if the original contractor files a corporate surety bond with the Clerk of the Board of Supervisors, in the amount of 125% of the stop notice claim. Alternatively, the original contractor may file an affidavit pursuant to California Civil Code S3198, stating objections to the validity of the stop notice. A counter affidavit may be filed by the claimant pursuant to 53200 and a summary legal proceeding may be held pursuant to 3201 and following, to determine the validity of the stop notice. If no counter affidavit is filed, the stop notice funds shall be released. Alternatively, the Stop Notice claimant may file a Release in a form which substantially complies with California Civil Code 3262.

STOP NOTICE LAWSUIT: See California Civil Code 53210 through 3214. These sections provide that a stop notice is perfected only by the filing of a lawsuit. A lawsuit must be filed no sooner than 10 days after service of a stop notice and no later than 90 days after the expiration of the time for filing stop notices. Notice of suit must be given to the Clerk of the Board within 5 days after commencement. The Court has the discretionary right to dismiss the lawsuit if it is not brought to trail within two years.

I HEREBY ACKNOWLEDGE THAT I RECEIVED AND READ THE ABOVE STOP NOTICE INFORMATION AND IF I AM AWARDED THIS CONTRACT, I AGREE TO INCLUDE A COPY OF THIS PAGE IN ALL SUBCONTRACTS AND CONTRACTS FOR LABOR, MATERIALS, EQUIPMENT, AND SERVICES THAT I ENTER INTO FOR THIS PROJECT:

Bidder's Signature: _____

Bidder's Name and Title (Print): _____

Date: _____

END OF DOCUMENT

NON-COLLUSION DECLARATION TO BE EXECUTED BY BIDDER

A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION

SUBMIT WITH BID

I, _____, am the
(name)

_____ of _____
(Position Title) (Company)

the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid; and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct:

Signature

Date

END OF DOCUMENT

PREVAILING WAGE STATEMENT

SUBMIT WITH BID

If awarded the contract, we and our subcontractors shall pay all the workers we assign to the project not less than the prevailing wage as determined by the state of California, Director of Industrial Relations in compliance with Article 7 of the Supplementary Conditions. We are aware that the contractor shall be penalized for non-compliance by either the contractor or his subcontractor(s).

In addition, we are informed of the following:

Copies of the prevailing wage rates are on file at:

Marina Coast Water District
11 Reservation Road
Marina, CA 93933

or

State of California Department of Industrial Relations
Division of Labor Statistics and Research
455 Golden Gate Avenue, 10th Floor
San Francisco, CA 94104
(415) 703-4774

On-line at <https://www.dir.ca.gov/oprl/DPreWageDetermination.htm>

The successful bidder shall be required to post the prevailing wage determinations at each job site.

Each contractor and subcontractor shall keep accurate payroll records showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per them wages paid to each journeyman, apprentice, worker or other employee employed by him or her in connection the public work.

Certified copies of such payroll records must be furnished to the State Department of Industrial Relations electronically. Certified copies of such payroll records must be furnished to the Marina Coast Water District upon request.

By signing below, the bidder certifies that he shall comply with the prevailing wage laws.

Company Name: _____

Bidder's Signature: _____

Date: _____

END OF DOCUMENT

PUBLIC WORKS CONTRACTOR REGISTRATION CERTIFICATION

SUBMIT WITH BID

Pursuant to Labor Code sections 1725.5 and 1771.1, all contractors and subcontractors that wish to bid on, be listed in a bid proposal, or enter into a contract to perform public work must be registered with the Department of Industrial Relations. See <http://www.dir.ca.gov/Public-Works/PublicWorks.html> for additional information.

No bid will be accepted nor any contract entered into without proof of the contractor's and subcontractors' current registration with the Department of Industrial Relations to perform public work.

Bidder hereby certifies that it is aware of the registration requirements set forth in Labor Code sections 1725.5 and 1771.1 and the bidder and all bidder's subcontractors are currently registered as a contractor with the Department of Industrial Relations.

Name of Bidder: _____

DIR Registration Number: _____

Name of Subcontractor: _____

DIR Registration Number: _____

Name of Subcontractor: _____

DIR Registration Number: _____

Name of Subcontractor: _____

DIR Registration Number: _____

Name of Subcontractor: _____

DIR Registration Number: _____

Name of Subcontractor: _____

DIR Registration Number: _____

Name of Subcontractor: _____

DIR Registration Number: _____

Bidder further acknowledges:

1. Bidder shall maintain a current DIR registration for the duration of the project.
2. Bidder shall include the requirements of Labor Code sections 1725.5 and 1771.1 in its contract with subcontractors and ensure that all subcontractors are registered at the time of bid opening and maintain registration status for the duration of the project.
3. Failure to submit this form or comply with any of the above requirements may result in a finding that the bid is non-responsive.

Bidder's Signature: _____

Bidder's Name and Title: _____

Firm: _____

Date: _____

END OF DOCUMENT

LOCAL HIRING FOR PUBLIC WORKS

SUBMIT WITH BID

This contract is for a Marina Coast Water District public works project. All Contractors and Subcontractors are required to comply with all of the provisions of Ordinance 53 Local Hiring (Chapter 2.10 of the District Code). Failure to comply with the local hiring ordinance may subject the Contractor herein with disqualification from any future Marina Coast Water District public works contracts.

The Bidder hereby certifies that (initial as applicable):

_____ Bidder has read Ordinance 53, Local Hiring for District Public Works, and

_____ Bidder can meet the local hiring requirements of Ordinance 53, or

_____ Bidder has made a good faith effort to meet the requirements of Ordinance 53 as documented on the attached pages, and anticipates a total of _____ percent of the workforce will be residents of the Monterey Bay Area, or

_____ Bidder requires an exception because a suitable pool of persons does not exist locally for the specialized skills listed below. These workers will constitute _____ percent of the workforce.

Specialized Skill	No. of Workers	County of Residence

Company Name: _____

Contractor's Signature: _____

Date: _____

Efforts to Hire Employees (submit only if needed)

Classification	Agency Contacted	Date	Results

Efforts to Hire Subcontractors (submit only if needed)

Work Item	Company Contacted	Date	Results*

* Standard codes: DNR-did not respond, NA-not available for job, NB-not bidding, USED-included in bid, HIGH-selected lower cost bid

END OF DOCUMENT

IRAN CONTRACTING ACT CERTIFICATION

SUBMIT WITH BID

Reference: Public Contract Code Section 2200 et seq.

As required by California Public Contract Code Section 2204, the Contractor certifies subject to penalty for perjury that the option checked below relating to the Contractor's status in regard to the Iran Contracting Act of 2010 (Public Contract Code Section 2200 et seq.) is true and correct:

The Contractor is not:

(i) identified on the current list of persons and entities engaging in investment activities in Iran prepared by the California Department of General Services in accordance with subdivision (b) of Public Contract Code Section 2203; or

(ii) a financial institution that extends, for 45 days or more, credit in the amount of \$20,000,000 or more to any other person or entity identified on the current list of persons and entities engaging in investment activities in Iran prepared by the California Department of General Services in accordance with subdivision (b) of Public Contract Code Section 2203, if that person or entity uses or will use the credit to provide goods or services in the energy sector in Iran.

MCWD has exempted the Contractor from the requirements of the Iran Contracting Act of 2010 after making a public finding that, absent the exemption, MCWD will be unable to obtain the goods and/or services to be provided pursuant to the Contract.

The amount of the Contract payable to the Contractor for the Project does not exceed \$1,000,000.

Bidder's Signature: _____

Bidder's Name and Title: _____

Firm: _____

Date: _____

Note: In accordance with Public Contract Code Section 2205, false certification of this form shall be reported to the California Attorney General and may result in civil penalties equal to the greater of \$250,000 or twice the Contract amount, termination of the Contract and/or ineligibility to bid on contracts for three years.

END OF DOCUMENT

NOTICE OF AWARD

Date of Issuance:

Owner: Marina Coast Water District Owner's Contract No.:

Engineer: Engineer's Project No.:

Project: A1/A2 Reservoirs and B/C Booster Pump Station Contract Name:

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated [] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is: \$ [] *[note if subject to unit prices, or cost-plus]*

[] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. *[revise if multiple copies accompany the Notice of Award]*

a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of this Notice of Award:

1. Deliver to Owner [] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security *[e.g., performance and payment bonds]* and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:

Authorized Signature

By:

Title:

Copy: Engineer

**AGREEMENT
 BETWEEN MARINA COAST WATER DISTRICT
 AND [CONTRACTOR]
 FOR A1/A2 RESERVOIRS AND B/C BOOSTER PUMP STATION**

THIS AGREEMENT is by and between Marina Coast Water District (“Owner”) and _____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

ARTICLE 2 – THE PROJECT

2.01 *The Project, of which the Work under the Contract Documents is a part, is generally described as follows: A1/A2 Reservoirs and B/C Booster Pump Station*

ARTICLE 3 – ENGINEER

3.01 The part of the Project that pertains to the Work has been designed by Schaaf & Wheeler Consulting Civil Engineers, 3 Quail Run Circle, Suite 101, Salinas, CA 93907.

3.02 The Owner has retained Schaaf & Wheeler (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Days*

A. The Work will be substantially completed within 700 calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 760 calendar days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the

delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$2,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$2,000 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

4.04 *Special Damages*

- A. In addition to the amount provided for liquidated damages, Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.
- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
 - A. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item):

Unit Price Work					
Item No.	Description	Unit	Estimated Quantity	Unit Price	Extended Price
1	Mobilization/Demobilization	LS	1		
2	Sheeting, Shoring and Bracing	LS	1		
3	Traffic Control	LS	1		

Unit Price Work					
Item No.	Description	Unit	Estimated Quantity	Unit Price	Extended Price
4	Yard Piping, Sitework, Paving and Fencing	LS	1		
5	1.6 MG Steel Water Tank A1	LS	1		
6	Booster Pump Station Building	LS	1		
7	Booster Pump Station Mechanical	LS	1		
8	Booster Pump Station Electrical	LS	1		
9	75 HP Pump and Motor	EA	3		
10	150 HP Pump and Motor	EA	3		
11	Relocate and Install 600 KW Generator	LS	1		
12	24-inch DIP in Imjin Parkway	LS	1		
13	24-inch DIP, BPS to 6th Ave.	LS	1		
14	18-inch DIP, BPS to 6th Ave	LS	1		
15	16-inch DIP, BPS to B-Zone Tie-In	LS	1		
16	28-inch HDPE Sanitary Sewer	LS	1		
17	HDPE Storm Sewer in 5th Ave.	LS	1		
18	Chlorine System Modification	LS	1		
19	Replace 300 KW Generator at Intermediate Reservoir	LS	1		
20	SCADA Integration Allowance	ALW	1		
21	Permit Allowance	ALW	1		
A1	12-inch DIP, BPS to 5th Ave	LS	1		
A2	1.6 MG Steel Water Tank A2	LS	1		
Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities)					\$

The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 Progress Payments; Retainage

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 30th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
 - a. 95 percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. 0 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
 - B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 Final Payment

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate of 5 percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

- D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
1. This Agreement.
 2. Performance bond.
 3. Payment bond.
 4. General Conditions.
 5. Supplementary Conditions.
 6. Specifications as listed in the table of contents of the Project Manual.
 7. Drawings (not attached but incorporated by reference) .
 8. Addenda (numbers 1 to , inclusive).
 9. Exhibits to this Agreement (enumerated as follows):

-
- a. Contractor's Bid (Document 00 41 00).
 - b. Contractor's Representations (Documents 00 45 12 to 00 45 30, as included in the Bid)
10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 11. The Standard Plans and Specifications of the Marina Coast Water District, dated November 2007 (not attached but incorporated by reference).
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
 - C. There are no Contract Documents other than those listed above in this Article 9.
 - D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 Other Provisions

- A. Owner stipulates that the General Conditions that are made a part of this Contract are the EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, with modifications made solely in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on [redacted] (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: General Manager

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

Marina Coast Water District

11 Reservation Road

Marina, CA 93933

License No.: _____

(where applicable)

PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

Marina Coast Water District
11 Reservation Road, Marina, CA 93933

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):* A1/A2 Reservoirs and B/C Booster Pump Station, Marina, CA

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: None See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

_____ *(seal)*

Contractor's Name and Corporate Seal

_____ *(seal)*

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the

Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of

action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been

made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

PAYMENT BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

Marina Coast Water District
11 Reservation Road, Marina, CA 93933

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):* A1/A2 Reservoirs and B/C Booster Pump Station, Marina, CA

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: None See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

(seal)

Contractor's Name and Corporate Seal

(seal)

Surety's Name and Corporate Seal

By: _____

Signature

By: _____

Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____

Signature

Attest: _____

Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

- 11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
- 12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
- 13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
- 14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
- 15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
- 16. **Definitions**
 - 16.1 **Claim:** A written statement by the Claimant including at a minimum:
 - 1. The name of the Claimant;
 - 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 - 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 4. A brief description of the labor, materials, or equipment furnished;
 - 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic’s lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of “labor, materials, or equipment” that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
 - 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
 - 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
- 6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
- 7. The total amount of previous payments received by the Claimant; and
- 8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
- 18. Modifications to this Bond are as follows:

**DOCUMENT 00 72 00
STANDARD GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT**

Prepared by



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**STANDARD GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT**

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY**1.01 Defined Terms**

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

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37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
 38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
 39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
 40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, 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.
 41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
 42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
 43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
 44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
 45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
 46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
 47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

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48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

- A. *Reporting Discrepancies:*
 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 Reuse of Documents

- A. Contractor and its Subcontractors and Suppliers shall not:
1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK**4.01 Commencement of Contract Times; Notice to Proceed**

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 Starting the Work

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 Reference Points

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 Progress Schedule

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
2. abnormal weather conditions;
3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

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- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 Availability of Lands

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 Differing Subsurface or Physical Conditions

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings*: The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

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- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE**6.01 Performance, Payment, and Other Bonds**

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 Insurance—General Provisions

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 Contractor's Insurance

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

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4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result
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of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
1. include at least the specific coverages provided in this Article.
 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 Owner's Liability Insurance

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 Property Insurance

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 Waiver of Rights

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 Receipt and Application of Property Insurance Proceeds

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

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- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
 - F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
 - G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
 - H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
 - I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
 - J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
 - K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
 - L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
 - M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
 - N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

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- O. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 Taxes

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 Laws and Regulations

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 Record Documents

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 Safety and Protection

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
 1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
 5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
 6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
 7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 Coordination

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 Legal Relationships

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

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- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

- C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:
- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 - 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 - 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.
- D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.
- E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

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- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
 - C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
 - D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

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- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

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- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

- A. *Application for Payment:*
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SUPPLEMENTARY CONDITIONS

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A1/A2 Reservoirs and B/C Booster Pump Station

CIP # GW-0112

Document 00 73 00

Marina Coast Water District

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I. General

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, Document 00 72 00 (EJCDC® C-700, 2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

II. Specific Items**ARTICLE 1 – DEFINITIONS AND TERMINOLOGY***SC-1.01 Defined Terms*

SC-1.01.A.28 Add the following sentence to the end of Paragraph 1.01.A.29:

The Terms "Owner", "District" and "MCWD" shall be used interchangeably and shall have the same meaning.

ARTICLE 2 – PRELIMINARY MATTERS*SC-2.02 Copies of Documents*

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:

- A. Owner shall furnish to Contractor 4 copies of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE*SC-3.01 Intent*

SC-3.01.F Add the following new paragraphs immediately after Paragraph 3.01.E:

- F. In case of conflicts between the Contract Documents, the order of precedence shall be as follows:
1. Change Orders, Field Orders or Work Change Directives
 2. Permits from Agencies having jurisdiction
 3. Addenda
 5. Special Conditions (Document 00 73 00)
-

6. Technical Specifications (Divisions 01 to 48)
 7. Drawings
 8. Agreement (Document 00 52 00)
 9. General Conditions (Document 00 72 00)
 10. Contractor’s Bid Forms (Documents 00 41 00 – 00 45 38)
 11. Standard Specifications
 12. Standard Plans (Drawings)
 13. Reference Documents
- G. With respect to the Drawings, the order of precedence shall be as follows:
1. Figures govern over scaled dimensions
 2. Detail drawings govern over general drawings
 3. Addenda, Change Orders, Field Orders or Work Change Directives govern over Contract Drawings, with the most recent governing over earlier changes
 4. Contract Drawings govern over Standard Drawings
 5. Contract Drawings govern over Shop Drawings

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC--5.02 Use of Site and Other Areas

SC-5.02.E Add the following new paragraph immediately after Paragraph 5.02.D

- E. Contractor shall submit copies of all agreements made with property owners for property use related to this project such as material and/or equipment storage, material disposal, etc.

SC-5.03 Subsurface and Physical Conditions

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.B:

- C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:
1. Report dated December 2020, prepared by Cornerstone Earth Group, entitled: “Geotechnical Investigation MCWD A1/A2 Reservoirs and B/C Booster Pump Station”, consisting of 81 pages.
- D. The following drawings of physical conditions relating to existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities) are known to Owner:
1. Drawings dated January 24, 1964, prepared by George S. Nolte & Associates, entitled: “Water Well Field, Fort Ord, California”, consisting of 30 pages.

2. Drawings dated October 2019, prepared by TJC & Associates, entitled: "Marina Coast Water District, Pump Station Standby Generators", consisting of 25 pages.

E. Contractor may examine copies of reports and drawings identified in SC 5.03.C and SC 5.03.D that were not included with the Bidding Documents at Marina Coast Water District, Engineering Office, 2840 4th Avenue, Marina, CA 93933, during regular business hours, or may request copies from Engineer.

SC-5.06 Hazardous Environmental Conditions

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.
- B. Not Used.

SC 5.06.I Delete Paragraph 5.06.I in its entirety.

SC-5.07 Environmental Reports

Add the following new subparagraphs immediately before Article 6:

SC-5.07 Environmental Reports

- A. Environmental Report(s) have been prepared for this project under the California Environmental Quality Act (CEQA), as listed below. Contractor shall familiarize himself with these reports and implement the applicable mitigation measures during construction as outlined therein.
 - 1. Report dated January 2020, prepared by Denise Duffy & Associates, entitled: "Initial Study / Mitigated Negative Declaration for the MCWD A1/A2 Reservoirs and B/C Zone Booster Pump Station Project".
- B. Copies of reports itemized in SC-5.07.A that are not included with Bidding Documents may be examined at Marina Coast Water District, Engineering Office, 2840 4th Ave, Marina, CA 93933 during regular business hours. These reports are not part of the Contract Documents, but the controls and mitigation measures contained therein which are required for performance of the Work are incorporated therein by reference.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.02 Insurance—General Provisions

SC-6.02.A Replace 6.02.A with the following text:

"Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions."

SC-6.02.B Delete the words "Owner or" in first sentence of 6.02.B.

SC-6.02.C Add the following paragraph immediately after Paragraph 6.02.C:

All insurance shall be provided on policy forms acceptable to the Owner (Accord Form 25-S or equivalent), signed by the insurer's representative. Such evidence shall include an original copy of the additional insured endorsement signed by the insurer's representative.

Each policy shall contain a cross liability or severability of interest clause or endorsement.

SC-6.02.D Delete paragraph 6.02.D in its entirety.

SC-6.02.E Delete paragraph 6.02.E. and replace with following text:

"Failure of Owner to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance."

SC-6.02.I Delete paragraph 6.02I in its entirety.

SC-6.03 Contractor's Insurance

SC-6.03.C.7 Remove the following text:

"; or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent".

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

State:	<u>Statutory</u>
--------	------------------

Federal, if applicable (e.g., Longshoreman's):	<u>Statutory</u>
--	------------------

Employer's Liability:

Bodily injury, each accident	\$ <u>2,000,000.00</u>
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Bodily injury by disease, each employee	\$ <u>2,000,000.00</u>
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Bodily injury/disease aggregate	\$ <u>2,000,000.00</u>
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Foreign voluntary worker compensation	<u>Statutory</u>
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2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate	\$ <u>10,000,000.00</u>
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Products - Completed Operations Aggregate	\$ <u>10,000,000.00</u>
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Personal and Advertising Injury	\$ <u>10,000,000.00</u>
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Each Occurrence (Bodily Injury and Property Damage)	\$ <u>10,000,000.00</u>
3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:	
Bodily Injury:	
Each person	\$ <u>10,000,000.00</u>
Each accident	\$ <u>10,000,000.00</u>
Property Damage:	
Each accident	\$ <u>10,000,000.00</u>
4. Excess or Umbrella Liability:	
Per Occurrence	\$ <u>2,000,000.00</u>
General Aggregate	\$ <u>2,000,000.00</u>
5. Contractor's Pollution Liability:	
Each Occurrence	\$ <u>1,000,000.00</u>
General Aggregate	\$ <u>2,000,000.00</u>
<input type="checkbox"/>	If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract
6. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following:	
a. Owner's Construction Manager	
b. City of Marina, CA	
c. California State University, Monterey Bay	
d. University of California, Santa Cruz	
7. Contractor's Professional Liability:	
Each Claim	\$ <u>2,000,000.00</u>
Annual Aggregate	\$ <u>2,000,000.00</u>

SC-6.05 Property Insurance

SC-6.05.A.1 Add the following new subparagraph after subparagraph 6.05.A.1:

- a. In addition to Owner, Contractor, and all Subcontractors, include as insureds the following:
 - 1. Owner’s Construction Manager
 - 2. City of Marina, CA
 - 3. California State University, Monterey Bay
 - 4. University of California, Santa Cruz

SC-6.05.A. Add the following to the list of items in Paragraph 6.05.A, as numbered items:

- 14. include by express endorsement coverage of damage to Contractor’s equipment.
- 15. be payable to MCWD as trustee for the insureds as their interests may appear. Any insured loss shall be adjusted with MCWD as trustee.
- 16. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:
 - a. 600 kW generator, Caterpillar model C-18, 1 each, \$121,000
 - b. 1200A Automatic Transfer Switch, ASCO Series 300, 1 each, \$11,300

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

SC-7.02 Labor; Working Hours

SC-7.02.B. Add the following new subparagraphs immediately after Paragraph 7.02.B:

- 1. Owner's legal holidays are:
 - a. New Year’s Day
 - b. Martin Luther King Day
 - c. President’s Day
 - d. Memorial Day
 - e. Independence Day
 - f. Labor Day
 - g. Veterans Day
 - h. Thanksgiving Weekend (Thursday and Friday)
 - i. Working Day immediately preceding Christmas Day
 - j. Christmas Day

SC-7.08 Permits

SC-7.08 Add the following new subparagraph immediately after Paragraph 7.08.A:

- B. The Owner shall provide the following permits:
 - 1. CEQA Negative Declaration / Mitigated Negative Declaration
 - 2. Construction easement / right of entry

SC-7.10 Laws and Regulations

SC-7.10 Add the following new paragraphs immediately after Paragraph 7.10.C:

7.10.D. Public Contract Provisions

- 1. The Contractor is responsible for his own compliance, and is responsible for all Subcontractors' compliance, with all applicable sections of the California Labor Code regarding the payment of wages, the employment of apprentices, and hours of work, all as set forth in Section 1170 through Section 1815 of that Code. Those requirements are set forth below.
- 2. Payment of Prevailing Wages
 - a. Pursuant to Sections 1774 and 1775 of the Labor Code, unless the contract price is under \$1,000.00, the Contractor and any subcontractor under him, shall pay not less than the general prevailing rate of per diem wages, including holiday and overtime pay, to all workmen employed in the execution of this Contract. Failure to so comply will result in a fine of \$25.00 per day per violation, and the obligation to compensate each such employee the difference between the wage actually paid and the prevailing wage applicable to that employee's craft.
 - b. Pursuant to Section 1773.2 of the California Labor Code, the District has on file at its principal office, copies of the prevailing rate of per diem wages for each craft, and classification or type of workman needed to execute the contract, and a copy shall be available to any interested party upon request.
 - c. The Contractor shall obtain and post copies of the prevailing per diem wage rates at the job site during the term of this project.
 - d. Pursuant to Labor Code Section 1776, the Contractor and each subcontractor shall keep an accurate payroll record, showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor or subcontractor in connection with the project, and such other information as required by law, and such payroll records shall be certified and made available for inspection and release all in accordance with Labor Code Section 1776 and 8 California Code of Regulations Section 16000 et seq. All contractors and subcontractors must furnish electronic certified payroll records directly to the Labor Commissioner (aka Division of Labor Standards Enforcement). The Contractor shall file with the District certified copies of its and all its subcontractors' payroll records within thirty (30) calendar days after completion of each payroll period at no cost to the District.

- e. Pursuant to Section 1773.8 of the Labor Code, travel and subsistence payments shall also be paid to each workman needed to execute such work if such travel and subsistence payments are set forth in the applicable collective bargaining agreements and filed with the Department of Industrial Relations thirty (30) days prior to the call for bids.
 - f. Unless the Contract amount is under \$30,000 or will be completed in less than twenty (20) days (or if this Contract involves a specialty contractor under \$2,000 or less than 5 days) the Contractor shall comply with Section 1777.5 regarding the employment of registered apprentices upon public works by hiring, and by requiring that all subcontractors hire apprentices at the wage rate and ratio required, if at all, and by requiring the contribution of funds to appreciable crafts or trades as applicable under Section 1777.5.
 - g. The Contractor shall, as a penalty to the District, forfeit not more than two hundred dollars (\$200.00) for each calendar day, or portion thereof, for each worker paid less than the prevailing rates as determined by the Director of the Department of Industrial Relations for such work or craft in which such worker is employed for any public work done under this contract by the Contractor or by any subcontractor under the Contractor. The difference between such prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the prevailing wage rate shall be paid to each worker by the Contractor. Labor Code Section 1775.
 - h. Required California Department of Industrial Relations provisions:
 - No contractor or subcontractor may be listed on a bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].
 - No contractor or subcontractor may be awarded a contract for public work on a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.
 - This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.
 - i. The Contractor certifies that the Contractor and all subcontractors for this public works project have been registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.
 - j. The District shall not recognize any claim for additional compensation from the Contractor because of the payment by the Contractor of any wage rate in excess of the prevailing rate of per diem wages. The possibility of wage increases is one of the elements to be considered by the Contractor in determining its bid and will not, under any circumstances, be considered as the basis of a claim against the District under this contract.
3. Hours of Labor
- a. Pursuant to Sections 1810 through 1815 of the Labor Code, eight hours of labor constitutes a legal day's work, and work performed by employees of the Contractor or any subcontractor in excess of eight hours per day, and forty hours

in any one week, shall be compensated at not less than one and one-half times their basic rate of pay. Violation of this condition shall result in a penalty of \$25.00 per day per workman so underpaid.

4. Unidentified Utilities – Costs (Government Code 4215)
 - a. The District shall be responsible for the timely removal, relocation, or protection of existing main or trunk line utility facilities located on the construction site, if such utilities are not identified in the plans and specifications for the work. The Contractor shall be compensated for his actual costs of locating, repairing damage not due to his failure to exercise reasonable care, and removing or relocating such utility facilities not indicated in the plans and specifications with reasonable accuracy and for equipment on the project necessarily idled during such work. If the Contractor discovers utility facilities not identified in the contract plans or specifications, he shall immediately notify the District and the utility in writing. The Contractor shall not be assessed liquidated damages for delay if caused by the failure of the District or the owner of the utility to provide for removal or relocation of such utility facilities. The District shall provide a layout of all main lines and existing service laterals. The Contractor shall exercise due care in verifying the locations provided by the District and shall notify the District of site conditions that differ from those indicated.
5. Dispute Resolution Procedures for Claims of Less Than \$375,000
 - a. Sections 20104 - 20104.6 of the Public Contract Code set forth required procedures for the parties to resolve claim disputes involving less than \$375,000, including the presentation of written claims with substantiating documents on or before the date of final payment, requests for additional documentation, time limits for responding to written claims, and requiring a conference to meet and confer; and also relating to filing a claim before suit, and required arbitration provisions in the event of a civil action filed to resolve the claim. All of such procedures, time limits and requirements shall be complied with if such Code sections are applicable to disputed claim.
6. Assignment of Antitrust/Unfair Business Practice Claims
 - a. Pursuant to Public Contract Code Section 7103, Contractor and any subcontractors supplying goods, services or materials under this contract agree to assign District all rights, title and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C Sec. 15) or under the Cartwright Act (Chapter 2 commencing with Section 16700 of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services or materials pursuant to this contract or the subcontract.
7. Substitution of Securities for Retention. Pursuant to Public Contract Code Section 22300 and upon Contractor's request, the District will make payments into escrow of funds which would otherwise be retained from progress payments under the payments to contractor provisions in the Agreement and the Supplementary and General Conditions if the Contractor deposits into that escrow securities eligible for investment under Public Contract Code Section 22300 (hereafter collectively referred to as "securities"), upon the following terms and conditions:

- a. The escrow agent shall be either the District Treasurer or a state or federal chartered bank acceptable to the District.
- b. The Contractor shall bear all expenses of the District and of the escrow agent in connection with the escrow.
- c. The fair market value of the securities shall be at least equal to 100 percent of the cash amount withheld as retention under the contract and the amount of the required securities shall be adjusted from time to time based upon changes in the fair market value of the securities on deposit with the escrow agent. Such securities shall be valued by the District Treasurer whose decision on valuation of the securities shall be final.
- d. The Contractor shall enter into an escrow agreement substantially similar in form to that prescribed in Public Contract Code Section 22300.
- e. The Contractor shall obtain the written consent to the escrow agreement of the surety or sureties furnishing Contractor with its performance and payment bonds.

SC-7.12 Safety and Protection

SC-7.12 Add the following new paragraphs after paragraph 7.12.G:

- H. In carrying out his/her work, the Contractor shall at all times, exercise all necessary precautions for the safety of employees appropriate to the nature of the work and the conditions under which the work is to be performed, and be in compliance with all federal, state and local statutory and regulatory requirements including California Department of Industrial Relations (Cal/OSHA) regulations; and the U.S. Department of Transportation Omnibus Transportation Employee Testing Act (as applicable). Safety precautions as applicable shall include, but shall not be limited to, adequate life protection, and lifesaving equipment; adequate illumination for underground and night operations; instructions in accident prevention for all employees such as machinery guards, safe walkways, scaffolds, ladders, bridges, gang planks; confined space procedures; trenching and shoring; fall protection; and other safety devices, equipment and wearing apparel as are necessary or lawfully required to prevent accidents, injuries, or illnesses; and adequate facilities for the proper inspection and maintenance of all safety measures.
- I. The Contractor shall be responsible for the safeguarding of all utilities. At least two working days before beginning work, the Contractor shall call the Underground Service Alert (USA) in order to determine the location of sub-structures. The Contractor shall immediately notify the District and the utility owner if he/she disturbs, disconnects, or damages any utility.
- J. In accordance with Section 6705 of the California Labor Code, the Contractor shall submit to the District specific plans to show details of provisions for worker protection from caving ground during excavations of trenches of five feet or more in depth. The excavation/trench safety plan shall be submitted to and accepted by the District prior to starting excavation. The trench safety plan shall have details showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground. If such a plan varies from the shoring system standards established by the Construction Safety Orders of the California Department of

Industrial Relations (Cal/OSHA), the plan shall be prepared by a California registered civil or structural engineer. As part of the plan, a note shall be included stating that the registered civil or structural engineer certifies that the plan complies with the Cal/OSHA Construction Safety Orders, or that the registered civil or structural engineer certifies that the plan is not less effective than the shoring, bracing, sloping or other provisions of the Safety Orders. In no event shall the Contractor use a shoring, sloping, or protective system less effective than that required by said Construction Safety Orders. Submission of this plan in no way relieves the Contractor of the requirement to maintain safety in all areas. If excavations or trench work requiring a Cal/OSHA permit are to be undertaken, the Contractor shall submit his/her permit with the excavation/trench work safety plan to the District before work begins.

- K. Trench Excavation: Approval of Plan for Protection from Caving
1. If the contract involves an estimated expenditure of more than \$25,000, for the excavation of any trench or trenches five feet or more in depth, the Contractor shall submit, for acceptance and approval by the District or its designated engineer, in advance of excavation, a detailed plan showing the design of shoring, bracing, sloping, or other provision to be made for worker protection from the hazard of caving ground during such excavation, all in accordance with Labor Code Section 6705.
- L. Excavations Deeper than Four Feet Involving Hazardous Wastes or Materially Different Site Conditions
1. If the contract involves digging trenches or other excavations that extend deeper than four feet below the surface:
 - a. The Contractor shall promptly, and before any of the following conditions are disturbed, notify the District, in writing, of any:
 - (1) Material that the Contractor believes may be material that is hazardous waste as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law;
 - (2) Subsurface or latent physical conditions at the site differing from those indicated;
 - (3) Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.
 - b. The District shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the work, it shall issue a change order under the procedures described in the Agreement.
 - c. In the event that a dispute arises between the District and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the work, the Contractor shall not be excused from any scheduled completion date provided for by the Agreement, but shall

proceed with all work to be performed under the Agreement. The Contractor shall retain any and all rights provided either by contract or by law, which pertains to the resolution of disputes and protests between the contracting parties.

SC-7.16 Shop Drawings, Samples and Other Submittals

SC-7.16.E Delete Paragraph 7.16.E.2 in its entirety and insert the following in its place:

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

SC-7.18 Indemnification

SC-7.18.A Delete paragraph 7.18.A in its entirety and insert the following in its place:

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work or the failure, neglect or refusal of the Contractor to perform the Work and all obligations under the Contract, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

ARTICLE 8 – OTHER WORK AT THE SITE

SC-8.01 Other Work

SC-8.01.E Add the following new paragraph immediately after Paragraph 8.01.D of the General Conditions:

- E. Owner is aware of Other Work at the Site which is planned by others and relates to the Work contemplated by these Bidding Documents:
 1. Roadway widening and reconstruction by the City of Marina of Imjin Parkway from (and including) the Intersection of Abrams Drive to (and including) the intersection of Reservation Road. Work is scheduled to begin April 1, 2021.

2. Recoating of the Intermediate Reservoir (interior and exterior). Work is scheduled for Spring 2021.

SC-8.02 Coordination

SC-8.02 Delete Paragraph 8.02.A in its entirety and replace with the following:

- A. Owner intends to contract with others for the performance of other work at or adjacent to the Site.
 1. The Owner's Construction Manager shall have authority and responsibility for coordination of the various contractors and work forces at the Site;
 2. The following specific matters are to be covered by such authority and responsibility: coordination of work schedules and use of laydown and staging areas at the Intermediate Reservoir;
 3. The extent of such authority and responsibilities is: Construction Manager shall maintain and consolidated schedule and schedule meetings and/or teleconferences to coordinate the work of multiple contractors within the Intermediate Reservoir site.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

SC-9.13 *Owner's Site Representative*

SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

SC-9.13 Owner will engage a Construction Manager (CM) to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Construction Manager is not Engineer's consultant, agent, or employee. Owner's Construction Manager will be [TBD]. The authority and responsibilities of Owner's Construction Manager follow:

- A. General: CM's dealings in matters pertaining to the Work in general shall be with Owner, Engineer and Contractor. CM's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor.
- B. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
- C. Conferences and Meetings: Schedule and run meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
- D. Liaison:
 1. Serve as Owner's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 2. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

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- E. Interpretation of Contract Documents: Report to Owner and Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
 - F. Shop Drawings and Samples:
 - 1. Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - 2. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - 3. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which CM believes that the submittal has not been approved by Engineer.
 - G. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with CM's recommendations, if any, to Owner and Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
 - H. Review of Work and Rejection of Defective Work:
 - 1. Conduct On-Site observations of Contractor's work in progress to assist Owner and Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - 2. Report to Owner and Engineer whenever CM believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Owner and Engineer of that part of work in progress that CM believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
 - I. Inspections, Tests, and System Start-ups:
 - 1. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 - 2. Observe, record, and report to Owner and Engineer appropriate details relative to the test procedures and systems start-ups.
 - J. Records:
 - 1. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Owner and Engineer.

2. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
 3. Maintain records for use in preparing Project documentation.
- K. Reports:
1. Furnish to Owner and Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
 2. Draft and recommend to Owner and Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
 3. Immediately notify Owner and Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.
- L. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Owner and Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.
- M. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.
- N. Completion:
1. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
 2. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
 3. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Project Representative

- B. On this Project, by agreement with the Owner, Engineer will not furnish a Resident Project Representative to represent Engineer at the Site or assist Engineer in observing the progress and quality of the Work. *[See explanatory text at beginning of*

SC-9.13, and at beginning of SC-10.03, for discussion of this second alternative SC-10.03.B]

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

SC-11.01 Amending and Supplementing Contract Documents

SC-11.01 Insert the following subparagraphs immediately following 11.01.A.1.b.

- c. In signing a Change Order, the Owner and Contractor acknowledge and agree that:
 - 1) the stipulated compensation (Contract Price or Contract Times, or both) set forth in the Change Order includes not only all direct costs of Contractor such as labor, material, job overhead, and profit markup, but also includes any costs for modifications or changes in sequence of work to be performed, delays, rescheduling, disruptions, extended direct overhead or general overhead, acceleration, material or other escalation which includes wages and other impact costs. This document will become a supplement to the Contract and all Contract provisions will apply hereto. It is understood that this Change Order shall be effective on the date approved by the Owner’s Representative.
 - 2) the Change Order constitutes full mutual accord and satisfaction for the change to the Work;
 - 3) no reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and
 - 4) no subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

SC-11.05 Change of Contract Times

SC-11.05 Add the following new paragraphs immediately after 11.05.B:

- C. Use of Float:
 - 1. A request for adjustment of Contract Times (or Milestones), otherwise allowable under the Contract Documents, shall be granted only when the time lost or gained exceeds the float for the activity at the time of the event giving rise to the claim. Float, the amount of time between the early start date and the late start date, or the early finish date and the late finish date, is jointly owned by both Owner and Contractor whether expressly disclosed or implied in any manner.
 - 2. Contractor shall not use float suppression techniques (including, but not limited to, preferential sequencing caused by late starts of follow-up trades, unreasonably small crews, extended durations, or imposed dates) in information provided to Engineer.

D. Weather Days:

1. The Contract Time includes a weather day allowance of 25 working days. No extension in Contract Time will be allowed for the first 15 working days lost due to weather conditions.

ARTICLE ARTICLE 12 - CLAIMS*SC-12.01 Claims*

SC-12.01 Delete Paragraph 12.01 in its entirety and insert the following in its place:

SC-12.01 Claims:

- A. Claims between the Owner and Contractor shall be addressed as provided by California Public Contract Code Section 9204, which is set forth in its entirety:

9204. Legislative findings and declarations regarding timely and complete payment of contractors for public works projects; claims process

(a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.

(b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.

(c) For purposes of this section:

(1) "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

(A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.

(B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

(C) Payment of an amount that is disputed by the public entity.

(2) "Contractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.

(3) *Public entity definition*

(A) "Public entity" means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau,

board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

(B) "Public entity" shall not include the following:

(i) The Department of Water Resources as to any project under the jurisdiction of that department.

(ii) The Department of Transportation as to any project under the jurisdiction of that department.

(iii) The Department of Parks and Recreation as to any project under the jurisdiction of that department.

(iv) The Department of Corrections and Rehabilitation with respect to any project under its jurisdiction pursuant to Chapter 11 (commencing with Section 7000) of Title 7 of Part 3 of the Penal Code.

(v) The Military Department as to any project under the jurisdiction of that department.

(vi) The Department of General Services as to all other projects.

(vii) The High-Speed Rail Authority.

(4) "Public works project" means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

(5) "Subcontractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

(d) Claims Process

(1) Claims review and response

(A) Upon receipt of a claim pursuant to this Section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.

(B) The claimant shall furnish reasonable documentation to support the claim.

(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time

following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to 3 days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.

(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.

(2) Claims dispute

(A) If the claimant disputes the public entity's written response, or if the public entity fails to respond to a claim issued pursuant to this Section within the time prescribed, the claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.

(B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

(C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

(D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this Section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.

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- (E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.
- (3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.
- (4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.
- (5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on their own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.
- (e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.
- (f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.
- (g) This section applies to contracts entered into on or after January 1, 2017.
- (h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.

- (i) This section shall remain in effect only until January 1, 2027, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2027, deletes or extends that date.

End of PCC Section 9204

B. Claims Process Additional Requirements:

- 1. Claims asserted by the Owner against the Contractor shall be submitted according to the procedures set forth above.
- 2. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled. Such a claim shall be submitted promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal.
- 3. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

C. Mediation:

- 1. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision.

D. Claims of \$375,000 or less shall be resolved in accordance with California Public Contract Code Section 20104 et seq. unless Owner elects to resolve the dispute in accordance with California Public Contract Code Section 10240 et seq.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC-13.02 Allowances

SC 13.02 Add the following new subparagraph immediately paragraph 13.02.D:

- E. *Reimbursement Allowance:* Contractor agrees that a reimbursement allowance, if any, is for reimbursement of the actual cost or fee for which it is designated (typically permits), without additional markup for overhead, profit or handling. If the Owner includes a reimbursement allowance in the Bid Form, the Owner will establish its value.

SC-13.03 Unit Price Work

SC 13.03.E Delete Paragraph 13.03.E in its entirety and insert the following in its place:

- E. The unit price of an item of Unit Price Work shall be subject to reevaluation and adjustment under the following conditions:

1. if the extended price of a particular item of Unit Price Work amounts to 25 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 10 percent from the estimated quantity of such item indicated in the Agreement; and
2. if there is no corresponding adjustment with respect to any other item of Work; and
3. if Contractor believes that Contractor has incurred additional expense as a result thereof, Contractor may submit a Change Proposal, or if Owner believes that the quantity variation entitles Owner to an adjustment in the unit price, Owner may make a Claim, seeking an adjustment in the Contract Price.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01 Progress Payments

15.01.C Delete Paragraph 15.01.C.1 in its entirety and insert the following in its place:

1. Engineer will, within 7 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer’s reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

15.01.D Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

1. Thirty calendar days after presentation of the Application for Payment to Owner with Engineer’s recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

SC-15.03 Substantial Completion

SC 15.03.A Add the following subparagraphs immediately after Paragraph 15.03.A:

1. To be considered substantially complete, all Work must be operational and ready for Owner's continuous use as intended.
2. Portions of the Work not essential to operation, which can be completed without interruption operation, may be completed after the Work is accepted as Substantially Complete, and may include the following items:
 - a. As-built documents.
 - b. Final clean-up.

SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to

agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.02 Arbitration

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

SC-17.02 Arbitration

- A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of AJMS Endispute Streamlined Arbitration Rules and Procedures, subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in this Article, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC-17.02.D below.
- C. No arbitration arising out of or relating to the Contract shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer’s consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:
 - 1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and
 - 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.
- D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include a concise breakdown of the award, and a written explanation of the award specifically citing the Contract provisions deemed applicable and relied on in making the award.
- E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.
- F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.

ARTICLE 18 – MISCELLANEOUS

SC-18.06 Survival of Obligations

SC-18.06 Delete paragraph 18.06.A in its entirety and replace it with the following:

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations in accordance with California Commercial Code, Section 1101 et seq., and as indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

SC-18.07 Controlling Law

SC-18.07 Delete paragraph 18.07.A in its entirety and replace it with the following:

- A. This Contract shall be construed and enforced according to the laws of the State of California, and the parties hereby agree that the County of Monterey shall be the proper venue for any dispute arising hereunder.

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Description of Work
- B. Contractor Use of Site
- C. Owner-Furnished Equipment
- D. Activities by Others
- E. Project Meetings

1.02 DESCRIPTION OF WORK

- A. The Work includes, but is not limited to, the following items:
 - a. Provide new A1/A2 Reservoirs including piping, valves, and appurtenances;
 - b. Provide new B/C Booster Pump Station including three 150 hp pumps, three 75 hp pumps, piping, valves, appurtenances, and motor control center;
 - c. Remove existing 170 LF of 15" sanitary sewer pipe and 160 LF of 6" water pipe;
 - d. Provide new ductile iron yard piping in sizes ranging from 6-inch to 30-inch, with associated valves and fittings;
 - e. Provide 830 LF of 24" DIP, 820 LF of 18" DIP and 310 LF of 16" DIP from 6th Ave to the pump station, with associated valves and fittings;
 - f. Provide
 - g. Provide 1,100 LF of 24" DIP in Imjin Parkway, with associated valves and fittings;
 - h. Provide 630 LF of 12" DIP from 5th Ave to the pump station, with associated valves and fittings;
 - i. Provide conduits, transformer pad and associated items for the new primary electrical service;
 - j. Provide 310 LF of 15" HDPE storm pipe in the yard, with 5 manholes and 5 catch basins;
 - k. Provide 655 LF of 15" HDPE storm pipe in 5th Avenue, with 2 manholes and an outlet headwall;
 - l. Provide 360 LF of 28" HDPE sanitary sewer pipe in the yard, with 4 manholes;
 - m. Relocate and install the existing 600 kW emergency generator with sound enclosure and automatic transfer switch from the existing booster pump station to the new booster pump station;
 - n. Provide new flow meter and chlorination dosing system at Intermediate Reservoir; and

- o. Provide a 300 kW emergency generator with sound enclosure and equipment pad at the Intermediate Reservoir.

1.03 CONTRACTOR USE OF SITE

- A. The A1/A2 Reservoir and B/C Booster Pump Station are located within CSUMB property. Work is subject to the conditions of the CSUMB construction permit.
- B. A portion of the Work is within City of Marina owned land and subject to the conditions of the City of Marina Encroachment Permit. The encroachment permit application is at Appendix B of the Project Manual.
- C. Contractor shall coordinate any additional staging and storage areas per Section 01 55 00.

1.04 OWNER-FURNISHED EQUIPMENT

- A. The Owner's existing 600 kW engine generator set shall be transported from the existing B/C Zone Booster Pump Station and installed at the new site as part of the Work.

1.05 ACTIVITIES BY OTHERS

- A. Activities by others that may affect performance of the Work:
 - 1. City of Marina, Imjin Parkway Roadway Improvements
 - 2. California State University, Monterey Bay, academic schedule
 - 3. Marina Coast Water District, recoating of Intermediate Reservoir

1.06 PROJECT MEETINGS

- A. Preconstruction Conference:
 - 1. Prior to the commencement of Work at the site, one preconstruction conference will be held at a mutually agreed time and place which shall be attended by the Contractor's Project Manager, its Superintendent, and its Subcontractors as the Contractor deems appropriate. Other attendees will be:
 - a. Engineer.
 - b. Representatives of Owner.
 - c. Representatives of Property Owner.
 - d. Governmental representatives as appropriate.
 - e. Others as requested by Engineer, Contractor, or Owner.
 - 2. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, the Contractor should be prepared to discuss all of the items listed below.
 - a. Status of Contractor's insurance and bonds.
 - b. Contractor's tentative schedules.
 - c. Processing applications for payment.
 - d. Maintaining record documents.
 - e. Critical work sequencing.
 - f. Field decisions and Change Orders.

- g. Use of project site, office and storage areas, security, housekeeping, and Owner's needs.
 - h. Major equipment deliveries and priorities.
 - i. Contractor's assignments for safety and first aid.
- 3. The Engineer will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.
 - 4. The Contractor and its Subcontractors should plan on the conference taking 2 hours.
- B. Progress Meetings:
- 1. The Contractor shall attend regular on-site progress meetings at least weekly -and at other times as requested by Engineer or as required by progress of the Work. The Contractor, Engineer, and all Subcontractors active on the site must attend each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.
 - 2. The Engineer shall preside at the meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the Contractor is required to present any issues which may impact his work, with a view to resolve these issues expeditiously.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 DEFINITION OF JURISDICTIONS

- A. The following are approximate locations of jurisdictions throughout the project. See the drawings for more detailed information.
- B. California State University, Monterey Bay:
 - 1. A1/A2 Reservoirs and B/C Booster Pump Station Easement
 - 2. Pipeline easements from BPS Site to 6th Avenue (Sheet C-013)
 - 3. Sanitary sewers outside the tank site (Sheet C-105)
 - 4. Intermediate Reservoir/F Booster/Chlorination Yard Easement (Sheet C-140)
- C. City of Marina:
 - 1. Pipeline in Imjin Parkway (Sheet C-015)
 - 2. Pipeline in 5th Avenue and percolation lot (Sheet C-107)
 - 3. Driveway/pipeline easement through City corporation yard (Sheet C-014)
 - 4. Existing B/C BPS and Sand Tank easement (Sheet C-016)
- D. University of California, MBEST Center
 - 1. Wellfield pipeline in Old County Road (unpaved)
- E. Marina Coast Water District
 - 1. SCADA control room in corporation yard Operations Office, 2840 4th Avenue, Marina
 - 2. Reservoir 2 (antenna site), Beach Road behind Windy Hill Park, Marina
- F. Public Health Agencies
 - 1. California Department of Public Health
 - 2. Monterey County Health Department

1.03 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

- A. The listing of schedule constraints in this Section and Section 01 55 00 – Traffic Control; and elsewhere in the contract documents shall not mean that all constraints or special conditions have been identified. The list does not substitute for the Contractor's

coordination and planning for completion of work within the Contract Time in the Agreement.

- B. The Contractor shall allow for construction and schedule constraints in preparing the construction schedule. The schedule shall include the Contractor's activities necessary to satisfy all constraints included and referenced in the Contract Documents.
- C. Utilize description of critical events in work constraints in this Section as a guideline for scheduling and undertaking the Work.
- D. Business Licenses:
 - 1. Contractor shall obtain business licenses from the City of Marina prior to commencing work within the boundaries of the respective jurisdiction. Business license information can be found on each jurisdictions website.
- E. Public Health Orders related to Covid-19:
 - 1. The Contractor shall comply with the most current health orders from the State and County Public Health Officers.
 - 2. The Contractor shall prepare a written workplace-specific plan per the State Guidance for Construction Employers. This plan may be included in the overall Health and Safety Plan, or as a separate document.
- F. General:
 - 1. The Contractor shall schedule construction activities at each location in accordance with the requirements of all permits.
 - 2. The Contractor shall coordinate with local property owners before and during construction in accordance with the project specifications and requirements of all governing agencies.
 - 3. Only MCWD shall operate MCWD valves. The Contractor shall provide the MCWD with a minimum 2 weeks advance notice for any valve closure requests, such as those required for a temporary shutdown to tie-in new facilities. All closures / openings of existing MCWD valves shall be performed by the MCWD.
 - 4. For all segments of the project located in paved roadways, the Contractor shall at a minimum, backfill, compact and install temporary asphalt paving (or steel plating as allowed) for all open trenches, and reopen the roadway to traffic by the end of every working day.
 - 5. Temporary paving shall not be left in place for more than 30 consecutive days. Contractor shall inspect temporary paving for failure each calendar day. Where temporary paving has failed, Contractor shall immediately repair or replace it.
 - 6. For specific temporary traffic control constraints see Section 01 55 00 – Traffic Control. Contractor shall inspect temporary traffic control facilities each calendar day. Where temporary traffic control facilities are damaged or different than the approved traffic control plan, Contractor shall immediately repair or replace the temporary traffic control facilities.
 - 7. The Contractor is responsible for complying with all mitigation and monitoring measures identified in the CEQA/NEPA documents provided in the Appendices.
 - 8. The Contractor shall sweep the streets daily to maintain the roadway clear of all debris and loose material.

9. Contractor shall provide a construction schedule, traffic control plans, and road closure schedule to all affected agencies prior to start of construction activities.
10. In addition to MCWD, agencies include but are not limited to:
 - a. California State University, Monterey Bay
 - b. City of Marina.
 - c. University of California Monterey Bay Education, Science, and Technology Center (UCMBEST).
11. General Work restrictions:
 - a. Work days:
 - 1) Work days are Monday through Friday, except Marina Coast Water District holidays, which are listed in Section 00 73 00 - Supplementary Conditions.
 - 2) Agencies where the work occurs may further restrict work days.
 - b. Work hours:
 - 1) Work hours are specific to the governing agency where work occurs, but not beyond Marina Coast Water District's work hours.
 - 2) Extended work hours, holiday, nighttime, and weekend work will be allowed only when approved in writing by the governing agency and Construction Manager.
 - 3) When extended hours, holiday, nighttime and/or weekend work is allowed, Contractor shall pay the costs for inspection by the Construction Manager during that time.
 - 4) Extended hours are any working hours over 8.5 consecutive work hours in a single day.
 - 5) Work outside of the normal working hours is subject to the availability of the Construction Manager/inspector.
 - c. Special Events:
 - 1) CSMB Commencement: Contractor shall anticipate that work will not be allowed outside the tank and pump station easement during the week of the spring commencement.
 - 2) Pebble Beach Pro-Am Golf Tournament: Contractor shall anticipate that work will not be allowed in Imjin Parkway the Wednesday, Thursday, and Friday of the golf tournament and the Monday following the tournament.
 - 3) Laguna Seca Raceway: Contractor shall anticipate that work will not be allowed in Imjin Parkway the Thursday and Friday before a major race event and the Monday following a major race event.

G. Marina Coast Water District:

1. Work days: Per the general work restrictions.
2. Work Hours: Allowable working hours on Marina Coast Water District property are 7:00 a.m. to 5:00 p.m.

H. City of Marina:

1. Road section: The minimum standard road section is 6-inches of asphalt concrete over 8-inches of aggregate base course. Match existing sections if greater than the listed minimum.
2. Work days: Per the general work restrictions and final encroachment permit. Where there is a conflict, the more restrictive requirements will govern.
3. Work hours: Allowable work hours within City of Marina streets are 8:30 a.m. to 4:30 p.m. unless otherwise stated in the encroachment permit.

4. Encroachment Permit: The permit application form and conditions are included in the Appendices. Contractor shall anticipate the requirement to comply with all conditions of the encroachment permits.
5. Other requirements:
 - a. Staging, stockpiling, and placing material in the streets is prohibited (even if the material is excavated material or backfill material) without prior written City approval.
 - b. Traffic control plans shall be specific to each street and work location. A generic or typical plan will not be accepted.
 - c. Temporary paving shall not be left in place for more than 30 calendar days.
 - d. Final paving shall be completed after each location is constructed (not all at once at the end of the project).
 - e. Compaction and paving testing data shall be provided to the City within 24 hours of performing the test.
- I. California State University, Monterey Bay (CSUMB):
 1. Road section: The standard road section is 6-inches of asphalt concrete above 8-inches of aggregate base course.
 2. Work Days: Per the general restrictions.
 3. Work Hours: Allowable work hours within CSUMB are 7:30 a.m. to 5:00 p.m. After-hours work requires prior written approval from the Campus Staff.
 4. Permit/Construction Right-of-Entry:
 - a. All work is subject to the terms and conditions of the temporary construction permit issued by CSUMB. The template permit is included in the Appendices.
- J. University of California Monterey Bay Education, Science, and Technology Center (UCMBEST):
 1. Work on the existing wellfield pipeline is subject to biological monitoring per the MMRP.
 2. All other requirements are per the City of Marina requirements.

1.04 UTILITIES

- A. Provide advance notice to and utilize services of Underground Services Alert (U.S.A.) for location and marking of underground utilities operated by utility agencies other than the Owner.
- B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.
- C. New yard utilities (Intermediate Reservoir and Reservoir 2 sites) were designed using existing facility drawings:
 1. Field verification of utilities locations was not performed during design.
 2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
 3. Pipe alignments as indicated on the Drawings.
- D. Contact information for utility owners and property owners is listed below:

1. California State University, Monterey Bay:
 - a. Mike Lerch, CSUMB - Director of Energy & Utilities, (831)582-3739, mderch@csumb.edu
2. City of Marina:
 - a. Edrie Delos Santos, City of Marina - Engineering Division, 209 Cypress Ave, Marina, CA 93933, (831)884-1212, edelossantos@ci.marina.ca.us
 - b. Nourdin Khayata, City of Marina - Engineering Division, 209 Cypress Ave, Marina, CA 93933, nkhayata@ci.marina.ca.us
3. University of California, MBEST Center
 - a. Steve Matarazzo, MBEST Planning Director, 3180 Imjin Road, Marina, CA 93933, (831)521-7273, smataraz@ucsc.edu
4. PG&E:
 - a. Katrina Lopez, PG&E, 2311 Garden Road, Monterey, CA 93940, (831)784-3581, K1HC@pge.com
5. AT&T:
 - a. Susan Barraza, 515 Chappell Road, Watsonville, CA 95076, (831)728-6571, sb8239@att.com
6. Comcast:
 - a. Comcast, 2440 Fremont Street Suite 207, Monterey, CA 93940, (800)391-3000
7. Suddenlink Communications:
 - a. Robert Hager, Sudden Link Communications, 761 Neeson Rd, Suite #7, Marina, CA 93933, (831)901-5682, Robert.Hager@Suddenlink.com

1.05 PERMIT FEES

- A. For bidding purposes, estimated permit fees are included in the Document 00 41 00 - Bid Form. Upon project completion, actual fees paid shall be compared to the estimated permit fees. Excess fees paid will be credited to the project; shortfall of fees paid will be owed to the Contractor.

1.06 PUBLIC OUTREACH

- A. Contractor shall pay for and perform the following public outreach activities:
 1. Install door hangers on all properties on the street where work will occur, within 500 feet of the work, 1 month before work will begin.
 2. Install door hangers on all properties on the street where work will occur, within 100 feet of the work, 1 week before work will begin.
 3. Depending on the timing of work, separate door hangers may be needed for separate work activities such as pipeline installation and paving.
 4. Door hangers shall be submitted for review and approval prior to being used.
 5. Door hangers shall include the following:
 - a. Name of Project
 - b. Name of Contractor
 - c. Phone number to contact (Contractor's phone number)
 - d. Name of Owner
 - e. Date(s) when work is expected to occur at or near the residence
 - f. Type of work being performed
 - g. Date(s) when work is expected to be completed

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Methods of Measurement
- B. Description of Bid Items

1.02 METHODS OF MEASUREMENT

- A. Materials and items of work which are to be paid for on the basis of measurement shall be measured in accordance with the method stipulated in the particular sections involved. In determining quantities, all measurements shall be made in a horizontal plane unless otherwise specified.
- B. Measurements shall be in accordance with U.S. Standard Measures. A pound is an avoirdupois pound. A ton is 2,000 pounds avoirdupois. The unit of liquid measure is the U.S. gallon. The unit of length is feet. The unit of volume is cubic yards.
- C. Material not used from a transporting vehicle shall be determined by the ENGINEER and deducted from the certified tag.
- D. When material is to be measured and paid for on a volume basis and it would be impractical to determine the volume, or when requested by the CONTRACTOR in writing and approved by the ENGINEER in writing, the material will be weighed and converted to volume measurement for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the ENGINEER and shall be agreed to by the CONTRACTOR before such method of measurement of pay quantities will be adopted.
- E. Full compensation for all expense involved in conforming to the above requirements for measuring and weighing materials shall be considered as included in the unit prices paid for the materials being measured or weighed and no additional allowances will be made therefore.
- F. Quantities of material wasted or disposed of in a manner not called for under the Contract; or rejected loads of material, including material rejected after it has been placed by reason of failure of the CONTRACTOR to conform to the provisions of the Contract; or material not unloaded from the transporting vehicle; or material placed outside the lines indicated on the plans or given by the ENGINEER; or material remaining on hand after completion of the Contract, will not be paid for and such quantities will not be included in the final total quantities. No compensation will be allowed for hauling rejected material.

- G. Bid items include all work necessary to complete the specific item described and not otherwise included in other bid items. The CONTRACTOR shall include in each bid item **all** costs required to construct the work in accordance with the Contract Documents and as identified below.

1.03 DESCRIPTION OF BID ITEMS

A. Bid Item 1: Mobilization/Demobilization.

- 1. The lump sum bid price for this item shall constitute full compensation for mobilization and demobilization including but not limited to equipment shipping and delivery, equipment set up, materials shipping and delivery, utility coordination, permitting including the Monterey County Construction and Encroachment Permits and the City of Seaside Encroachment Permit, removal of equipment, and project closeout. The Mobilization/Demobilization bid item shall not be in excess of ten percent (10%) of the total bid schedule. Twenty-five percent (25%) of the total Mobilization / Demobilization bid price shall be considered the cost of Demobilization and will not be paid until completion of the work.

B. Bid Item 2: Sheeting, Shoring and Bracing

- 1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide sheeting, shoring and bracing of excavations, trenches and grading as required in the Contract Documents. Cost shall include any engineering or geotechnical investigations performed by the Contractor.

C. Bid Item 3: Traffic Control

- 1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide traffic control around the work as required in the Encroachment Permit(s). This item includes, but is not limited to, temporary striping, signage, delineators, cones, labor and flagmen.

D. Bid Item 4: Yard Piping, Sitework, Paving and Fencing

- 1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to complete all work within the easement limits not paid elsewhere. Work includes, but is not limited to, demolition of pavements, fences and other items; removal of trees, including trees within the pipeline easements; on-site storm drain pipe, catch basins and manholes; on-site ductile iron and steel pipe, from 6-inch through 30-inch, including vaults, valves and fittings; site grading and compaction; asphalt paving and aggregate base; inspection and cleaning of the existing storm drain pipeline; removal of the existing oil-water separator and replacement with a catch basin; and providing new fences, gates and one electric gate operator.
- 2. Item includes grading and paving the new driveway from the booster pump station west into the City of Marina property, and any repaving required at the entrances at the south end of the tank site easement.
- 3. Item includes new motorized rolling gate and new motorize lift arm on the access easement from 5th Avenue, with associated electrical work.
- 4. Item includes 1-inch water service and backflow preventer for future landscape irrigation, as shown on the Drawings.

E. Bid Item 5: 1.6 MG Steel Water Tank

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide Reservoir A1, including, but not limited to, foundation preparation by over-excavation and compaction, reinforced concrete ring wall foundation, oiled sand pad, welded steel tank, interior and exterior tank appurtenances, interior and exterior coating, disinfection and leak testing.
2. Water for leakage testing will be provided by the Owner at no cost. If the tank fails the leakage test and must be drained, repaired and retested, water for second and subsequent tests will be charged at the MCWD standard water rates.

F. Bid Item 6: Booster Pump Station Building

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the pump station building as shown on the Drawings, including but not limited to foundation preparation and compaction, cast-in-place concrete floors and walls, concrete masonry unit walls, concrete roof system, roof hatches and skylights, wall vents and louvers, doors and hardware, railings, stairs, finishes, textures and painting.
2. Item includes the center pump column (pump can) for a future pump, and the seven concrete pedestals for the pumps.

G. Bid Item 7: Booster Pump Station Mechanical

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide all steel and ductile iron piping in and under the building, fittings, valves, meters, fans, floor grates and items not covered under other building pay items.

H. Bid Item 8: Booster Pump Station Electrical

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, programming and services necessary to provide the electrical switchgear, Motor Control Center, SCADA and controls, antennas, conduits and cables, building lighting and wiring.
2. Item includes providing primary electrical service conduits from the PG&E point of connection to the transformer, the pre-cast transformer pad and the protective bollards.
3. Item includes two 16-inch flow meters within the pump station, and one 24-inch flow meter located in an exterior vault.
4. Item includes all exterior lighting, cameras, cables and conduits in the yard.
5. Item includes all conduits, cables, level instruments and antennas on installed on Tank A1.
6. Item includes telemetry modifications at the Marina BPS/Reservoir 2 site, including antennas, conduits, cables and related equipment.

I. Bid Item 9: 75 HP Pump and Motor

1. The unit bid price per pump for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the 75 HP pump, steel pump column (pump can), pump base, electric motor, appurtenances, and mounting hardware as described in the contract documents.
2. Include the concrete pedestal in Bid Item 6, Pump Station Building.

- J. Bid Item 10: 150 HP Pump and Motor
1. The unit bid price per pump for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the 150 HP pump, steel pump column (pump can), pump base, electric motor, appurtenances, and mounting hardware as described in the contract documents.
 2. Include the concrete pedestal in Bid Item 6, Pump Station Building.
- K. Bid Item 11: Relocate and Install 600 KW Generator
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to relocate, install and test the existing 600 KW generator and automatic transfer switch from the existing booster pump station at the Sand Tank to the new booster pump station.
 2. Item includes the concrete pedestal at the new site.
 3. Include conduit and cable in Bid Item 8, BPS Electrical.
- L. Bid Item 12: 24-in DIP in Imjin Parkway
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the new pipeline in Imjin Parkway, including, but not limited to, 1,080 LF of 24-inch ductile iron pipe with fittings, 3 each 24-inch butterfly valves, cut-in and connection to existing 24-inch steel pipe, pressure testing and disinfection of the pipeline, bedding, backfill, concrete thrust blocks, repaving of the trench, curb replacements, slurry sealing and restriping the traffic lane.
 2. Item includes custom transition fittings from ductile iron to the existing concrete cylinder pipe.
 3. Item includes second excavation to provide a 24-inch blind flange to isolate the new tee from the old C-Zone transmission main after the system transitions to the new booster pump station.
- M. Bid Item 13: 24-inch DIP, BPS to 6th Ave
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the 24-inch pipeline from the booster pump station to 6th Avenue, including, but not limited to, 822 LF of 24-inch ductile iron pipe, four 24-inch butterfly valves, two 24-inch tees, cut-in and connection to the existing 24-inch pipe in 6th Avenue, pressure testing and disinfection of the pipeline, bedding, backfill, concrete thrust blocks, and repaving of sidewalks and pedestrian paths.
 2. Item includes custom transition fittings from ductile iron to the existing concrete cylinder pipe.
 3. Item includes second excavation to provide a 24-inch blind flange between the two tees after the system transitions to the new booster pump station.
- N. Bid Item 14: 18-inch DIP, BPS to 6th Ave
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the 18-inch pipeline from the booster pump station to 6th Avenue, including, but not limited to, 815 LF of 18-inch ductile iron pipe, 1 each 18-inch butterfly valve, pressure testing and disinfection of the pipeline, bedding, backfill, and repaving of sidewalks and pedestrian paths.

O. Bid Item 15: 16-in DIP, BPS to B-Zone Tie-In

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the 16-inch pipeline from the booster pump station to the existing 16-inch B-Zone pipeline, including, but not limited to, 520 LF of 16-inch ductile iron pipe, three 16-inch butterfly valves, one 12-inch gate valve, two 16-inch tees, cut-in and connection to the existing 16-inch steel pipe, pressure testing and disinfection of the pipeline, bedding, backfill, concrete thrust blocks, and repaving.
2. Item includes custom transition fittings from ductile iron to the existing concrete cylinder pipe.

P. Bid Item 16: 28-in HDPE Sanitary Sewer

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide a new gravity sanitary sewer, including, but not limited to, 261 LF of 28-inch DR 17 HDPE pipe, 4 sanitary sewer manholes, by-pass pumping, trench bedding and backfill, leakage testing of new work, removing 160 LF of 15-inch gravity sewer, and all related work required to connect the new sewer to the existing system.

Q. Bid Item 16: HDPE Storm Sewer in 5th Avenue

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide a new gravity storm sewer in 5th Avenue, including, but not limited to, 675 LF of 15-inch HDPE storm pipe, three storm drain manholes, cast-in-place concrete headwall, trench bedding, backfill, compaction and repaving, and slurry seal of the traffic lane, and all related work required to connect the new sewer to the existing system.

R. Bid Item 17: Wellfield Flow Meter

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide a new flow meter on the wellfield water main near the Intermediate Reservoir. This item includes, but is not limited to, one 24-inch ultrasonic flow meter with pre-cast concrete vault, traffic-rated locking lid, two 24-inch butterfly valves, remote read controller, conduit, cables, trench bedding, backfill and restoration, and all related work required to add the new equipment onto the existing pipeline.
2. Item also includes calibration, programming and start-up and testing support for this equipment.

S. Bid Item 18: Chlorination System Modification

1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to modify the wellfield pipeline chlorination system as shown on the Drawings. This item includes, but is not limited to, providing a packaged dosing system including a PLC, three dosing pumps and mounting hardware, one saddle tap of the existing pipeline, one pre-cast meter vault, an injection quill with ½-inch PE tubing connection to the dosing pump system, ½-inch PE tubing in a 1.5-inch conduit from the injection point to the chlorine building, and all conduits and cables required for this item of work.
2. Item also includes removing the existing chloring injection point vault, replacing 8 LF of the existing pipeline, bedding, backfill, trench compaction and site restoration.

3. Item also includes calibration, programming and start-up and testing support for this equipment.
- T. Bid Item 19: Replace 300KW Generator at Intermediate Reservoir
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to replace the generator at the Intermediate Reservoir/ F-Booster Pump Station site. This item includes, but is not limited to, removal and disposal of the existing generator and fuel tank, saw-cutting and removal of the existing containment wall and generator slab, providing a cast-in-place concrete slab, providing a 300KW generator with sound enclosure, conduit and cables to connect to the existing automatic transfer switch, installation, start-up and testing.
- U. Bid Item 21: SCADA Integration Allowance
1. This allowance is for the reimbursement of the fees charged by the District's SCADA integration consultant. The value of this allowance is pre-entered in the Bid Form.
 2. Payment under this item shall be for the actual cost of the fees charged, as reflected on the SCADA Integrator's invoices. Contractor's costs with respect to coordinating the SCADA programming shall be included under Bid Item 8, Pump Station Electrical.
- V. Bid Item 22: Permit Allowance.
1. This allowance is for the reimbursement of the permit fees charged by the City of Marina for Encroachment and Construction Permits. The value of this allowance is pre-entered in the Bid Form.
 2. Payment under this item shall be for the actual cost of the permit fees, as reflected on the issuing agency invoices. Contractor's costs with respect to obtaining permits shall be included under Bid Item 1, Mobilization/Demobilization.
- W. Alternate Bid Item A1: 12-in DIP, BPS to 5th Avenue
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide the 12-inch ductile iron pipeline from 5th Avenue to the Booster Pump Station as shown on the Drawings (from Station 101+00 to Station 107+32), including the hot tap connection to the existing main in 5th Avenue. This item includes, but is not limited to, the ductile iron pipe, fittings, excavation, bedding, backfill, compaction and repaving the trench.
 2. The gate valve at station 107+32 is not included in the alternate item. If this item is not included in the project, an MJ cap must be provided at that gate valve.
- X. Alternate Bid Item A2: 1.6 MG Steel Water Tank
1. The lump sum bid price for this item shall constitute full compensation for all material, labor, equipment, tools, and services necessary to provide Reservoir A2, including, but not limited to, foundation preparation by over-excavation and compaction, reinforced concrete ring wall foundation, oiled sand pad, welded steel tank, interior and exterior tank appurtenances, interior and exterior coating, disinfection and leak testing.
 2. This item includes the associated 20-inch water main (yard piping) from the tank to the fitting at station 1+69.
 3. This item includes all conduits, cables and level instruments on installed on Tank A2.

4. Water for leakage testing will be provided by the Owner at no cost. If the tank fails the leakage test and must be drained, repaired and retested, water for second and subsequent tests will be charged at the MCWD standard water rates.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 30 00

CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

- A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer.
- B. Prior to receiving Notice to Proceed, the Contractor shall submit a Site Specific Safety Plan as required in Article 25 of the General Conditions.
- C. Within 14 days after the date of commencement as stated in the Notice to Proceed or at Preconstruction Conference, whichever occurs earliest, the Contractor shall submit the following items to the Engineer for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.
 - 2. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

1.02 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. At the preconstruction conference referred to in Section 01 11 00, "Summary of Work," the Contractor shall submit the following items to the Engineer for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
 - 2. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 3. Construction schedule for entire project.
 - 4. A preliminary schedule of values for lump sum pay items.

1.03 SHOP DRAWINGS

- A. Shop drawings shall be submitted electronically (.pdf format print or scan) via e-mail or through an on-line construction management system (to be determined). The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an Engineer registered in the appropriate engineering branch and in the State of California, unless otherwise directed.

- B. Wherever hard copy original submittals are called for in the Contract Documents or required by the Engineer, the Contractor shall furnish to the Engineer for review, 8 copies of each shop drawing submittal.
- C. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.
- D. Except as may otherwise be indicated herein, the Engineer will return each submittal to the Contractor with its comments noted thereon, within 7 working days following their receipt by the Engineer. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The OWNER reserves the right to withhold monies due to the Contractor to cover additional costs of the Engineer's review beyond the second submittal. The Engineer's maximum review period for each submittal, including all resubmittals, will be 7 working days per submittal. In other words, for a submittal that requires two resubmittals before it is complete, the maximum review period for that submittal could be 14 working days. No extension of Contract Time will be granted for delays due to resubmittals that are reviewed within the number of days specified.
- E. If a submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," no revisions are required.
- F. If a submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," the noted revisions must be made but resubmission of said submittal will not be required.
- G. If a submittal is returned to the Contractor marked "REVISE AND RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.
- H. If a submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.
- I. Submittals which are for information only or which must be reviewed and approved by a permitting jurisdiction will be marked "RECEIPT ACKNOWLEDGED" by the Engineer.
- J. Fabrication of an item shall be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.
- K. All Contractor shop drawings submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submittal to the Engineer. Each submittal shall

be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.

- L. The Engineer's review of Contractor shop drawings submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of connections between provided items (parts must fit together) and for the anchorage of supplied equipment when not detailed on the design drawings.

1.04 CONTRACTOR'S SCHEDULE

- A. Prepare construction schedule showing sequence of activities and proposed shutdowns.
- B. Submit a preliminary construction schedule not later than the Pre Construction Meeting.
- C. Update construction schedule on monthly basis and submit with request for Progress Payment.

1.05 RECORD DRAWINGS

- A. The Contractor shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the WORK as actually constructed. These master record drawings of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the WORK. Copies of the modified record drawings shall be submitted on completion of WORK.
- B. Record drawings shall be accessible to the Engineer at all times during the construction period. Owner may hold a progress payment amount of \$5,000 until Contract Record Drawings are up-to-date.
- C. Final payment will not be acted upon until the Contractor's record drawings have been prepared and delivered to the Engineer. Said up-to date record drawings shall be in the form of a set of Contract Documents prints with any changes from the original Contract Documents carefully plotted on the prints in red ink.
- D. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of record drawings to the Engineer for

transmittal to the OWNER, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the WORK. The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 33 12

SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Products to be furnished under this contract shall be designed, constructed, and installed in conformance with the seismic requirements contained within the 2019 California Building Code (CBC), Seismic Soil Profile Type "D", and the following seismic design parameters:
 - 1. Design Spectral Response Acceleration for Short Period (S_{DS}): 0.900g
 - 2. Design Spectral Response Acceleration for 1-second Period (S_{D1}): 0.895g
 - 3. Risk Category IV
 - 4. Seismic Design Category D
 - 5. $I_E = 1.25$ for entire structure
 - 6. $I_P = 1.5$ for elements of structures and equipment

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. California Building Standards Commission (CBSC)
 - 1. California Building Code
- B. American Society of Civil Engineers (ASCE)
 - 1. ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures
- C. American Concrete Institute (ACI)
 - 1. ACI 318, Building Code Requirements for Structural Concrete
- D. International Code Council Evaluation Services (ICC-ES)
 - 1. Manufacturer Evaluation Reports, as appropriate.
- E. International Association of Plumbing and Mechanical Officials Uniform Evaluation Services (IAPMO-UES)
 - 1. Manufacturer Evaluation Reports, as appropriate.
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - 1. Seismic Restraint Manual – Guidelines for Mechanical Systems
- G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 CONTRACTOR SUBMITTALS

- A. Submit calculations and/or shop drawings, in accordance with Division 1, and shall include the following information.

B. Design Data:

1. Equipment Qualification – CONTRACTOR shall submit for review and approval (if required). Structural seismic qualification of the equipment to demonstrate that it is capable of withstanding forces as specified.
2. Anchorage System – CONTRACTOR shall submit for review and approval. Structural calculations, of the proposed anchorage system, certified by a Professional Civil or Structural Engineer licensed within the State of California.

1.04 FIXTURE AND EQUIPMENT ANCHORAGE

- A. Anchorage and other supports for all important equipment shall be designed to resist seismic forces occurring independently in at least two orthogonal directions, concurrent with a vertical seismic force.
- B. Structural design of equipment anchorage shall be submitted for equipment identified as *Designated Seismic System*, or mechanical and electrical components not identified as being exempt under ASCE 7, Chapters 13 or 15. Calculations shall be sealed by a Civil or Structural Engineer licensed within the State of California.
- C. Architectural elements (racks, shelving, cladding, windows, doors, non-engineered partition walls, parapets, ornamentation, gutters and downspouts, etc.) mechanical and electrical components, equipment housings and their attachments, supporting structures, and anchorage:
 1. Shall be designed and constructed to resist the seismic forces in accordance with Chapter 16 of the CBC. This force shall be considered acting at the center of mass of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the ENGINEER.
 2. Component Amplification Factor (ap) as defined in ASCE 7, Table 13.5.1 for Architectural Components or ASCE 7, Table Mechanical and Electrical Components. For components not listed, Component Amplification Factor shall be equal to 2.5 for nonbuilding structures with flexible dynamic characteristics or 1.0 for nonbuilding structures with rigid dynamic characteristics.
 3. Vibration isolated equipment shall be provided with snubbers capable of retaining the equipment in its designated location without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment shall not exceed ¼-inch.
 4. Piping with flexible connection and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.
 5. Calculations and shop drawings shall be submitted for all anchorage details. All calculations shall be made and signed by a Professional Civil or Structural Engineer licensed in the State of California. Inasmuch as all anchorage of equipment is to be made of poured-in-place concrete elements, it is imperative that types of anchorage be coordinated with the concrete contractor so that anchorage may be installed at time of concrete placement. If calculations and anchorage details are not submitted prior to placing concrete, the CONTRACTOR will become financially responsible for any strengthening of concrete elements because of superimposed seismic loading.

- D. Cast-in anchor bolts are preferred for support of critical equipment and framing. Post-installed concrete anchors will not be used, without approval from the ENGINEER, for critical fastening such as extreme vibratory conditions, impact loads, seismic connections, and overhead installations.
- E. Expansion and adhesive post-installed concrete anchors will have an associated research report issued by The International Code Council Evaluation Service, Inc. (ICC-ES) and/or International Association of Plumbing and Mechanical Officials Uniform Evaluation Services (IAPMO-UES). Design values and installation requirements for anchors will be as presented in the appropriate ICC-ES and/or IAPMO-UES report(s). Edge distance, bolt spacing, inspection requirements and operating temperatures will be considered when determining the appropriate allowable design values.

1.05 VIBRATION ISOLATION

- A. In general, equipment should be rigidly mounted to supporting foundations and structures, without the aid of vibration isolation devices. Exceptions are mechanical equipment in which vibrations transmitted from the equipment would be troubling to building occupants and/or other equipment within the building.
- B. If vibration isolation mountings are required for equipment. The mountings, and their attachments to the supporting structure, shall be designed as flexible mountings in accordance with governing Code. The supplier of the vibration isolation mounting hardware shall be required to submit certified calculations, sealed by a Civil or Structural Engineer licensed within the State of California. Indicating the adequacy of the hardware and attachment anchorage to meet these criteria.

1.06 ABOVE GROUND PIPING

- A. Steel piping shall as a minimum, be provided with braces that satisfy the latest edition of SMACNA requirements for Seismic Hazard Level A unless demonstrated to the satisfaction of the DISTRICT that it is capable of resisting the required seismic forces under other support conditions. Connection Level I shall be used for all piping.
- B. Plastic piping shall be braced laterally at intervals not exceeding twice that recommended by the manufacturer for vertical support.
- C. Piping crossing expansion joints between adjacent structures shall be provided with expansion fittings, multiple bends, or other suitable provisions to ensure capacity to sustain expected differential movement between structures.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.01 GENERAL

- A. All equipment designed to be fixed in position shall be securely fastened in place in conformance with the CBC, ASCE 7, or as specified herein the Technical Specifications for a specific piece of equipment under Division 2 through 16. For other equipment, the equipment manufacturer shall provide recommended anchorage information to the CONTRACTOR for use in the installation of the equipment.
- B. See also Section 01614 for Wind Design Requirements.

3.02 STRUCTURAL INTEGRITY AND ANCHORAGE

- A. It shall be the responsibility of the equipment manufacturer/supplier or their designee to provide the engineering anchorage calculations and figures to the CONTRACTOR for submission to the ENGINEER. As a minimum, the equipment manufacturer/supplier or their designee shall determine the number, dimensions, material, location, embedment and installation conditions of all anchor bolts to be set in concrete in accordance with Contract Specifications and Drawings. At the option of the CONTRACTOR, the CONTRACTOR or equipment manufacturer/supplier shall furnish the anchor bolts and associated hardware as specified herein and as determined by the manufacturer/supplier's engineering anchorage calculations for installation by the CONTRACTOR.
- B. Engineering anchorage calculations and figures shall be prepared, stamped and signed by a Professional Civil or Structural Engineer licensed in the State of California. Calculations shall include the following steps as a minimum:
 - 1. Determination of the operating equipment weight and centroid of the equipment.
 - 2. Determination of the shear and overturning forces at each anchorage due to the force determined, as specified below, being applied at the equipment's centroid.
 - 3. Determination of the shear and tension forces that must be developed by the anchorage at each support to resist the forces calculated.
 - 4. Selection of the anchorage details based upon the maximum shear and tension forces calculated above. As a minimum, details shall include number of bolts, materials, diameter, total length, embedded length, required edge distance and bolt dimensions.
- C. For all equipment weighing 400 pounds or more, the minimum anchor bolt size shall be 5/8-inch diameter, with 5-inch minimum embedment. The minimum anchor bolt size for all other equipment shall be 3/8-inch diameter, with 4-inch minimum embedment. All anchor bolts securing equipment to be grouted shall be furnished with leveling nuts, the faces of which shall be tightened against the flat surfaces to not less than 10 percent of the bolts safe tensile stress.
- D. Cast-in-place anchor bolts shall be set before concrete has been placed and shall be carefully held in position with suitable templates of an acceptable design.
- E. No equipment shall be anchored to vertical structural elements without the written approval of the ENGINEER, with the exception of pipe hangers/supports or anchorage as specified.

3.03 SEISMIC REQUIREMENTS

- A. The seismic qualification for the *Designated Seismic Systems* shall be demonstrated by structural calculation(s), engineering shake table test(s) or experience data.
- B. Certification based on experience data shall include, at a minimum, the following information:
 - 1. Address and year of installation of the “similar” equipment;
 - 2. Certification that cited installation is/are essentially similar to that proposed for the Work; and
 - 3. Earthquake(s) experienced during equipment’s lifetime, including but not limited to:
 - a. Earthquake date, magnitude, distance from equipment location,
 - b. Site-specific motion parameters, including but not limited to, Peak Ground Acceleration (PGA) and Spectral Acceleration (Sa).

3.04 PROOF OF COMPLIANCE

- A. Equipment with complex component structural systems, (i.e. systems involving components with multiple degrees of freedom and higher order modes of vibration), contains low weight components (e.g. circuit boards, relays, or solenoids), an additional empirical evaluation for such low weight components shall be certified in writing by a Professional Civil or Structural Engineer, licensed in the State of California, to satisfy the requirements set forth above. At a minimum, such certification shall be based on an empirical evaluation of direct observation of such equipment as part of the factory or shop witness testing including physical “hand” shake and pull tests, and general calculations (if required to verify capacity overload) necessary to satisfy the ENGINEER of compliance with the above requirements. Certification shall be in the form of a letter from the licensed engineer incorporating the nature of the observations and/or calculations performed including the licensed engineer’s seal and signature

END OF SECTION

SECTION 01 33 14

WIND DESIGN CRITERIA

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All products to be furnished under this contract shall be designed, constructed, and installed in conformance with the wind design requirements contained within the 2016 California Building Code (CBC), and the following design parameters:
 - 1. Risk Category, IV
 - 2. Basic Wind Speed (3 Second Gust) 103 miles per hour
 - 3. Wind Exposure Category "D"

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. California Building Standards Commission (CBSC)
 - 1. California Building Code
- B. American Society of Civil Engineers (ASCE)
 - 1. ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures
- C. American Concrete Institute (ACI)
 - 1. ACI 318, Building Code Requirements for Structural Concrete
- D. International Code Council Evaluation Services (ICC-ES)
 - 1. Manufacturer Evaluation Reports, as appropriate.
- E. International Association of Plumbing and Mechanical Officials Uniform Evaluation Services (IAPMO-UES)
 - 1. Manufacturer Evaluation Reports, as appropriate.
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 CONTRACTOR SUBMITTALS

- A. Submit calculations and/or shop drawings, in accordance with Division 1, and shall include the following information:
- B. Design Data:
 - 1. Anchorage System – CONTRACTOR shall submit for review and approval. Structural calculations, of the proposed anchorage system, certified by a Professional Civil or Structural Engineer licensed within the State of California.

1.04 FIXTURE AND EQUIPMENT ANCHORAGE

- A. Anchorage and other supports for all important equipment shall be designed to resist wind forces occurring along each of the three principal directions.
- B. Architectural elements (racks, shelving, cladding, windows, doors, non-engineered partition walls, parapets, ornamentation, gutters and downspouts, etc.) mechanical and electrical components, equipment housings and their attachments, supporting structures, and anchorage:
 - 1. Calculations and shop drawings shall be submitted for all anchorage details. All calculations shall be made and signed by a Professional Civil/Structural Engineer licensed in the State of California. Inasmuch as all anchorage of equipment is to be made of poured-in-place concrete elements, it is imperative that types of anchorage be coordinated with the concrete contractor so that anchorage may be installed at time of concrete placement. If calculations and anchorage details are not submitted prior to placing concrete, the CONTRACTOR will become responsible for any strengthening of concrete elements because of superimposed wind loading.
- C. Cast-in anchor bolts are preferred for support of critical equipment and framing. Post-installed concrete anchors will not be used, without approval from the ENGINEER.
- D. Expansion and adhesive post-installed concrete anchors will have an associated research report issued by The International Code Council Evaluation Service, Inc. (ICC-ES) and/or International Association of Plumbing and Mechanical Officials Uniform Evaluation Services (IAPMO-UES). Design values and installation requirements for anchors will be as presented in the appropriate ICC-ES and/or IAPMO-UES report(s). Edge distance, bolt spacing, inspection requirements and operating temperatures will be considered when determining the appropriate allowable design values.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.01 GENERAL

- A. All equipment designed to be fixed in position shall be securely fastened in place in conformance with the CBC, ASCE 7, or as specified herein the Technical Specifications for a specific piece of equipment under Division 2 through 16. For other equipment, the equipment manufacturer shall provide recommended anchorage information to the CONTRACTOR for use in the installation of the equipment.
- B. See also Section 01612 for Seismic Design Requirements.

3.02 STRUCTURAL INTEGRITY AND ANCHORAGE

- A. It shall be the responsibility of the equipment manufacturer/supplier to provide the engineering anchorage calculations and figures to the CONTRACTOR for submission to the ENGINEER. As a minimum, the equipment manufacturer/supplier shall determine the number, dimensions, material, location, embedment and installation conditions of all anchor bolts to be set in concrete in accordance with Contract Specifications and Drawings. At the option of the CONTRACTOR, the CONTRACTOR or equipment manufacturer/supplier shall furnish the anchor bolts and associated hardware as specified herein and as determined by the manufacturer/supplier's engineering anchorage calculations for installation by the CONTRACTOR.
- B. Engineering anchorage calculations and figures shall be prepared, stamped and signed by a Professional Civil or Structural Engineer licensed in the State of California. Calculations shall include the following steps as a minimum:
 - 1. Determination of the shear and overturning forces at each anchorage due to the force determined, as specified below, being applied.
 - 2. Determination of the shear and tension forces that must be developed by the anchorage at each support to resist the forces calculated.
 - 3. Selection of the anchorage details based upon the maximum shear and tension forces calculated above. As a minimum, details shall include number of bolts, materials, diameter, total length, embedded length, required edge distance and bolt dimensions. The embedded length of bolts shall be suitable to develop the ultimate tensile capacity of the anchorage for ductile failure.
- C. Cast-in-place anchor bolts shall be set before concrete has been placed and shall be carefully held in position with suitable templates of an acceptable design.
- D. No equipment shall be anchored to vertical structural elements without the written approval of the ENGINEER, with the exception of pipe hangers/supports or anchorage as specified.

END OF SECTION

SECTION 01 41 00

REFERENCE STANDARDS

PART 1 - GENERAL

1.01 GENERAL

A. Titles of Sections and Paragraphs

1. Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications

1. Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists, Assignments

1. In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the Contractor.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- ###### A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents.

- ###### B. All Work within this Project is subject to the requirements of the California Building Standards Code. The latest edition of the code as approved by California Building Standards Commission and used by the local agency as of the date that the Work is advertised for bids, or as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto. References herein to:

1. "Building Code" or "Uniform Building Code" shall mean the California Building Code;

2. "Mechanical Code' or "Uniform Mechanical Code" shall mean the California Mechanical Code;
 3. "Plumbing Code' or "Uniform Plumbing Code" shall mean the California Plumbing Code;
 4. "Fire Code" or "Uniform Fire Code," shall mean the California Fire Code;
 5. "Electric Code" or "National Electric Code (NEC)" shall mean the California Electrical Code.
- C. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. The Contractor shall bid for the most stringent requirements.
- D. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.
1. References in the Contract Documents to "CALTRANS Standard Specifications" shall mean the State of California Department of Transportation Standard Specifications and Standard Plans. The Contractor should be prepared to distinguish between these two references.
 2. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
 3. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
 4. Applicable Safety Standards
 - a. References herein to "Cal-OSHA" shall mean State of California Department of Industrial Relations, Construction Safety Orders, as amended to date, and all changes and amendments thereto.
 5. Accessibility requirements shall conform to Title 24 of the California Administration Code and ADA Guidelines.

1.03 REGULATIONS RELATED TO CONSTRUCTION ACTIVITIES.

- A. The Contractor is responsible that all Work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing construction activities, as referenced in Section 00 70 00, "General Conditions."

1.04 REGULATIONS RELATED TO HAZARDOUS MATERIALS

- A. The Contractor is responsible that all Work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.

- B. Where no specific regulations exist, all chemical, hazardous, and petroleum product piping and storage in underground locations must be installed with double containment piping and tanks, or in separate concrete trenches and vaults, or with an approved lining which cannot be penetrated by the chemicals, unless waived in writing by the OWNER.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS OF INSTITUTIONS

PART 1 - GENERAL

1.01 GENERAL

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.02 ABBREVIATIONS

AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS-	American Nuclear Society
ANSI	American National Standards Institute, Inc.

APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLPCA	California Lathing and Plastering Contractors Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute

DCDMA	Diamond Core Drill Manufacturer's Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute
APMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards

NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction

TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 53 00

PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents.
- B. The Contractor shall verify the exact locations and depths of existing utilities shown that will be affected by the work. Contractor shall make exploratory excavations as necessary to confirm locations shown. The depths shown for existing underground utilities are based on record drawings, limited potholing, and survey information, and are approximate only (± 1 foot vertical and ± 5 feet horizontal). Where the depths are not shown, no such information was obtained during design. When such exploratory excavations show the utility location as shown to be in error, the Contractor shall immediately notify the Engineer when existing utilities are not as shown on the drawings.
- C. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities. The Contractor shall also notify Underground Service Alert-North at 1-800-227-2600 at least 2 days, but no more than 14 days, prior to such excavation.
- D. Contractor shall photograph and document all project sites before and after construction. Contractor shall provide the Engineer with site pictures before work begins. Contractor shall provide the Engineer with photographs of completed work before requesting final payment.

1.02 PROTECTION OF STREET OR ROADWAY MARKERS AND MONUMENTS

- A. The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. All survey markers or points disturbed by the Contractor shall be restored accurately after all street or roadway resurfacing has been completed.

1.03 RESTORATION OF PAVEMENT

- A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of at least equal thickness to

match the existing adjacent undisturbed areas. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.

- B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements. Temporary surfacing shall be replaced with permanent pavement within no more than 5 days after completion of work in an area. At no time shall the Contractor have more than 2,000 feet of trench with temporary surfacing.
- C. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration or, if no such period of times is so fixed, the Contractor shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

1.04 EXISTING UTILITIES AND IMPROVEMENTS

A. General

- 1. The Contractor shall protect all Underground Utilities and other improvements which may be impaired during construction operations. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary. The following clearances shall be met for gas mains and electric lines encountered:
 - a. Five feet from power pole to edge of straight trench.
 - b. Three feet from edge of slope for sloped trench.
 - c. Five feet from anchor blocks.
 - d. Three feet from edge of gas main to edge of pipeline.
 - e. One foot minimum crossing of gas main with pipeline.
 - f. A minimum of ten radial feet from the conductors on overhead power lines.
- 2. Clearances to be met for telephone are the following:
 - a. Five feet for anchor blocks and telephone poles.
 - b. Three feet for sloped trench.

B. Utilities to be Moved:

- 1. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the Owner to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

- C. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the owner of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal. The Contractor shall arrange with the utility for utility poles to be moved whenever any of the clearances described above cannot be maintained. Contractor shall pay for such utility pole relocation. No extra compensation shall be paid to the Contractor for movement of utility poles.
- D. Owner's Right of Access:
1. The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- E. Underground Utilities Indicated:
1. Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the Contractor.
- F. Underground Utilities Not Indicated:
1. In the event that the Contractor damages any existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, a written report thereof shall be made immediately to the Engineer.
- G. Approval of Repairs:
1. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.
- H. Maintaining in Service:
1. All oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The Contractor shall be responsible for all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 55 00

SITE ACCESS AND STORAGE

PART 1 - GENERAL

1.01 HAUL ROADWAYS

- A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work.
- B. Provide traffic control as specified in Section 01 57 00.

1.02 CONTRACTOR'S WORK AND STORAGE AREA

- A. The Contractor shall make its own arrangements for any necessary off-site storage or shop areas necessary for the proper execution of the Work.
- B. Contractor may use the pump station site for temporary staging and storage, at the location shown on the Drawings. The use of additional areas within the Farmworker Housing Complex may be coordinated directly with the Property Owner.
- C. Contractor shall be responsible for the security of its equipment, materials, and facilities stored in the temporary staging and storage areas.
- D. Contractor shall not use temporary staging and storage areas for maintenance of vehicles and equipment used in constructing the Work without prior approval by the Property Owner.

1.03 PARKING

- A. The Contractor shall direct its employees to park in areas that do not interfere with traffic.
- B. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The Contractor shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 56 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Temporary facilities for the project including sanitary facilities, storage of materials, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, disposal of trash, debris and excavated material, and pest and rodent control.
- B. The facilities and controls specified in this section are considered minimum for the Project. The Contractor may provide additional facilities and controls for the proper execution of the Work and to meet Contractor's responsibilities for protection of persons and property.

1.02 CONTRACTOR'S RESPONSIBILITY

- A. Comply with applicable requirements as specified in other Sections.
 - 1. Maintain and operate temporary facilities and systems to assure continuous service.
 - 2. Modify and extend systems as Work progress requires.
 - 3. Completely remove temporary materials and equipment when their use is no longer required.
 - 4. Restore existing facilities used for temporary services to specified or to original condition.

1.03 TEMPORARY UTILITIES

- A. Obtaining Temporary Service:
 - 1. Make arrangements with utility service companies for temporary services.
 - 2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.
 - 3. Be responsible for utility service costs until the Work is substantially complete. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of the Work.
- B. Water:
 - 1. Provide water required for and in connection with Work to be performed or for other use as required for proper completion of the Work.
 - 2. For water to be drawn from public fire hydrants or other points of connection designated by the District, obtain special permit and meter from the District. All temporary connections shall be protected with an approved backflow prevention device or air-gap. Backflow prevention device must have proof of proper function (inspection certificate).

3. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel and Engineer or his Representatives.
- C. Electricity and Lighting:
1. Electrical power is not currently available on the well site.
 2. Provide electric power service as required for the Work. Provide power for operation of the Contractor's equipment, or for any other use by Contractor.
- D. Sanitary Facilities:
1. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction. Locate toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.
 2. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the site in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto.
- E. Rubbish
1. During the progress of the Work, the Contractor shall keep the site of the Work and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Work site, and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.04 FIELD OFFICE

- A. Contractor's Office at the Site:
1. Maintain a suitable office at the site for the Contractor's Superintendent who shall be authorized to receive submittals, drawings, instructions, or other communications from the Engineer or the Owner.
 2. Provide a meeting room suitable for twelve (12) people for conducting the regular construction progress meetings.
 3. The Contractor shall coordinate with CSUMB Staff for the location of the office.
- B. Engineer's Office at the Site:
1. Office: Provide a trailer-type temporary structure for the Engineer's use as an office with the following features:
 - a. All-metal frame, exterior, sides and roof.
 - b. Size: 300 square feet minimum, with minimum interior ceiling height of 8 feet.
 - c. Number of Rooms: Two (2) minimum.

- d. Windows: Two (2) minimum per office room with horizontal sliders, security guard screens and mini-blinds on all windows.
 - e. Lighting: Interior fluorescent ceiling lights with 70 foot-candles of uniform lighting at desk level. Provide outside lights above each door.
 - f. Heating, Ventilation and Air Conditioning: Provide at least six (6) air changes per hour in all rooms and provide air conditioning equipment capable of maintaining at least 70°F for heating and 78°F maximum for cooling.
 - g. Toilet room with flush toilet or chemical toilet, wash basin, mirror, toilet paper and paper towel dispensers; or nearby portable toilet and handwash station.
 - h. Doors equipped with automatic retracting deadbolt locks. Provide four (4) keys.
 - i. OSHA-approved staircase with stair handrail and landing with guardrail at entrances.
 - j. Electrical service, disconnect switch and a circuit breaker panel. Provide ground fault protected outlets.
 - k. Multiple 115-volt, 15-amp receptacles, spaced no more than 8 feet apart.
 - l. Smoke detectors and outside alarm.
2. Equipment and Furnishings: Provide the following:
- a. Two (2) desks each with two-drawer pedestals.
 - b. Two (2) swivel chairs.
 - c. One (1) 4 drawer filing cabinet.
 - d. One (1) 12 stick plan holder.
 - e. Two (2) desk lamps.
 - f. Two (2) drafting tables and stools.
 - g. One (1) paper towel dispenser.
 - h. One (1) paper cup dispenser.
 - i. One (1) bookcase, 4 feet wide and 3 feet high.
 - j. Two (2) wastepaper baskets.
 - k. One (1) first-aid kit.
 - l. Two (2) telephones, one (1) with speaker.
 - m. One (1) color digital copier/scanner with the following minimum capabilities:
 - 1) Stack feed 50 original document sheets
 - 2) Sort and staple 20 copies
 - 3) Copy rate of 25 copies per minute
 - 4) Ability to reproduce 8.5" x 11", 8.5" x 14", and 11" x 17" documents
 - 5) Enlarge and diminish copy size capability
 - 6) Double-side copy and scanning capability
 - 7) Network capability
 - n. One (1) 14A 60 BC dry chemical fire extinguisher. Fire extinguisher shall be mounted to be plainly visible always. The Contractor shall service the fire extinguisher on an annual basis.
 - o. One (1) water chiller fountain with hot water accessory and refrigerated compartment, EBCO Manufacturing Co. Model ODP8AH Oasis; equivalent by Hawes; or equal.
 - p. Security alarm and security contract with Bay Alarm Company, Sonitrol, or equal for the duration of the project.
3. Utilities: Install sewer (if applicable) and potable water service. Arrange and pay for telephone and electrical service. The Contractor shall pay for periodic water, sewer, and electrical charges. The Owner will pay for periodic telephone charges.
4. Installation and Removal: Install the Engineer's office at the location directed by the Engineer within fifteen (15) days after the Notice-to-Proceed. Provide rigid level

supports and seismic and wind tie-downs. Remove the Engineer's office no later than thirty (30) days after recording of the Notice of Completion, but no earlier than the Notice of Completion.

5. Maintenance: Maintain the Engineer's office in good repair. Provide daily cleaning and maintenance service. Replenish paper towels, paper cups, soap, toilet paper, and bottled water daily. Service, pump and clean chemical toilets at least twice weekly. Service the copier machine monthly or more frequently if needed.

1.05 STORAGE OF MATERIALS

- A. Storage of materials not susceptible to weather damage may be on blocks off the ground.
- B. Store materials in a neat and orderly manner. Place materials to permit easy access for identification, inspection and inventory.
- C. Fill and grade site for temporary structures to provide drainage away from temporary and existing buildings.

1.06 SAFETY REQUIREMENTS

- A. Contractor shall prepare and implement a Site-Specific Health and Safety Plan. Prepare supplemental safety plans, if required, to address the Contractor's means and methods. Contractor shall keep a copy of this plan on-site at all times.
- B. Conduct operations in strict accord with applicable Federal, State and local safety codes and statutes and with good construction practice. The Contractor is fully responsible and obligated to establish and maintain procedures for safety of all work, personnel and equipment involved in the Project.
- C. Observance of and compliance with the regulations shall be solely and without qualification the responsibility of the Contractor without reliance or superintendence of or direction by the Engineer or the Engineer's representative. Immediately advise the Engineer of investigation or inspection by Federal Safety and Health inspectors of the Contractor or subcontractor's work or place of work on the job site under this Contract, and after such investigation or inspection, advise the Engineer of the results. Submit one copy of accident reports to Engineer within 10 days of occurrence.
- D. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test such devices frequently to assure their functional capability. Constantly observe infiltration of liquids into the Work area for visual or odor evidences of contamination, immediate take appropriate steps to seal off entry of contaminated liquids to the Work area.
- E. Safety measures, including but not limited to safety personnel, first aid equipment, ventilating equipment and safety equipment, in the specifications and shown on the Drawings are obligations of the Contractor.
- F. Maintain required coordination with the Police and Fire Departments during the entire period covered by the Contract.

1.07 FIRST AID EQUIPMENT

- A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.
- B. Have at least one person thoroughly trained in first aid procedures present on the site whenever Work is in progress.

1.08 FIRE PROTECTION

- A. Conform to specified fire protection and prevention requirements established by Federal, State or local governmental agencies and as provided in Contractor's Safety Program.

1.09 SECURITY MEASURES

- A. Protect all Work materials, equipment, and property from loss, theft, damage, and vandalism. Contractor's duty to protect property includes Owner's property used in connection with the performance of the Contract.
- B. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.
- C. Provide temporary fencing as needed to secure the construction site.

1.10 PROTECTION OF PUBLIC UTILITIES

- A. Prevent damage to existing public utilities during construction. Give owners of utilities at least 48 hours notice before commencing Work in the area, for locating utilities during construction, and for making adjustments or relocation of utilities when they conflict with the proposed Work.

1.11 PRE-CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs and video of the condition of the entire site, including each area of the Work and temporary work, equipment storage and laydown areas prior to the start of the Work.
 - 1. Areas to be photographed and videoed shall include the site of the Work and all existing facilities either on or adjoining the Project site, including the interior of existing structures that could be damaged as a result of the Contractor's work.
 - 2. Include general condition, structures and vegetation in all staging, storing, working, parking and excavation areas.
 - 3. Pre-construction video of pipeline alignments shall be performed in each direction with a continuous video for each alignment. Videoing the alignment in a slow-moving (20 mph) vehicle with a Go-Pro or similar camera is acceptable.
- B. Submit photographs and videos per Section 01 30 00
 - 1. Submittal media may be:
 - a. PC-compatible DVD
 - b. PC-compatible flash (USB) drive
 - c. Web-based file sharing system (download from Contractor's site or upload to owner's site)

- C. Provide photos as individual, indexed JPG files with the following characteristics:
 - 1. Compression shall be set to preserve quality over file size
 - 2. JPG image resolution shall be 5 megapixels at 2400 x 1800 or higher.
 - 3. Images shall have rectangular clean edges.
 - 4. Images shall have time/date stamp
 - 5. Images or image index shall include:
 - a. Project name
 - b. Description of vantage point, indicating location and direction by compass point.
- D. Provide videos as MPG, MP4 or AVI files with the following characteristics:
 - 1. Video quality shall be 1080p or greater.
 - 2. Digital video color format
 - 3. Audio, if used, shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
 - 4. Label video with project name, location and date of recording.

1.12 PROTECTION OF THE WORK AND PROPERTY

- A. Preventive Actions:
 - 1. Take precautions, provide programs, and take actions necessary to protect the Work and public and private property from damage.
 - 2. Take action to prevent damage, injury or loss, including, but not be limited to, the following:
 - a. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with progress of the Work or the Owner's operations.
 - b. Provide suitable storage for materials which are subject to damage by exposure to weather, theft, breakage, or otherwise.
 - c. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
 - d. Frequently clean up refuse, rubbish, scrap materials, and debris caused by construction operations, keeping the Project site safe and orderly.
 - e. Provide safe barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways, and other hazardous areas.
 - 3. Obtain written consent from proper parties before entering or occupying with workers, tools, materials or equipment, privately owned land.
 - 4. Assume full responsibility for the preservation of public and private property on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of the Work by the Contractor, it shall be restored by the Contractor to a condition equal to or better than that existing before the damage was done.
- B. Barricades and Warning Signals: Where Work is performed on or adjacent to any roadway, right of way, or public place, furnish and erect barricades, fences, lights, warning signs, and danger signals; provide watchmen; and take other precautionary measures for the protection of persons or property and protection of the Work. Use barricades painted to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade. Erect sufficient barricades to keep vehicles from being

driven on or into Work under construction. Furnish watchmen in sufficient numbers to protect the Work. Maintain barricades, signs, and lights, and provide watchmen until the Project is accepted by the Owner.

C. Protection of Existing Structures:

1. Underground Structures:

- a. Underground structures are defined to include, but not be limited to, sewer, water, gas, and other piping, and manholes, chambers, electrical and signal conduits, tunnels, and other existing subsurface installations located within or adjacent to the limits of the Work.
- b. Known underground structures, including existing siphons are shown on the Drawings. This information is shown for the assistance of the Contractor in accordance with the best information available, but is not guaranteed to be correct or complete.
- c. Explore ahead of trenching and excavation work and uncover obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption of utility services. Restore to original condition damages to underground structure at no additional cost to the Owner.
- d. Necessary changes in location of the Work may be made by the Engineer to avoid unanticipated underground structures.
- e. If permanent relocation of an underground structure or other subsurface installations is required and not otherwise provided for in the Contract Documents, the Engineer will direct Contractor in writing to perform the Work, which shall be paid for under the provisions for changes in the Contract Price as described in Document 00700 - General Conditions.

2. Surface Structures: Surface structures are defined as existing buildings, structures and other constructed installations above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities that are visible above the ground surface.

3. Protection of Underground and Surface Structures:

- a. Support in place and protect from direct or indirect injury underground and surface structures located within or adjacent to the limits of the Work. Install such supports carefully and as required by the party owning or controlling such structure. Before installing structure supports, Contractor shall satisfy the Engineer that the methods and procedures to be used have been approved by the owner of the structure.
- b. Avoid moving or in any way changing the property of public utilities or private service corporations without prior written consent of a responsible official of that service or public utility. Representatives of these utilities reserve the right to enter within the limits of this project for the purpose of maintaining their properties, or of making such changes or repairs to their property that may be considered necessary by performance of this Contract.
- c. Notify the owners and/or operators of utilities and pipelines of the nature of construction operations to be performed and the date or dates on which those operations will be performed. When construction operations are required in the immediate vicinity of existing structures, pipelines, or utilities, give a minimum of 5 working days advance notice. Probe and flag the location of underground

utilities prior to commencement of excavation. Keep flags in place until construction operation reach and uncover the utility.

- d. Assume risks attending the presence or proximity of underground and surface structures within or adjacent to the limits to the Work including but not limited to damage and expense for direct or indirect injury caused by his Work to any structure. Immediately repair damage caused, to the satisfaction of the owner of the damaged structure.

D. Protection of Installed Products:

1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.
2. Control traffic to prevent damage to equipment, materials, and surfaces.
3. Provide coverings to protect equipment and materials from damage.

1.13 ROADS AND PARKING

- A. Prevent interference with traffic on existing roads.
- B. Designate temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Engineer.
- C. Minimize use by construction traffic of existing streets and driveways.
- D. Do not allow heavy vehicles or construction equipment in existing parking areas.

1.14 ENVIRONMENTAL CONTROLS

- A. Provide and maintain methods, equipment, and temporary construction as necessary for controls over environmental conditions at the construction site and adjacent areas.
- B. Comply with statutes, regulations, and ordinances which relate to the proposed Work for the prevention of environmental pollution and preservation of natural resources, including but not limited to the National Environmental Policy Act of 1969, PL 91 190, Executive Order 11514.
- C. The Owner recognizes that the site has considerable natural value and that construction of projects should have minimum impact to the surrounding environment. The Contractor shall adopt construction procedures that do not cause unnecessary excavation and filling of the terrain, indiscriminate destruction of vegetation, air or stream pollution, nor the harassment or destruction of wildlife.
- D. Recognize and adhere to the environmental requirements of the Project. Disturbed areas shall be strictly limited to boundaries established by the Contract Documents. Particularly avoid pollution of "on site" streams, wells or other water sources.
- E. Burning of rubbish, debris or waste materials is not permitted.
- F. Comply with the Mitigation and Monitoring Plan in the Initial Study/ Mitigated Negative Declaration adopted for the Project.

1.15 POLLUTION CONTROL

- A. Prepare a Spill Response and Prevention Plan, specific to the Contractor's means and methods. Submit prior to mobilization per Section 01 30 00, Contractor Submittals.
- B. Provide methods, means, and facilities required to prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.
- C. Provide equipment and personnel to perform emergency measures required to contain any spillage, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- D. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
- E. Prevent toxic concentrations of chemicals.
- F. Prevent harmful dispersal of pollutants into the atmosphere.
- G. Use equipment during construction that conforms to current Federal, State and local laws and regulations.
- H. Dispose of all trash and debris in permitted landfills or recycling facilities, as applicable, in accordance with state and local laws and regulations.

1.16 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.
- B. Employ methods and use materials which will not adversely affect conditions at the site or on adjoining properties.

1.17 NOISE CONTROL

- A. Provide vehicles, equipment, and construction activities that minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and local ordinances.
- B. Conduct construction operations during daylight hours except as approved by Engineer.
- C. Select construction equipment to operate with minimum noise and vibration. If in the opinion of the Engineer, objectionable noise or vibration is produced by equipment, rectify such conditions without additional cost to the Owner. The Sound Power Level (PWL) of any equipment shall not exceed 85 dbA (re: 10-12 watts) measured 50 feet from the piece of equipment, or the levels prescribed by local ordinances, whichever is lower. Explicit equipment noise requirements are specified with equipment specifications.

1.18 EXPLOSIVES AND BLASTING

- A. The use of explosives on the Work will not be permitted.

1.19 DUST AND MUD ABATEMENT

- A. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operation from producing dust and/or mud in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from any dust and/or mud originating from its operations. The dust or mud abatement measures shall be continued until the Contractor is relieved of further responsibility by the Engineer.

1.20 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.
- B. All chemicals used during the project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, fertilizer, disinfectants, polymers, reactants, fuel, oil, hydraulic fluid, detergent, paint, solvent, glue, or any other classification, shall be stored within a containment area that minimizes contact of the chemicals and the storage containers with surface waters. The Contractor shall notify the Engineer to determine if the surface water has been contaminated or may be allowed to be discharged to the storm drains or stream channels. If the surface water flows have become contaminated due to contact with the chemicals or the storage containers, the Contractor shall provide for removal and/or treatment of the surface water flows at no additional costs to the Owner. If spills occur in the containment area, the Contractor shall immediately notify the Engineer and contain and cleanup the spill to prevent spilled material from entering storm drains, stream channels, or groundwater or from being absorbed by the underlying pavement or soil.

1.21 TRENCH SPOILS DISPOSAL

- A. All trench spoils shall be hauled in trucks fitted with tarps and tailgates.
- B. All trench spoils shall be disposed of at suitable sites retained by the Contractor and in compliance with fill and grading permits, copies of which shall be provided to the Engineer.
- C. If disposing of trench spoils on private property, Contractor shall provide a release of liability from property owner upon construction completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 57 00

TRAFFIC REGULATION

PART 1 - GENERAL

1.01 TRAFFIC CONTROL REQUIREMENTS

- A. Traffic control plans shall comply with the encroachment permit issued by the City of Marina as applicable.
- B. Contractor shall supply and install all traffic control devices (including all warning, regulatory and guide signs) as required in Section 7-1.08, "Public Convenience," 7-1.09, "Public Safety," and 12, "Construction area Traffic Control Devices," of the CALTRANS Standard Specifications.
- C. Contractor shall furnish traffic control plans for approval by the City of Marina Public Works Department a minimum of two (2) full working days prior to the preconstruction meeting. The traffic control plans must be approved by the City prior to any installation of traffic control devices. Submit a copy of the plans to the Engineer "For Information Only".
- D. The traffic control plans shall be to scale and complete for each significant portion of the work requiring lane closures, traffic detours and/or restriction of traffic movements. The traffic control plans shall indicate the work area, all proposed signs, the spacing and location of all traffic control devices (arrow boards, flagmen, barricades, cones, pylon construction markers, etc.) the limits of proposed parking prohibitions, and the width and location of any rerouted traffic lanes.
- E. All open trenches must be adequately delineated by use of acceptable warning signs and devices during non-construction hours. The Contractor shall devise a typical plan indicating the type and spacing of barricades, signs, arrow boards, warning lights, pylon construction markers, construction tape, etc. to be used during non-construction hours. This plan must be submitted to the Engineer at the preconstruction meeting for review and approval.
- F. It is imperative that field traffic control be handled in such a manner as to adequately and safely direct all traffic movements in the project area. The Contractor shall not be allowed to proceed with construction at any time that, in the opinion of the Engineer, traffic control is inadequate to meet the field conditions. Traffic control measures, in addition to those indicated on the approved traffic control plans may be required as field conditions dictate.

1.02 TEMPORARY CROSSINGS

- A. General:
 - 1. Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, commercial, agricultural and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and

hospitals. Safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 500 feet shall be provided. The Contractor shall cooperate with parties involved in the delivery of mail and removal of trash and garbage so as to maintain existing schedules for such services. Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.

B. Temporary Bridges:

1. Wherever necessary, the Contractor shall provide suitable temporary bridges or steel plates over unfilled excavations. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case, and the Contractor shall adopt designs furnished by said authority for such bridges or steel plates, or shall submit designs to said authority for approval, as may be required. If Contractor does not consider temporary bridge or steel plates necessary. Contractor shall secure written approval to omit the steel plates from the Engineer prior to excavation.

1.03 STREET USE

- A. Nothing herein shall be construed to entitle the Contractor to the exclusive use of any public street, alleyway, or parking area during the performance of the Work hereunder, and it shall so conduct its operations as not to interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the Engineer and proper governmental authority. Where excavation is being performed in primary streets or highways, one lane in each direction shall be kept open to traffic at all times unless otherwise indicated. Toe boards shall be provided to retain excavated material if required by the Engineer or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the Work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to assure the use of sidewalks and the proper functioning of all gutters, storm drain inlets, and other drainage facilities.
- B. Do not block driveway access to adjacent properties without the consent of the affected landowner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 57 20

EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General erosion and sediment controls and other control-related practices. Provide and maintain erosion and sediment controls until the site is finally stabilized or as directed by Engineer. Contractor shall prepare, submit and obtain SWPPP permit from State. Contractor shall prepare and submit all required documentation to State and Owner throughout project duration.
- B. Filter Fabric Fences:
 - 1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
 - 2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized flow areas.
- C. Straw Bale Fence.
- D. Dust controls are specified in Section 01 56 00 – Temporary Facilities and Controls.

1.02 REFERENCES

- A. National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ, NPDES No. CAS000002, State Water Resources Control Board
- B. Stormwater Best Management Practice Handbook, Construction, California Stormwater Quality Association (CASQA), January 2003
- C. Caltrans Storm Water Quality Handbook, Construction Site Best Management Practices Manual, March 1, 2003
- D. ASTM:
 - 1. D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
 - 2. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

1.03 SYSTEM DESCRIPTIONS

- A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.

- B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.

1.04 SUBMITTALS

- A. Follow Section 01 30 00 – Contractor Submittals.
- B. Submit manufacturer's catalog sheets and other product data on filter fabric and wire fencing.
- C. Submit the Storm Water Pollution Prevention Plan (SWPPP) prior to Notice to Proceed.
- D. Submit documentation verifying SWPPP compliance, including periodic inspection records and post-rain event reports. Contractor shall maintain SWPPP documentation on construction site and make available for review by Owner when requested.

PART 2 - PRODUCTS

2.01 EROSION CONTROL PRODUCTS AND SYSTEMS

- A. Sandbags: Polypropylene, polyethylene, or polyamide woven fabric, with minimum unit weight of 4 ounces per square yard, Muller burst strength exceeding 300 psi, and ultraviolet stability exceeding 70 percent. Fill bags with bank-run sand.
- B. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.
- C. Sediment Pump Pit Aggregate: Nominal 2-inch diameter river gravel.
- D. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.
- E. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.
- F. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- G. Straw Bale Stakes (applicable where bales are on soil): No. 3 diameter concrete reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 8 inch bury and full height bales.
- H. Filter Fabric: Mirafi, Inc., Synthetic Industries, or equivalent following Section 31 05 19.13.
 - 1. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.

2. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.
 3. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.
- I. Wire Fencing: Woven galvanized steel wire, 14 gauge by 6 inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.
 - J. Fence Stakes: Nominal 2 by 2 inch moisture-resistant treated wood; length as required for minimum 8 inch bury and full height of filter fabric.

PART 3 - EXECUTION

3.01 GENERAL

- A. Do not clear, grub or rough cut until erosion and sediment controls are in place, other than site work specifically directed by Engineer to allow surveying and soil testing.
- B. Maintain existing erosion and sediment controls, if any, until directed by Engineer to remove and dispose of existing controls.
- C. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage, caused by construction traffic, to erosion and sediment control systems.

3.02 INSPECTION AND REPAIR

- A. Inspect erosion and sedimentation controls daily during periods of prolonged rainfall, at end of rainfall period, and minimum once each week.
- B. Repair or replace damaged sections immediately.
- C. Remove eroded and sedimented products when silt reaches a depth one-third the height of the control or 6 inches, whichever is less.

3.03 FILTER FABRIC FENCES

- A. Layout fence lines with wood stakes.
- B. Fence Type 1:
 1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory preassembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
 2. Trench in the toe of the fence lines so the downward face of the trenches are flat and perpendicular to direction of flow. V trench configuration as shown on Drawings may also be used.
 3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.

4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
 5. Backfill and compact trench.
- C. Fence Type 2:
1. Layout fences same as for Type 1.
 2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.
 3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
 4. Install trench same as for Type 1.
 5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
 6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
 7. Backfill and compact trench.

3.04 STRAW BALE FENCES

- A. Install bales in a row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface. Where bales are installed on soil:
1. Embed bales in soil 4 inches minimum.
 2. Anchor bales with 2 stakes driven into soil, with top end of stake flush with top of bales. Angle the first stake in each bale toward previously laid bale to force bales together.
 3. Fill gaps between bales with straw to prevent water from escaping between bales. Wedge carefully to not separate bales.

3.05 STREET AND SIDEWALK CLEANING

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not hose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.06 WASTE COLLECTION AREAS

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.07 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.

- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.08 PRODUCT STORAGE

- A. Follow Sections 01 56 00 - Temporary Facilities and Controls for basic storage requirements.
- B. Isolate areas where cements, solvents, paints, or other potential water pollutants are stored so they do not cause runoff pollution.
- C. Store toxic products, such as pesticides, paints, and acids following manufacturer's guidelines. Protect groundwater resources from leaching, with plastic mats, packed clay, tarpaper, or other impervious materials on areas where toxic products are opened and stored.

3.09 WATER RUNOFF AND EROSION CONTROL

- A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.
- E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.
- F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold area of bare soil exposed at one time to a minimum.
 - 2. Provide temporary controls such as berms, dikes, and drains.
- G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.
- H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
- I. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers. Provide

compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.

- J. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.
- K. Do not damage existing trees intended to remain.

3.10 REMOVAL OF CONTROLS

- A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Engineer.
- B. Dispose of sediments and waste products following Section 01 56 00 - Temporary Facilities and Controls.

END OF SECTION

SECTION 01 60 00

PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 DEFINITIONS

- A. The word "Products," as used herein, is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.
- B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying and erection of the WORK.

1.02 QUALITY ASSURANCE

- A. Source Limitations: To the greatest extent possible for each unit of work, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.
- B. Compatibility of Options: Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.03 PRODUCT DELIVERY AND STORAGE

- A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.
- B. The CONTRACTOR shall provide a certificate of compliance for all materials to be incorporated in the Work.

1.04 TRANSPORTATION AND HANDLING

- A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturers unopened containers and packaging.
- B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment, including those provided by OWNER, by methods to prevent soiling and damage.
- C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.05 STORAGE AND PROTECTION

- A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.
- B. For exterior storage of fabricated products including pipe, products shall be placed on sloped supports above ground. Products subject to deterioration, including all ferrous metals, shall be covered with impervious sheet covering and heat and ventilation shall be provided to avoid condensation. PVC pipe shall be stored to avoid prolonged exposure to sunlight.
- C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
- D. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.
- E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.
- F. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.
- G. The CONTRACTOR shall maintain manufacturer-required environmental conditions continually.
- H. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.
- I. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.
- J. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to acceptance by the OWNER in accordance with the Contract Documents.

1.06 PROPOSED SUBSTITUTES OR "OR-EQUAL" ITEM

- A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other suppliers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:
1. The burden of proof as to the type, function, and quality of any such substitute product, material or equipment shall be upon the CONTRACTOR.
 2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitute and the ENGINEER'S decision shall be final.
 3. The ENGINEER may require the CONTRACTOR to furnish at the CONTRACTOR'S expense additional data about the proposed substitute.
 4. The OWNER may require the CONTRACTOR to furnish at the CONTRACTOR'S expense a special performance guarantee or other surety with respect to any substitute.
 5. Acceptance by the ENGINEER of a substitute item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitute.
 6. The CONTRACTOR shall be responsible for resultant changes including design and construction changes and all additional costs resulting from the changes which the accepted substitution requires in the CONTRACTOR'S WORK, the WORK of its subcontractors and of other contractors, and shall effect such changes without cost to the OWNER.
- B. The procedure for review by the ENGINEER will include the following:
1. If the CONTRACTOR wishes to provide a substitute item, the CONTRACTOR shall make written application to the ENGINEER on a "Substitution Request Form."
 2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 14 days after award of the Contract.
 3. Wherever a proposed substitute item has not been requested as specified herein, or wherever the submission of a proposed substitute material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.
 4. The CONTRACTOR shall certify that the proposed substitute will perform adequately the functions and achieve the results called for by the general design and be similar and of equal substance to that indicated, and be suited to the same use as that specified.
 5. The ENGINEER will evaluate each proposed substitute within a reasonable period of time.
 6. As applicable, no shop drawing submittals shall be made for a substitute item nor shall any substitute item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."
 7. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby. Whether or not the

ENGINEER accepts a proposed substitute, the CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitute.

- C. The CONTRACTOR's "Substitution Request Forms" shall contain the following statements and information which shall be considered by the ENGINEER in evaluating the proposed substitution:
1. The evaluation and acceptance of the proposed substitute will not prejudice the CONTRACTOR's achievement of substantial completion on time.
 2. Whether or not acceptance of the substitute for use in the WORK will require a change in any of the Contract Documents to adopt the design to the proposed substitute.
 3. Whether or not incorporation or use of the substitute in connection with the WORK is subject to payment of any license fee or royalty.
 4. All variations of the proposed substitute from the items originally specified will be identified.
 5. Available maintenance, repair, and replacement service will be indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
 6. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including cost of redesign and claims of other contractors affected by the resulting change.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 71 13

MOBILIZATION/DEMobilIZATION

PART 1 - GENERAL

1.01 GENERAL

- A. Mobilization shall include the obtaining of all permits; moving onto and off of the site of all plant and equipment; furnishing and erecting plants, temporary buildings, and other construction facilities, including the dismantling and removal of such plants, buildings, and facilities; and implementing security requirements; all as required for the proper performance and completion of the Work. Mobilization shall include the following principal items:
1. Moving on to the site of all Contractor's plant and equipment required for first month operations.
 2. Providing Contractor's field office trailers, complete with all specified furnishings and utility services including telephones, telephone appurtenances, etc., required to manage the WORK.
 3. Providing on-site sanitary facilities and potable water facilities.
 4. Arranging for and erection of Contractor's work and storage yard.
 5. Obtaining all required permits.
 6. Having all OSHA required notices and establishment of safety programs.
 7. Having the Contractor's superintendent at the job site full time.
 8. Submitting initial submittals, including those required for the Preconstruction Conference.
 9. Completing the Preconstruction Conference.
 10. Taking pre-construction photographs of existing conditions
- B. Demobilization shall include moving off the site all plant and equipment; temporary buildings; and other construction facilities; final cleaning of all work sites and the Contractor's staging area; completion of all punch list items; and submittal of construction record drawings, any required permits signed by the issuing agency, certifications, and operation and maintenance manuals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 23

FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes field engineering to establish lines and grades for the work.

1.02 QUALITY CONTROL

- A. Employ a State of California Licensed Land Surveyor acceptable to engineer for:
 1. Recovering control points established by District.
 2. Verifying benchmarks furnished by District.
 3. Establishing temporary benchmarks and construction control points.
 4. Recording location(s) and elevation(s) of temporary benchmarks and construction control points.
 5. Setting stakes for grading and fill placement, slopes, and inverts.
 6. Survey cross-sections of completed excavations.
- B. The survey activities shall be performed under direct supervision of the Licensed Land Surveyor.

1.03 SUBMITTALS

- A. Submit the name, address, and telephone number of Surveyor before starting survey work.
- B. On request, submit documentation verifying accuracy of survey work.
- C. Submit 3 original copies of certificate, signed by surveyor and sealed, stating that horizontal and vertical control lines, elevations, and benchmarks follow contract documents.

1.04 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. Submit Record Documents following section 01 70 00 - Project Closeout.
 1. Record, on as-built drawings, locations where pipeline alignments changed.
 2. Provide certified site survey to 0.01 foot precision of buildings, structures, pads and benchmarks signed by the professional land surveyor.

1.05 EXAMINATION

- A. Establish benchmarks, control points, lines and elevations prior to starting work. Notify engineer immediately of discrepancies discovered between stated attributes of owner-furnished data and surveyor's verification.

1.06 SURVEY REFERENCE POINTS

- A. Control datum for survey is that indicated on the Drawings.
- B. Contractor is required to establish its own control and references points as required to properly lay out the work.
- C. Locate and protect benchmarks, control points, lines and elevations prior to starting site work. Preserve permanent reference points during construction.
- D. Notify Engineer 48 hours in advance of need for relocation of reference points due to changes in grades or other reasons.
- E. Report promptly to Engineer the loss or destruction of reference points.
- F. Reestablishment of permanent reference points disturbed by contractor's operations shall be at the Contractor's expense.

1.07 SURVEY REQUIREMENTS

- A. Utilize recognized engineering survey practices.
- B. Establish a minimum of 2 permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on record documents.
- C. Establish elevations, lines and levels to provide appropriate controls for the work. Locate and lay out by instrumentation and similar appropriate means.
- D. Periodically verify layouts by same means.
- E. Utilize the project-specific coordinate system as defined on the drawings.

1.08 CONSTRUCTION STAKES, LINES AND GRADES

- A. Execute the work in accordance with the lines and grades indicated.
- B. Make distances and measurements on horizontal planes, except elevations and structural dimensions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 75 00

START-UP, TESTING AND TRAINING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for equipment and system testing and facility startup, including the following:
 - 1. Start-up Plan.
 - 2. Performance Testing.
 - 3. General Start-up and Testing Procedures.
 - 4. Functional Testing.
 - 5. Operational Testing.
 - 6. Certificate of Proper Installation.
 - 7. Services of manufacturer's representatives.
 - 8. Training of Owner's personnel.
 - 9. Final testing requirements for the complete facility.

1.02 GENERAL TESTING, TRAINING, AND START-UP REQUIREMENTS

- A. Contract Requirements: Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete testing, training, and start-up within the Contract Times.
- C. Allow realistic durations in the Progress Schedule for testing, training, and start-up activities.
- D. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- E. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.

1.03 START-UP PLAN

- A. Submit start-up plan for each piece of equipment and each system not less than 3 weeks prior to planned initial start-up of equipment or system.
- B. Provide detailed sub-network of Progress Schedule with the following activities identified:
 - 1. Manufacturer's services and source testing.
 - 2. Installation certifications.
 - 3. Operator training.

4. Submission of Operation and Maintenance Manual.
 5. Functional testing.
 6. Performance testing.
 7. Operational testing.
- C. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
- D. Provide summary of shutdown requirements for existing systems which are necessary to complete start-up of new equipment and systems.
- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.04 FACTORY TESTING

- A. Test equipment for proper performance at point of manufacture or assembly when specified.
- B. When source quality control testing is specified:
1. Demonstrate equipment meets specified performance requirements.
 2. Provide certified copies of test results.
 3. Do not ship equipment until certified copies have received written acceptance from Engineer. Written acceptance of factory test results does not constitute final acceptance.
 4. Perform testing as specified in the equipment specification sections.

1.05 GENERAL START-UP AND TESTING PROCEDURES

- A. Mechanical Systems: As specified in the individual equipment specification sections:
1. Remove rust preventatives and oils applied to protect equipment during construction.
 2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
 3. Flush fuel system and provide fuel for testing and start-up.
 4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
 5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
 6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
 7. Perform cold alignment and hot alignment to manufacturer's tolerances.
 8. Adjust V-belt tension and variable pitch sheaves.
 9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
 10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.
- B. Electrical Systems: As specified in the individual equipment specification sections:
 1. Perform insulation resistance tests on wiring except 120 volt lighting wiring, and control wiring inside electrical panels.
 2. Perform continuity tests on grounding systems.
 3. Test and set switchgear and circuit breaker relays for proper operation.
 4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.
 5. Check motors for actual full load amperage draw. Compare to nameplate value.
- C. Instrumentation Systems: As specified in the individual equipment specification sections:
 1. Bench or field calibrate instruments and make required adjustments and control point settings.
 2. Leak test pneumatic controls and instrument air piping.
 3. Energize transmitting and control signal systems, verify proper operation, ranges and settings.

1.06 FUNCTIONAL TESTING

- A. Perform checkout and performance testing as specified in the individual equipment specification sections.
- B. Functionally test mechanical and electrical equipment, and instrumentation and controls systems for proper operation after general start-up and testing tasks have been completed.
- C. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
- D. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- E. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.07 OPERATIONAL TESTING

- A. After completion of operator training, conduct operational test of the entire facility. Demonstrate satisfactory operation of equipment and systems in actual operation.
- B. Conduct operational test for continuous 7-day period.
- C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.

- D. Immediately correct defects in material, workmanship, or equipment which become evident during operational test.
- E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.08 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of Functional Testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:
 - 1. Has been properly installed, adjusted, aligned, and lubricated.
 - 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3. Is suitable for satisfactory full-time operation under full load conditions.
 - 4. Operates within the allowable limits for vibration.
 - 5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
 - 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.
- B. Furnish written report prepared and signed by the electrical and/or instrumentation Subcontractor certifying:
 - 1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 - 2. Control logic for equipment start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.
 - 3. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.09 TRAINING OF OWNER'S PERSONNEL

- A. Provide operations and maintenance training for items of mechanical, electrical and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.
- B. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than 2 sessions per week.
- C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems one (1) month prior to training session for that piece of equipment or system.
- D. Satisfactorily complete functional testing before beginning operator training.
- E. Training Sessions: Provide training sessions for equipment as specified in the individual equipment specification sections. At a minimum, training shall address:
 - 1. Vertical pump operation and maintenance
 - 2. Adjustable valve settings
 - 3. Level transducer type and calibration

4. Flow meter type and calibration
 5. Automatic valve settings and adjustments
 6. System control panel, manual operation and set-point adjustments
 7. SCADA control logic and component addressing
- F. The Contractor shall designate and provide one or more persons to be responsible for coordinating and expediting his/her training duties. The person or persons so designated shall be present at all training coordination meetings with the Owner.
- G. The Contractor's coordinator shall coordinate the training periods with Owner personnel and manufacturer's representatives, and shall submit a training schedule for each piece of equipment or system for which training is to be provided. Such training schedule shall be submitted not less than 21 calendar days prior to the time that the associated training is to be provided and shall be based on the current plan of operation.

1.10 RECORD KEEPING

- A. Maintain and submit following records generated during start-up and testing phase of Project:
1. Daily logs of equipment testing identifying all tests conducted and outcome.
 2. Logs of time spent by manufacturer's representatives performing services on the job site.
 3. Equipment lubrication records.
 4. Electrical phase, voltage, and amperage measurements.
 5. Insulation resistance measurements.
 6. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 77 00

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 FINAL CLEANUP

- A. The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.02 CLOSEOUT TIMETABLE

- A. The Contractor shall establish a date for acceptance of work. The date shall be established not less than one week prior to beginning any of the foregoing items, to allow the Owner, the Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.03 FINAL SUBMITTALS

- A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for transmittal to the Owner:
 - 1. Written guarantees, where required.
 - 2. Operating manuals and instructions.
 - 3. Maintenance stock items; spare parts; special tools.
 - 4. Completed record drawings.
 - 5. Geospatially referenced locations of all installed facilities and equipment (i.e., GPS data)
 - 6. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 - 7. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.04 MAINTENANCE AND GUARANTEE

- A. The Contractor shall comply with the warranty requirements contained in the Construction Contract.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing.

- C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 78 20

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Preparation and submittal of Operation and Maintenance Manuals.
- B. Related Sections:
 - 1. Section 01 75 00 – Start-up, Testing and Training
 - 2. Section 01 77 00 – Project Closeout
 - 3. Section 26 05 80 – Commissioning Electrical Systems
 - 4. Section 26 24 19 – Motor Control Centers
 - 5. Section 26 32 13 – Diesel Engine Driven Generator Set
 - 6. Section 43 24 10 – Vertical Turbine Pumps
 - 7. Section 46 33 00 – Liquid Chemical Feed Equipment

1.02 SUBMITTALS

- A. Submit Operation and Maintenance Manuals as part of the shop drawing approval process.
- B. Make additions and revisions to the Manuals in accordance with Engineer's review comments.
- C. Submit four (4) complete Manuals for each piece of equipment or system after shop drawing approval.

1.03 OPERATION AND MAINTENANCE MANUALS

- A. Preparation:
 - 1. Provide Operations and Maintenance Manuals in 3-ring binders with rigid covers. Utilize tab sheets to organize information.
- B. Contents of Operation and Maintenance Manuals:
 - 1. Cover Page: Equipment name, equipment tag number, project name, Owner's name, appropriate date.
 - 2. Table of Contents: General description of information provided within each tab section.
 - 3. Lubrication Information: Required lubricants and lubrication schedules.
 - 4. Control Diagrams:
 - a. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer-based systems, and connections

between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.

5. Start-up Procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.
6. Operating Procedures:
 - a. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation.
 - b. Include safety precautions and emergency operating shutdown instructions.
7. Preventative Maintenance Procedures: Recommended steps and schedules for maintaining equipment.
8. Overhaul Instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
9. Parts List: Generic title and identification number of each component part of equipment; include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
10. Spare Parts List: Recommended number of parts to be stored at the site and special storage precautions.
11. Drawings: Exploded view or plan and section views with detailed callouts.
12. Provide electrical and instrumentation schematic record drawings.
13. Provide approved shop and fabrication drawings.
14. Source (Factory) Quality Control Test Results: Provide copies of factory test reports as specified in the applicable equipment section.
15. Field Quality Control Test Results: After field testing is completed, insert field test reports as specified in the applicable equipment section.
16. Equipment Summary Form: Completed form in the format attached at the end of this Section. Insert Equipment Summary Form after the tab sheet of each equipment section. The manufacturer's standard form will not be acceptable.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT IDENTIFICATION NUMBER(S) _____
(maps equipment number)

4. LOCATION OF EQUIPMENT _____

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

NAMEPLATE DATA -

Horsepower _____
Amperage _____
Voltage _____
Service Factor (S.F.) _____
Speed _____
ENC Type _____
Capacity _____
Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name _____

Address _____

Telephone Number _____

8. MAINTENANCE REQUIREMENTS _____

9. LUBRICANT LIST _____

10. SPARE PARTS (recommendations) _____

11. COMMENTS _____

END OF SECTION

SECTION 02 01 00

EXISTING FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes requirements for connection to and abandonment of existing facilities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Abandonment of Pipelines 02 22 20
 - 2. Trenching, Backfilling, and Compacting: 31 23 00
 - 3. Manual Valves: 33 12 16

1.03 SUBMITTALS

- A. Submit a connection plan detailing the schedule and methods for transitioning from existing to new facilities.

1.04 CONDITION OF EXISTING FACILITIES

- A. The Owner does not warranty the condition, size, material, and location of existing facilities.

1.05 LOCATION

- A. The Contractor shall be responsible for potholing and verifying in advance the location of all existing pipelines as shown on the plans. Discrepancies shall be reported to the Engineer, prior to the fabrication of, or purchase of material affected by the discrepancy.

1.06 PROTECTION OF EXISTING UTILITIES AND FACILITIES

- A. The Contractor shall be responsible for the care and protection of all existing sewer pipe, water pipe, gas mains, culverts, power or communications lines, sidewalks, curbs, pavement, or other facilities and structures that may be encountered in or near the area of the work.
- B. It shall be the duty of the Contractor to notify Underground Service Alert and each agency of jurisdiction and make arrangements for locating their facilities prior to beginning construction.

- C. In the event of damage to any existing facilities during the progress of the work, the Contractor shall pay for the cost of all repairs and protection to said facilities. The Contractor's work may be stopped until repair operations are complete.

1.07 PROTECTION OF LANDSCAPING

- A. The Contractor shall be responsible for the protection of all the trees, shrubs, irrigation systems, fences, and other landscape items adjacent to or within the work area, unless they are directed to do otherwise on the plans.
- B. In the event of damage to landscape items, the Contractor shall replace the damaged items to the satisfaction of the Engineer and the Owner, or pay damages to the property Owner as directed by the Owner.
- C. When the proposed pipeline is to be within planted or other improved areas in public or private easements, the Contractor shall restore such areas to the original condition after completion of the work. This restoration shall include grading, a placement of 5 inches of good topsoil, re-sodding, and replacement of all landscape items indicated.
- D. If the Contractor does not proceed with the restoration after completion of the work or does not complete the restoration in a satisfactory manner, the Engineer reserves the right to have the work done and to charge the Contractor for the actual cost of the restoration including all labor, material, and overhead required for restoration.

1.08 PERMITS

- A. All work shall conform to the specifications and requirements of the State of California Department of Transportation, the County, the city having jurisdiction, or the other affected agencies involved. The Contractor shall keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits. Permits shall also include any related to the abandonment of an existing water or sewer pipe.

PART 2 - MATERIALS

All materials used in making the connection or removing the facility from service shall conform to the applicable sections of these specifications.

2.01 GROUT

- A. Grout used for filling or plugging abandoned facilities shall be in accordance with Section 02 22 20.

2.02 CONCRETE

- A. Concrete used for the replacement of damaged or removed facilities shall be in accordance with Section 03 30 00 and shall match the mix design of the existing facility and per the requirement of the jurisdictional agency.

PART 3 - EXECUTION

3.01 CONNECTION TO EXISTING FACILITIES

- A. All connections shall be made by the Contractor unless shown otherwise on the plans or specified herein.
- B. If multiple connections to the water or sewer system are anticipated, the Contractor shall submit a connection plan developed with the intent of minimizing the down time to customers.
- C. When customers are affected, the Contractor shall notify the Owner a minimum of seven working days before the time of any proposed shutdown of existing mains or services. The Owner's inspector may postpone or reschedule any shutdown operation if for any reason he feels that the Contractor is improperly prepared with competent personnel, equipment, or materials to proceed with the connection work.
- D. When no customers are affected, the Contractor shall notify the Owner a minimum of two working days before the time of any proposed shutdown of existing mains or services. The Owner's inspector may postpone or reschedule any shutdown operation if for any reason he feels that the Contractor is improperly prepared with competent personnel, equipment, or materials to proceed with the connection work.
- E. Connections shall be made only in the presence of the Owner or Owner's inspector, and no connection work shall proceed until the Engineer has given notice to proceed. If progress is inadequate during the connection operations to complete the connection in the time specified, the Engineer shall order necessary corrective measures. All costs for corrective measures shall be paid by the Contractor.
- F. The Contractor shall furnish all pipe and materials including furnishing all labor and equipment necessary to make the connections, all required excavation, backfill, pavement replacement, lights, and barricades, and may be required to include a water truck, high line hose, and fittings as part of this equipment for making the connections. In addition, the Contractor shall assist the Owner in alleviating any hardship incurred during the shutdown for connections. Standby equipment or materials may be required by the Engineer.
- G. The Contractor shall de-water existing mains, as required, in the presence of the Owner's inspector.
- H. Prior to tapping or cutting an existing pipe:
 - 1. Locate all existing isolation valves required for the Work.
 - 2. Test the existing isolation valves a minimum of 3 days prior to the Work.
 - 3. If the valves cannot be operated, Contractor shall meet with the owner and Engineer to determine if the valves must be replaced, or if plugs can be used for the Work.
- I. Prior to disconnecting any flanged connection, if reconnection is required as part of the Work:
 - 1. Locate all flanged connections a minimum of two days before the Work.

2. A minimum of one day before the Work, expose the flanged connection(s). Remove and inspect each flange bolt, one at a time so as not to break the piping connection. If serviceable, clean the bolt with a wire brush and reinstall on the flange. If not serviceable, replace with a new bolt set (bolt, nut and washers) of the appropriate type.
 3. During the Work, replace the flange gasket and install new bolt sets throughout.
- J. Prior to disconnecting any electrical or control equipment (for replacement):
1. Locate all control devices and wiring a minimum of two days before the work.
 2. Review wiring and termination diagrams for the existing and replacement equipment.
 3. Label (tag) all wiring to remain to facilitate identification during the installation. Annotate changes on the wiring diagrams, if needed.
 4. Pull all new cables and wires through conduits prior to the scheduled outage, to the extent possible.
 5. Coordinate any changes to the control system with the Owner and Engineer in advance, so that SCADA programming is adjusted as needed.
- K. Connections shall be made with as little change as possible in the grade of the new main. If the grade of the existing pipe is below that of the new pipeline, a sufficient length of the new line shall be deepened so as to prevent the creation of any high spot or abrupt changes in grade of the new line. Where the grade of the existing pipe is above that of the new pipeline, the new line shall be laid at specified depth, except for the first joint adjacent to the connection, which shall be deflected within the allowances of the pipe manufacturer as necessary to meet the grade of the existing pipe. If sufficient change in direction cannot be obtained by the limited deflection of the first joint, a fitting of the proper angle shall be installed. Where the connection creates a high or low spot in the line, a standard air release or blow off assembly shall be installed as directed by the engineer.
- L. Where connections are made to existing valves, the contractor shall furnish and install all temporary blocking, steel clamps, shackles, and anchors as required by the District, and he shall replace the valve riser box and cover and adjust the valve cover to the proper grade in accordance with these specifications. The District will operate all existing valves. All valves, existing or newly installed, shall be readily accessible at all times to the District for emergency operation.
- M. New pipelines shall not be connected to existing facilities until the new pipelines have been successfully tested, disinfected and accepted by the District.
- N. Tapping connection can be made to the existing system while it is either in service or shut down depending on the District's prior direction. A tapping valve shall be used when the existing system is maintained in service during connection. Tapping shall be in accordance with the specification requirements for the pipe being tapped.
- O. All saddle connections into existing sewer pipes shall be made with a wye saddle. Saddles shall conform to the applicable provisions of the section for the existing sewer pipe material.

3.02 REMOVAL FROM SERVICE OF EXISTING MAINS AND APPURTENANCES

- A. Existing mains and appurtenances shall be removed from service at the locations shown on the plans or as directed by the Engineer.
- B. Abandoned pipe shall be filled with flowable fill in accordance with Section 02 22 20.
- C. Existing pipe and appurtenances removed from the ground will require backfill and repair of surface in accordance with Section 31 23 00.
- D. Removed pipe and appurtenances shall be temporarily stockpiled on the job in a location that will not disrupt traffic or be a safety hazard, disposed of in a proper manner (as determined by the Engineer). The Contractor shall remove and dispose of all removed pipe at his own expense to a landfill permitted to accept such materials.
- E. Before excavating for installing mains that are to replace existing pipes and/or services, the Contractor shall make proper provisions for the maintenance and continuation of service as directed by the Engineer unless otherwise specified.
- F. If the meter box is to be removed from an abandoned water service, the service line is to be removed and the corporation stop closed and capped. If there is no corporation stop on the service, the adapter is to be removed and a brass plug is to be installed in the service saddle.
- G. Asbestos Cement Pipe (ACP) shall be cut, removed and disposed of in a proper manner. The Contractor shall be responsible for the proper manifesting of any and all ACP at an authorized disposal site.

3.03 CUTTING AND RESTORING STREET SURFACING.

- A. In cutting or breaking up street surfacing, the Contractor shall not use equipment that will damage adjacent pavement.
- B. All asphalt and/or Portland cement concrete surfaces shall be scored with sawing equipment of a type meeting the approval of the Owner; providing however, that any cement concrete base under an asphaltic mix surface will not be required to be scored by sawing. Existing paving surfaces shall be sawcut back beyond the edges of the trenches to form neat square cuts before repaving is commenced.
- C. Pavement, sidewalks, curbs, or gutters removed or destroyed in connection with performance of the work shall be saw cut to the nearest score marks, if any, and shall be replaced with pavement sidewalks, curbs, or gutters of the same kind, or better by the Contractor in accordance with the latest specifications, rules, and regulations and subject to the inspection of the agency having jurisdiction over the street or highway.
- D. Aggregate base shall be placed beneath the restored pavement to the thickness required by the agency having jurisdiction.

END OF SECTION

SECTION 02 22 20

ABANDONMENT OF PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes abandonment in place of existing pipelines and manholes, when indicated on the Drawings for abandonment.
- B. Related Work Specified Elsewhere
 - 1. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
 - 2. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - a. Trenching, Backfilling, and Compacting: 31 23 00

1.02 REFERENCE STANDARDS

- A. ASTM C150 – Standard Specification for Portland Cement.
- B. ASTM C494 – Standard Specification for Chemical Admixture for Concrete.
- C. ASTM C618 – Standard Specification for Fly Ash and Raw or Calcinated Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.
- D. ASTM C940 – Standard test Method for Expansion and Bleeding of Freshly Mixed grout for Replaced Aggregate Concrete in the Laboratory.
- E. ASTM C1017 – Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
- F. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

1.03 DEFINITIONS

- A. Abandonment. Pipeline abandonment consists of filling or plugging portions of existing pipelines with flowable fill or grout plugs, as indicated on the Drawings. Manhole abandonment consists of removing cylinders, rings and lids above the depth indicated on the Drawings, and filling the remainder with flowable fill.
- B. Flowable Fill. Flowable fill shall be controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in pipelines or other restricted areas, or as mass placement by chutes or tremie methods in

unrestricted locations with open access. Long-term hardened strength shall be within specified range.

- C. Backgrouting. Secondary stage pressure grouting to ensure that voids have been filled within abandoned pipes. Backgrouting will only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.04 SUBMITTALS

- A. Submit flowable fill mix design report.
 - 1. Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.
 - 2. Aggregate gradation of fill. Aggregate gradation of mix shall be used as pilot curve for quality control during production.
 - 3. Fill mix constituents and proportions including materials by weight and volume, and air content. Give types and amounts of admixtures including air entrainment or air generating compounds.
 - 4. Fill densities and viscosities, including wet density at point of placement.
 - 5. Initial time of set.
 - 6. Bleeding and shrinkage.
 - 7. Compressive strength.
- B. Submit technical information for equipment and operational procedures including projected injection rate, grout pressure, method for controlling grout pressure, bulkhead and vent design and number of stages for grout application.

PART 2 - MATERIALS

2.01 FLOWABLE FILL

- A. Design Mix Criteria. Provide design of one or more mixes to meet design criteria and conditions for placement. Present mix design information required by Part 1, Paragraph 1.04.A, to include the following:
 - 1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 50 pounds per cubic yard.
 - 2. Fly ash: ASTM C618, Class C or F. Volume and weight per cubic yard of fill. Provide minimum fly ash content of 200 pounds per cubic yard.
 - 3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
 - 4. Aggregate gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes: 3/8 inch, No. 4, 8, 16, 30, 50 100 and 200. Do not deviate from pilot gradation by more than plus or minus 10 percentage points for any sieve for production material.

5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent natural aggregate to provide workability.
 6. Admixtures: use admixtures meeting ASTM C494 and ASTM C1017 as needed to improve pumpability, to control time of set and to reduce bleeding.
 7. Fluidifier: Use fluidifier meeting ASTM C937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
 8. Performance additive: Use flowable fill performance additive, if needed, to control fill properties.
- B. Flowable Fill Requirements:
1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
 2. Placement characteristics: self-leveling.
 3. Shrinkage characteristics: non-shrink.
 4. Water bleeding for fill to be placed by grouting method in pipes: not to exceed 2 percent according to ASTM C940.
 5. Minimum wet density: 90 pounds per cubic foot.

2.02 GROUT PLUGS

- A. Cement-based dry-pack grout conforming to ASTM C1107, Grade B or C.

PART 3 - EXECUTION

3.01 REQUIREMENTS BY PIPE LOCATION, SIZE AND DEPTH

- A. General areas, up to 5-feet of cover from finished grade. Abandonment not allowed except within specific listed areas. Pipes with less than 60-inches cover shall be removed and properly disposed.
- B. General areas, pipes greater than 8-inch diameter, greater than 5-feet of cover from finished grade. Pipes indicated on the Drawings to be abandoned in place shall be completely filled with flowable fill.
- C. General areas, pipes equal or less than 8-inch diameter, greater than 5-feet of cover from finished grade. Pipes indicated on the Drawings to be abandoned in place shall be cut and a grout plug set at each end.
- D. Pipes under structures, waterways, roads, railroads tracks, rail right-of-ways or similar surface obstructions, and depth or diameter. Pipes indicated on the Drawings to be abandoned in place shall be completely filled with flowable fill.

3.02 PREPARATION

- A. Notify inspector at least 24-hours in advance of grouting with flowable fill.

- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portions of the work, new or existing.
- C. Cut and cap portions of the piping system to remain, as shown on the Drawings. Drain water mains to be abandoned.
- D. Clean sewer lines and video to identify connections and locate obstructions. Locate previously unidentified connections which have not been redirected or reconnected as part of the work and report them to the Project Manager. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions or open joints, to ensure no voids remain unfilled.
- E. Perform demolition work prior to starting fill placement. Clean placement areas for pipes and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of the fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume. Dispose of waste material in accordance with applicable codes and regulations.
- F. Remove free water prior to fill placement.

3.03 EQUIPMENT

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.04 DEMOLITION OF MANHOLES AND SEPTIC TANKS PRIOR TO ABANDONMENT

- A. Remove covers and castings and dispose or recycle as applicable.
- B. Demolish and remove precast concrete rings to the depth indicated on the plans. Minimum depth of removal shall be 4-feet below finished grade, or 12-inches below any crossing utility, whichever is greater.
- C. Clean tanks and manholes, break out inverts and backfill as shown on the Drawings.

3.05 INSTALLATION OF FLOWABLE FILL

- A. Abandon pipelines, as required 3.01, by completely filling with flowable fill. Abandon manholes by filling the portion not removed with flowable fill.
- B. Place flowable fill equal to volume of pipe being filled. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 linear feet of pipe per fill segment.
- C. Perform operation with experienced crews with equipment to monitor density of flowable fill and to control pressure.
- D. Temporarily plug or cap pipe segments which are to remain in operation during filling to keep lines free of flowable fill.

- E. Pump flowable fill through bulkheads or use other suitable construction methods to contain flowable fill in lines to be abandoned.
- F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction. Fill sewers from the downstream end to vent at upstream end.
- G. Backfill excavations per Section 31 23 00, Trenching, Backfilling and Compacting.
- H. Collect and dispose of excess flowable fill material and debris.

3.06 INSTALLATION OF GROUT PLUGS

- A. Abandon pipelines of diameter 8-inches and below, as required in Part 3, Paragraph A, by cutting and placing grout plugs.
- B. Clean inside surface of pipe at least 12-inches from ends, achieving firm bond and seal grout plug to pipe surface. Similarly clean and prepare exterior surface if manufactured cap is to be used.
- C. Place temporary plug or bulkhead approximately 12-inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
- D. Backfill excavations per Section 31 23 00, Trenching, Backfilling and Compacting.
- E. Collect and dispose of excess grout material and debris.

3.07 QUALITY CONTROL

- A. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.
- B. Check flow characteristics and workability of fill as placement proceeds.
- C. Obtain at least three test cylinders from each placement area for determination of 56-day compressive strength and bleeding. Acceptance of placement will be based on average strength of three tests.
- D. Record volume of flowable fill placement to demonstrate that voids have been filled. If voids exceed 10% of pipeline volume, injection grouting may be required at the direction of the Project Manager.

3.08 PROTECTION OF PERSONS AND PROPERTY.

- A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals required, and design, install, and remove formwork for cast-in-place concrete as shown on the Drawings and as specified herein.
- B. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts, and other items furnished under other Sections and required to be cast into concrete.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
 - 2. ACI 301 – Specifications for Structural Concrete
 - 3. ACI 318 – Building Code Requirements for Structural Concrete
 - 4. ACI 347 – Guide to Formwork for Concrete
- B. American Plywood Association (APA)
 - 1. APA – Material Grades and Designations as Specified
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, shop drawings and product data showing materials of construction and details of installation for the following:
 - 1. Form release agent
 - 2. Form ties
- B. Falsework and Drawings – The CONTRACTOR will adhere to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, which require that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a Professional Civil Engineer, registered in the State of California. A copy of the falsework plan or shoring layout shall be available on the job site at all times.

- C. The CONTRACTOR shall, in accordance with the requirements in Division 1, submit detailed plans of falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, and typical soil conditions.
- D. Location and sequence of the concrete placement - Indicate locations of form joints, form-tie layout, panel sizes, and patterns.
- E. Review of pour sequence, form system, and panel layout shall be for appearance and conformance to design concept only. ENGINEER's review of the forming plans or procedures shall not relieve the CONTRACTOR of responsibility for the strength, safety, or correctness of methods used, the adequacy of equipment, or from carrying out the work in full compliance with the requirements of the Drawings and as specified herein.

1.04 SYSTEM DESCRIPTION

- A. General – Architectural Concrete is wall, slab, beam, or column concrete that will have surfaces exposed to view in the finished work.
- B. Structural Design Responsibility – All forms and shoring shall be designed at the CONTRACTOR's expense by a Professional Civil Engineer, registered in the State of California. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

- A. Forms for cast-in-place concrete shall be made of wood, metal, or other approved material. Wood forms for the project shall be new and unused. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the ENGINEER and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.
- B. Wall Forms:
 - 1. Forms for all exposed exterior and interior concrete walls shall be new and unused "Plyform" exterior grade plywood panels manufactured in compliance with APA and bearing the trademark of that group, or equal acceptable to the ENGINEER. Provide B grade or better veneer on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.

2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging outward or creating surface patterns.
- C. Form Release Agent - Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water-based, bond-breaking form coating, unless otherwise noted.
- D. Form Ties:
1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1 1/2 inches of the face of the concrete. The part of the tie to be removed shall be at least 1/2 inch in diameter or be provided with a wood or metal cone at least 1/2 inch in diameter and 1 1/2 inches long. Form ties in concrete exposed to view shall be the cone-washer type.
 2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be approved wood or plastic.
 3. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 1/2 inches and sufficient dimensions to permit proper patching of the tie-hole.
 4. Common wire shall not be used for form ties.
 5. Alternate form ties, consisting of tapered through-bolts at least 1 inch in diameter at the smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size, may be used at the CONTRACTOR's option. Obtain ENGINEER's acceptance of system and spacing of ties before ordering or purchasing of forming. Clean, fill, and seal form tie hole with non-shrink cement grout. The CONTRACTOR shall be responsible for water-tightness of the form ties and any repairs needed.

PART 3 - EXECUTION

3.01 GENERAL

- A. Forms shall be used for all cast-in-place concrete including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions, and appearance indicated on the Drawings.
- B. Forms for walls shall have removable panels at the bottom for cleaning, inspection, and joint surface preparation. Forms for wall heights in excess of 16 feet shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete inspection, prevent segregation, and prevent the accumulation of hardened concrete on the forms above the fresh concrete.
- C. Molding, bevels, or other types of chamfer strips shall be placed to produce blockouts or chamfers as shown on the Drawings or as specified herein. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a 3/4-inch chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the drawings. Size of moldings shall conform to the sealant manufacturer's recommendations.

- D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms such that the concrete and/or exposed rebar (dowels) will not be damaged by their removal. The CONTRACTOR shall be entirely responsible for the adequacy of the forming system.
- E. Before form material is reused, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn, and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like-new" condition of the form is maintained.
- F. Metal items, such as rebar, wire, or plates used to support pipe penetrations and pipe embedment shall have a minimum clearance of 2 inches from reinforcing bars.
- G. Tolerances in concrete construction shall be in accordance with ACI 117, unless otherwise noted.

3.02 FORM TOLERANCE

- A. Forms shall be surfaced, designed, and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for specified finishes.
- B. Formed Surfaces Exposed to View - Edges of all form panels in contact with concrete shall be flush within 1/32 inch and forms for plane surfaces shall be such that the concrete will be plane within 1/16 inch in 4 feet. Forms shall be tight to prevent the passage of mortar, water, and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4 inch from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.
- C. Formed surfaces not exposed to view or buried shall meet the requirements of Class "C" Surface in ACI 347.
- D. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement, and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1 inch.
- E. Architectural Concrete - All smooth faces to be exposed to view shall have surface deflections limited to 1/32 inch at any point and the variation in wall deflection shall not exceed 1/16 inch per 4 feet. The maximum deviation of the finished wall surface at any point shall not exceed 1/4 inch from the intended surface as shown on the Drawings.

3.03 FORM PREPARATION

- A. Wood forms in contact with concrete shall be coated with an effective release agent before form installation.
- B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms except those

utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

3.04 REMOVAL OF FORMS

- A. The CONTRACTOR shall be responsible for all damage resulting from removal of forms. Form removal shall conform to the requirements specified in Section 03300.

3.05 INSPECTION

- A. The ENGINEER shall be notified when the forms are complete and ready for inspection at least 24 hours before the proposed concrete placement.
- B. Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with the requirements of this Section, shall be grounds for rejection of that portion of the form/concrete work. Rejected work shall be repaired or replaced as directed by the ENGINEER at no additional cost to the OWNER. Such repair or replacement shall be subject to the requirements of this Section and approval of the ENGINEER.

3.06 FALSEWORK

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements specified herein.
- B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.
- C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure that is already constructed, the loading imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

END OF SECTION

SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Federal Specifications
 - 1. SS-S-210A – Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
- B. ASTM International (ASTM)
 - 1. ASTM A675 – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
 - 2. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 3. ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
 - 4. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
 - 5. ASTM D1752 – Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- C. US Army Corps of Engineers (CRD)
 - 1. CRD-C 572 – Specification for Polyvinylchloride Waterstops
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, submittals including the following:
 - 1. Waterstops – Product data including catalogue cut, technical data, storage requirements, splicing methods, and conformity to ASTM standards.
 - 2. Premolded Joint Fillers – Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.

3. Bond Breaker – Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.
 4. Compressible Joint Filler – Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.
 5. Bonding Agents – Product data including catalogue cut, technical data, storage requirements, product life, application requirements, and conformity to ASTM standards.
 6. Samples – Two samples of each type of waterstop fitting(s).
- B. Certifications:
1. Certify that all materials used within the joint system are compatible with each other.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc.) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.
- C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

2.02 MATERIALS

- A. Polyvinylchloride (PVC) Waterstops (Standard) - The PVC waterstops shall be made by extruding elastomeric plastic compound with virgin PVC as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstops shall be 1,750 pounds per square inch. The waterstops shall conform to CRD-C 572.
 1. Waterstops joints shall be 6 inches wide and be the flat ribbed type. Non-expansion joint waterstops shall be style 679 by Greenstreak Incorporated, St. Louis, MO; style R638 by Vinylex Corp., Knoxville, TN; or equal. Equal waterstops may have an integral fastening system
- B. Premolded Joint Filler:
 1. Premolded joint filler for structures shall be self-expanding, cork, premolded joint filler conforming to ASTM D1752, Type III. The thickness shall be 3/4 inch unless shown otherwise on the Drawings.

2. Premolded joint filler for sidewalk and roadway concrete pavements, or where fiber joint filler is specifically noted on the Drawings, shall be asphalt-impregnated fiberboard conforming to ASTM D1751. The thickness shall be 3/4 inch unless otherwise shown on the Drawings.
- C. Bond Breaker:
1. Bond breaker tape shall be an adhesive-backed, glazed butyl or polyethylene tape that will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.
 2. Except where tape is specifically called for on the Drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Silcoseal Select, by Nox-Crete, Omaha, Nebraska; or equal.
- D. Bonding Agent:
1. Epoxy bonding agent shall be two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation; Concrevice Liquid LPL by BASF Building Systems; or equal.
 2. Latex bonding agent shall be non-reemulsifiable acrylic-polymer latex conforming to ASTM C1059, Type II.
- E. Compressible Joint Filler:
1. The joint filler shall be a non-extruded, watertight strip material used to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees Fahrenheit and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible joint filler shall be Phyzite/Evazote 380 as manufactured by Chase Construction Products; Wabo Evazote UV as manufactured by BASF Chemical Company; or equal.]

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Standard Waterstop:
1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. All fittings shall be factory made or shop welded in accordance with manufacturer's recommendations. Only straight butt splices shall be fabricated in the field.
 2. PVC splices shall be made by welding in accordance with the manufacturer's recommendations, subject to acceptance of the ENGINEER. Only manufacturer's special approved tools shall be used for welding. The finished splices shall provide a cross section that is dense and free of porosity.
 3. To properly secure PVC waterstops in wall joints before concrete is placed, center the waterstop in the joint. Clamp both edges of the waterstop and fasten to reinforcing steel with black annealed steel tie wire as specified for tying reinforcing steel and secure in place so that the waterstop will be perpendicular to the joint and will remain in the required position during concrete placement. The spacing of the waterstop ties

shall match the spacing of the adjacent reinforcing, but need not be spaced closer than 12 inches on center.

4. Horizontal PVC waterstops in slabs shall have the edge of the waterstop lifted while placing concrete below the waterstop. The waterstop shall then be manually forced against and into the placed concrete and covered with fresh concrete, to ensure adequate encasement of the waterstop in concrete.
5. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of splices.
6. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.
7. Waterstops shall be terminated 3 inches below the exposed top of walls.

B. Construction Joints:

1. Make construction joints only at locations shown on the Drawings or as approved by the ENGINEER. Any additional or relocation of construction joints proposed by the CONTRACTOR must be submitted to the ENGINEER for written approval.
2. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings.
3. Provide sealant grooves for joint sealant where indicated on the Drawings.
4. At all construction joints, and at concrete joints designated on the Drawings to be "roughened," uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately 1/4 inch to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by water blasting or sandblasting and prepare for bonding. At least 2 hours before, and again shortly before the new concrete is deposited, saturate the joints and adjacent concrete surfaces to at least 12 inches past the joint with water.
5. In lieu of the above method for bonding plastic concrete to hardened concrete, the following optional method may be used. Concrete must be allowed to set a minimum of 28 days. Use a latex-bonding agent applied to roughened and cleaned surfaces of set concrete in strict accordance with manufacturer's recommendations.
6. Provide waterstops in all wall and slab construction joints in below grade structures and at other locations shown on the Drawings.
7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the ENGINEER.

C. Control Joints:

1. Provide sealant grooves, sealants, and waterstops at control joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab control joints in below grade structures and at other locations shown on the Drawings.
2. Control joints may be sawed if specifically approved by the ENGINEER. If control joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during sawcutting.

3. Extend every other bar of reinforcing steel through control joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface of the joint with a bond breaker before placing new concrete against the joint. Avoid coating reinforcement or waterstops with bond breaker at these locations.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Federal Specifications
 - 1. QQ-W-461H – Wire, Steel, and Carbon (round, bare and coated)
- B. American Concrete Institute (ACI)
 - 1. ACI 301 – Specifications for Structural Concrete
 - 2. ACI 315 – Details and Detailing of Concrete Reinforcement
 - 3. ACI 318 – Building Code Requirements for Structural Concrete
 - 4. ACI SP-66 – ACI Detailing Manual
- C. ASTM International (ASTM)
 - 1. ASTM A615 – Standard Specification for Deformed and Plain Carbon Steel - Bars for Concrete Reinforcement
 - 2. ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
 - 3. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- D. American Welding Society (AWS)
 - 1. AWS D1.4 – Structural Welding Code - Reinforcing Steel
- E. Concrete Reinforcing Steel Institute (CRSI)
 - 1. CRSI - Manual of Standard Practice
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Reinforcing Steel – Submit to the ENGINEER, in accordance with Division 1, placement drawings conforming to the recommendations of ACI 315. All reinforcement in a concrete placement shall be included in a single placement drawing or cross-referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc.) shown on the standard details sheets.

Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified.

- B. Bar Bending Details – The bars shall be referenced to the same identification marks shown on the placement drawings. Bars to have special coatings and/or to be of special steel or special yield strength shall be clearly identified.
- C. Mechanical Connectors – Submit two samples of each type of mechanical reinforcing steel connectors.
- D. Test Reports – Submit test reports for each of the following items:
 - 1. Mill Test – Submit a certified copy of a mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
 - 2. Foreign Manufactured Steel - Submit a certified copy of test reports for each foreign manufactured steel proposed for use in the fabrication of reinforcement. The tests shall be specifically made for this project at the expense of the CONTRACTOR by a domestic independent testing laboratory certified to perform the tests. The testing shall be for conformity to the applicable ASTM standard(s).

1.04 QUALITY ASSURANCE

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing, and position of the reinforcement has been observed by the ENGINEER and the ENGINEER's release to proceed with concreting has been obtained. The ENGINEER shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the ENGINEER has completed observations of the reinforcing steel.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- B. Reinforcing steel shall be shipped and stored with bars of the same size and shape, fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placement Drawings.
- C. Reinforcing steel shall be stored off the ground, protected from moisture, and kept free from dirt, oil, or other injurious contaminants.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

- A. Materials shall be new and shall comply with the following material specifications.
- B. Deformed concrete reinforcing bars are to be ASTM A615, Grade 60 deformed bars.
- C. Concrete Reinforcing Bars required on the Drawings are to be Field Bent or Welded - ASTM A706.
- D. Welded Steel Wire Fabric shall comply with ASTM A1064.
- E. The following alternative materials are allowed:
 - 1. ASTM A615, Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:
 - a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 pounds per square inch (psi). Retests shall not exceed this value by more than an additional 3,000 psi.
 - b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
 - c. The carbon equivalency of the bars shall be 0.55 or less.
- F. Reinforcing Steel Accessories:
 - 1. Plastic protected bar supports shall comply with CRSI Bar Support Specifications, Class 1 - Maximum Protection.
 - 2. Stainless steel protected bar supports shall comply with CRSI Bar Support Specifications, Class 2 - Moderate Protection.
 - 3. Precast concrete block bar supports (dobies) shall comply with CRSI Bar Support Specifications, Precast Block. Block shall have equal or greater compressive strength than the surrounding concrete.
- G. Tie Wire:
 - 1. Tie wires for Reinforcement shall be 16-gauge or heavier, black annealed wire, conforming to Federal Specification QQ-W-461H.

2.03 FABRICATION

- A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice.
- B. Bars shall be cold bent. Bars shall not be straightened or re-bent.
- C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by ACI 318.
- D. Bar ends that are to be butt-spliced, placed through limited diameter holes in metal, or threaded shall have the applicable end(s) saw-cut. Such ends shall terminate in flat surfaces within 1.5 degrees of a right angle to the axis of the bar.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Surface condition, bending, spacing, and tolerances of placement of reinforcement shall comply with CRSI Manual of Standard Practice. The CONTRACTOR shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.
- B. Except as otherwise noted on the Drawings, the minimum concrete cover for reinforcement shall be as follows:
 - 1. Concrete cast against and permanently exposed to earth - 3 inches
 - 2. Concrete exposed to soil, water, sewage, sludge, and/or weather (including bottom cover of slabs over water or sewage) - 2 inches
 - 3. Concrete not exposed to soil, water, sewage, sludge, and/or weather:
 - a. Slabs (top and bottom cover), walls, joists, shells and folded plate members - 1.5 inches.
 - b. Ties and stirrups - 1.5 inches
 - 4. Tie wires in all concrete – 1.5 inches
- C. Reinforcement that will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the ENGINEER. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. If welding of reinforcement is approved or specifically called for, it shall comply with AWS D1.4.
- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits, or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacements of bars to avoid interference shall only be made with the approval of the ENGINEER. Do not cut reinforcement to install inserts, conduits, mechanical openings, or other items without the prior approval of the ENGINEER.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.
- G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the ENGINEER. If authorized, bars shall be cold-bent around a standard diameter spool as specified within CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld, or otherwise repair as directed by the ENGINEER. Do not bend reinforcement after it is embedded in concrete unless specifically permitted on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one-half of the cross-sectional area of the reinforcing steel interrupted by the opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings shall be 30 bar diameters, but not less than 12 inches, unless otherwise noted.
- B. Contact tension lap splices shall be provided at all laps in compliance with ACI 318. The length of splices shall conform to the Contract Drawings. Splices in adjacent bars shall be staggered. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.
- C. Install wire fabric in as long lengths as practicable. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI 318 but not less than 12 inches. The spliced fabrics shall be tied together with wire ties spaced not more than 24 inches on-center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.

3.04 ACCESSORIES

- A. Determine, provide, and install accessories such as chairs, chair-bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks (dobies) where the reinforcing steel is to be supported over soil. In no case shall such supports be continuous.
- C. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fasteners to the bottom and top mats may be used if approved by the ENGINEER.

3.05 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing, and position of the reinforcement, has been observed by the ENGINEER and the ENGINEER's release to proceed with the concreting has been obtained. The ENGINEER shall be given a minimum of 24 hours prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the ENGINEER has completed observations of the reinforcing steel.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor and materials required and install all cast-in-place concrete complete as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 2. ACI 305R – Hot Weather Concreting
 - 3. ACI 306.1 – Standard Specification for Cold Weather Concreting
 - 4. ACI 315 – Details and Detailing of Concrete Reinforcement
 - 5. ACI 318 – Building Code Requirements for Structural Concrete
- B. ASTM International (ASTM)
 - 1. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C33 – Standard Specification for Concrete Aggregates
 - 3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 4. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - 5. ASTM C94 – Standard Specification for Ready-Mixed Concrete
 - 6. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete
 - 7. ASTM C150 – Standard Specification for Portland Cement
 - 8. ASTM C157 – Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
 - 9. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete
 - 10. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 11. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - 12. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
 - 13. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 14. ASTM C311 – Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
 - 15. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete

16. ASTM C596 – Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
 17. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete
 18. ASTM C1017 – Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, submittals including the following:
1. Sources of cement, pozzolan, and aggregates.
 2. Safety Data Sheets (SDS) for all concrete components and admixtures.
 3. Air-entraining admixture – Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 4. Water-reducing admixture – Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 5. High range, water-reducing admixture – Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range, and conformity to ASTM standards. Identify proposed locations for use.
 6. Concrete mix design for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, type, and manufacturer of cement, compressive strength, concrete slump, shrinkage, and air content. Provide with (a) or (b) below for each mix proposed.
 - a. Standard deviation data for each proposed concrete mix based on statistical records, OR
 - b. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28-day cylinder strength test results for each mix. Provide results of 7- and 14-day tests if available.
 7. Sheet curing material – Product data including catalogue cut, technical data, and conformity to ASTM standards.
 8. Liquid curing compound – Product data including catalogue cut, technical data, storage requirements, product life, application rate, and conformity to ASTM standards. Identify proposed locations of use.
 9. Samples – Fine and coarse aggregates if requested by the ENGINEER.
 10. Test Reports – Submit test reports for each of the following items:
 - a. Fine aggregates – Sieve analysis, physical properties, and deleterious substances
 - b. Coarse aggregates – Sieve analysis, physical properties, and deleterious substances
 - c. Cements – Chemical analysis and physical properties for each type
 - d. Pozzolans – Chemical analysis and physical properties

11. Certifications:
 - a. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
 - b. Certify that the Contractor is not associated with the independent testing laboratory nor does the Contractor or its officers have a beneficial interest in the laboratory.
12. Work Plans:
 - a. Hot weather concreting
 - b. Cold weather concreting

1.04 QUALITY ASSURANCE

- A. Reinforced concrete shall comply with ACI 318, and other stated requirements, codes, and standards. The most stringent requirement of the codes, standards, and this Section shall apply when conflicts arise.
- B. Only one source of cement and aggregate shall be used on any one structure. Concrete shall be uniform in color and appearance.
- C. Well in advance of placing concrete, discuss with the ENGINEER the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops, and curing. Propose methods of hot and cold weather concreting as required.
- D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the ENGINEER may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the CONTRACTOR's expense.
- E. If, during the progress of work, the materials from the sources originally accepted change in characteristics, the CONTRACTOR shall, at their expense, make new acceptance tests of aggregates and establish new design mixes.
- F. Testing of the following materials shall be furnished by the CONTRACTOR to verify conformity with this Specification Section and the stated ASTM Standard(s).
 1. Fine aggregates for conformity to ASTM C33 – sieve analysis, physical properties, and deleterious substances
 2. Coarse aggregates for conformity to ASTM C33 – sieve analysis, physical properties, and deleterious substances
 3. Cements for conformity to ASTM C150 – chemical analysis and physical properties
 4. Pozzolans for conformity to ASTM C618 – chemical analysis and physical properties
 5. Proposed concrete mix design(s) – compressive strength, slump and air content
- G. The OWNER will provide field-testing and inspection services. The cost of such work, except as specifically stated otherwise, shall be paid by the OWNER. Testing of the following items shall be by the OWNER to verify conformity with this Specification Section.
 1. Concrete placement – compressive strength (cylinders), compressive strength (cores), slump, and air content

2. Other materials or products that may come under question

H. All materials incorporated in the work shall conform to accepted samples.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Cement – Store cement in weathertight buildings, bins, or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate – Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
- C. Sand – Arrange and use stockpiles to avoid contamination. Allow sand to drain to uniform moisture content before using. Do not use frozen or partially frozen sands.
- D. Admixtures – Store in closed containers to avoid contamination, evaporation, or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions that tend to separate. Protect liquid admixtures from freezing and other temperature changes that could adversely affect their characteristics.
- E. Pozzolan – Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials – Store in weathertight buildings or off the ground and under cover.
- G. Liquid curing compounds – Store in closed containers.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance, and manufacturer's services.

2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable state or local requirements.
- B. Cement – Domestic Portland cement shall comply with ASTM C150 Type I or II. Air-entraining cement shall not be used. The cement brand shall be subject to approval by the ENGINEER and one brand shall be used throughout the work.
- C. Fine Aggregates – Fine aggregates shall be washed inert natural sand conforming to the requirements of ASTM C33.

- D. Coarse Aggregates – Coarse aggregates shall be well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of deleterious substances and physical property requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for concrete mixes shall be as shown in Table 1 herein. Use of recycled concrete, aggregate or other recyclable materials is not permissible.
- E. Water – Water shall be potable and free from injurious amounts of oil, acids, alkalis, salts, organic matter, or other deleterious substances. Use of recycled or reclaimed water is not permissible.
- F. Admixtures – Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures [and shall be suitable for use in contact with potable water after 30 days of concrete curing].
 - 1. Air-Entraining Admixture – The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 - 2. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the ENGINEER. When allowed, the admixtures shall be retarding or accelerating water-reducing or high-range water-reducing admixtures.
 - 3. Water-Reducing Admixture – The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 - 4. High-Range Water-Reducer (Plasticizer) – The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
- G. Pozzolan (Fly Ash) – Pozzolan shall be Class C or Class F fly ash complying with ASTM C618, except the Loss On Ignition (LOI) shall be limited to 3 percent maximum.
- H. Granulated Ground Blast Furnace Slag (GGBFS) - Use of Granulated Ground Blast Furnace Slag within the concrete mix is not permitted.
- I. Sheet Curing Material – Sheet curing material shall be waterproof paper, polyethylene film, or white burlap-polyethylene sheeting, all of which must comply with ASTM C171.
- J. Liquid Curing Compound – Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. [Curing compound shall be approved for use in contact with potable water after 30 days (nontoxic and free of taste or odor).]

2.03 CONCRETE MIXES

- A. Development of mix designs and testing shall be by an independent testing laboratory acceptable to the ENGINEER but engaged by and at the expense of the CONTRACTOR.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogenous mixture that will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
 - 1. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the ENGINEER, engaged by and at the expense of the CONTRACTOR. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between the water-cementitious ratio and 7- and 28-day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water-cementitious ratio and net minimum cementitious content as specified in Table 1.
 - 2. Use of recycled materials, including but not limited to concrete, aggregate and/or water is not permissible.
- C. Compression Tests – Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.
- D. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
 - 1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- E. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10 inches.
- F. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

**Table 1
Concrete Mix Requirements**

<u>Class</u>	<u>Design</u>	<u>Cement</u>	<u>Fine</u>	<u>Coarse</u>	<u>Cementitious</u>
	<u>Strength</u>		<u>Aggregate</u>	<u>Aggregate</u>	<u>Content</u>
	<u>(1)</u>	<u>(2)</u>	<u>(2)</u>	<u>(3)</u>	<u>lbs./cu. yd.</u>
					<u>(min)</u>
					<u>(4)</u>
A	2500	C150 Type II	C33	57	440
B	3000	C150 Type II	C33	57	480
D	4000	C150 Type II	C33	57	560

<u>Class</u>	<u>W/C</u>	<u>Fly Ash</u>	<u>AE Range</u>	<u>WR</u>	<u>HRWR</u>	<u>Slump</u>
	<u>Ratio (Max.)</u>		<u>(7)</u>	<u>(8)</u>	<u>(9)</u>	<u>Range</u>
	<u>(5)</u>	<u>(6)</u>				<u>Inches</u>
A	0.62	--	3.5 to 5	Yes	No	1-4
B	0.54	--	3.5 to 5	Yes	No	1-3
D	0.42	15-25%	3.5 to 5	Yes	No	3-5

NOTES:

- (1) Minimum compressive strength in pounds per square inch at 28 days
- (2) ASTM designation
- (3) Size Number in ASTM C33
- (4) Cementitious content in pounds per cubic yard
- (5) W/C is water-cementitious ratio by weight
- (6) Percent content of total cementitious material
- (7) AE is percent air entrainment
- (8) WR is water-reducer admixture
- (9) HRWR is high-range water-reducer admixture

PART 3 - EXECUTION

3.01 MEASURING MATERIALS

- A. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, and admixtures as specified and shall be produced by a plant acceptable to the ENGINEER. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may be added in the field. Use of recycled materials, including but not limited to, concrete, aggregates and/or water is not permissible.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within one year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as batched on printed batching tickets.

- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTATION

- A. Concrete shall be ready-mixed concrete. No hand mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the nameplate.
- C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be approved by the ENGINEER. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- D. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
- E. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar that has reached initial set will not be permitted.
- G. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting, or delays in placing successive layers of concrete in the forms.
- H. Furnish a delivery ticket for ready-mixed concrete to the ENGINEER as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement, and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.

3.03 TEMPERATURE AND MIXING TIME CONTROL

- A. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees-Fahrenheit.
- B. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees-Fahrenheit.
- C. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees-Fahrenheit. If necessary, substitute well-crushed ice for all or part of the mixing water.
- D. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the values shown in Table 2.
- E. If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

Table 2
Maximum Time to Discharge of Concrete

<u>Air or Concrete Temperature</u> <u>(Whichever is higher)</u>	<u>Maximum Time</u> <u>(Minutes)</u>
70 to 90 Degrees-F (21 to 32 Degrees-C)	60
40 to 69 Degrees-F (5 to 20 Degrees-C)	90

F = Fahrenheit, C = Celsius

3.04 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
 - 1. The gradation of the aggregate
 - 2. The proportion of fine and coarse aggregate
 - 3. The percentage of entrained air, within the allowable limits
- B. Concrete for the work shall provide a homogeneous structure that, when hardened, will have the required strength, durability, and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. After concrete surfaces are stripped, the concrete, when viewed in good lighting from 10 feet away, shall be pleasing in appearance, and at 20 feet shall show no visible defects.

3.05 PLACING AND COMPACTING

A. Placing:

1. Placing of all concrete shall be in accordance with the recommendations contained in ACI 304R.
2. Verify that all formwork completely encloses concrete to be placed and is securely braced before concrete placement. Remove ice, excess water, dirt, and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent worker at the location of the placement that can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous sub grades or forms to eliminate suction of water from the mix. Seal extremely porous sub grades in an approved manner.
3. Deposit concrete as near to its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate that ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete that has partially hardened or has been contaminated by foreign materials or on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
4. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
5. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
6. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs, and/or walls) has reached adequate strength.

B. Slabs:

1. After suitable bulkheads, screeds, and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
2. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
3. "Jitterbugs" shall not be used on slab surfaces to aid in finishing.

C. Formed Concrete:

1. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12- to 24-inch lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7 feet and the maximum free fall of concrete shall not exceed 15 feet.

D. Compacting:

1. Consolidate concrete by vibration, puddling, spading, rodding, or forking so that concrete is thoroughly worked around reinforcement, embedded items, and openings, and into corners of forms. Puddling, spading, etc. shall be continuously performed along with vibration of the placement to eliminate air or stone pockets that may cause honeycombing, pitting, or planes of weakness.
2. All concrete shall be placed and compacted with mechanical vibrators. The number, type, and size of the units shall be approved by the ENGINEER in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job site.
3. A minimum frequency of 7,000 revolutions per minute is required for mechanical vibrators. Insert and withdraw vibrators vertically at points from 18 to 30 inches apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over-vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.
4. Concrete Slabs – Concrete for slabs less than 8 inches thick shall be consolidated with vibrating screeds; slabs 8 to 12 inches thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls – Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the ENGINEER. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize, and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration – Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until the following conditions are met:
 - a. The frequency returns to normal.
 - b. The surface appears liquefied, flattened, and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into the surface, but has not disappeared.

3.06 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods:
 1. Curing Methods for Concrete Surfaces – Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
 - a. Water Curing – Keep entire concrete surface wet by ponding, continuous sprinkling, or covering with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
 - b. Sheet Material Curing – Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.

- c. Liquid Membrane Curing – Apply curing compound over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.
- C. Specified Applications of Curing Methods:
 - 1. Slabs on Grade and Footings – Water curing, sheet material curing, or liquid membrane curing shall be used.
 - 2. Structural Slabs – Water curing or liquid membrane curing shall be used.]
 - 3. Formed Surfaces – No curing shall be used if nonabsorbent forms are left in place 7 days. Water curing shall be used if absorbent forms are used. Sheet curing or liquid membrane curing shall be used if forms are removed before 7 days. Exposed horizontal surfaces of formed walls shall be water cured for 7 days or until next placement of concrete is made.
 - 4. Concrete Joints – Water curing or sheet material curing shall be used.
- D. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

3.07 REMOVAL OF FORMS

- A. Except as otherwise specifically approved by the ENGINEER, forms shall not be removed before the concrete has attained a strength of at least 30 percent of its specified design strength, nor before reaching 100 degree days of curing for walls and vertical surfaces, and 500 degree days of curing for beams and slabs, (whichever is the longer). Degree days are defined as the total number of 24-hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., 5 days at an average 70 degrees F = 350 degree days).
- B. Shores shall not be removed until the concrete has attained at least 60 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.08 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing, and curing of concrete shall be subject to the inspection of the ENGINEER at all times. The CONTRACTOR shall advise the ENGINEER of their readiness to proceed at least 24 hours before each concrete placement. The ENGINEER will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, and the cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the ENGINEER.

- B. Sets of field control cylinder specimens will be taken by an independent entity paid for by the CONTRACTOR during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cubic yards of concrete, nor less than one set for each 3,000 square feet of surface area for slabs or walls. If the total volume of concrete were such that the frequency of testing required for a given class of concrete would provide less than five strength tests, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are anticipated.
- C. A "set" of test cylinders consists of six 6"x12" cylinders: two to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The final two may be used for a special test at 3 days or to verify strength after 28 days if 28-day test results are low. The CONTRACTOR shall provide a copy of all concrete test results to the OWNER for review.
- D. When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7-day strengths (where the proper relationships between 7- and 28-day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- E. The CONTRACTOR shall cooperate in the making of tests by allowing free access to the work for the selection of samples; providing an insulated, closed curing box for specimens; affording protection to the specimens against injury or loss through the operations; and furnishing material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the CONTRACTOR. Curing boxes shall be acceptable to the ENGINEER.
- F. Concrete Slump:
1. Slump tests will be made in the field immediately before placing the concrete by an independent entity paid for by the CONTRACTOR. Such tests shall be made in accordance with ASTM C143. If the slump is greater than the specified range, the concrete shall be rejected.
 2. At a minimum the first three trucks shall be tested to establish consistency. Additionally, testing will be performed with each strength test (cylinders) and each air content test.
 3. The ENGINEER reserves the right to increase the frequency of testing when deemed necessary.
- G. Air Content:
1. Testing for air content shall be performed on a fresh concrete sample by an independent entity paid for by the CONTRACTOR. Air content testing for concrete made of ordinary aggregates having low absorption shall be performed in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used. If air content is below the specified air-entrainment range (+1.5%) listed, air-entraining admixture may be added on-site to bring the concrete within specifications. If air content is above the specified air-entrainment range (+1.5%), the concrete shall be rejected.

2. At a minimum, the first three trucks shall be tested to establish consistency, then every third truck thereafter. Additionally, an air content test shall be performed with each strength test (cylinders). Concrete samples for the testing of air content shall be taken at the point of placement and not at the truck chute/hopper.
 3. The ENGINEER reserves the right to increase the frequency of testing when deemed necessary.
- H. The ENGINEER may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection, or determining the continuation of concrete work.
- I. The CONTRACTOR shall cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the OWNER.

3.09 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the ENGINEER shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the ENGINEER shall have the right to require additional curing on those portions of the structure represented by the test specimens that failed. The cost of such additional curing shall be at the CONTRACTOR's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the ENGINEER shall have the right to require strengthening or replacement of those portions of the structure that fail to develop the required strength. The cost of all such core borings and/or load tests, and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the CONTRACTOR. In such cases of failure to meet strength requirements, the CONTRACTOR and ENGINEER shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the CONTRACTOR in this Section.
- B. When the tests on field control specimens of concrete fall below the specified strength, the ENGINEER will permit check tests for strengths to be made by means of a minimum of three (3) typical cores drilled from the structure in compliance with ASTM C42 and C39. Concrete in the area represented by the core samples will be considered structural adequate if the average of the three (3) core corrected compressive tests is equal to at least 85-percent of the 28-day design compressive strength and no single core corrected compressive test is less than 75-percent of the design strength. In the case of cores not indicating adequate strength, the ENGINEER, in addition to other recourses, may require, at the CONTRACTOR's expense, load tests on any one of the elements in which such concrete was used. Tests need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 85-percent of the required minimum 28-day design strength, the concrete shall be rejected and shall be removed and replaced, unless otherwise directed by the ENGINEER.

3.10 PATCHING AND REPAIRING

- A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete, and curing, so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas shall be repaired as directed by the ENGINEER.
- C. As soon as forms have been removed and the concrete surfaces exposed, fins and other projections shall be removed. All exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced. The CONTRACTOR, at their own expense, shall promptly execute all repairs and replacements herein specified.
- D. Defective surfaces to be repaired as specified in Paragraph C shall be cut back from true line a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for the repair proposed shall contain such proportion of Atlas White Portland Cement as is required to make the color of the patch match the color of the surrounding concrete.
- E. Recesses left by the removal of form ties shall be filled. Immediately after removal of forms, remove plugs and break off metal ties as required by Section 03100. Promptly fill holes upon stripping as follows: moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.
- F. Surface defects that do not impair structural strength shall be repaired. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down to flush with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

G. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

3.11 SCHEDULE

A. Table 3 lists the general applications for the various concrete classes and design strengths.

**Table 3
Concrete Schedule**

Class	Design Compressive Strength at 28 days (psi)	Description
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavements
C	N/A	Not used
D	4,000	Walls, slabs on grade, suspended slab, grade beams, and all other structural concrete
E	5,000	Precast Concrete

END OF SECTION

SECTION 03 35 00

CONCRETE FINISHING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment and incidentals required to finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ASTM International (ASTM)
 - 1. ASTM C33 – Standard Specification for Concrete Aggregates
 - 2. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 3. ASTM C779 – Standard Test Method for Abrasion Resistance of Horizontal Concrete
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, product data showing materials of construction and details of application for the following:
 - 1. Concrete Sealer – Submit product data including catalogue cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Safety Data Sheet. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.
 - 2. Concrete Hardener – Submit product data including catalogue cuts, technical data, storage requirements, product life, application requirements, conformity to required ASTM standards, and Safety Data Sheet.

1.04 QUALITY ASSURANCE

- A. Finish:
 - 1. For concrete that will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finish are required and provide the proper finish to receive these products.
 - 2. Changes in finish made to accommodate products different from those specified shall be performed at no additional cost to the OWNER. Submit the proposed new finish and their construction methods to the ENGINEER for approval.

B. Services of Manufacturer's Representative:

1. The CONTRACTOR shall make available, at no additional cost to the OWNER, upon 72 hours notification, the services of a qualified field representative of the manufacturer of the curing compound, sealer, or hardener to instruct the user on the proper application of the product under the prevailing job conditions.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.02 MATERIALS

- A. Concrete sealer shall comply with ASTM C309, Type 1, Class A or B. Concrete sealer must also be compliant with State of California VOC regulations. Concrete sealer shall be Spartan Cote WB II by Edoco (Burke), Kure-N-Seal WB by BASF Building Systems (Sonneborn), or equal.
- B. Concrete Hardener must be compliant with State of California VOC regulations. Concrete hardener shall be Master Top 100 by BASF Building Systems, Burke Nonmetallic Hardener by Edoco (Burke), or equal.

PART 3 - EXECUTION

3.01 FORMED SURFACES

- A. Forms shall not be removed before the requirements of Section 03 30 00 have been satisfied.
- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or performing any other work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- D. Rough-Formed Surfaces:
 1. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.
 2. Promptly fill holes left by tie cones and defects as specified in Section 03 30 00.
- E. Rubbed Finish:
 1. Immediately upon stripping forms and before concrete has changed color, carefully remove all fins. While the wall is still damp apply a thin coat of medium-consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes, or blemishes in the parent concrete. Avoid coating large areas with slurry at one time.

2. Before slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6 inches square used as a float. Scrub grout into the pits and air holes to provide dense mortar in all imperfections.
3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather and ambient temperature. If the air is hot and dry, keep the wall damp during this period using a fine fog spray. When the grout is hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Caution: Grout allowed to remain on the wall too long will harden and will be difficult to remove).
4. Allow the surface to dry thoroughly and rub it vigorously with clean, dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cut off with the trowel so it can be wiped off clean with the burlap.
5. On the day following the repair of pits, air holes, and blemishes, the walls shall again be wiped clean with dry, used pieces of burlap containing old, hardened mortar, which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining in the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.
6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operations. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after application of the repair grout.

3.02 FLOORS AND SLABS

A. Machine Float:

1. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in proportion of two sacks of Portland cement to 350 pounds of coarse natural concrete sand shall be broadcast evenly over the surface at a rate approximately equal to 500 pounds per 1,000 square feet of floor area. Do not sprinkle neat, dry, cement on the surface.
2. The application of the cement/sand shake may be eliminated at the discretion of the ENGINEER if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated.
3. When the concrete has hardened sufficiently to support the weight of a power float without it digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing 200-pound compaction force distributed over a 24-inch-diameter disc.
4. Start floating along the walls and around columns and then move systematically across the surface, leaving a matte finish.

5. The compacting machine shall be a "Kelley Power Float with Compaction Control" as manufactured by Kelly Industries, or equal. Troweling machines equipped with float (shoes) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine that has water attachments for wetting the concrete surface during finishing will not be permitted.
- B. Hand Float:
1. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the ENGINEER. Screed the floors and slabs with straightedge to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened as to support a finisher and kneeboards with no more than 1/4-inch indentation, float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the floats to bring moisture to the surface.
- C. Finishing Tolerances:
1. Level floors and slabs to a tolerance of plus or minus 1/8 inch when checked with a 10-foot straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other corrective measure as directed by the ENGINEER.
- D. Broomed Finish:
1. Finish concrete as specified in Paragraph 3.2A. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a bristle broom lightly across the surface in the direction of drainage, or in the case of walks and stairs, perpendicular to the direction of traffic to provide a nonslip surface.
- E. Steel Trowel Finish:
1. Finish concrete as specified in Paragraph 3.2A, then hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.
 2. Where concrete is greater than 15 feet in each direction, the CONTRACTOR may use a power steel trowel provided a minimum of three troweling passes are made of the entire surface.

3.03 CONCRETE SEALER

- A. Prepare and seal floor surfaces indicated on the Drawings as follows:
1. Finish the concrete as specified in the preceding paragraphs and in accordance with the Schedule of Finishing in Paragraph 3.6.
- B. Newly Placed Concrete:
1. Surface must be sound and properly finished. Surface is application-ready when it is damp, but not wet and can no longer be marred by a walking worker.

C. Newly Cured Bare Concrete:

1. Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt, and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.

D. Aged Concrete:

1. Restore surface soundness by patching, grouting, filling cracks, and holes, etc. Surface must also be free of any dust, dirt, and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.

E. Methods:

1. Comply with the manufacturer's recommendations to apply sealer so as to form a continuous, uniform film by spray, soft-bristle push broom, long-nap roller, or lamb's wool applicator.

F. Applications:

1. Two coats are required for curing concrete. Apply the first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 square feet per gallon. Apply the second coat when all trades are completed and the structure is ready for occupancy, at the rate of 400 to 600 square feet per gallon.
2. For sealing new concrete, both coats shall be applied full strength.
3. For sealing aged concrete, when renovating, dust proofing, and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.04 CONCRETE HARDENER

A. Prepare and apply hardener to floor surfaces indicated on the Drawings as follows:

1. Finish the concrete as specified in the preceding paragraphs and in accordance with the Schedule of Finishing in Paragraph 3.06.
2. Concrete floor hardener shall be applied to green (newly placed) concrete surfaces only.

B. Methods:

1. Comply with the manufacturer's recommendations in the application of the product.
2. Do not apply dry shake into the bleed water.

C. Applications:

1. The product shall be applied using a two-pass process ("shakes"). Using a mechanical spreader, spread approximately 1/2 to 2/3 of the required floor hardener evenly over the concrete surface.
2. If the CONTRACTOR chooses to broadcast the floor hardener by hand, in lieu of a mechanical spreader, apply each pass perpendicular to the previous application to better ensure complete coverage.
3. Apply the product in quantities prescribed for "medium duty," but not less than 100 pounds per 100 square feet.
4. Approval of Finishing

- D. All concrete surfaces, when finished, will be inspected by the ENGINEER.
- E. Surfaces that do not meet the requirements in this Specification shall be refinished or reworked.
- F. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03 30 00, unless otherwise directed by the ENGINEER.

3.05 SCHEDULE OF FINISHING

- A. Concrete shall be finished as specified either to remain as natural concrete or to receive an additional applied finish or material under another Section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:
 - 1. Concrete to receive dampproofing and waterproofing: Rough-Formed Finish
 - 2. Concrete not exposed to view and not scheduled to receive an additional applied finish or material: Rough-Formed Finish
 - 3. Exterior vertical concrete above grade, exposed to view: Rubbed Finish
 - 4. Interior vertical concrete exposed to view: Rubbed Finish]
 - 5. Interior or exterior horizontal concrete not requiring floor hardener or sealer: Floated Finish
 - 6. Interior or exterior horizontal concrete requiring floor hardener or sealer: See Paragraphs 3.03 and 3.04, and prepare floor in accordance with manufacturer's recommendations
 - 7. Concrete for exterior walks, interior and exterior stairs: Broomed Finish perpendicular to direction of traffic.

END OF SECTION

SECTION 03 38 00

CONCRETE ELECTRICAL/INSTRUMENTATION DUCT ENCASEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals required and place concrete encasement around underground electrical/instrumentation ductwork as shown on the Drawings and as specified herein.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. Concrete shall be measured, mixed and placed, and compacted as required in Section 03300 for Class A concrete and as specified below.
- B. Add 8 pounds of red coloring pigment per cubic yard of concrete.
- C. Provide not less than 3 inches of concrete between the outside of a duct and the earth. Provide not less than 3 inches of concrete between adjacent ducts.
- D. All duct line concrete pours shall be continuous between manholes or handholes and between manholes or handholes and structures.
- E. Where duct lines pass through concrete walls, concrete envelopes shall be extended through and finished flush with inside surfaces and finished as indicated on the Drawings. Construction joints as shown on the Drawings shall be provided.
- F. All duct encasements shall be reinforced with concrete reinforcement complying with Section 03200.
- G. Duct lines shall be laid in trenches on mats of Class 2 aggregate base not less than 6 inches thick and well graded.
- H. The minimum top cover for duct banks shall be 24 inches.

END OF SECTION

SECTION 03 41 00

PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The CONTRACTOR shall install precast concrete boxes, traffic covers and catch basins as specified herein and as shown on the Project Drawings.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 301 – Specifications for Structural Concrete
 - 2. ACI 318 – Building Code Requirements for Structural Concrete
- B. American Association of State Highway and Transportation (AASHTO)
 - 1. AASHTO M 198 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 2. AASHTO M 199 – Standard Specification for Precast Reinforced Concrete Manhole Sections.
- C. ASTM International (ASTM)
 - 1. ASTM C150 – Standard Specification for Portland Cement
 - 2. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
 - 3. ASTM C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
 - 4. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- D. Precast/Prestressed Concrete Institute (PCI)
 - 1. PCI MNL 116 – Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
 - 2. PCI MNL 120 – PCI Design Handbook - Precast and Prestressed Concrete
 - 3. PCI MNL 123 – Design and Typical Details of Connections for Precast and Prestressed Concrete

1.03 CONTRACTOR SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, submittals for items specified herein.
- B. Submittals shall be provided to confirm that materials to be used comply with information specified herein.

- C. Shop Drawings – Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, openings intended to be field cut, relationship to adjacent materials, design loads, deflections, cambers, bearing requirements, and special conditions. Shop drawings shall be sealed by a Civil or Structural Engineer licensed within the State of California.
- D. Product Data: Anchorage and lifting insert and devices.
- E. Concrete Design and Calculations:
 - 1. Concrete Mix Design: Include copies of test reports showing that the mix has successfully tested to produce concrete with the properties specified and will be suitable for the job condition. Test reports shall be not more than 24 months old.
 - 2. Reinforcement Design Calculations: stamped and signed by a Civil or Structural Engineer licensed within the State of California.
 - 3. Load Calculations stamped and signed by a Civil or Structural Engineer licensed within the State of California.
- F. Certifications: Submit quality control procedures established in accordance with OCI MNL-116 by the precast manufacturer.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with the requirements of PCI MNL-116, -120 and -123.
- B. Perform Work in accordance with State of California Public Works Standard.
- C. Maintain a copy of each document on-site.
- D. Qualifications:
 - 1. Fabricator: Company specializing in performing Work of this Section with minimum of three (3) years documented experience.
 - 2. Design precast concrete members under direct supervision of Professional Engineer experienced in design of this Work and licensed within the State of California.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Precast concrete structures shall be manufactured in a plant especially designed for that purpose and shall conform to the size and dimensions indicated on the Contract Drawings.

2.02 PRECAST CONCRETE STRUCTURES

- A. Precast concrete structures shall comply with AASHTO M 199, ASTM C478 and/or C913 as appropriate, except as modified herein.
- B. Design shall also comply with the following restrictions:
 - 1. The maximum reinforcement ratio allowed is one-half the reinforcement ratio that would produce a balanced strain condition.

2.03 BASE

- A. Base material shall conform to Aggregate Base Backfill as specified in Section 02 20 0, Earthwork.
- B. Compaction requirements for base material shall be in accordance with Section 02 20 0, Earthwork.

2.04 CEMENT

- A. Cement shall be ASTM C150, Type II. Class of concrete shall be 5,000 psi as a minimum.

2.05 ADMIXTURES

- A. Provide concrete admixtures as specified in Section 03 30 00, Cast-in-Place Concrete.

2.06 JOINT SEALING

- A. The joint sealing compound shall be permanently adhesive flexible plastic material complying in every detail to Federal Specification SS-S-00210 (GSA-FSS), Ramnek by Henry; EZ-Stik by Press-Seal; or equal.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. All concrete boxes shall be installed in strict conformance with the manufacturer's written instructions, on a well compacted foundation, as specified in Section 02 20 00, Earthwork.

3.02 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill required to accomplish the construction. After concrete forms have been removed and all debris is cleaned up from the areas to be filled, place backfill from excavation in 6-inch lifts to grade and compact each lift thoroughly with pneumatic tamper or other suitable equipment to prevent future settlement. Dispose of all excess excavation off site.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.
- B. When required by product manufacturer or as directed by the ENGINEER. Perform all sampling and furnish all testing of materials and products by an independent testing laboratory acceptable to the ENGINEER but engaged by and at the expense of the CONTRACTOR.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ASTM International (ASTM)
 - 1. ASTM C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
 - 2. ASTM C579 – Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
 - 3. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
 - 4. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - 5. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics
- B. US Army Corps of Engineers (CRD)
 - 1. CRD-C 621 – Corps of Engineers Specification for Nonshrink Grout
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, submittals including the following:
 - 1. Commercially Manufactured Nonshrink Cementitious Grout - Submit product data including catalogue cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Safety Data Sheet.
 - 2. Commercially Manufactured Nonshrink Epoxy Grout– Submit product data including catalogue cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Safety Data Sheet.

B. Samples:

1. Submit samples of commercially manufactured grout products when requested by the ENGINEER.

C. Certifications:

1. Certify that the CONTRACTOR is not associated with the independent testing laboratory, nor does the CONTRACTOR or its officers have a beneficial interest in the laboratory.

1.04 QUALITY ASSURANCE

- A. Qualifications – Grout manufacturer shall have a minimum of 10-years-experience in the production and use of the type of grout proposed for the work.
- B. Preinstallation Conference – Well in advance of grouting, hold a preinstallation meeting to review the requirements for surface preparation, mixing, placing, and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days before its scheduled date.
- C. Services of Manufacturer's Representative – A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the preinstallation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- C. Material that becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the OWNER.
- D. Nonshrink, cement-based grouts shall be delivered as pre-blended, prepackaged mixes requiring only the addition of water.
- E. Nonshrink epoxy grouts shall be delivered as pre-measured, prepackaged, three-component systems requiring only blending as directed by the manufacturer.

1.06 DEFINITIONS

- A. Nonshrink Grout – A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state, and bonds to a clean baseplate.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Nonshrink Cementitious Grout:

- 1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD-C 621. Grouts shall be Portland cement-based, contain a pre-proportioned blend of selected aggregates and shrinkage-compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827. The minimum 28-day compressive strength of 5,000 pounds per square inch (psi) is required for all nonshrink cementitious grout.
- 2. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; NS Grout by The Euclid Chemical Co.; FSP Construction Grout by Five Star Products Inc.; or equal.
- 3. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by BASF Building Systems; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout, by Five Star Products Inc.; or equal.

B. Nonshrink Epoxy Grout:

- 1. Nonshrink epoxy-based grout shall be a pre-proportioned, three-component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a minimum compressive strength of 10,000 psi in 7 days when tested in accordance with ASTM C579, Method B, and have a maximum thermal expansion of 30×10^{-6} when tested in accordance with ASTM C531. The grout shall be Masterflow 648 CP by BASF Building Systems; Five Star HP Epoxy Grout by Five Star Products, Inc.; Sikadur 42 Grout-Pak by Sika Corp.; E³-HP by the Euclid Chemical Co.; or equal.

C. Water:

- 1. Water shall be potable, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances. Use of recycled or reclaimed water is not permissible.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Grout shall be placed over cured concrete that has attained its full design strength unless otherwise approved by the ENGINEER.

- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance, and paints; and free of all loose material or foreign matter that may affect the bond or performance of the grout.
- C. Roughen hardened concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance, and firmly embedded into the parent concrete.
 - 1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil, or other deleterious substances from metal embedments or bottom of baseplates before the installation of the grout.
- E. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- F. Construct grout forms or other leak proof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.
 - 1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- G. Level and align the structural element(s) or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
- H. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks, or other approved means. The shims, wedges, and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the ENGINEER.

3.02 INSTALLATION - GENERAL

- A. Mix, apply, and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees Fahrenheit (F) during grouting and until grout compressive strength reaches 1,000 psi or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60–90 degrees Fahrenheit range.

3.03 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the ENGINEER.
- B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3 inches in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added. Place grout into the designated areas in a manner that will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner that will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- E. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of the bearing plate unless otherwise approved by the ENGINEER. Finish this surface with a wood float (brush) finish.
- F. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding, or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not over mix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.
- C. Place grout into the designated areas in a manner that will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond baseplate). In no case shall the shoulder length of the grout be greater than the grout thickness.

- E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.05 SCHEDULE

- A. General Purpose Nonshrink Cementitious Grout - Use at all locations where nonshrink grout is called for on the Drawings except for baseplates greater in area than 3 feet wide by 3 feet long and except for the setting of anchor rods, anchor bolts, or reinforcing steel in concrete.
- B. Flowable Nonshrink Cementitious Grout - Use under all baseplates greater in area than 3 feet by 3 feet. Use at all locations indicated to receive flowable nonshrink grout on the Drawings. The CONTRACTOR, at his/her option and convenience, may substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.
- C. Nonshrink Epoxy Grout - Use at locations specifically indicated to receive epoxy grout.

END OF SECTION

SECTION 03 63 00

EPOXIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Epoxy.
 - 2. Epoxy gel.
 - 3. Epoxy bonding agent.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
- B. D 638 - Test Method for Tensile Properties of Plastics.
- C. D 695 - Test Method for Compressive Properties of Rigid Plastics.
- D. D 790 - Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
- B. Provide epoxy materials that are new and use them within shelf life limitations set forth by manufacturer.
- C. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data completely describing epoxy materials.
- B. Quality Control Submittals:
 - 1. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Epoxy: Water-insensitive two-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified: Manufacturers: One of the following or equal:
 - 1. Master Builders, Inc., Concessive Standard LVI.

2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch at 14 days and 77 degrees Fahrenheit cure.
Flexure Strength	ASTM D 790	11,000 pounds per square inch at 14 days and 77 degrees Fahrenheit cure.
Compressive Strength	ASTM D 695	16,000 pounds per square inch at 24 hours and 77 degrees Fahrenheit cure.
Bond Strength	---	Concrete shall fail before failure of epoxy.
Gel Time In 5-Mil Film	---	Four hours maximum at 77 degrees Fahrenheit.
Elongation	ASTM D 638	1 percent minimum at 14 days and 77 degrees Fahrenheit.

- B. Epoxy Gel: Manufacturers: One of the following or equal:

1. Sika Chemical Corp.'s, Sikadur 31, Hi-Mod Gel.

- C. Epoxy Bonding Agent: Manufacturers: One of the following or equal:

1. Master Builders, Inc., Concessive 1001 Liquid LPL.
2. Sika Chemical Corp.'s, Sikadur 32, Hi-Mod.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Epoxy:
1. Apply in accordance with manufacturer's installation instructions.
- C. Epoxy Gel:
1. Apply in accordance with manufacturer's installation instructions.
 2. Use for vertical or overhead work, or where high viscosity epoxy is required.
 3. Epoxy gel used for vertical or overhead work may be used for horizontal work.
- D. Epoxy Bonding Agent:
1. Apply in accordance with manufacturer's installation instructions.
 2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 04 20 00

MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals required to construct all masonry work as shown on the Drawings and as specified herein.
- B. Work under this Section includes, but is not limited to, the following:
 - 1. Unit masonry including:
 - a. Concrete masonry units (CMU)
 - b. Installation of deformed steel reinforcement provided under Section 03200.
 - c. Masonry ties, anchors, and through-wall flashing.
 - d. Coordination and installation of items in masonry such as doorframes, piping, and other items furnished and installed by other trades.
 - e. Mortar for masonry.
 - f. Grouting of masonry cells, bond beams, and lintels.
 - 2. Provide masonry unit, masonry prism, mortar, and grout testing prior to installation by an independent testing laboratory engaged by the CONTRACTOR and acceptable to the ENGINEER.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Masonry Society (TMS)/American Concrete Institute (ACI)/American Society for Civil Engineers (ASCE):
 - 1. TMS 402/602 – Building Code Requirements and Specification for Masonry Structures
- B. ASTM International (ASTM)
 - 1. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel hardware
 - 2. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 3. ASTM C33 – Standard Specification for Concrete Aggregates
 - 4. ASTM C90 – Standard Specification for Load bearing Concrete Masonry Units
 - 5. ASTM C140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 - 6. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar
 - 7. ASTM C150 – Standard Specification for Portland Cement
 - 8. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes
 - 9. ASTM C270 – Standard Specification for Mortar for Unit Masonry
 - 10. ASTM C331 – Standard Specification for Lightweight Aggregates for Concrete Masonry Units
 - 11. ASTM C404 – Standard Specification for Aggregates for Masonry Grout

12. ASTM C426 – Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units
 13. ASTM C476 – Standard Specification for Grout for Masonry
 14. ASTM C780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
 15. ASTM C1019 – Standard Test Method for Sampling and Testing Grout
 16. ASTM C1314 – Standard Test Method for Compressive Strength of Masonry Prisms
- C. Federal Specifications:
1. SS-C-621B Int. Amd. 2, Concrete Masonry Units, Hollow (and Solid, Prefaced and Unglazed).
- D. Where reference is made to one of the preceding standards, the revision in effect at the time of bid opening shall apply unless otherwise indicated.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, submittals showing materials of construction and details of installation for:
1. Reinforcement. Fabrication and placing drawings and details for mild steel and prefabricated joint reinforcement. Reinforcement placing drawings shall conform to the requirements of Section 03200.
 2. Cement and hydrated lime.
 3. Proposed mortar and grout proportions.
 4. Material properties and test results letters for unit strength method.
- B. Samples: Submit samples for review sufficiently in advance of installation of the materials to allow investigation and re-submittal of new samples if the original samples are found not to conform to the Contract requirements. Submit samples of the following in sizes and quantities stated:
1. Concrete Masonry Units (CMU): Two samples of each type.
 2. Anchors and ties: Two samples of each type.
 3. Masonry joint material: Two samples at least 6-in long of each type.
- C. Test Reports:
1. Sieve analysis, mechanical properties, and deleterious substance content for coarse and fine aggregate or mortar and grout in accordance with ASTM C144 and C404, as applicable.
 2. Chemical analysis and physical tests for each type of cement.
 3. Chemical analysis and physical tests for hydrated lime.
 4. For each type of masonry unit, certified preconstruction test reports, including compressive strength, absorption, dimensional analysis, unit weight, and moisture content in accordance with ASTM C140.
 5. Mortar test results in accordance with ASTM C270.
 6. Grout test results during construction in accordance with ASTM C1019.

7. Compression strength testing reports for masonry prisms before and during construction as specified.
- D. Certifications:
1. Certify that the CONTRACTOR is not associated with the independent testing laboratory and that the CONTRACTOR or its officers have no beneficial interest in the laboratory.
- E. Qualifications:
1. Independent testing laboratory: Name, address, and qualifications. Laboratories affiliated with the CONTRACTOR or in which the CONTRACTOR or its officers have a beneficial interest are not acceptable.
- F. Procedures:
1. Cold weather construction procedures. Submit a description of procedures to be used.
 2. Hot weather construction procedures. Submit a description of procedures to be used.
 3. Review of hot and cold weather construction procedures will be for information only. The CONTRACTOR remains fully responsible for complying with the requirements of this Section and for the adequacy of procedures employed.

1.04 QUALITY ASSURANCE

- A. Concrete Masonry shall conform to the Building Code, the Masonry Design Manual published by the Masonry Industry Advancement Committee, and other applicable codes and standards of governing authorities.
- B. Concrete block masonry shall be sampled and tested in accordance with ASTM C140.
- C. Testing services required to demonstrate that the materials proposed for incorporation into the work comply with the requirements of the Contract documents shall be provided by the CONTRACTOR. The cost of such testing, unless specifically stated otherwise, shall be paid by the CONTRACTOR.
- D. Field-testing of masonry units, prisms, grout, and mortar for materials delivered to the site for placement as part of the work, to determine compliance with the Contract Documents, will be provided by the OWNER.
- E. All field testing and inspection services to confirm that the properties of the materials actually incorporated into the work conform to these specifications, and to satisfy the building code requirements for special inspection will be provided by the CITY. The OWNER, unless specifically stated otherwise, will pay the cost of such work. Facilitate such testing and inspection as follows:
 1. Advise ENGINEER of installation far enough in advance to allow for assignment and scheduling of inspection and testing personnel.
 2. Furnish any labor necessary to assist the OWNER's testing agency in obtaining and handling samples.
- F. Methods of testing shall conform to ASTM or other standards as indicated. Include in reports for prisms or test specimens a description of the portion of construction

represented by the specimen(s), and a summary of conditions under which the specimens were stored prior to testing.

- G. Testing Schedule – Tests shall be taken at the following times:
1. At the commencement of the masonry work, at least two test samples each of mortar and grout shall be taken on three successive working days.
 2. At any change in materials or job conditions, at least two samples of each modified material; grout and/or mortar shall be tested.
 3. Four random test each of mortar and grout shall be made. The random test samples shall be taken when requested by the ENGINEER.
 4. Additional samples and tests may be required whenever, in the judgment of the ENGINEER, additional tests (beyond the random tests) are necessary to determine quality.

1.05 SPECIAL INSPECTION

- A. Continuous inspection by a Special Inspector approved by the OWNER and by the ENGINEER will be required where necessary to conform to code requirements.
- B. The OWNER will provide field-testing and inspection services. The cost of such work, except as specifically stated elsewhere, shall be paid by the OWNER.. Testing and inspection of the following items shall be by the OWNER to verify conformity with this Specification Section and these paragraphs.
- C. The Special Inspector shall observe the work of this Section for conformance with the Drawings and specifications, and shall bring any discrepancies to the immediate attention of the CONTRACTOR and the ENGINEER.
- D. The Special Inspector shall furnish three original copies of inspection reports on all inspections within 48 hours after the inspections are made.
- E. The Special Inspector shall sign and submit three original copies of a final report stating whether the work was, to the best of his/her knowledge, performed in accordance with the Contract Documents and the applicable workmanship provisions of the governing building code.
- F. The Special Inspector shall submit the original copy of the reports described in the preceding paragraphs to the building official, with additional copies to the OWNER and the ENGINEER.
- G. Make special inspections as follows:
 1. Observe the preparation of all masonry prisms and of all grout or mortar test specimens.
 2. Observe site sampling of masonry units for compression testing.
 3. Observe the laying of masonry units.
 4. Observe reinforcement placement including sizes, positioning, embedment, and splices.
 5. Observe the condition of grout spaces just prior to each grouting operation.
 6. Observe placement of anchor bolts.

7. Observe all grouting operations.
 8. Compression strength of masonry, f'_m , shall be equal to or exceed 2,000 psi. The ENGINEER has selected this compression strength based on the Prism Test Method in accordance with California Building Code.
- H. Test for material compression strength as follows. Compression strength of masonry in each structural wythe shall equal or exceed the specified value of f'_m .
1. Prior to construction, perform the following tests using samples of materials that will be incorporated in the work.
 - a. One prism test consisting of five test specimens. Construct and test prisms in accordance with ASTM E447 Method B as modified in ACI 530.1/ASCE 6 Section 1.6.3.
 - b. One mortar test consisting of one set of three 2-in diameter by 4-in cylindrical specimens constructed and tested in compliance with ASTM C780.
 - c. One grout test consisting of one set of three specimens constructed and tested in compliance with ASTM C1019.
 2. During construction, perform one prism test consisting of three test specimens, one mortar cube test, and one grout test as specified in the previous paragraph for each 5,000 ft² of wall area or portion thereof.
- I. Sample Panel: Before masonry work is begun, provide a sample panel for ENGINEER's approval. The panel shall be approximately 6-ft long by 4-ft high, and of the same construction as the walls shown for the building. One face shall show the workmanship, coursing, bond, thickness, and tooling of joints, range of color and texture of the masonry, the color of the mortar, and installation of face brick, all of which shall be as specified. The accepted panel shall form the standard for acceptable finished work on the project. The panel shall be erected in a location as designated by the ENGINEER and, when directed, shall be completely removed from the job site.
- J. Cold and Hot Weather Construction: Masonry construction in cold and hot weather shall conform to the applicable requirements of the CBC unless otherwise specified herein. Heat and enclosures will be the only protection method allowed for cold weather construction. No mortar additives shall be used for this purpose.
1. Cold weather construction procedures: Submit an outline of procedures to be used.
 2. Hot weather construction procedures: Submit an outline of procedures to be used.
- K. All masonry work shall conform to TMS 402, except as modified herein.

1.06 DELIVERY, STORAGE AND HANDLING

- A. All materials for the work of this Section shall be delivered, stored, and handled so as to preclude damage of any nature. Store materials off the ground and protected from weather. Prevent wetting by capillary action, rain, or snow. Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of material and maker. Materials in broken containers, or in packages showing watermarks or other evidence of damage, shall not be used and shall be removed from the site.
- B. All masonry shall be shipped stacked with hay or straw protection or other suitable protective device, and shall be similarly protected and stacked off the ground on the site.

Masonry shall be protected from the weather and staining with the use of tarpaulins or other covering approved by the ENGINEER.

1.07 MAINTENANCE – SPARE MATERIAL

- A. Furnish spare masonry units, including at least the following items:
 - 1. CMU - One pallet
- B. All spare material shall be furnished in containers clearly identified with permanent markings as to their contents. Each container shall be packed with its contents protected for prolonged storage. Place containers for storage at locations indicated by the ENGINEER.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like materials shall be the end products of one manufacturer in order to provide standardization for appearance.
- C. Materials shall conform to the standards listed herein and to any applicable state or local building code standards.

2.02 MATERIALS – MASONRY

- A. Masonry Units: Concrete:
 - 1. General
 - a. Use formed "U" shaped units for reinforced masonry lintels.
 - b. Similar units shall be obtained from one manufacturer to ensure even color and texture.
 - c. Units shall be sound and free of cracks or other defects that would interfere with the proper placing of the units or impair the strength or permanence of the construction. Minor cracks or defects incidental to the usual method of manufacture, or minor chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection except that not more than 5 percent of a shipment shall contain chips larger than ¼-in from any edge or corner on the faces.
 - 2. Hollow and solid concrete masonry units (CMU) shall conform to ASTM C90 medium weight, load-bearing units of 4-inch by 16-inch and 8-inch by 16-inch nominal face size and bed dimensions, unless otherwise noted. Masonry units shall be split face and precision block as indicated on drawings, color to match Basalite Base Color 645.
 - 3. Linear shrinkage shall meet the requirements of ASTM C90.

2.03 REINFORCEMENT, TIES, ANCHORS

- A. Deformed steel reinforcing bars conform to ASTM A615, Grade 60 and shall be as specified in Section 03200.
 - 1. Fabricate reinforcement for masonry in accordance with the provisions of Section 03200, except as amended by the following paragraphs.
 - 2. Hooks. The term "standard hook" as used herein or as shown on the Drawings for masonry reinforcement shall be as defined in the following paragraphs. Inside diameter of the bend shall not be less than that shown in Table 1.
 - a. A minimum 135-degree bend plus an extension of at least 6 bar diameters but not less than 4-in at the free end of the bar.
 - b. Where ties are placed in the horizontal bed joints, a 90-degree bend having a radius of not less than 4 diameters plus an extension of at least 32 bar diameters at the end of the bar.
 - c. For stirrups or ties, either a 90-degree or a 135-degree bend plus an extension of at least 6 bar diameters but not less than 2-in at the free end of the bar.
 - d. Inside Bend Diameter:

**Table 1:
Reinforcement Bend Diameter**

Bar		Min. Inside Diameter
Stirrups & Ties:	#4 & Smaller	4 Diameters
Other	#3 thru #8	6 Diameters
	#9 thru #11	8 Diameters

2.04 MORTAR AND GROUT MATERIALS

- A. Cementitious Materials:
 - 1. Cementitious materials for mortar and grout shall not contain epoxy resins and derivatives, phenols, asbestos fiber, or fireclays.
 - 2. Portland cement shall conform to ASTM C150 Type II. Masonry cements, mortar cements, and plastic cement shall not be used.
 - 3. Slag shall not be used in mortar or grout materials.
 - 4. Lime for masonry mortar shall be hydrated lime conforming to ASTM C207, Type M.
- B. Aggregates:
 - 1. Sand shall be clean, durable particles, free from injurious amounts of organic matter, dust, lumps, shale, alkali, or surface coatings.
 - 2. Sand for mortar shall conform to ASTM C144.
 - 3. Sand for grout shall conform to ASTM C404, Size No. 2.
 - 4. Coarse aggregate for grout shall conform to ASTM C404, Size No. 8.
- C. Water shall be from a potable water supply. Water shall be free from deleterious amounts of oils, acids, alkalis, or organic matter, and shall be clean and fresh.

D. Admixtures/Additives:

1. Additives and admixtures to mortar or grout shall not be used unless approved by the ENGINEER. Acceptable admixtures are as follows:
 - a. Accelerators and Retarders,
 - b. Superplasticizers, and
 - c. Shrinkage Reducing Admixtures.
2. Antifreeze Compounds. Antifreeze liquids, chloride salts, or other such substances shall not be used in mortar or grout.
3. Air Entrainment. Air entraining substances shall not be used in mortar or grout.
4. Integral Waterproofing: Integral waterproofing for use in all exterior mortar shall be metallic stearate type, and shall be Hydrocide Powder by Sonneborn Contech; Omicron Mortarproofing by Master Builders; Integral Waterpeller by Euclid Chemical; or approved equal.

2.05 MORTAR MIXES

- A. Mortar for concrete masonry shall be Type M Portland cement - lime mortar. Mortar proportions shall comply with building code except that increases in lime content may be permitted to adjust the mixture for initial rate of absorption of the masonry or for temperature if mortar strength tests are performed. Admixtures shall not be used in the mortar mix.
1. Mix mortar in accordance with the requirements of ACI 530.1, using a mechanically operated mixer in which the quantity of water added can be accurately and uniformly controlled. Accurately measure mortar constituents by volume.
 2. The consistency of the mortar shall be adjusted to the satisfaction of the mason with water added as necessary to produce a workable mix. Mortar may be re-tempered one time by adding water when needed to restore the required consistency. When water is added, it shall be mixed into the mortar, not splashed over the surface.
 3. Mortar which has begun to "set" or which has not been used within 2-hours after initial mixing water was added to the dry ingredients shall be discarded.
 4. Mortar color shall match block color.

2.06 GROUT MIXES

- A. Masonry grout for use in bond beams, lintels, masonry cells, and at other locations shown on the Drawings shall conform to ASTM C476. Admixtures shall not be used without prior approval by the ENGINEER. Control grout materials and water content to provide adequate fluidity for placement without segregation.
- B. Strength:
1. Grout shall attain a minimum compressive strength of 2,000 psi at 28 days when tested in accordance with ASTM C1019.
 2. Where grout space is less than 4-inches, pea-gravel shall be omitted.
- C. Mixing and Handling:
1. Accurately measure all ingredients according to the proportions specified for the batch and mix in a mechanically operated batch mixer. Mix grout for at least 5 minutes but

not more than 10 minutes after all ingredients have been added. Add water as required to provide the desired workability.

2. Do not handle or pump grout using aluminum equipment.
 3. Transit mixed grout may be used. Continually rotate transit mixed grout from the time the water is added until the grout is discharged.
 4. Grout mixing drums shall be completely emptied before the succeeding batch of materials is introduced for mixing.
- D. Tempering:
1. The consistency of grout shall be adjusted so that it will flow into place without segregation of ingredients. Water may be added to compensate for loss.
 2. Grout that has begun final "set" and becomes harsh or which has not been used within 1-1/2 hours after initial mixing water was added to the dry ingredients shall not be used.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before beginning masonry construction, verify that tolerances of supporting members are within allowable limits, and that any required reinforcing dowels have been placed in accordance with the requirements of the Contract Documents.
- B. Bearing surface for masonry shall be such that the thickness of the initial bed joint shall be not less than 1/4-in nor more than 3/4-in in thickness.
- C. Before laying masonry, remove laitance, loose aggregate, or anything else, which would interfere with bond between the mortar and substrate.
- D. The surface of concrete upon which masonry is constructed shall have a minimum surface roughness of 1/8-inch.

3.02 MASONRY - INSTALLATION

- A. Cold Weather Construction. When the ambient temperature or the temperature of masonry units falls below 40 degrees F, conform to approved cold weather construction procedures. Provide cold weather heating and protection for both mortar and grout.
- B. Hot Weather Construction. Where the ambient temperature exceeds 100 degrees F or 90 degrees F with a wind velocity greater than 8 mph, conform to approved hot weather construction procedures.
- C. Wetting Masonry Units
 1. Do not wet concrete masonry units before laying unless prior approval is obtained from the ENGINEER.
- D. Masonry units shall be laid in running bond, with full stretchers, unless otherwise indicated. Tool joints dense and neat. Placing of mortar and units shall conform to ACI 530.1.

- E. Sizes shall be as specified and called for on the Drawings. Where "soaps" and "splits" are used, the space between these members and the backup material shall be slushed full of mortar.
- F. Joints of all masonry shall be tooled in accordance with the following:
 - 1. Wait until unit mortar is thumbprint hard before tooling joint. This may require as much as 3 hours in the shade and 1 hour in the sun in the summertime.
 - 2. The required personnel shall be kept on the job after hours, if necessary, to properly tool joints.
 - 3. Both vertical and horizontal joints shall be maintained uniform in spacing.
 - 4. Joints for all types of CMU shall be 3/8-in and concave.
- G. Install all frames required to be set in masonry, set masonry tightly against frames, build in all frame anchors, and fill frames with mortar.
- H. Control joints shall be installed as detailed on the Drawings. The maximum length, horizontally, between vertical control joints shall be 30-ft, but joints shall be located only as shown or approved in writing. Joints shall be equal in width to the standard mortar joint.
- I. All masonry slots, chases, or openings required for the proper installation of the work of other Sections shall be constructed as indicated on the Drawings or in accordance with information furnished before the work is started at the points affected. No chase shall be cut into any wall constructed of hollow units after it is built, except as directed and approved by the ENGINEER.
- J. Surfaces shall be brushed as work progresses and maintained as clean as is practicable. Protect sills, ledges, offsets, etc. from mortar droppings. Unfinished work shall be raked back where possible, and toothed only where acceptable to the ENGINEER. The top of partially completed work shall be covered at all times while work is not in progress. Before leaving fresh or unfinished work, walls shall be fully covered and protected against rain, wind, frost, or the elements. Covers of waterproof paper, tarpaulins, or other means acceptable to the ENGINEER, shall be draped over the wall, shall extend a minimum of 2-ft down both sides, and shall be firmly held in place.
- K. Build in all miscellaneous items to be set in masonry for which placement is not specifically provided under separate Divisions, including reglets, lintels, ties, electrical panel boxes, process equipment, sleeves, vents, grilles, anchors, grounds, and exterior electric conduits and fixtures. Cooperate with other trades whose work is to be coordinated with the work under this Section.
- L. Do not embed pipes or electrical conduits in masonry unless their location has been detailed on the structural drawings. Pipes or conduits placed in unfilled cells of hollow unit masonry will not be considered as embedded. Sleeves through masonry shall not be placed closer than 3 diameters, center to center, nor shall they be placed through reinforced courses or cells.
- M. Do not place dissimilar metals in contact with each other.

- N. Do not embed aluminum conduits, pipes, or accessories in masonry, grout, or mortar, unless they have been coated or covered with materials, which will effectively prevent chemical reactions with cement or steel.
- O. Do not insert through-wall flashing or other elements, which stop bond in masonry joints unless approved by the ENGINEER.
- P. All anchorage, attachment, and bonding devices shall be set so as to prevent slippage and shall be completely covered with mortar or grout.
- Q. All ties and reinforcing for masonry shall be furnished and installed under this Section.
- R. Furnish and place precast concrete or masonry lintels of the type and dimensions shown on the Drawings and specified. Extend lintels beyond the opening and firmly bed the bearing ends in mortar as shown on the Drawings.
- S. Bed and grout for items coming in contact with masonry where grouting is required, including, but not limited to, door bucks and frames set in masonry. Install all anchor bolts, base plates, and seats in masonry walls, and build in all items required for the completion of the building as they apply to masonry.

3.03 BONDING, ANCHORS AND TIES

- A. Unless otherwise shown, corners and intersections of load-bearing masonry walls shall be bonded in each course with a true masonry bond, except that when necessarily erected separately, they shall be anchored with rigid steel anchors spaced not more than 2-ft apart vertically.
- B. Intersections of non-load-bearing partitions with other walls or partitions shall be tied with corrugated metal anchors at vertical intervals of not more than 16-in or with masonry bonding in alternate courses.

3.04 REINFORCED MASONRY

- A. Install reinforcement of the type, size, and spacing and at locations as indicated on the Drawings and specified herein.
- B. Concrete masonry unit walls shall be laid in such a manner as to preserve the alignment and unobstructed vertical continuity of cells. Cross webs adjacent to vertical cores that are to be filled with grout shall be fully bedded with mortar, to prevent grout leakage. Mortar fins protruding from joints shall be removed before grout is placed. The minimum clear dimensions of vertical cores to be grouted shall be 2-in by 3-in.
- C. Reinforcement shall be free of dirt, oil, and other materials that will adversely affect bond, and shall be straight except where bends or hooks are detailed on the plans. Reinforcement that, in the opinion of the ENGINEER, is bent or otherwise damaged so as to affect its structural capacity shall not be incorporated into the Work.
- D. Bond beams shall be continuous with lapped splices as specified.
- E. Reinforcing around openings

1. Unless otherwise shown on the Drawings, at openings in masonry greater than or equal to 16-in in any direction, provide a minimum of one #5 in grouted cells or bond/ lintel beams on all sides of the opening. Bars shall extend at least 48 bar diameters past the opening on each side.
2. See lintel schedules and miscellaneous details on the Drawings for additional requirements.

F. Reinforcing Details

1. Support and fasten masonry reinforcement to prevent displacement beyond the tolerances noted herein.
2. Position and accurately space reinforcement in units as shown on the Drawings. Maintain a clear distance between reinforcement and any masonry surface or adjacent bar of not less than 1/4-in for fine grout or 1/2-in for coarse grout.
3. Tolerances for placing reinforcement shall be as follows, where "d" equals distance from centerline of steel to the compression face of masonry.
 - a. Walls, beams, lintels, and bond beams:

"d" (in)	Tolerance (in)
$d \leq 8$	+1/2
$8 < d \leq 24$	+1
$24 < d$	$\pm 1-1/4$

- b. If it becomes necessary to move reinforcement to avoid interferences with other reinforcement, conduits, or embeds, bars shall not be moved beyond their specified tolerances nor more than one diameter without prior approval from the ENGINEER.
4. Splice deformed reinforcing steel at least 48 bar diameters (for grade 60 rebar) unless otherwise noted on the Drawings. When lapped bars are spaced 3-in apart or less, increase the lap length to 52 bar diameters or stagger the laps at least 24 bar diameters with no increase in lap length.
5. Clear spacing between vertical bars in columns or pilasters shall be not less than 2-1/2 times the bar diameter nor 1-1/2-in. Stagger adjacent splices vertically.
6. Completely embed all reinforcing bars in mortar or grout with minimum cover (including the masonry unit) as follows:
 - a. Interior exposure: 1-1/2-in
 - b. Exposed to soil or weather: 2-in
7. Provide masonry dowels cast into the supporting concrete at all corners of the structure, in the first adjacent cell in each direction from the corner, at cells requiring vertical reinforcement, and elsewhere as shown on the Drawings and miscellaneous details.

3.05 GROUTING – GENERAL

- A. Walls shall be fully grouted unless otherwise indicated on the Drawings.
- B. Prior to grouting, the grout space shall be clean and free of mortar projections greater than 1/2-in, mortar droppings, or other foreign materials.

- C. Reinforcement shall be in place and adequately supported before commencing grouting operations. Reinforcement shall be clean and free of mortar droppings or other debris. Notify the ENGINEER at least 24 hours prior to any grouting operations so that reinforcement placement, support, and laps may be observed before grouting. Accurately set embedded bolts with templates and hold in place to prevent movement. Provide minimum 1-in grout space between any bolt and an adjacent masonry surface.
- D. Control grout materials and water content during grouting to provide adequate fluidity for placement without segregation. Place grout within one hour after the introduction of water into the mix and prior to initial set.
- E. Place grout in a continuous pour to its maximum placement height in accordance with Table 2, and consolidating the grout after each lift.
- F. Consolidate grout by mechanical vibration before loss of plasticity, in a manner that will solidly fill the grout space and minimize voids due to absorption of water into the masonry. Reconsolidate grout by mechanical vibration after initial water loss and settlement has occurred. Consolidation should normally occur when the plasticity of the grout approaches that of stiff mortar (i.e., when a touch leaves an indentation).
- G. Complete grouting of beams over openings in one continuous operation.
- H. Use extreme care to prevent any grout or mortar from staining the face of masonry to be left exposed or unpainted. If any grout or mortar does contact the face of such masonry, it shall be removed immediately. Protect all sills, ledges offsets, etc. from grout droppings.
- I. Limitations on grout type (fine or coarse), and height of grout pours shall be as shown in Table 2. Units may be laid to the maximum height of the grout pour before grouting unless otherwise noted on the Drawings or specified. Where this table or notes on the Drawing indicate that walls are to be grouted at intervals less than their final height, use "low-lift" grouting procedures. Where walls are grouted to their final height in one pour, use "high-lift" grouting procedures.

**Table 2:
Grout and Pour Height Limitations**

Grout Type	Grout Pour Max. Height ⁽¹⁾	Least Clear Dimensions ⁽²⁾	
		Width of Grout Space ⁽³⁾	Cell Dimensions ⁽⁴⁾
Fine	1 ft.	1-1/2 in.	1-1/2 in. x 2 in.
	5 ft.	2 in.	2 in. x 3 in.
	12 ft.	2-1/2 in.	2-1/2 in. x 3 in.
	24 ft.	3 in.	3 in. x 3 in.
Coarse	1 ft.	1-1/2 in.	1-1/2 in. x 3 in.
	5 ft.	2 in.	2-1/2 in. x 3 in.
	12 ft.	2-1/2 in.	3 in. x 3 in.
	24 ft.	3 in.	3 in. x 4 in.

(1) Maximum pour heights may be used, when approved by the ENGINEER, when it can be

demonstrated that the grout spaces can be properly filled.

- (2) The clear dimension is the cell width less mortar projections; or the grout space width less the sum of mortar projections plus the width of any horizontal reinforcement inside the space.
- (3) For grout spaces between masonry wythes.
- (4) For grouted cells in hollow unit masonry.

3.06 GROUTING – LOW-LIFT GROUTING PROCEDURES

- A. Between grout pours in vertical cells, form a horizontal construction joint "key" in walls by stopping all wythes at the same elevation, and stopping the grout lift a minimum of 1-1/2-in below the mortar joint, except at the top of a wall. Consolidate the grout and then continue the pour. For horizontal bond beams, grout cells below the bond beam and consolidate, then grout the bond beam itself stopping the grout pour 1/2-in below the top of the masonry. At the finished course of both walls and bond beams, bring the last pour flush with the top of the masonry during initial placing and again after consolidation.

3.07 GROUTING – HIGH-LIFT GROUTING PROCEDURES

- A. Do not erect masonry to a height of more than 80 times the minimum clear cell or grout space dimension nor higher than 30-ft before grouting unless approval is obtained in writing from the ENGINEER.
- B. Where grout pours exceed 5-ft in height, provide clean-outs in the bottom course of masonry. Clean-out openings shall be not less than 12-in² in area and the least dimension of any opening shall not be less than 3-in. In solid grouted masonry, space clean-outs at each vertical bar, but not more than 32-in on center.
- C. Before grouting, clean cells and collar joints and close and seal clean-out openings. Brace closures to resist grout pressure. Pour grout at a rate that will minimize the potential for "blowouts" at the closed clean-out openings, but rapidly enough to allow consolidation before loss of plasticity.

3.08 REPAIR

- A. Exposed masonry shall be protected against staining by wall coverings, and excess mortar shall be wiped off the surface as the work progresses to reduce need for cleaning at completion of the work.
- B. Where ordered, remove masonry units which are loose, chipped, broken, stained, or otherwise damaged, and units which do not match adjoining units and install new units in fresh mortar or grout, pointed to eliminate, as approved by the ENGINEER, evidence of replacement.

3.09 POINTING

- A. During the tooling of joints, except for weep holes, enlarge any voids or holes, and completely fill with mortar matching the color of the surrounding work as approved by the ENGINEER and tool to match. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance and properly prepare joints for application of sealants where required.

- B. Before final cleaning, repoint all unsatisfactory joints as specified above and as required by the ENGINEER.

3.10 FINAL CLEANING OF MASONRY

- A. After mortar has thoroughly set and cured (three weeks minimum during the summer; five weeks minimum during the winter), a sample wall area (approximately 20-ft²), shall be cleaned, with an approved commercial masonry cleaner, diluted and mixed with potable water as recommended by the manufacturer and as approved. The sample area may be the sample wall panel specified above or an area in the finish work as approved by the ENGINEER.
- B. The ENGINEER's acceptance of sample cleaning shall be obtained before proceeding to clean remainder of masonry work. A minimum of one week of dry weather is required to evaluate effectiveness of cleaning and effect on masonry and mortar. Upon acceptance by the ENGINEER, all masonry shall be cleaned by the same method to the satisfaction of the ENGINEER.
- C. Acid solutions shall not be used for cleaning any CMU. Upon completion of the work, all surfaces of CMU shall be washed with soap powder and warm water, applied with a scrubbing brush, and then rinsed thoroughly with clear water. Other cleaning methods may be ordered to obtain required appearance.
- D. Masonry areas not satisfactorily cleanable will be replaced at no extra cost to the OWNER.

END OF SECTION

SECTION 05 20 00

METAL JOISTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment and incidentals and install steel joists and bridging complete as shown on the Drawings and as specified herein.
- B. Provide all brackets, braces and supports required to install joists as shown on the Drawings, at no additional expense to the OWNER.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Steel Joist Institute (SJI)
 - 1. Standard Specifications for Open Web Steel Joists, K-Series.
 - 2. Standard Specifications for Joist Girders
- B. ASTM International (ASTM)
 - 1. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - 2. ASTM B695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
- C. American Welding Society (AWS)
 - 1. AWS D1.1 – Structural Welding Code - Steel
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit, in accordance with Division 1, shop drawings and product data, showing:
 - 1. Location and size of all members.
 - 2. Materials and details of construction of all members, including camber.
 - 3. Details of installation of all members.
 - 4. Size and length of all field welds to supports.
 - 5. Erection marks. Mark each field piece to correspond to the Shop Drawings.
 - 6. Uniform, concentrated and varying loads used to design the special joists indicated on the Drawings.
- B. Product data for shop primer. Certify compatibility with additional coatings specified in Section 09 80 00.

- C. Certificates:
 - 1. Certification from the Steel Joist Institute showing that the manufacturer's products conform to the Institute's standards and load tables for the type of member provided.
 - 2. Certification for welders.
- D. Shop drawings shall be stamped by a Professional Civil or Structural Engineer registered in the State of California.
- E. Submit Structural calculations stamped by a Professional Civil or Structural Engineer registered in the State of California.

1.04 QUALITY ASSURANCE

- A. Steel joists, bridging and accessories shall be fabricated in accordance with the standards of the Steel Joist Institute by a manufacturer certified by the Steel Joist Institute. Steel joists shall be of welded construction and top and bottom chords shall be constructed of hot rolled shapes. Rods, reinforcing bars, or cold-formed shapes will not be allowed for top and bottom chords.
- B. Field welding shall be done by certified welders in accordance with AWS D1.1.

1.05 DELIVERY STORAGE AND HANDLING

- A. Handle material with cranes and derricks. Do not dump joists off cars or trucks, or handle in any way likely to cause damage.
- B. Store material on skids and not on the ground. Pile and block stored material to prevent bending or other damage.
- C. Materials with excessive damage, in the opinion of the ENGINEER, shall not be incorporated in the work. Remove and replace them with new undamaged materials at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Open web steel joists shall conform to SJI Standard for Open Web Steel Joists, size and location as shown on the Drawings.
- B. Size and location of diagonal and horizontal bridging shall be as shown on the Drawings.
- C. Provide top chord extensions, extended ends, deep bearings, and/or sloped bearings where shown on the Drawings.
- D. High strength steel bolts shall conform to ASTM A325 and shall be mechanically galvanized in accordance with ASTM B695, Class 50, Type II.
- E. Joists shall be fabricated without preset camber.

2.02 SURFACE PREPARATION AND SHOP COATINGS

- A. Prepare surfaces and apply shop paint in accordance with Section 09800.
- B. The CONTRACTOR shall notify the OWNER at least four weeks in advance of surface preparation and painting in the fabricator's shop so that a local independent NACE paint inspector can provide local inspection and dry film testing before the steel leaves the shop. The cost for the independent NACE paint inspector will be paid for by the OWNER.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install steel joists in accordance with the Steel Joist Institute standards, approved Shop Drawings and the Drawings. Weld or bolt joists to supports as shown on the Drawings.
- B. Weld or bolt bridging to joists and structural steel as shown on the Drawings. Bridging and bridging anchors shall be completely installed before construction loads are placed on the steel joists.

3.02 FIELD PAINTING

- A. After erection, prepare shop primed surfaces as approved and touch-up all steel surfaces which have become abraded or where paint has been omitted or removed due to welding or other erection procedure with the shop primer used.

3.03 INSPECTION

- A. The ENGINEER reserves the right to inspect joists in the field for compliance with the Steel Joist Institute standards, this Section and the approved shop drawings. The ENGINEER may reject or require repair or refabrication of any joists or accessories not meeting these requirements.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment and incidentals required and install steel roof deck complete as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Steel Deck Institute (SDI)
 - 1. SDI Specifications and Commentary for Steel Roof Deck
- B. ASTM International Testing and Materials (ASTM)
 - 1. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron, Alloy-Coated (Galvannealed) by the Hot-Dip Process
- C. American Iron and Steel Institute (AISI)
 - 1. AISI SG-673 – Cold-Formed Steel Design Manual
- D. International Code Council (ICC)
 - 1. California Building Code - 2019
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit, in accordance with Division 1, shop drawings and product data, showing:
 - 1. Location and size of all members.
 - 2. Materials, finishes and details of construction of all members.
 - 3. Manufacturer's load table including design thickness in inches and section properties.
 - 4. Fastener types and layout patterns.
 - 5. Erection marks. Mark each bundle to correspond to the shop drawings.
- B. Certification:
 - 1. Certification from the Steel Deck Institute (SDI) that the steel roof deck is designed in accordance with SDI standards.

1.04 QUALITY ASSURANCE

- A. Steel roof deck shall conform to the requirements of the SDI standard for Steel Roof Deck.

- B. Field welding shall be done by certified welders and shall be in accordance with the AISI standard. Welding shall receive special inspection in accordance with Section 1704 of the CBC.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle material with cranes and derricks. Do not dump materials off cars or trucks, or handle in any way likely to cause damage.
- B. Store materials off the ground with one end elevated to provide drainage. Protect from the elements with a waterproof covering, ventilated to avoid condensation.
- C. Materials with excessive damage, in the opinion of the ENGINEER, shall not be incorporated in the work. Remove and replace with new undamaged materials at no expense to the OWNER.

1.06 PROJECT/SITE REQUIREMENTS

- A. Bring inaccuracies in alignment or level of structural steel and steel joists to the attention of the ENGINEER in writing and correct before the deck is placed.

1.07 DEFINITIONS

- A. Transverse supports – supports that are perpendicular to the direction of the deck ribs.
- B. Longitudinal support – supports that are parallel to the direction of the deck ribs.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel roof deck shall be 1-1/2-in rib depth, Type B (wide rib) as manufactured by Vulcraft (or approved equal). Deck sheets shall be 36-in wide with interlocking side laps. Gauge shall be as shown on the Drawings.
- B. Steel roof deck and accessories shall be manufactured from steel conforming to ASTM A653, Grade A, B, C, D, E or F.
- C. Steel roof deck and accessories shall be galvanized in accordance with ASTM A653. Coating designation shall be G90.
- D. Provide minimum 18 gauge closure strips, cant strips and butt plates as shown on the Drawings and as specified herein. Provide minimum 14 gauge roof sump pans as shown on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install steel roof deck as shown on the Drawings, in accordance with manufacturer's instructions and in accordance with approved shop drawings. Where possible, extend deck sheets over three or more spans.
- B. End laps of steel roof deck shall be at least 2-in long and shall occur over transverse supporting members.
- C. Fasten steel roof deck to all interior and exterior transverse supports and at side laps and longitudinal supports. Deck fasteners and fastener spacing shall be as noted in the Steel Deck Schedule and Roof Deck Fastening Standard Details or as indicated on the Roof Framing Drawing.
- D. Maintain contact between deck sheets and deck sheets and steel supports while fastening steel roof deck to reduce burn holes at welded connections.
- E. Welds to supporting members at end laps and side laps shall go through both sheets and fuse properly to the supporting steel.
- F. Coordinate size, location and details of all penetration with the Drawings, other trades and details of approved equipment. Pipe and conduit openings in the steel roof deck shall be reinforced according to the manufacturer's recommendation.

3.02 CUTTING AND FITTING

- A. Cut and fit steel roof deck units and accessories around projections through steel roof deck.
- B. Make cuts neat, square and trim.
- C. Cut openings in steel roof deck true to dimensions using metal saws, drills or cuttings torches.
- D. Do not use cutting torches if neat appearance is required.
- E. Openings greater than 6-in and less than 12-in in greatest dimension shall be reinforced with a 24-in by 24-in flat plate, minimum 20-gauge thickness, centered on the opening.
- F. Weld closure strips, cant strips, butt plates and roof sump pans directly to steel deck to provide a finished surface.

3.03 ROOF SUMP PANS AND REINFORCING PLATES

- A. Place roof sump pans and reinforcing plates over openings in steel roof deck and weld to top surface of steel roof deck.
- B. Space welds not more than 6-in on center with at least one weld at each corner.
- C. Cut openings in roof sump pan or reinforcing plate to accommodate drain or other fixture.

3.04 CANT STRIPS AND BUTT PLATES

- A. Weld to top surface of steel roof deck at no more than 12-in on center.
- B. Lap end joints not less than 3-in.

3.05 CLOSURE STRIPS EAVE PLATES

- A. Install closure strips at all open uncovered ends and edges of steel roof deck and in voids between deck and other construction.
- B. Weld to top surface of steel roof deck at not more than 12-in on center and into position to provide complete deck installation for support of roof insulation.
- C. Suspended ceilings, light fixtures, ducts, piping, conduits or other utilities shall not be attached to steel roof deck.

3.06 FIELD PAINTING

- A. Touch-Up Field Painting
- B. Clean thoroughly and touch-up all steel surfaces which have become abraded or where galvanizing has been damaged due to welding and/or erection procedures.
- C. Paint shall be approved 95 percent zinc dust, organic vehicle primer compatible with the galvanized surfaces.

3.07 INSPECTION

- A. The ENGINEER reserves the right to inspect steel roof deck in the field for compliance with the requirements specified herein and the approved shop drawings. The ENGINEER may reject or require repair or refabrication of any steel roof deck or accessories not meeting these requirements at no additional cost to the OWNER.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Miscellaneous metal fabrications including:
 - 1. Handrails and Guardrails.
 - 2. Manhole Frames and Covers.
 - 3. Gratings and Covers.
 - 4. Splash Guards.
 - 5. Miscellaneous Metals: Includes aluminum, stainless steel, structural steel.
 - 6. Associated accessories to the above items.

- B. Related Sections:
 - 1. Section 09 90 00 – Painting and Coating.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. Specification M32-C22-A41 - Aluminum Finishes.

- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.

- C. American Society for Testing and Materials (ASTM):
 - 1. A 36/A 36M - Specification for Carbon Structural Steel.
 - 2. A 48 - Specification for Grey Iron Castings.
 - 3. A 53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 4. A 123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. A 167 - Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 6. A 240 - Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - 7. A 269 - Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 8. A 276 - Specification for Stainless Steel Bars and Shapes.
 - 9. A 307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 10. A 320 - Specification for Alloys - Steel Bolting Materials for Low-Temperature Service

11. A 325 - Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
12. A 489 - Specification for Carbon Steel Lifting Eyes.
13. A 490 - Specification for Steel Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength.
14. A 500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
15. A 501 - Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
16. A 568 - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
17. A 570/A 570M - Specification for Steel, Sheet and Strip, Carbon. Hot-Rolled, Structural Quality.
18. A 635/A 635M - Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled.
19. A 653/A 653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process.
20. B 209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
21. B 221 – Aluminum Alloy, Extruded Bars, Rods, Wire, Profiles and Tubes.
22. B 429 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

D. American National Standards Institute (ANSI):

1. A14.3 - Ladders-Fixed: Safety Requirements.
2. 531 Metal Bar Grating Manual

E. American Welding Society (AWS).

F. International Conference of Building Officials (ICBO):

1. Uniform Building Code (UBC), latest edition.

G. Occupational Safety and Health Administration (OSHA).

1.03 QUALITY ASSURANCE

- A. Hand railing and Walkways shall comply with SAA Code for fixed platforms, walkways, stairways and ladders, AS1657.
- B. Regulatory Requirements: Except as modified by the requirements specified herein and detailed on the plans, the installation of fabricated metal work shall conform to the "Uniform Building Code" (UBC).

1.04 SUBMITTALS

- A. Shop Drawings: Submit for handrails and guardrails, including details on connection attachments, gates, kickplates, ladders, and angles.
 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

2. Include erection drawings, elevations, and details where applicable.
 3. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
- B. Quality Control Submittals:
1. Design Data.
 2. Test Reports:
 - a. Manufacturers' calculations showing that gratings and covers will meet specified load-bearing and deflection requirements for each size grating or cover for each type of installation.
 - b. Reports of tests performed.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials: Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals shall conform with the standards of the ASTM, including the following:

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Cast Iron		
Cast Iron	A 48	Class 40B
Steel		
Galvanized sheet iron or steel	A 653	Coating G90
Black steel, sheet or strip	A 569	--
	A 570	--
Coil (plate)	A 635	--
Structural plate, bars, rolled shapes, and miscellaneous items	A 36	--
Standard bolts, nuts, and washers	A 307	--
High strength bolts, nuts, and hardened flat washers	A 325	--
	A 490	--
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	--
Tubing, hot-formed	A 501	--
Steel pipe	A 53	Grade B
Stainless steel		
Plate, sheet and strip	A 167	Type 304 or 316*

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Bars and shapes	A 276	Type 304 or 316*
Bolts and threaded rods	A 320	Type 304 or 316*
Aluminum		
Sheet aluminum-flashing	B 209	Alloy 5005-H14, 0.032 inches minimum thickness
Sheet aluminum-structural	B 209	Alloy 6061-T6
Structural aluminum	B 308 B 209	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42
* Use Type 304L or Type 316L if material will be welded.		

1. Stainless steels are designated by type or series defined by ASTM.
2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANHOLE FRAMES AND COVERS

A. Material:

1. Gray iron castings, ASTM A 48, Class 30-B.
2. Stainless steel, ASTM A 276.

B. Type: Heavy-duty traffic type, with combined set weight of minimum 265 pounds.

1. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.

C. Frame:

1. Bottom flange type.
2. Approximately 4-1/2 inches frame height.
3. 24-inch diameter clear inside dimension, unless otherwise indicated on the Drawings.
4. Approximately 32 inches bottom flange outside diameter.

D. Cover:

1. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as "ELECTRICAL," "STORM", "SEWER," "TELEPHONE," or "WATER."
2. Solid type without ventilation holes.

E. Finish: Unpainted.

2.03 HATCHES

- A. Where access hatches are called for on the drawings to be mounted on a floor slab (including top slabs that are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein.
- B. All hatches shall be fabricated from Aluminum 6061 T6 unless otherwise indicated. All hatch hardware shall be Type 316 stainless steel. Hatches, Bilco, Babcock-Davis, USF Fabrication or approved equal, or as shown.
- C. Design Live Loads:
 - 1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no loading is given, a minimum of 300 psf, unless indicated otherwise.
- D. Hatch Opening:
 - 1. Sizes, number and direction of swing of door leaves, and locations, shall be as indicated on the Drawings. Sizes given shall be for the clear opening. Where the number of leaves is not given, openings larger than 42 inches in either direction shall have double-leaf doors.
 - 2. Unless indicated otherwise, hinges shall be located on the longer dimension side.
 - 3. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension, and the door hinge opposite the ladder.
- E. Door leaves shall be a minimum of 1/4-inch checkered pattern plate. Channel frames shall be a minimum of 1/4-inch material with an anchor flange around the perimeter.
- F. Hatches shall be provided with an automatic hold-open arm with release handle. Hatches shall be designed for easy opening by one person from both inside and outside and shall be balanced to require no more than 30 pounds of opening force (lift-assist). Compression spring operators enclosed in telescoping tubes shall be provided for smooth, easy, and controlled door operation throughout the entire arc of opening and closing.
- G. Hatches shall be designed to be watertight.
- H. Hatches shall include a recessed hasp for a padlock that is covered by a hinged lid flush with the surface.
- I. Finish:
 - 1. Factory finish shall be mill finish aluminum. Sections embedded in or that may come into contact with concrete shall receive a bituminous coating.
 - 2. An adhesive backed vinyl material, that protects the product, during shipping and installation, shall cover the entire top of the door.

2.04 MISCELLANEOUS METAL

- A. Miscellaneous Aluminum: Fabricate aluminum products, not covered separately herein, in accordance with the best practices of the trade and field assemble by riveting or bolting. Do not weld or flame cut.

- B. Miscellaneous Cast Iron:
 - 1. General:
 - a. Tough, gray iron, free from cracks, holes, swells, and cold shuts.
 - b. Quality such that hammer blow will produce indentation on rectangular edge of casting without flaking metal.
 - c. Before leaving the foundry, clean castings and apply 16 mil dry film thickness coating of coal-tar epoxy, unless otherwise specified or indicated on the Drawings.
- C. Miscellaneous Stainless Steel:
 - 1. Provide miscellaneous stainless steel items not specified herein as indicated on the Drawings or specified elsewhere. Fabricate and install in accordance with the best practices of the trade.
- D. Miscellaneous Structural Steel:
 - 1. Provide miscellaneous steel items not specified herein as indicated on the Drawings or specified elsewhere. Fabricate and install in accordance with the best practices of the trade.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Contractor shall examine work in place to verify that it is satisfactory to receive the work of this Section. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

- A. General: Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.
- B. Installation: As specified in Section 33 05 13, Precast Concrete Manholes.

END OF SECTION

SECTION 05 51 33

METAL LADDERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment and incidentals required to provide complete ladders and accessories as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Occupational Safety and Health Standards (OSHA)
 - 1. Code of Federal Regulations, 29 CFR, Part 1910
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit manufacturer's shop drawings, in accordance with Division 1, showing dimensions, material lists, methods of supporting, methods of anchoring, and finishes.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 FIXED WALL LADDERS

- A. Fixed wall ladders and accessories shall comply with all requirements of OSHA, 29 CFR 1910.27.
- B. Acceptable Manufacturers:
 - 1. Shop-fabricated from details on the Drawings
 - 2. Precision Ladders LLC, Morristown, TN, FL Series (length as shown on the Drawings)
 - 3. O'Keeffe's Inc. San Francisco, Model 500 (Standard)
 - 4. Aluminex, Inc., Model LC-100 (Standard)
 - 5. Premanufactured equal approved by the ENGINEER.

2.03 MATERIALS

- A. Side Rails – Aluminum plates and bars, alloy 6061-T6 or alloy 6063-T5 for aluminum extrusions. Where side rail extensions are provided, the side rail shall be channel shape having a wall thickness not less than 0.125-in and a depth of not less than 3-in.
- B. Rungs/Treads – Knurled or serrated aluminum bars, not less than 3/4-inches in diameter fabricated of alloy 6061-T6. Alternatively, serrated tubular aluminum extrusions of alloy 6063-T5/T6 not less than 1¼-inch square. Attach rungs to side rails with self-locking Type 316 Stainless Steel fasteners or weld as shown on the Drawings.
- C. Wall/Floor Support Brackets: Aluminum plates, alloy 6061-T6.

2.04 LADDER SAFETY-POST EXTENSION

- A. Fixed ladders shall be provided with attached telescoping tubular safety post extension, unless otherwise noted. Unit shall be completely assembled with stainless steel fasteners and brackets for securing to the ladder rungs provided by the manufacturer. Provide corrosion resistant construction.

2.05 FALL PREVENTION SYSTEM

- A. Provide complete rigid-rail and locking sleeve fall prevention system at locations noted on the Drawings. System shall be complete with all mounting hardware and accessories.
- B. The fall prevention system shall be the RTC-2000 Climb Rite, as manufactured by Sellstrom; Saf-T-Climb, as manufactured by North Products, Inc., or approved equal.
- C. All necessary components shall be provided, including two safety belts for each fall prevention installation to provide a complete and fully operational fall prevention system. Safety belts shall fit a waist range from 23 inches to 54 inches.
- D. A rail extension shall be provided for each installation. At all locations where fall prevention systems are installed, a safety chain with a snap hook shall be permanently attached to the top of the ladder. The chain shall be long enough to allow a person to connect the belt to the chain while standing on the landing adjacent to the ladder. The chain and snap hook shall have a minimum allowable capacity of 500 pounds.
- E. Safety rails and associated accessories shall match the ladder material. Except that fiberglass ladders shall have stainless steel safety rails and accessories.
- F. Where ladders begin below the access platform of a structure (e.g.: meter vaults, hatchways, etc.) provide a permanently installed mandril at each ladder to allow use of the removable extension previously specified.
- G. Unless otherwise designated by the ENGINEER or indicated on the Drawings, fall prevention systems shall be provided on all ladders. At minimum fall prevention system shall be provide on all ladders used to ascend heights exceeding 20 ft.

2.06 GENERAL FABRICATION

- A. Details shall be as shown on the Drawings and as specified.
- B. Components shall be free of splinters, sharp edges, burrs or hazardous projections.
- C. For ladder rungs or capped top ends of side rails. Grind welds on exterior face of side rails or stringers smooth. Accurately fabricate joints for neat, tight fit.
- D. Attachments not made by welding shall be made with self-locking Type 316 stainless steel fasteners.
- E. Mill finish unless otherwise noted. Ship with a shop coat of methacrylate lacquer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install ladders and accessories in compliance with manufacturer's shop drawings and detailed instructions.
- B. Install fabrications, plumb, square and level and securely anchored to supports. Smooth and adjust miters and field cuts to assure tight joints.
- C. Where aluminum contacts a dissimilar metal, apply to the dissimilar a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint.
- D. Where aluminum contacts concrete, apply a heavy coat of acceptable alkali resistant epoxy paint to the concrete.

3.02 PROTECTION

- A. Protect aluminum fabrications from damage due to work of adjacent trades.

3.03 CLEANING

- A. As work progresses, remove debris and leave installation sites broom clean.
- B. Prior to final acceptance, clean ladders of any paint, mud or other adherents.

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, incidentals, and services necessary to install ornamental aluminum or galvanized steel guardrail systems and handrail assemblies as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM International (ASTM)
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless.
 - 3. ASTM A386 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 5. ASTM A510 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Tubing.
 - 6. ASTM A536 – Standard Specification for Ductile Iron Castings
 - 7. ASTM-E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 8. ASTM B210 – Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tube.
 - 9. ASTM B211 – Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar Rod and Wire.
 - 10. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.
 - 11. ASTM B241 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - 12. ASTM B429 – Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications.
 - 13. ASTM B483 – Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications.
- B. Society for Protective Coatings (SSPC)
 - 1. SSPC-Paint 12 – Cold Applied Asphalt Mastic (Extra Thick Film).
- C. National Association of Architectural Metal Manufacturers (NAAMM)
 - 1. Metal Finishes Manual.

D. American Architectural Manufacturers Association (AAMA)

1. AAMA 607.1

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

A. Submit, in accordance with Division 1, Shop Drawing Procedures, product data for manufacturer's product lines of guardrail systems and handrail assemblies fabricated from standard components.

1. Shop Drawing Procedures, shop drawings showing fabrication and installation of guardrail systems and handrail assemblies including plans, elevations, sections, details of components, gates, and attachments to other units of Work.
2. For installed guardrail systems and handrail assemblies indicated to comply with certain design loadings, include structural analysis data, sealed and signed by the qualified Professional Civil or Structural Engineer licensed in the State of California, who was responsible for their preparation.
3. Samples – Samples for verification of each type of exposed finish required, prepared on components indicated below of same thickness and metal indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
4. Samples – 6-inch-long sections of each distinctly different linear guardrail member, including handrails, top rails, posts, and balusters.
5. Shop Drawing Procedures, qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Testing – Testing Laboratory Services, product test reports from a qualified independent testing agency evidencing compliance of guardrail systems and handrail assemblies with requirements based on comprehensive testing of current products.

C. Certification – Testing Laboratory Services, test reports from independent testing agency evidencing compliance of guardrail systems and handrail assemblies.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility – Obtain guardrail systems and handrail assemblies of each type and material from a single manufacturer.

B. Engineer Qualifications – A Professional Civil or Structural Engineer licensed in the State of California and experienced in providing engineering services of the kind indicated that have resulted in the installation of guardrail systems and handrail assemblies similar to this Project in material, design, and extent and that have a record of successful in-service performance.

1.05 PERFORMANCE REQUIREMENTS

- A. General – In engineering guardrail systems and handrail assemblies to withstand structural loads indicated, determine allowable design working stresses of metal railing materials based on governing design standards.
- B. Structural Performance of Guardrail Systems and Handrail Assemblies – Engineer, fabricate, and install guardrail systems and handrail assemblies to comply with governing design standards and the following minimum structural performance criteria based on structural computations.
 - 1. All guardrail systems and handrail assemblies shall be designed to resist a single concentrated load of 200 lbf applied in any direction at any point along the top-rail and to transfer this load through the supports to the structure.
 - 2. All guardrail systems and handrail assemblies shall be designed to resist a load of 50 lb/ft (pound-force per linear foot) applied in any direction at any point along the top-rail and to transfer this load through the supports to the structure. This load need not be assumed to act concurrently with the 200 lbf load specified above.
 - 3. All guardrail systems and handrail assemblies shall be designed for a maximum horizontal deflection at the prescribed loads, measured at the line of the vertical supports, or rail height divided by 12, with rail height being the distance between the surface of the post anchorage and the top of the top-rail.
 - 4. Reductions in the prescribed loads for building classification and/or occupancy permitted by governing Codes and/or Standards are not permissible.
- C. Thermal Movements:
 - 1. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in engineering, fabricating, and installing guardrail systems and handrail assemblies to prevent buckling, opening of joints, overstressing of components and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - 2. Temperature Change (Range): Allowance for thermal movement shall be based on temperature change of plus or minus 90 degrees-Fahrenheit from the average ambient temperature at the project site, or from the temperature at time of installation, whichever is more stringent.
- D. Control of Corrosion – Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store guardrail systems and handrail assemblies inside a well-ventilated area, away from uncured concrete and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.07 PROJECT CONDITIONS

- A. Field Measurements – Where guardrail systems and handrail assemblies are indicated to fit to other construction, CONTRACTOR shall check actual dimensions of other construction by accurate field measurements before fabrication. CONTRACTOR shall provide field measurements to manufacturer/supplier such that they may be shown on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MANUFACTURERS

- A. Available Manufacturers – Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Julius Blum & Co., Inc.
 - 2. Blumcraft of Pittsburgh.
 - 3. J.G. Braun Co.
 - 4. Newman Brothers, Inc.
 - 5. Approved equal

2.03 METALS

- A. General – Provide metal free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
- B. Aluminum Railing Systems:
 - 1. Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required.
 - a. Extruded Bar and Tube: ASTM B221, alloy 6063-T5/T52.
 - b. Extruded Structural Pipe and Tube: ASTM B429, 6063-T6.
 - c. Drawn Seamless Tube: ASTM B210, 6063-T832.
 - d. Plate and Sheet: ASTM B209, 6061-T6.
 - e. Die and Hand Forgings: ASTM B247, 6061-T6.
 - f. Castings: ASTM B26, A356-T6.
 - g. Finish: AA-M12C22A41: M12- Mechanical Finish, Non-Specular; C22 – Finish, Medium Matte; A41 – Clear Anodic Coatings, Class 1.

C. Steel Railing System:

1. Material recommended by steel producer and finish for type of use, with not less than the strength and durability properties designated below.
 - a. Steel Tubing: ASTM A53, Grade B
 - b. Cold—Formed: ASTM A500, Grade B
 - c. Hot Formed: ASTM A510
 - d. Plate and Sheet: ASTM A36
 - e. Castings: ASTM A536
 - f. Finish: Galvanized Zinc with 0.5 percent (minimum) nickel added.

2.04 FASTENERS

- A. Fasteners for Anchoring Metal Railings to Other Construction – Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring guardrail to other types of construction indicated and capable of withstanding design loadings.
 1. For aluminum guardrails, provide fasteners fabricated from Type 304 or Type 316 Stainless Steel.
- B. Fasteners for Interconnecting Metal Railing Components – Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 1. Provide concealed fasteners for interconnecting guardrail and handrail components and for attaching them to other work, except where exposed fasteners are unavoidable or are the standard fastening method for guardrail and handrail system indicated.
 2. Provide Phillips flathead machine screws for exposed fasteners, unless otherwise indicated.
- C. Cast-in-Place Anchor Bolts – Unless otherwise indicated, the embedded end of the anchor bolt shall be either headed or with nut and washer. Threaded dimensions for cast-in headed studs and/or headed bolts, prior to zinc coating, shall conform to the requirements of ANSI/ASME B1.1 having Class 2A tolerances (ANSI/ASME Standard B1.1#M, Grade 6g). Use of hooked bolts (J-bolts and L-bolts) in lieu of headed studs/bolts is not permissible.
- D. Post Installed Concrete Adhesive Anchors and Dowels – Unless otherwise indicated, post installed concrete adhesive anchors and dowels for installation in concrete shall have satisfied the requirements of the Simulated Seismic Tests of ACI 355.4. No substitutions will be considered unless accompanied with ICC-ES or IAPMO-UES report verifying strength of material equivalency and compliance with ACI 355.4. All-thread rods for adhesive anchors shall be zinc plated carbon steel complete with nuts and washers. Type 316 stainless steel all-thread rods shall be used where they will be submerged or exposed to the weather.
- E. Post Installed Concrete Expansion (Wedge) Anchors – Unless otherwise indicated, all post installed concrete expansion anchors for installation in concrete shall have satisfied the requirements of the Simulated Seismic Tests of ACI 355.2. Expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless-steel wedge type anchors are required. When the length

or embedment of the bolt is not noted on the Drawings, provide length sufficient to place wedge and expansion sleeve portion of the bolt at least 1-inch behind the concrete reinforcing steel.

2.05 PAINT

- A. Bituminous Paint – Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.06 GROUT

- A. Comply with requirements of Section 03 60 00.

2.07 FABRICATION

- A. General – Fabricate guardrail systems and handrail assemblies to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacing, and anchorage, but not less than that required to support structural loads.
- B. Assemble guardrail systems and handrail assemblies in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of guardrail and handrail components.
- D. Non-welded Connections – Fabricate guardrail systems and handrail assemblies by connecting members with guardrail manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- E. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to connect guardrail system and handrail assembly members to other construction.
- F. Provide inserts and other anchorage devices to connect guardrail system and handrail assembly to concrete work. Fabricate anchorage devices capable of withstanding loads imposed by guardrail system or handrail assembly. Coordinate anchorage devices with supporting structure.
- G. For removable railing posts, fabricate slip-fit sockets from aluminum/steel pipe whose inside diameter is sized for a close fit with posts. Provide socket covers designed and fabricated to resist accidental dislodgement.
- H. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

- I. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.
- J. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.
- K. Provide weep holes or other means to drain entrapped water in hollow sections of guardrail/handrail members that are exposed to exterior or to moisture from condensation or other sources.
- L. Fabricate joints that will be exposed to weather in a watertight manner.
- M. Close exposed ends of guardrail/handrail members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of the handrail and wall is ¼-inch or less.
- O. Toe Boards – Where indicated, provide toe boards at guardrails around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.
- P. Fillers – Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of guardrails/handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thickness. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.
- Q. Gates – Provide swing-type gates where indicated. Unless otherwise shown, fabricate gates with components to match adjacent guardrails. Furnish gates with aluminum or stainless-steel hinges and keeper/latch mechanism.

2.08 FINISH

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Aluminum: Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.7 mil or thicker) complying with AAMA 607.1.
- D. Steel: Galvanized Zinc with 0.5 percent (minimum) nickel added.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete construction. Coordinate delivery of such items to Project site.

3.02 INSTALLATION - GENERAL

- A. Fit exposed connections accurately together to form tight, hairline joints.
- B. Cutting, Fitting, and Placement – Perform cutting, drilling, and fitting required for installing guardrail systems and handrail assemblies. Set guardrail systems and handrail assemblies accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of guardrail/handrail components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb.
 - 3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed ¼-inch in 12 feet.
- C. Corrosion Protection – Coat concealed surfaces of metal railings that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust guardrail systems and handrail assemblies prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not more than that required by structural loads.
- E. Fastening to In-Place Construction – Use anchorage devices and fasteners where necessary for securing guardrail systems and handrail assemblies and for properly transferring loads to in-place construction.

3.03 GUARDRAIL CONNECTIONS

- A. Non-welded Connections – Use mechanical joints for permanently connecting guardrail/handrail components. Seal recessed holes of exposed locking screws using plastic filler, cement colored to match finish of guardrail/handrail.
- B. Expansion Joints: Install expansion joints at locations indicated but not further apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2-inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6-inches of post.

3.04 ANCHORING POSTS

- A. Anchor posts in concrete by forming or core-drilling holes not less than 6-inches deep and $\frac{3}{4}$ -inch greater than outside diameter of post. Clean holes of all loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's directions.
- B. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch buildup, sloped away from post.
- C. Anchor posts to metal surfaces with oval flanges, angle type or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For metal railings, attach posts as indicated using fittings designed and engineered for this purpose.
- D. Install removable guardrail sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.

3.05 ANCHORING RAIL ENDS

- A. Anchor rail ends into concrete with round flanges connected to rail ends and anchored into wall construction with post installed anchors and bolts.
- B. Anchor rail ends to metal surfaces with oval or round flanges.
 - 1. Connect flanges to rail ends using non-welded connections.

3.06 ATTACHING HANDRAILS TO WALLS

- A. Attach handrail assemblies to wall with wall brackets and end fittings. Provide bracket with $1\frac{1}{2}$ -inches clearance from inside face of handrail assembly and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and wall return fittings to building construction as follows.
 - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
 - 2. For concrete anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 - 3. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

3.07 ADJUSTING AND CLEANING

- A. Clean soiled surfaces by washing thoroughly with clean water and soap, followed by rinsing with clean water.

3.08 PROTECTION

- A. Protect finishes of guardrail systems and handrail assemblies from damage during construction period with temporary protective coverings approved by metal railing manufacturer. Remove protective coverings at the time of Final Completion.
- B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units at no additional cost to the DISTRICT.

END OF SECTION

SECTION 07 14 16

COLD-FLUID APPLIED WATERPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Application of single-component, cold-applied, liquid waterproofing membrane.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete.
- B. Section 04 20 00 – Masonry.

1.03 REFERENCES

- A. ASTM C1250 – Standard Test Method for Nonvolatile Content of Cold Liquid-Applied Elastomeric Waterproofing Membranes.
- B. ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
- D. ASTM D2240 - Standard Test Method for Rubber Property—Durometer Hardness.
- E. ASTM D2369 - Standard Test Method for Volatile Content of Coatings
- F. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.04 SUBMITTALS

- A. Comply with Section 01 30 00 – Contractor Submittals.
- B. Submit manufacturer's product data and application instructions.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of fluid applied waterproofing membranes.
 - 2. Obtain waterproofing materials from a single manufacturer regularly engaged in manufacturing the product.

3. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

1.06 MOCK-UPS

- A. Prior to installation of waterproofing membrane, apply waterproofing membrane to 100 sq-ft of deck or wall to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution.
- B. Cooperate and coordinate with the owner's inspection and testing agency. Do not cover any installed waterproofing membrane unless it has been inspected, tested and approved.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Store at temperatures between 40° - 70° F (4° - 21° C).
- D. Protect materials during handling and application to prevent damage or contamination.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Product not intended for uses subject to abuse or permanent exposure to the elements.
- B. Do not apply membrane when air, material, or surface temperatures are expected to fall below 30° F (-1° C) within four hours of completed application.
- C. Do not apply membrane if rainfall is forecast or imminent within 12 hours.
- D. Do not apply waterproofing membrane to any surfaces containing frost.
- E. Consult manufacturer for applications to green concrete.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. W. R. MEADOWS®, INC., PO Box 338, Hampshire, Illinois 60140-0338. (800) 342-5976. (847) 683-4500. Fax (847) 683-4544.
- B. Or approved equal.

2.02 MATERIALS

- A. Waterproofing Membrane: single-component, cold-applied, solvent-free, non-shrink, liquid waterproofing membrane.

- B. Performance Based Spec: Waterproofing membrane shall have the following properties as determined by laboratory testing:
 - 1. Solids content by weight, ASTM C1250: 98%.
 - 2. Tensile Strength, ASTM D412: 100 psi.
 - 3. Elongation at break, ASTM D412: 425%.
 - 4. Water Vapor Transmission, ASTM E96 (Method BW): 0.1 perms.
 - 5. Shore 00 Hardness, ASTM D2240: 57.
 - 6. VOC, ASTM D2369: 36 g/L
- C. Proprietary Based Spec:
 - 1. HYDRALASTIC 836 Waterproofing Membrane by W. R. MEADOWS.

2.03 ACCESSORIES

- A. Joint Tape: 6” (150 mm) wide reinforcing fabric for corners, crack, and joint treatment.
 - 1. REINFORCING FABRIC HCR by W. R. MEADOWS.
- B. Reinforcing Fabric for High Build Applications:
 - 1. REINFORCING FABRIC HCR by W. R. MEADOWS.
- C. Reinforced Joint Tape for outside corners subject to backfill.
 - 1. PRECON® FABRIC TAPE by W. R. MEADOWS.
- D. Epoxy Primer:
 - 1. REZI-WELD™ LV or REZI-WELD LV STATE by W. R. MEADOWS.
- E. Detailing Membrane:
 - 1. BEM by W. R. MEADOWS
- F. Concrete Repair Materials:
 - 1. MEADOW-PATCH® 5 and 20 Concrete Repair Mortars.
- G. Waterproofing Protection Course:
 - 1. PERMINATOR® or PROTECTION COURSE.
- H. Rolled Matrix Drainage System:
 - 1. MEL-DRAIN™.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer.
- D. Clean concrete surfaces so they are free of all coatings, dirt, oil, paints and any other contaminants.
- E. Patch all holes and voids and smooth out any surface misalignments.
- F. Remove and patch all concrete form ties.
- G. Priming
 - 1. Apply the low viscosity epoxy with a nap roller or squeegee at a coverage rate of 150 - 200 ft.² per gallon (3.75 - 5.0 m²/L) providing a uniform coverage over the substrate.
 - 2. Allow the epoxy primer to become tack-free prior to the application of the fluid applied waterproofing membrane.
- H. Treatment of Existing Cracks and All Non-Structural Joints
 - 1. Identify and install detailing membrane in all cracks and all non-structural joints.
 - 2. Apply a 30 wet mil coat of the fluid applied membrane ensuring that there is a minimum of 3" (75 mm) of membrane extending onto the wall in all directions.
 - 3. Embed the non-woven reinforcing fabric over the entire area of this membrane and work in using trowel.
 - 4. Completely cover the glass mesh with a second coat of the fluid applied membrane at 30 wet mils while the first coat is still wet, again extending 3" onto the wall in all directions.
- I. Treatment of Inside & Outside Corners
 - 1. Install detailing membrane to create a minimum ¾" (25.4 mm) fillet in all inside corners.
 - 2. Apply a 30 wet mil coat of the fluid applied membrane ensuring that there is a minimum of 3" (75 mm) of membrane extending onto the wall in all directions.
 - 3. Embed the non-woven reinforcing fabric over the entire area of this membrane and work in using trowel.
 - 4. Completely cover the glass mesh with a second coat of fluid applied membrane at 30 wet mils while the first coat is still wet, again extending 3" (75 mm) onto the wall in all directions.
 - 5. On outside corners subject to backfilling, install reinforced joint tape in lieu of fabric joint tape following the same procedure.

3.03 APPLICATION

- A. Apply waterproofing membrane system in accordance with manufacturer's instructions.
- B. Gently mix membrane prior to application.

- C. Apply membrane by trowel, flat-blade squeegee, or roller, at a minimum coverage rate of 25 ft.²/U.S. gal (2.3 m²/3.78 L), providing a thickness of 60 wet mils.
- D. If a two-coat application is required, apply second coat as soon as possible with no more than eight hours between coats providing a minimum total thickness of 60 wet mils. Fully embed the reinforcing fabric into the first coat of material.
- E. Frequently inspect surface area to ensure proper adhesion and consistent thickness is achieved.
- F. Work material into any fluted rib forming indentations.
- G. Provide minimum cured membrane thickness of 60 mils dry.

3.04 PROTECTION

- A. Protect membrane with application of waterproofing protection course, drainage board, or other approved material.
- B. Backfill immediately using care to avoid damaging waterproofing membrane system.

END OF SECTION

SECTION 07 55 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Hot Applied 2-Ply Asphalt Roofing (StressPly, OptiMax, or Versiply). (2.9) (3.5)
- B. Accessories. (2.19)
- C. Edge Treatment and Roof Penetration Flashings. (2.20)(3.9)

1.02 RELATED SECTIONS

- A. Section 05 31 00 – Steel Decking
- B. Section 07 72 33 - Roof Hatches
- C. Section 08 62 13 – Domes Unit Skylights

1.03 REFERENCES

- A. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- B. ASTM D 312 - Standard Specification for Asphalt used in Roofing.
- C. ASTM D 451 - Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.
- D. ASTM D 1970 - Specification for Sheet Materials, Self-Adhering Polymer Modified Bituminous, Used as Steep Roofing Underlayment for Ice Dam Protection.
- E. ASTM D 1079 Standard Terminology Relating to Roofing, Waterproofing and Bituminous Materials.
- F. ASTM D 1863 Standard Specification for Mineral Aggregate Used as a Protective Coating for Roofing.
- G. ASTM D 2178 Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
- H. ASTM D 2824 Standard Specification for Aluminum-Pigmented Asphalt Roof Coating.
- I. ASTM D 4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- J. ASTM D 4601 Standard Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing.

- K. ASTM D 5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.
- L. ASTM D 6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
- M. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings
- N. Factory Mutual Research (FM): Roof Assembly Classifications.
- O. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.
- P. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.
- Q. Underwriters Laboratories, Inc. (UL): Fire Hazard Classifications.
- R. Warnock Hersey (WH): Fire Hazard Classifications.
- S. ANSI-SPRI ES-1 Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.
- T. ASCE 7, Minimum Design Loads for Buildings and Other Structures
- U. UL - Fire Resistance Directory.
- V. FM Approvals - Roof Coverings and/or RoofNav assembly database.
- W. California Title 24 Energy Efficient Standards.

1.04 DESIGN / PERFORMANCE REQUIREMENTS

- A. Perform work in accordance with all federal, state and local codes.
- B. Exterior Fire Test Exposure: Roof system shall achieve a UL, FM or WH Class rating for roof slopes indicated on the Drawings as follows:
 - 1. Factory Mutual Class A Rating.
 - 2. Underwriters Laboratory Class A Rating.
 - 3. Warnock Hersey Class A Rating.
- C. Design Requirements:
 - 1. Uniform Wind Uplift Load Capacity
 - a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
 - 1) Design Code: ASCE 7, Method 2 for Components and Cladding.
 - 2) Importance Category:
 - a) III.
 - 3) Importance Factor of:
 - a) 1.0
 - 4) Wind Speed: 120 mph

- 5) Ultimate Pullout Value: 375 pounds per each of the fastener
 - 6) Exposure Category:
 - a) C.
 - 7) Design Roof Height: 40 feet.
 - 8) Minimum Building Width: 75 feet.
 - 9) Roof Pitch: 1/4 :12.
- D. Energy Star: Roof System shall comply with the initial and aged reflectivity required by the U.S. Federal Government's Energy Star program.
 - E. Roof System membranes containing recycled or bio-based materials shall be third party certified through UL Environment.
 - F. Roof system shall have been tested in compliance with the following codes and test requirements:
 - 1. Cool Roof Rating Council:
 - a. CRRC Directory CRRC 0700-0027
 - 2. Underwriters Laboratories:
 - a. Certification
 - 3. Warnock Hersey
 - a. ITS Directory of Listed Products
 - 4. FM Approvals:
 - a. RoofNav Website

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions.
- C. Shop Drawings: Submit shop drawings including installation details of roofing, flashing, fastening, insulation and vapor barrier, including notation of roof slopes and fastening patterns of insulation and base modified bitumen membrane, prior to job start.
- D. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- E. Manufacturer's Certificates: Provide to certify products meet or exceed specified requirements.
- F. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147. Testing must be performed at 77 deg. F. Tests at 0 deg. F will not be considered.
- G. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.

- H. **Manufacturer's Fire Compliance Certificate:** Certify that the roof system furnished is approved by Factory Mutual (FM), Underwriters Laboratories (UL), Warnock Hersey (WH) or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.
- I. **Closeout Submittals:** Provide manufacturer's maintenance instructions that include recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.06 QUALITY ASSURANCE

- A. **Perform Work** in accordance with NRCA Roofing and Waterproofing Manual.
- B. **Manufacturer Qualifications:** Company specializing in manufacturing products specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.
- C. **Installer Qualifications:** Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.
- D. **Installer's Field Supervision:** Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.
- E. **Product Certification:** Provide manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.
- F. **Source Limitations:** Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. **Convene** minimum two weeks prior to commencing Work of this section.
- B. **Review** installation procedures and coordination required with related Work.
- C. **Inspect** and make notes of job conditions prior to installation:
 - 1. **Record** minutes of the conference and provide copies to all parties present.
 - 2. **Identify** all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
 - 3. **Installation** of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging with labels intact until ready for installation.
- B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with "breathable" tarpaulins.
- C. Stored in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface except store KEE-Stone FB 60 rolls flat on a clean flat surface. No wet or damaged materials will be used in the application.
- D. Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50 degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.
- E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.
- F. Adhesive storage shall be between the range of above 50 degree F (10 degree C) and below 80 degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.09 COORDINATION

- A. Coordinate Work with installing associated metal flashings as work of this section proceeds.

1.10 PROJECT CONDITIONS

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

1.11 WARRANTY

- A. Upon completion of the work, provide the Manufacturer's written and signed Edge-To-Edge NDL System Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material or defective workmanship by the installer, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition including Garland Metal Components.
 - 1. Warranty Period:
 - a. 30 years from date of acceptance.
- B. Installer is to guarantee all work against defects in materials and workmanship for a period indicated following final acceptance of the Work.
 - 1. Warranty Period:

- a. 5 years from date of acceptance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Garland Company, Inc. (The); 3800 E. 91st St., Cleveland, OH 44105. Monterey County Representative: Tom Chapman Phone: 831-682-6827. Fax: 216-641-0633. Web Site: www.garlandco.com.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.
- C. The Products specified are intended and the Standard of Quality for the products required for this project. If other products are proposed the bidder must disclose in the bid the manufacturer and the products that they intend to use on the Project. If no manufacturer and products are listed, the bid may be accepted only with the use of products specified.
 1. Bidder will not be allowed to change materials after the bid opening date.
 2. If alternate products are included in the bid, the products must be equal to or exceed the products specified. Supporting technical data shall be submitted to the Architect/ Owner for approval prior to acceptance.
 3. In making a request for substitution, the Bidder/Roofing Contractor represents that it has:
 - a. Personally investigated the proposed product or method, and determined that it is equal or superior in all respects to that specified.
 - b. Will provide the same guarantee for substitution as for the product and method specified.
 - c. Will coordinate installation of accepted substitution in work, making such changes as may be required for work to be completed in all respects.
 - d. Will waive all claims for additional cost related to substitution, which consequently become apparent.
 - e. Cost data is complete and includes all related cost under his/her contract or other contracts, which may be affected by the substitution.
 - f. Will reimburse the Owner for all redesign cost by the Architect for accommodation of the substitution.
 4. Architect/ Owner reserves the right to be the final authority on the acceptance or rejection of any or all bids, proposed alternate roofing systems or materials that has met ALL specified requirement criteria.
 5. Failure to submit substitution package, or any portion thereof requested, will result in immediate disqualification and consideration for that particular contractors request for manufacturer substitution.

2.02 HOT APPLIED 2-PLY ASPHALT ROOFING - STRESSPLY, OPTIMAX, OR VERSIPLY

- A. Base (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
 1. StressBase 120:
- B. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive.

1. StressPly E (Environmental):
- C. Interply Adhesive: (1 and 2)
 1. Generic Type III Asphalt:
- D. Flashing Base Ply: One ply bonded to the prepared substrate with Interply Adhesive: except torch sheet.
 1. VersiPly 40:
- E. Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive: except torch sheet.
 1. StressPly E FR Mineral (Environmental):
- F. Surfacing:
 1. Aggregate/Flood Coat
 - a. White-Star with All-Knight Primer: Lucas Fire Star A-1 Grit

2.03 INSULATION AND COVERBOARD:

- A. Coverboard: Nominal 1/2" thick, high density polyisocyanurate insulation coverboard with coated glass facer.
 1. Isogard HD by Firestone
 2. As approved by alternate membrane manufacturer.
- B. Rigid Thermal Insulation: Minimum 4'x8' rigid polyisocyanurate insulation boards conforming to ASTM C 1289, Type II, Class 1. Insulation shall have a glass reinforced facer at top and bottom of board.
 1. Iso 95+GL
 2. As approved by alternate membrane manufacturer.

2.04 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

- A. Pre-Manufactured Edge Metal: R-Mer Edge Snap-On Fascia Cover and Splice Plate.
 1. Zinc-coated steel, ASTM A653, coating designation G-90, in thickness of 24 gauge, 22 gauge or 20 gauge, 36" to 48" by coil length, chemically treated, commercial or lock-forming quality.
 2. Aluminum, ASTM B209, alloy 3105-H14, in thickness of .032" nom. or .040" nom. or .050" nom. or .063" nom.
- B. Flashing Boot - Rubbertite Flashing Boot: Neoprene pipe boot for sealing single or multiple pipe penetrations adhered in approved adhesives as recommended and furnished by the membrane manufacturer.
- C. Vents and Breathers: Heavy gauge aluminum and fully insulated vent that allows moisture and air to escape but not enter the roof system as recommended and furnished by the membrane manufacturer.
- D. Pitch pans, Rain Collar 24 gauge stainless or 20oz (567gram) copper. All joints should be welded/soldered watertight. See details for design.

- E. Drain Flashings should be 30" x 30" Sheet Zink formed and rolled.
- F. Plumbing stacks should be Zinkjak formed and rolled, as recommended by manufacturer.
- G. Liquid Flashing - Tuff-Flash: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.
 - 1. Tensile Strength, ASTM D 412: 400 psi
 - 2. Elongation, ASTM D 412: 300%
 - 3. Density @77 deg. F 8.5 lb/gal typical
- H. Fabricated Flashings: Fabricated flashings and trim are specified in Section 07620.
 - 1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.
- I. Manufactured Roof Specialties: Shop fabricated copings, fascia, gravel stops, control joints, expansion joints, joint covers and related flashings and trim are specified in Section 07710.
 - 1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.
- C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.
- D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. General: Clean surfaces thoroughly prior to installation.
 - 1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
 - 2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.
 - 3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.

4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.
 5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
 6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pull-out capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with cap nails require a minimum pullout capacity of 40 lb. per nail.
 7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.
- B. Metal Deck: Metal deck shall be installed as specified in Section
1. Fastening of the deck should comply with the anticipated live and dead loads pertaining to the building as well as applicable Code.
 2. Steel decks shall be minimum 22-gauge factory galvanized or zinc alloy coated for protection against corrosion.
 3. Suitable insulation shall be mechanically attached as recommended by the insulation manufacturer.
 4. Decks shall comply with the gauge and span requirements in the current Factory Mutual FM Approval Guide and be installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
 5. When re-roofing over steel decks, surface corrosion shall be removed, and repairs to severely corroded areas made. Loose or inadequately secured decking shall be fastened, and irreparable or otherwise defective decking shall be replaced.

3.03 INSTALLATION - GENERAL

- A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.
- B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
 1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
 2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.
- C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water

- D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.04 INSTALLATION OF TAPERED RIGID INSULATION AND RIGID COVERBOARD

- A. General: Install materials in strict conformance with the manufacturer's published instructions. Roof insulation shall be installed whereby the long dimension of the board(s) run in parallel alignment and the short dimensions are staggered.
- B. Boards shall be installed with minimum joint dimensions and shall be tightly butted where possible. Maximum joint widths shall be 3/8-inch. Damaged corners shall be cut out and replaced with an insulation piece a minimum of 12 inch x 12 inch. Pieces which are cut from larger panels and are smaller than one square foot will not be accepted.
- C. Install no more material than can be covered during the same working day.
- D. Taper roof insulation to drain sumps using tapered edge strips. If an insulation layer is 1-1/2 inches or less, taper 12 inches from the drain bowl. If insulation thickness exceeds 1-1/2 inches, taper 18 inches from the drain bowl. All taper boards or pieces must be adhered or mechanically fastened with a minimum of two fasteners per board.
- E. When a cover board and/or multiple layers are installed, each layer should be offset from the previous layer a minimum of 12 inches on center.
- F. At the end of each working day, provide a weathertight cover on all unused insulation as to avoid moisture penetration.

3.05 INSTALLATION HOT APPLIED ROOF SYSTEM

- A. Base/Felt Ply(s): Install base sheet or felt plies in twenty five (25) lbs (11.3kg) per square of bitumen shingled uniformly to achieve one or more plies over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof. Do not step on base rolls until asphalt has cooled, fish mouths should be cut and patched.
 - 1. Lap ply sheet ends 8 inches (203 mm). Stagger end laps 2 inches (304mm) minimum.
 - 2. Install base flashing ply to all perimeter and projection details after membrane application.
 - 3. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
 - 4. Install base flashing ply to all perimeter and projection details.
 - 5. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.
- B. Modified Cap Ply(s): Solidly bond the modified membrane to the base layers with specified material at the rate of 25 to thirty 30 lbs. (11-13kg) per 100 square feet.

1. Roll must push a puddle of hot material in front of it with material slightly visible at all side laps. Use care to eliminate air entrapment under the membrane. Exercise care during application to eliminate air entrapment under the membrane.
 2. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.
 3. Install subsequent rolls of modified membrane as above with a minimum of 4 inch (101 mm) side laps and 8 inch (203 mm) end laps. Stagger end laps. Apply membrane in the same direction as the previous layers but stagger the laps so they do not coincide with the laps of the base layers.
 4. Apply hot material no more than 5 feet (1.5 m) ahead of each roll being embedded.
 5. Extend membrane 2 inches (50 mm) beyond top edge of all cants in full moppings of the specified hot material.
- C. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.
- D. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.
1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
 2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
 3. Nailer lengths should be spaced with a minimum 1/8 inch gap for expansion and contraction between each length or change of direction.
 4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.
- E. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07620 or Section 07710. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.
- F. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.
- G. Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
 2. Prepare all walls, penetrations, expansion joints and surfaces to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

3. Adhere to the underlying base flashing ply with specified hot material unless otherwise noted in these specifications. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
 4. Solidly adhere the entire sheet of flashing membrane to the substrate.
 5. Seal all vertical laps of flashing membrane with a three-course application of trowel-grade mastic and mesh.
 6. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work as specified.
 7. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.
- H. Flood Coat/Aggregate:
1. Install after cap sheets and modified flashing, tests, repairs and corrective actions have been completed and approved.
 2. Apply flood coat materials in the quantities recommended by the manufacturer.
 3. Uniformly embed aggregate in the flood coat of cold adhesive at a rate recommended by the manufacturer.
 4. Aggregate must be dry and placed in a manner required to form a compact, embedded overlay. To aid in embedment, lightly roll aggregate.
- I. Flashing Cap Ply: Install flashing cap sheets by the same application method used for the cap ply.
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
 2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
 3. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
 4. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
 5. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.
 6. All stripping shall be installed prior to flashing cap sheet installation.
 7. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.
 8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.
- J. Roof Walkways: Provide walkways in areas indicated on the Drawings.

3.06 INSTALLATION EDGE TREATMENT AND ROOF PENETRATION FLASHING

- A. Scupper Through Wall:

1. Inspect the nailer to assure proper attachment and configuration.
 2. Run base ply over nailer, into scupper hole and up flashing as in typical wall flashing detail. Assure coverage of all wood nailers.
 3. Install a scupper box in a 1/4 inch (6 mm) bed of mastic. Assure all box seams are soldered and have a minimum 4 inch (101 mm) flange. Make sure all corners are closed and soldered. Prime scupper and allow to dry.
 4. Fasten flange of scupper box every 3 inches (76 mm) o.c. staggered.
 5. Strip in flange of scupper box with base flashing ply covering entire area with 6 inch (152 mm) overlap on to the field of the roof and wall flashing.
 6. Then install thermoplastic cap field ply run over the base flashing ply in bitumen or foam adhesive.
 7. Install a second ply of thermoplastic flashing cap ply heat welded over the thermoplastic cap ply, 9 inches (228 mm) on to the field of the roof.
 8. Heat weld a cover strip over all seams.
- B. Scupper Through Wall (Overflow):
1. Inspect the nailer to assure proper attachment and configuration.
 2. Run base ply over nailer up the overflow, into the scupper hole and up flashing as in typical wall flashing detail. Assure coverage of all wood nailers.
 3. Install scupper box in a 1/4 inch (6 mm) bed of mastic. Assure all box seams are soldered and have a minimum 4 inch (101 mm) flange. Make sure all corners are closed and soldered. Prime scupper and allow to dry.
 4. Fasten flange of scupper box every 3 inches (76 mm) o.c. staggered.
 5. Strip in flange scupper box with base flashing ply covering entire area with 6 inch (152 mm) overlap on to the field of the roof and wall flashing.
 6. Then install thermoplastic cap field ply run over the base flashing ply in bitumen or foam adhesive.
 7. Install a second ply of thermoplastic flashing cap ply heat welded over the thermoplastic cap ply, 9 inches (228 mm) on to the field of the roof.
 8. Heat weld a cover strip over all seams.
- C. Coping Cap:
1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Maximum flashing height is 24 inches (609 mm). Prime vertical wall and allow to dry.
 2. Set cant in bitumen. Run all base field plies over cant a minimum of 2 inches (50 mm).
 3. Install base flashing ply covering entire wall and wrapped over top of wall and down face with 6 inches (152 mm) on to the base field ply and set in bitumen. Nail base flashing ply at 8 inches (203 mm) o.c. on the back side of the parapet wall.
 4. Then install thermoplastic cap field ply run over the base flashing ply in bitumen or foam adhesive.
 5. Install a second ply of thermoplastic flashing cap ply heat welded over the thermoplastic cap field ply, 9 inches (228 mm) on to the field of the roof.
 6. Heat weld a cover strip over all seams.
 7. Install continuous cleat and fasten at 6 inches (152 mm) o.c. to outside wall.
 8. Install new metal coping cap hooked to continuous cleat.

9. Fasten inside cap 24 inches (609 mm) o.c. with approved fasteners and neoprene washers through slotted holes, which allow for expansion and contraction.
- D. Reglet Mounted Counterflashing:
1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Maximum flashing height is 24 inches. Prime vertical wall and allow to dry.
 2. Set cant in bitumen. Run all base field plies over cant a minimum of 2 inches (50 mm).
 3. Install base flashing ply covering wall set in bitumen with 6 inches (152 mm) on to the base field ply and set in bitumen.
 4. Then install thermoplastic cap field ply run over the base flashing ply in bitumen or foam adhesive.
 5. Install the thermoplastic flashing ply in bitumen or foam over the base flashing ply, 9 inches (228 mm) on to the field of the roof.
 6. Apply butyl tape to wall behind flashing. Secure termination bar through flashing, butyl tape and into wall. Alternatively use caulk to replace the butyl tape.
 7. Cut reglet in masonry one joint above flashing.
 8. Secure reglet counterflashing with expansion fasteners and caulk reglet opening.
- E. Equipment Support:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical and allow to dry.
 2. Set cant in bitumen. Run all base field plies over cant a minimum of 2 inches (50 mm).
 3. Install base flashing ply covering the curb set in bitumen with 6 inches (152 mm) on to the base field ply and set in bitumen.
 4. Then install thermoplastic cap field ply run over the base flashing ply in bitumen or foam adhesive.
 5. Install the thermoplastic flashing ply in bitumen or foam over the base flashing ply, 9 inches (228 mm) on to the field of the roof.
 6. Install pre-manufactured cover. Fasten sides at 24 inches (609 mm) o.c. with fasteners and neoprene washers. Furnish all joint cover laps with butyl tape between metal covers.
 7. Set equipment on neoprene pad and fasten as required by equipment manufacturer.
- F. Curb Detail/Air Handling Station:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical and allow to dry.
 2. Set cant in bitumen. Run all base field plies over cant a minimum of 2 inches (50 mm).
 3. Install base flashing ply covering the curb set in bitumen with 6 inches (152 mm) on to the base field ply and set in bitumen.
 4. Then install thermoplastic cap field ply run over the base flashing ply in bitumen or foam adhesive.
 5. Install the thermoplastic flashing ply in bitumen or foam over the base flashing ply, 9 inches (228 mm) on to the field of the roof.
 6. Install pre-manufactured counterflashing with fasteners and neoprene washers or per manufacturer's recommendations.
 7. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

G. Roof Drain:

1. Plug drain to prevent debris from entering plumbing.
2. Taper insulation to drain minimum of 24 inches (609 mm) from center of drain.
3. Run roof system base plies over drain. Cut out plies inside drain bowl.
4. Set lead/copper flashing (30 inch square minimum) in 1/4 inch bed of mastic. Run lead/copper into drain a minimum of 2 inches (50 mm). Prime lead/copper and allow to dry.
5. Install base flashing ply (40 inch square minimum) in bitumen.
6. Install thermoplastic cap ply (48 inch square minimum) in bitumen or foam adhesive.
7. Install clamping ring and assure that all plies are under the clamping ring.
8. Remove drain plug and install strainer.

H. Plumbing Stack:

1. Minimum stack height is 12 inches (609 mm).
2. Run roof base ply over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install thermoplastic cap ply in bitumen or foam adhesive.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1 inch (25 mm) down inside of stack.

3.07 CLEANING

- A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.
- B. Remove asphalt markings from finished surfaces.
- C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.08 PROTECTION

- A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.
- B. Protect exposed surfaces of finished walls with tarps to prevent damage.
- C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch (16 mm) thick.
- D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.
- E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.09 FIELD QUALITY CONTROL

- A. Inspection: Provide manufacturer's field observations at start-up and at intervals of approximately 30 percent, 60 percent and 90 percent completion. Provide a final inspection upon completion of the Work.
 - 1. Warranty shall be issued upon manufacturer's acceptance of the installation.
 - 2. Field observations shall be performed by a Sales Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
 - 3. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
 - 4. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

3.10 SCHEDULES

A. Base (Ply) Sheet:

- 1. StressBase 120: 120 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet with dual fiberglass reinforced scrim, performance requirements according to ASTM D 5147.
 - a. Tensile Strength, ASTM D 5147
 - 1) 2 in/min. @ 0 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
 - 2) 50mm/min. @ -17.78 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
- 2. Tear Strength, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 100 lbf XD 85 lbf
 - b. 50mm/min. @ 23 +/- 2 deg. C MD 444 N XD 378 N
- 3. Elongation at Maximum Tensile, ASTM D 5147
 - a. 2 in/min. @ 0 +/- 3.6 deg. F MD 4 % XD 4 %
 - b. 50mm/min @ -17.78 +/- 2 deg. C MD 4 % XD 4 %
- 4. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)

B. Thermoplastic/Modified Cap (Ply) Sheet:

- 1. StressPly E (Environmental): 115 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) rubber modified roofing membrane reinforced with a dual fiberglass scrim and polyester scrim. ASTM D 6162, Type III Grade S:
- 2. Tensile Strength, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf/in XD 550 lbf/in
 - b. 50 mm/min. @ 23 +/- 2 deg. C MD 87.5 kN/m XD 96.25 kN/m
- 3. Tear Strength, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 900 lbf XD 950 lbf
 - b. 50 mm/min. @ 23 +/- 2 deg. C MD 4003 N XD 4226 N
- 4. Elongation at Maximum Tensile, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
 - b. 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
- 5. Low Temperature Flexibility, ASTM D 5147, Passes -30 deg. F (-34 deg. C)

C. Interply Adhesive:

1. Generic Type III Asphalt: Hot Bitumen, ASTM D 312, Type III steep asphalt having the following characteristics:
 - a. Softening Point 185 deg. F - 205 deg. F
 - b. Flash Point 500 deg. F
 - c. Penetration @ 77 deg. F 15-35 units
 - d. Ductility @ 77 deg. F 2.5 cm
- D. Flashing Base Ply:
1. VersiPly 40: 40 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet with dual fiberglass reinforced scrim.
 2. Tensile Strength, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 215 lbf/in XD 215 lbf/in
 - b. 50 mm/min. @ 23 +/- 2 deg. C MD 37.5 kN/m XD 37.5 kN/m
 3. Tear Strength, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 275 lbf XD 275 lbf
 - b. 50 mm/min. @ 23 +/- 2 deg. C MD 1223 N XD 1223 N
 4. Elongation at Maximum Tensile, ASTM D 5147
 - a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 4.5% XD 4.5%
 - b. 50 mm/min. @ 23 +/- 2 deg. C MD 4.5% XD 4.5%
 5. Low Temperature Flexibility, ASTM D 5147
 - a. Passes -30 deg. F (-34 deg. C). Meets or Exceeds ASTM D 4601 Type II Performance Criteria.
- E. Flashing Ply Adhesive:
1. Generic Type III Asphalt: Hot Bitumen, ASTM D 312, Type III steep asphalt having the following characteristics:
 - a. Softening Point 185 deg. F - 205 deg. F
 - b. Flash Point 500 deg. F
 - c. Penetration @ 77 deg. F 15-35 units
 - d. Ductility @ 77 deg. F 2.5 cm
- F. Surfacing:
1. Flood Coat/Aggregate:
 - a. White-Star with All-Knight Primer: Polyurea flood coat adhesive: White Star; one-component, flexible, low odor, polyurea roof adhesive top coat. Performance Requirements:
 - 1) Non-Volatile Content ASTM D 2369 89%
 - 2) Density 9.85 lbs./gal.
 - 3) V.O.C. Less than 130 g/L
 - 4) Viscosity at 77 deg. F Brookfield viscometer 60 poise
 - 5) Flash Point ASTM D 93 120 deg. F (41 deg. C)
 - 6) Roofing Aggregate: ASTM D 1863
 - a) Slag.
 - b) Pea gravel.
 - c) White spar.
 2. Flashing Cap (Ply) Sheet:
 - a. StressPly E FR Mineral (Environmental): 160 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) mineral surfaced rubber

modified roofing membrane with fire retardant characteristics and reinforced with a dual fiberglass scrim and polyester scrim. ASTM D 6162, Type III Grade G

- 1) Tensile Strength, ASTM D 5147
 - a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf/in XD 550 lbf/in
 - b) 50 mm/min. @ 23 +/- 2 deg. C MD 87.5 kN/m XD 96.25 kN/m
- 2) Tear Strength, ASTM D 5147
 - a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 900 lbf XD 950 lbf
 - b) 50 mm/min. @ 23 +/- 2 deg. C MD 4003 N XD 4226 N
- 3) Elongation at Maximum Tensile, ASTM D 5147
 - a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
 - b) 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
- 4) Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)

END OF SECTION

SECTION 07 72 33

ROOF HATCHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Factory-fabricated roof hatches for equipment access.

1.02 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a watertight installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected Work.
 - 1. Hatch Units: Show types, elevations, thickness of metals, and full size profiles.
 - 2. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.
 - 3. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of unit.
- B. Product Data: Manufacturer's technical data for each type of hatch assembly, including setting drawings, templates, finish requirements, and details of anchorage devices.
 - 1. Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
- C. Installation, Operating & Maintenance manuals
- D. Warranty: Submit executed copy of manufacturer's standard warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 5 years experience installing similar products.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.06 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard 5-year warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS (Not Used)

2.01 MANUFACTURERS

- A. The BILCO Company
- B. Babcock-Davis
- C. Or equal.

2.02 ROOF HATCH

- A. Metal roof hatch for equipment access, 48" wide x 48" long. Length denotes hinge side. The roof hatch shall be single leaf, 90-degree opening. The roof hatch shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
 - 1. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
 - 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 - 3. Operation of the cover shall not be affected by temperature.
 - 4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.
- C. Cover: Shall be minimum 11 gauge aluminum. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation:
 - 1. Fiberglass, polystyrene or polyisocyanurate
 - 2. Nominal 1" thickness
 - 3. Fully covered and protected by an 18 gauge (minimum) aluminum liner.
- E. Curb: Shall be 12" in height , minimum 11 gauge aluminum. The curb shall be formed with a 3-1/2" flange with pre-drilled holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1" thickness on outside of curb.

- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing.
- H. Hardware
 - 1. Heavy pintle hinges shall be provided
 - 2. Cover shall be equipped with a spring latch with interior and exterior turn handles
 - 3. Roof hatch shall be equipped with interior and exterior padlock hasps.
 - 4. The latch strike shall be a stamped component bolted to the curb assembly.
 - 5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" diameter red vinyl grip handle to permit easy release for closing.
 - 6. Hardware: All hardware shall be zinc plated and chromate sealed.
 - 7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
- I. Finishes: Factory finish shall be mill finish aluminum.

PART 3 - EXECUTION (Not Used)

3.01 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion
- B. Verify that deck, curbs, roof membrane, base flashing, and other items affecting Work of this Section are in place and positioned correctly.
- C. Verify tolerances and correct improper condition
- D. Identify conditions detrimental to providing proper quality and timely completions of work.
- E. Do not proceed with installation until detrimental conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's recommendations.
- B. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, and base flashing.
- C. Coordinate installation of sealant and roofing cement with Work of this Section to ensure water tightness.
- D. Securely anchor roof accessories in compliance with manufacturer's instructions.
- E. Set units plumb, level, and true to line without warp or rack. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed

surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

- F. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal

3.03 FIELD QUALITY CONTROL

- A. Test units for proper function and adjust until proper operation is achieved.
- B. Repair finishes damaged during installation.
- C. Restore finishes so no evidence remains of corrective work.
- D. Do not paint the internal mechanisms, especially moving parts such as spring/dampers and rotary latches. Painting any of these components may void the warranty.

3.04 ADJUSTING AND CLEANING

- A. Adjust movable parts for smooth operation.
- B. Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.
- C. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 08 11 00

STEEL DOORS, FRAMES AND HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Steel Fire Resistive Rated and Non-fire Resistive Rated:

1. Doors.
2. Door frames.
3. Combination door frames and window frames
4. Door Hardware

B. Related Sections:

1. Section 03 30 00 - Cast in Place Concrete
2. Section 04 20 00 - Masonry
3. Section 09 90 00 – Painting and Coating

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include cost of such work in facilities requiring steel doors, frames, and hardware.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. A 366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality.
2. A 525 - Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.
3. A 526 -Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process Commercial Quality.
4. A 569 Standard Specification for Steel, Carbon (0.5 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
5. E 152 - Standard Methods of Fire Tests of Door Assemblies.

B. Uniform Building Code (UBC) Standards:

1. CBC 703 – Fire-Resistance Ratings and Fire Tests

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. HMMA 810 - Hollow Metal Doors.
2. HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.

D. National Fire Protection Association (NFPA):

1. 80 - Fire Doors and Windows.

- E. Steel Door Institute (SDI):
 - 1. 100 - Standard Steel Doors and Frames.
 - 2. 117 - Manufacturing Tolerances Standard Steel Doors and Frames.
- F. Underwriters Laboratories Inc. (UL):
 - 1. 10B - Fire Tests of Door Assemblies.
- G. American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association (BHMA)
 - 1. A156.1 through A156.20: Standards for hardware items as sponsored and published by BHMA

1.04 SUBMITTALS

- A. Product Data.
- B. Shop Drawings: Show the following with references to the Engineer's door marks and hardware groups:
 - 1. Location of door and frame types.
 - 2. Details of fabrication, including core construction, glass lights, louvers, weatherstripping, and factory finish for each door.
 - 3. Cut-outs and reinforcements for hardware.
 - 4. Methods of installation and anchorage to adjacent construction.
- C. Certificates of Compliance: Submit certificates certifying compliance with designated standards, governing codes, and applicable labeling agencies.
- D. Manufacturer's Instructions: Submit manufacturer's installation instructions.
- E. Certifications: Manufacturer's certification that oversize fire-resistive doors conform to Specifications.
- F. Color Chips: Provide color chips as needed for selection by the Owner.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Approved by ultimate enforcing authority for the Project; regularly engaged in inspection of materials and workmanship at factory.
- B. Pre-finished steel doors and frames shall be furnished as a unit, complete with hardware by a single manufacturer, complying with product standards, features, and construction specified herein.
- C. Assembly and installation, including field modifications, shall be performed by qualified workmen.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Before delivery, identify type and size of each door and frame in such a way that markings will not damage finish.

- B. Preassemble door frames in shop and deliver to Project site with spreader bar at sill or tie them in pairs to form box.
- C. Protect doors and frames with resilient packaging sealed with heat shrunk plastic. Break seal on-site to permit ventilation.
- D. Protect doors and frames during shipment and storage to prevent warping, bending, and corrosion.

1.07 SEQUENCING AND SCHEDULING

- A. Ensure timely delivery of reviewed hardware schedule and hardware templates such that no delay occurs in the work of the Contract.

PART 2 - PRODUCTS

2.01 HOLLOW METAL DOORS

A. Materials

1. Sheet Steel: ASTM A 366, commercial quality, level, cold rolled steel, or ASTM A 569, hot rolled, pickled and oil rolled steel. Galvanize by hot-dip process with zinc-coating conforming to ASTM A 525 and A 526 A 60, with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side).
2. Face sheets shall be 14 gauge steel.
3. Clips, Bolts, Screws, and Rivets: Sized as recommended by manufacturer.

B. Construction

1. All doors shall be of the types and sizes shown on the plans and shall be constructed in accordance with the specifications.
2. Door face sheets shall be joined at their vertical edges with no visible seams on their faces. Minimum door thickness shall be 1.75-inches.
3. Face sheets shall be stiffened by 22 gauge steel stiffeners welded in place no more than 6 inches apart with the void between the stiffeners filled with fiberglass insulation.
4. Door edges shall be constructed as follows:
 - a. Door faces shall be joined at their vertical edges by a continuous weld extending the full height of the door. All such welds to be ground, filled, and dressed smooth to make them invisible and provide a smooth flush surface.
 - b. Top and bottom edges shall be closed with continuous 16 gauge steel channels, spots welded to both faces.
5. All hardware furnished for single acting doors shall be designed for beveled edges.
6. Hardware reinforcements:
 - a. Doors shall be mortised, reinforced at the factory for fully templated mortised hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface mounted or non-templated hardware is to be applied, doors shall have reinforcing plates only.
 - b. Minimum gauges for hardware reinforcing plates shall be as follows:
 - 1) Full mortise hinges and pivots – 7 gauge

- 2) Reinforcements for lock face, flush bolts – 10 gauge
 - 3) Reinforcements for all other surface mounted hardware – 12 gauge
7. Finish: After fabrication, all tool marks and surface blemishes shall be filled and sanded as required to make both faces and both vertical edges smooth and free from irregularities. After appropriate preparation, all exposed surfaces shall receive a rust inhibitive primer which meets or exceeds ASTM B 117 salt spray for 150 hours and ASTM D 1735 water fog test for organic coatings for 200 hours and which is fully cured prior to shipment.

2.02 DOOR FRAMES

A. Materials:

1. Frames shall be made of commercial grade 14 gauge cold-rolled steel conforming to ASTM A 366 or hot-rolled, pickled and oiled steel conforming to ASTM A 569 and shall have a zinc coating supplied by the hot-dip process conforming to ASTM A 526 (A60 or G60) with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side).

B. Design and Construction

1. All frames shall be welded units with integral trim.
2. All finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp or buckle. Molded members shall be clean cut, straight and of uniform profile through their lengths.
3. Jamb, head, mullion and sill profiles shall be in accordance with the frame schedule.
4. Corner joins at welded corners shall have all contact edges closed tight, with trim faces mitered and continuously welded, and stops mitered.
5. At drywall partitions, knocked down frames may be furnished. Knocked down frames shall be the pressure fit type that is installed after the partition is in place. Frames are to be anchored at the bottom of each jamb. Additional pressure fit type anchors are to be furnished at the mitered corners.
6. Minimum depth of stop shall be 5/8-inch
7. Frames for multiple or special openings shall have mullion and/or rail members which are closed tubular shapes having no visible seams or joints. All joints between faces of abutting members shall be securely welded and finished smooth.
8. Hardware reinforcements:
 - a. Frames shall be mortised, reinforced at the factory for fully templated mortised hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface mounted or non-templated hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:
 - 1) Hinge – 7 gauge x 1.25" x 10" minimum size
 - 2) Strike reinforcement – 12 gauge
 - 3) Flush bolt reinforcements – 12 gauge
 - 4) Closer reinforcements – 12 gauge
 - 5) Reinforcements – 12 gauge
9. Floor anchors:
 - a. Floor anchors shall be securely welded inside each jamb or floor anchorage.
 - b. Minimum thickness of floor anchors shall be 18 gauge.

10. Jamb anchors:
 - a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16 gauge steel.
 - b. Welded frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than 18 gauge thickness secured inside each jamb.
11. Plaster guards made from no less than 22 gauge thick steel shall be welded in place at all hardware mortises on frames to be set in masonry or concrete openings.
12. All welded frames shall be provided with a temporary steel spreader welded to the feet of jambs to serve as bracing during shipping and handling. The steel spreader shall not be used for installation purposes.
13. Finish: After fabrication, all tool marks and surface imperfections shall be removed, and exposed faces of all welded joints shall be dressed smooth. Frames shall be treated to insure maximum paint adhesion and shall be coated on all accessible surfaces with a rust inhibitive primer which meets or exceeds ASTM B 117 salt spray for 150 hours and ASTM D 1735 water fog test for organic coatings for 200 hours and which is fully cured prior to shipment.

2.03 DOOR CLEARANCES

- A. Edge clearances shall not exceed the following:
 1. Between doors and frames at head and jambs – 3/16”
 2. Between the edges of pairs of doors – 3/16”

2.04 HARDWARE

- A. All finished hardware shall conform to US26D or US28 and be carefully packed in separate clearly labeled boxes complete with all screws, expansion shields, and necessary fittings.
- B. Provide door-operating hardware in accordance with the schedule provided in Article E below. Coordinate standard key locks with Owner.
 1. Hinges:
 - a. Template screw hole locations.
 - b. Heavy Weight; minimum of 4 permanently lubricated non-detachable bearings.
 - c. Equip with easily seated, non-rising pins; NRP on all out-swing locking doors.
 - d. Sufficient size to allow 180-degree swing of door.
 - e. Furnish hinges with five knuckles and flush bearings.
 - f. Provide all hinges in brass based non-ferrous material with chrome plating.
 - g. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
 - h. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish.
 - i. UL10B listed for Fire.
 2. Mortise Type Locks and Latches:
 - a. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
 - b. Fit ANSI A115.1 door preparation.
 - c. Functions and design as indicated in the hardware groups.

- d. One or Two-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel.
 - e. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel.
 - f. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended.
 - g. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated.
 - h. Provide sufficient curved strike lip to protect door trim.
 - i. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable.
 - j. Lock shall have self-aligning, thru-bolted trim.
 - k. Levers to operate a roller bearing spindle hub mechanism.
 - l. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
 - m. Spindle to be designed to prevent forced entry from attacking of lever.
 - n. Provide locksets with 5-pin removable and interchangeable core cylinders.
 - o. Each lever to have independent spring mechanism controlling it.
 - p. Core face must be the same finish as the lockset.
3. Exit Devices:
- a. Tested and approved by BHMA for ANSI 156.3, Grade 1.
 - b. Provide a deadlocking latchbolt.
 - c. Non-fire rated exit devices shall have cylinder dogging.
 - d. Touchpad shall be "T" style.
 - e. Exposed components shall be of architectural metals and finishes.
 - f. Lever Trim shall be ANSI Function 08 and handle design shall match lockset lever design.
 - g. Provide vandal resistant or breakaway trim.
 - h. Provide strikes as required by application.
 - i. Fire exit devices to be listed for UL10C.
 - j. UL listed for Accident Hazard.
4. Stops and Bumpers:
- a. BHMA A156.16. Provide Wall or Floor type with feature as indicated.
5. Door Gasketing:
- a. BHMA A156.22. Provide with Aluminum Retainer Type Seals, Head and Jambs. Provide Astragals for Pairs.
6. Thresholds:
- a. BHMA A156.21. Provide 5 inch wide with Bumper seals as required.
- C. Functions and design as indicated in the hardware groups. All operating hardware Heavy Duty Commercial.
- D. Hardware Groups (Description / Product Number / Finish)
- 1. Group A
 - a. 4 Hinges / Stanley FBB199 4 ½ x 4 ½ NRP / US26D
 - b. 1 Exit Device - Rim Fire Exit Device with dull chromium finish, Lever – Night Latch with standard lever style / Von Duprin 99L-NL-06-F / US26D

- c. 1 Rim Cylinder / Schlage Full Size Interchangeable Core (5pin) with C-Keyway, Schlage cylinder housing / 626
 - d. 1 Closer –with door stop and hold open feature / Norton UNI 7500 / Cast Al 689 finish
 - e. 1 Kick Plate / Trimco K0050 / BHMA 630 satin stainless steel
 - f. 1 Threshold / Pemko 2005 AV / Al with mill finish
 - g. 1 Weatherstrip / Pemco 289APK at head, 290APK at jambs / mill finish Al with neoprene gasket (PemkoPrene)
 - h. 1 Door Sweep / Pemko 315 CN / anodized Al with black vinyl insert
 - i. 1 Drip Cap / Pemko 346 C / Clear anodized Al
2. Group B
- a. 8 Hinges / Stanley FBB199 4 ½ x 4 ½ NRP / US26D
 - b. (Active Door) 1 Exit Device - Rim Fire Exit Device with dull chromium finish, Lever – Night Latch with standard lever style / Von Duprin 9927L-NL-06-F / US26D
 - c. (Active Door) 1 Rim Cylinder / Schlage Full Size Interchangeable Core (5pin) with C-Keyway, Schlage cylinder housing / 626
 - d. (Passive Door) 1 Exit Device - Rim Fire Exit Device with dull chromium finish, Lever – Exit Only, no lever / Von Duprin 9927-EO-F / US26D
 - e. 2 Closers –with door stop and hold open feature / Norton UNI 7500 / Cast Al 689 finish
 - f. 2 Kick Plates / Trimco K0050 / BHMA 630 satin stainless steel
 - g. 1 Threshold / Pemko 2005 AV / Al with mill finish
 - h. 1 Weatherstrip / Pemco 289APK at head, 290APK at jambs / mill finish Al with neoprene gasket (PemkoPrene)
 - i. Weatherstrip: Provide weatherstrip between double doors.
 - j. 2 Door Sweeps / Pemko 315 CN / anodized Al with black vinyl insert
 - k. 1 Drip Cap / Pemko 346 C / Clear anodized Al

2.05 HARDWARE PREPARATION

- A. Cut-out, drill, and reinforce frames and doors for hardware in accordance with hardware templates.
- B. Install plaster guards or mortar boxes in back of hardware cut-outs in and welded to frames.
- C. Prepare fire resistive rated doors for hardware in accordance with requirements of labeling authority.
- D. Do not weld hinges to door frames.
- E. Silencers:
 - 1. Drill single leaf door frame jamb stops for minimum 3 silencers.
 - 2. Drill double-leaf door frame Head stops for minimum 2 silencers.
 - 3. Do not drill door frames for silencers when weatherstripping is to be installed.

2.06 FINISHING

- A. Thoroughly clean surfaces of oil, grease, and other impurities; touch-up abraded galvanizing; and chemically etch.
- B. Fill irregularities and sand smooth finish surface.
- C. Apply 1 coat of manufacturer's standard rust inhibitive baked-on primer.
- D. Finish Painting: As specified in Section 09 90 00.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine reviewed hardware schedules and verify proper coordination of hardware and doors and frames.
- B. Examine Opening Locations and Verify Following:
 - 1. Correctness of dimensions, backing or support conditions.
 - 2. Absence of defects that would adversely affect frame or door installation.

3.02 INSTALLATION

- A. Install doors and frames in accordance with approved shop drawings and manufacturer's instructions.
- B. Frames:
 - 1. Set accurately in position, plumb, align, and attach securely to structure.
 - 2. Anchor frames to previously placed and cured concrete.
 - 3. Set frames before removing spreader bars.
 - 4. Fully grout frames in concrete openings.
 - 5. Grout frames at concrete through keyways provided at head and jambs.
- C. Doors: Install at correct openings, ensure smooth swing and proper closure with frame.
- D. Fire Resistive Frames and Doors: Install to conform to NFPA 80 for fire resistive rated class as indicated on the Drawings.
- E. Door Hardware: Install in accordance with manufacturers' recommendations.
- F. Separate or isolate dissimilar metals with neoprene gaskets, sleeves, and washers, or with coatings acceptable to the Engineer.

3.03 TOLERANCES

- A. Manufacturing and Installation Tolerances: As indicated on the Drawings or in conformance to SDI 117 as minimum.

3.04 ADJUSTING AND CLEANING

- A. Prime Coat Touch-up: Immediately after installation, sand smooth and touch-up rust areas and other areas where primer has been damaged, with prime touch-up paint.
- B. Make adjustments as required for correct, proper, and free function and smooth operation without binding of hardware or doors and frames.
- C. Protect doors and frames from damage to surface or profile.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.02 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of locking devices, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Closeout Submittals:
 - 1. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
- B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.03 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Overhead Door Company or equal
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. when tested according to ASTM E 283..
- D. STC Rating: 26.
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch, fabricated from aluminum extrusions.
- H. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish..
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.

2.04 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Aluminum Door Curtain Slats: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch and as required.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.06 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
 - 2. Stainless Steel: 0.025-inch- (0.64-mm-) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
 - 3. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
 - 4. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
 - 5. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.07 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Chain Lock Keeper: Suitable for padlock.

2.08 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.

2.09 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft.of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
 - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.03 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.04 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 62 13

DOMED UNIT SKYLIGHTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Curb-mounted domed unit skylights.

1.02 RELATED SECTIONS

- A. Section 01 33 14 – Wind Design Criteria
- B. Section 07 55 00 – Modified Bituminous Membrane Roofing.

1.03 REFERENCES

- A. Aluminum Association (AA) M12C22A41 - Anodized Plus Finish.
- B. American Architectural Manufacturer's Association (AAMA) 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- C. Architectural Aluminum manufacturers Association (AAMA) 607.1 - Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
- D. American Society for Testing and Materials (ASTM) B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. American Society for Testing and Materials (ASTM) C1048 - Standard Specification for Heat-Treated Flat Glass Kind HS, Kind FT Coated and Uncoated Glass.
- F. American Society for Testing and Materials (ASTM) E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- G. American Society for Testing and Materials (ASTM) E773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units.
- H. American Society for Testing and Materials (ASTM) E774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units.
- I. AWS Structural Welding Code.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.

- B. Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Indicate materials, finishes and installation procedures recommended by manufacturer.
 - 4. Indicate compliance with specified design criteria.
 - 5. Indicate compliance with performance requirements.
 - 6. Include product specific glazing details.
- C. Shop Drawings:
 - 1. Indicate material types, gauges and finishes, fabrication details and installation details.
 - 2. Show glazing types, methods of attachment and thermal movement provisions.
- D. Indicate compliance with specified structural design criteria.
 - 1. Submitted design calculations shall bear seal of a professional engineer licensed in the State in which the skylight is to be installed.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Skylight manufacturer shall have a minimum of five years experience in skylight manufacturing, qualified by having performed similar work and having experienced workmen to perform work of type required by contract documents and licensed where appropriate.
- B. Installer Qualifications:
 - 1. Installer shall be trained and approved by manufacturer.
 - 2. Installer shall have five years experience with skylight type, size and complexity.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

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

1.08 WARRANTY

- A. Skylights shall be guaranteed for a period of 5 years from date of substantial completion against defects in materials or workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Wasco Skylights (Vellux Group)
- B. Artistic Skylight Domes, Ltd.
- C. American Skylights
- D. Or equal

2.02 SKYLIGHT PERFORMANCE

- A. Load:
 - 1. Deflection of framing members shall not exceed $L/180$ or 1 inch (25 mm) whichever is less.
 - 2. Acrylic and/or polycarbonate unit skylights shall meet the requirements of uniform load test ASTM E330 that requires glazing to withstand a positive and negative test pressure of 60 psf.
- B. Air Infiltration:
 - 1. Acrylic and/or polycarbonate unit skylights shall meet the requirements of ASTM E283 that allows a maximum air infiltration of 0.06 cfm (.0017 cu. m/m) of the total glazed surface area.
- C. Water Infiltration:
 - 1. Acrylic and/or polycarbonate unit skylights shall meet the requirements of ASTM E547/E331 that allows for no water infiltration at a test pressure of 12 psf (571 Pa).

2.03 CURB MOUNT SKYLIGHTS

- A. Curb mount frame shall be extruded aluminum alloy, 6063-T5 alloy, with heliarc welded corners. Frame shall have an integral condensation gutter and weep holes for sufficient drainage to exterior.
- B. Retainer Frame: Extruded aluminum alloy 6063-T5/T6, minimum effective thickness of 0.60 inch.
- C. Glazing shall be clear, sealed double acrylic or polycarbonate domes.
- D. Thermal Break: Fabricate skylight units with thermal chambered PVC frame.
- E. Gaskets: Continuous co-extruded vinyl, neoprene, EPDM or Santoprene rubber, providing an air and water impenetrable barrier between adjacent surfaces.
- F. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal as recommended by manufacturer.
- G. All exposed aluminum to be mill finish.

H. Size as indicated on the Drawings.

2.04 PREFABRICATED CURB

- A. Factory-fabricated curb matched to the skylight being provided:
1. Minimum 9-inch high
 2. Inner and outer walls to be mill finish aluminum, minimum 0.05 inch thickness
 3. Minimum 1-inch insulation between inner and outer walls
 4. 2-inch aluminum mounting flange

2.05 FABRICATION

- A. Skylights shall be factory assembled and shipped as such. Work which cannot be permanently assembled will be shipped in pre-assembled sections to minimize field assembly.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Installer shall inspect area to receive skylights to determine that the conditions are in accordance with shop drawings and specifications. Any variance shall be recorded in writing and corrections made before beginning installation.
- B. Installation shall be in strict accordance with these specifications and the manufacturers shop drawings and installation instructions.
- C. All materials provided by installer shall be in accordance with those shown on the shop drawings.

3.04 PROTECTION

- A. Installer shall remove all labels and protective packaging from components and shall leave the installation free of all heavy construction dirt and sealant smears.
- B. Final cleaning and physical protection of all installed materials shall be performed by the general contractor.
- C. Protect installed products until completion of project.

D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 91 19

FIXED LOUVERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated aluminum louvers.

1.02 REFERENCES

- A. Air Movement and Control Association, Inc. (AMCA)
 - 1. Publication 511, Certified Ratings Program - Product Rating Manual for Air Control Devices
- B. American Architectural Manufacturers Association (AAMA)
 - 1. 2605-13, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

1.03 SUBMITTALS

- A. Shop Drawings: Shop plans shall indicate large scale details of the louvers including their installation, anchorage and relationship to adjoining structures. Actual mounting details may vary according to the manufacturer.
- B. Manufacturer's Literature: The Contractor shall submit descriptive data regarding louvers including standard plans; louver free area; air performance data (pressure drop vs. free area diagram); parts list, if applicable; installation instructions; and maintenance procedures.
- C. Published louver performance data bearing the AMCA Certified Ratings Seal for Air Performance and Water Penetration shall be submitted to demonstrate compliance with these specifications. Indicate factory finish.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.
- B. Louvers shall be designed by a manufacturer who is regularly engaged in the manufacture of such structures. All material shall be new and free from defects.
- C. Like items of equipment provided shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
- D. All louvers furnished under this section shall be rated by the Air Movement and Control Association, Inc. (AMCA). Every louver shall be licensed to bear the AMCA seal.

AMCA ratings for free area and water penetration shall be based on the tests and procedures found in AMCA Publication 511.

1.05 DESIGN REQUIREMENTS

- A. All louvers and fasteners shall be designed to resist a wind load of not less than 25 lb/ft².
- B. Under no circumstances shall design loads be less than those prescribed in the California Building Code. Where more restrictive loading conditions are described herein, they shall supersede those of the CBC.

PART 2 - PRODUCTS

2.01 LOUVER SCHEDULE

- A. Louvers shall be 4-inch deep fixed drainable blade aluminum louvers as shown and detailed on the Drawings.
- B. All louvers supplied shall be of like style from the same manufacturer for uniformity of appearance and finish.
- C. All louvers shall be furnished with interior bird screen, supports, installation hardware and finishes as specified and required for a complete installation.

2.02 FIXED BLADE ALUMINUM LOUVERS

- A. Louvers shall incorporate stationary blades in a single frame. Louvers shall be 4 inches deep and assembled from extruded aluminum components suitable for installation as shown on the plans.
 - 1. Blades and frames shall be 0.081 inch (2 mm) thick extruded aluminum, alloy 6063-T5.
 - 2. Blades shall be stationary and drainable.
- B. Water penetration shall not occur with free air velocities less than 900 feet per minute as established by the AMCA Water Penetration Test.
- C. Minimum net free area shall be 50 percent.
- D. Blades shall be positioned at 35 to 45 degrees and spaced up to 4 inches on center.
- E. Head and jamb frame members shall incorporate integral drainable gutters to provide resistance to water penetration.
- F. Stationary blades, frames, and frame members shall be joined with fillet welds concealed from view.
- G. Vertical mullions shall be concealed.
- H. Interior bird screen shall be aluminum.

- I. Louvers shall be:
 1. Airolite Model K638HP as designed and manufactured by the Airolite Company LLC, Marietta, Ohio
 2. Architectural Louvers Model E4DP, as designed and manufactured by Architectural Louvers Company, 266 W. Mitchell Ave, Cincinnati, Ohio
 3. Or approved equal.

2.03 FACTORY FINISH

- A. Factory finish after assembly shall be polyvinylidene fluoride (PVDF) that meets the performance requirements of AAMA Specification 2605-13.
- B. All fabrications supplied under this section shall have the same factory finish.
- C. Damaged finishes shall be field repaired in kind, following the manufacturer's instructions.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

- A. Materials shall be delivered to the site in a weather protected and undamaged condition and stored out of contact with the ground.
- B. Materials shall be covered with weather tight coverings and kept dry. Storage accommodations shall provide good air circulation and protection from surface staining.

3.02 INSTALLATION

- A. Install louvers in openings properly aligned and level, in accordance with manufacturer's shop drawings.
- B. Secure louver rigid with semi-concealed fasteners to suit materials as being encountered.
- C. Separate aluminum frames from dissimilar metals and concrete with the application of asphaltic paint.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes the materials and application of painting and coating systems for buried and exposed surfaces.
- B. All articles to be painted or coated will be painted or coated in the place of manufacture, unless field painting and coating is absolutely necessary. The Engineer will make the determination. In the event that the paint or coating is damaged in the field, it will be touched up in the same manner as the original paint or coating applied in the place of manufacture.

1.02 RELATED WORK DESCRIBED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Ductile-Iron Pipe and Fittings: 33 11 13.15
 - 2. Steel Pipe: 33 11 13.20
 - 3. Manual Valves 33 12 16
 - 4. Underground Facilities Identification: 33 05 26
 - 5. Water Utility Storage Tanks 33 16 00
 - 6. Automatic Valves 40 92 13

1.03 SUBMITTALS

- A. Submit a Paint Plan for all proposed surfaces. The plan shall identify all materials and procedures, including proposed paint systems, names and experience of personnel to perform the work, proposed surface preparation specifications, required physical and environmental conditions to perform the work and proposed test methods and reporting for both factory and field applications. The plan shall also include proposed maintenance requirements for all surfaces. Samples of field applied paint and coating finishes, colors, and covering shall also be provided. The paint plan and all samples shall be provided at least 60 days prior to start of such finishing operations.

1.04 APPROVED MANUFACTURERS

- A. All materials shall be as manufactured by the companies listed herein or approved equal.
 - 1. Tnemec,

2. Carboline,
3. Dunn-Edwards,
4. International Protective Coatings,
5. Rust-Oleum Corporation,
6. 3M Minnesota Mining and Manufacturer

1.05 COATINGS

- A. All specified materials must meet and comply with National Sanitation Foundation (NSF) and California current air quality regulations governing architectural and industrial coatings.
- B. Organic Zinc Primer
 - Tnemec 90-97
 - Carboline 621
 - Rust-Oleum 7400 System Zinc Chromate Primer
 - Devoe CC 302V
 - International Protective Coatings – Interzinc 52
- C. Epoxy Coating
 1. Field Applied
 - Tnemec Series N69 Epoxoline II
 - Carboline 187
 - Rust-Olem 9100 High Performance Epoxy
 - Devoe BR235H
 - International Protective Coatings – Interguard 475HS
 2. Field or Factory Applied
 - Tnemec Series 140 NSF 61
 - International Protective Coatings – Interline 850 or 925
 - Devoe BR235H
 3. Factory Applied
 - 3M Scotchkote 206N Fusion Bonded Epoxy
 4. Manholes and Lift Stations, Field Applied
 - Raven 405
 - Hydro-Pox GL 212
 - Elastuff 120 hydrophobic Polyurethane Elastomer with Uni-Tile Sealer
- D. Polyurethane
 - Tnemec Series 1075
 - Carboline 134 HS VOC
 - Devoe 379H
- E. Bituminous Mastic Epoxy
 - Carboline 300M
 - Tnemec Series 46H413
 - Rust-Oleum
 - Devoe Devtar SA
- F. Acrylic Primer

International Intercryl 520
Tnemec Series 26 TyCRYL
Rust-Oleum Devoe Devflex 4020

- G. Acrylic Polymer
Tnemec Series 1029

1.06 PAINT SCHEDULE

- A. Aboveground or exposed facilities shall be color-coded per APWA Uniform Color Code for domestic water, recycled water facilities, or wastewater facilities.
- B. Domestic Water System
 - 1. Piping and Equipment: Safety Blue
 - 2. Public Fire Hydrants: Safety Yellow, unless different color is required by local fire jurisdiction. Comply with fire jurisdiction.
 - 3. Private Fire System: Safety Red
 - 4. Guard Posts / Bollards: Safety Yellow
- C. Sewer System
 - 1. Lift Station Piping and Equipment: Safety Green
- D. Recycled Water Facilities: Safety Purple

1.07 PERMITS

- A. All work shall conform to the specifications and requirements of the State of California Department of Transportation, the County, the city having jurisdiction, or and other agencies involved. The contractor shall keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits.

PART 2 - MATERIALS

2.01 ZINC PRIMER

- A. All primer shall contain not less than 79.60% zinc in dry film.
- B. Primer shall be of a different color than the outer coating.

2.02 BITUMINOUS MASTIC

- A. Bituminous mastic shall be coal-tar pitch based.
- B. Bituminous mastic shall have a minimum of 68% solids by volume.

2.03 EPOXY COATING FOR WATER SYSTEM

- A. Epoxy shall meet current local air quality standards and shall not be less than 65% solids.

- B. All coatings and pigments to be used on domestic water services shall have NSF approval for use with domestic water.

2.04 EPOXY COATING FOR WASTEWATER SYSTEM

- A. Epoxy shall meet current local air quality standards and shall be 100% solids.
- B. All coatings and pigments to be used on wastewater services shall be designed for prolonged exposure to hydrogen sulfides.

2.05 COATINGS FOR POTABLE WATER TANKS

- A. Tank Interior (listed or approved equal)
 - 1. Primer and strip coats: Tnemec Series 91-H2O or 94-H2O, Hydro-Zinc (2.5 to 3.5 mils DFT)
 - 2. Intermediate Coat: Tnemec Series 20, Pota-Pox, or L140, Pota-Pox Plus (4.0 to 6.0 mils DFT)
 - 3. Top Coat: same as intermediate coat (4.0 to 6.0 mils DFT)
 - 4. Total thickness: 10.5 to 15.5 mils DFT
- B. Tank Exterior (listed or approved equal)
 - 1. Primer and strip coats: Tnemec Series 91-H2O or 94-H2O, Hydro-Zinc (2.5 to 3.5 mils DFT)
 - 2. Intermediate Coat: Tnemec Series L69, Hi-Build Epoxoline II (4.0 to 6.0 mils DFT)
 - 3. Top Coat: Tnemec Series 1074 Endura-Shield II (4.0 to 6.0 mils DFT)
 - 4. Total thickness: 10.5 to 15.5 mils DFT

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Do not sandblast or prepare more surface area than can be coated in one day. Remove all sharp edges, burrs, and weld spatter. Do not sandblast epoxy-coated pipe that has already been factory coated.

- B. Surface preparation shall conform with the SSPC specifications as described below:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10

- C. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these specifications or in paint manufacturer’s

specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council, Surface Preparation Specifications, ANSI A159.1) specifications listed above.

3.02 PAINTING SYSTEMS

- A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.
- B. Deliver all paints to the job site in the original, unopened containers.

3.03 SURFACES NOT TO BE COATED

- A. The following surfaces shall not be painted and shall be protected during the painting of adjacent areas:
 - 1. Mortar-coated pipe and fittings
 - 2. Stainless steel
 - 3. Metal letters
 - 4. Nameplates
 - 5. Grease fittings
 - 6. Brass and copper, submerged
 - 7. Buried pipe, unless specifically required in the piping specifications
 - 8. Bronze meters and strainers

3.04 PROTECTION OF SURFACES NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.05 FIELD TOUCH UP OF MANUFACTURER-APPLIED PRIME COATS

- A. Surfaces that are primed at the place of manufacture shall receive a field touch-up of organic zinc primer to cover all scratches or abraded areas.

3.06 BITUMINOUS MASTIC

- A. Buried metal (flanges, non-stainless-steel nuts and bolts, flexible couplings, exposed reinforcing steel, etc.) shall be coated with a minimum of 20 mils of bituminous mastic.
- B. All surfaces coated with bituminous mastic shall be covered with 8 mil polyethylene wrap per Section 33 11 13.15, after applying the bitumastic.

3.07 EPOXY COATING OF METAL

- A. Only those metal surfaces specifically called out shall be epoxy coated.
- B. Epoxy lining and coating of valves shall be per AWWA C550 and Section 33 12 16 Manual Valves. All valves shall be lined and coated by manufacturer.
- C. Surfaces to be epoxy coated shall follow the surface preparation requirements as recommended by the manufacturer.
- D. Surfaces shall be coated with organic zinc primer to a dry film thickness of 3 mils.
- E. Apply two coats of epoxy paint (4 mils each) to the primed surface. The manufacturer's recommended drying time between coats shall be followed.
- F. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.08 EPOXY COATING OF CONCRETE

- A. Only those metal surfaces specifically called out shall be epoxy coated.
- B. Surfaces to be epoxy coated shall follow the surface preparation requirements as recommended by the manufacturer.
- C. Apply one or more coats of epoxy paint as needed to achieve a uniform coating thickness of 70 mils, minimum. The manufacturer's recommended drying time between coats shall be followed.
- D. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.09 DRY-FILM THICKNESS TESTING

- A. Measure coating thickness specified for metal surfaces with a majestic-type dry-film thickness gage. Test the finish coat (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Measuring equipment shall be provided by the contractor. Provide detector as manufactured by Tinker and Razor or K-D Bird Dog. Provide dry-film thickness gage as manufactured by Mikrotest or Elcometer. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

- B. If the item has an improper finish color or insufficient film thickness, the surface shall be cleaned and topcoated with the specified paint material to obtain the specified color and coverage. Visible areas of chipped, peeled, or abraded paint shall then be primed and finish coated in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.10 WARRANTY INSPECTION

- A. Warranty inspections shall be conducted during the eleventh (11th) month following completion of all coating work. Personnel present during the pre-construction meeting shall be present at this inspection. All defective work shall be repaired per the approved work plan as submitted by the contractor.

END OF SECTION

SECTION 22 05 53

UNDERGROUND FACILITIES IDENTIFICATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes special identification, markings, materials and their installation procedures for underground water, sewer and recycled water facilities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1. Painting and Coating:	09 90 00
2. General Piping Requirements:	33 11 00
3. Ductile Iron Pipe and Fittings:	33 11 13.15
4. PVC Gravity Sewer Pipe and Fittings:	33 31 11
5. Automatic Valves:	40 92 13
6. Manual Valves:	33 12 16
7. Fire Hydrants:	40 05 81.13

1.03 APPROVED MANUFACTURERS

- A. Warning Tape and Pipe Sleeves
 - 1. Griffolyn, Division of Reef Industries
 - 2. Terra Tape, Division of Reef Industries
 - 3. T. Christy Enterprises, Inc.
- B. Witness Markers
 - 1. Carsonite Water line Markers
 - 2. Or approved equal

1.04 IDENTIFICATION

- A. Ductile iron pipe (DIP) shall be encased within an 8-mil polyethylene sleeve per Section 33 11 13.15. Sleeves for potable water pipe shall be blue with the words "POTABLE WATER" or "DOMESTIC WATER" stenciled in 2-inch black letters. Sleeves for recycled water pipe shall be purple with the words "RECYCLED WATER" stenciled in 2-inch black letters.

- B. PVC pipe carrying potable water shall be blue in color, or shall be installed with a blue 8-mil polyethylene sleeve as for DIP.
- C. PVC pipe carrying recycled water shall be purple in color or shall be installed with a purple 8-mil polyethylene sleeve as for DIP.
- D. PVC pipes for sanitary gravity sewers shall be green in color. PVC pipes for sanitary sewer force mains shall be green in color or shall be installed with a green 8-mil polyethylene sleeve as for DIP.
- E. All water service lateral lines shall be encased within a color-coded 8-mil polyethylene sleeve. Sleeve shall be blue in color for all domestic water services and purple in color for all recycled water services.

1.05 VALVE BOXES

- A. Valve boxes for domestic water systems shall be as specified in Section 33 12 16.
- B. Valve boxes for recycled water facilities shall have circular valve box covers with the inscription "RECYCLED " cast thereon per Section 33 12 16, and shall be painted purple.
- C. All valve boxes installed in unpaved areas (open space areas) shall be marked with a witness pole, in addition to the above referenced markings.

1.06 COLOR AND PAINTING SCHEDULE

- A. Comply with the APWA Uniform Color Code for underground utilities.
- B. Domestic water facilities shall be blue, with the exception of fire hydrants which shall be painted as specified in Section 40 05 81.13. Witness poles for domestic water lines, valves and appurtenances shall be blue.
- C. Sanitary sewer facilities shall be green per Section 09 90 00. Witness poles for sanitary sewer lines and appurtenances shall be green.
- D. Recycled water facilities shall be purple per Section 09 90 00. Witness poles for recycled water lines, valves and appurtenances shall be purple.

1.07 RESTRICTION OF PUBLIC ACCESS TO RECYCLED WATER FACILITIES

- A. All off-site recycled water facilities shall be restricted from public access so that the general public cannot draw water from the system. Facilities such as air release assemblies, blow-off hydrants, blow offs on strainers, and other such facilities, shall be restricted from public access.
- B. Recycled water facilities, both above and below grade, shall be housed in an approved lockable container colored purple. A sign reading "CAUTION: RECYCLED WATER" shall be installed, its size approved by the District representative. Other means of restricting public access may be approved by the District representative.

1.08 RECYCLED WATER WARNING SIGNS AND LABELS

- A. Warning labels shall be installed on all recycled water appurtenances in vaults, such as, but not limited to, air release valves, blow offs, and meters.
- B. Warning signs or labels shall be installed on all exposed recycled water facilities such as, but not limited to, controller panels, irrigation pumps, water trucks and temporary construction services.

PART 2 - MATERIALS

2.01 BURIED PIPING WARNING TAPE

- A. Plastic warning tape shall be an inert plastic film specifically formulated for prolonged underground use. The minimum thickness shall be 4 mils and the minimum width of the tape shall be 6 inches. Printing shall be a minimum of 2-inch block letters.
- B. Warning tape for domestic water pipelines shall be blue with black printing having the words "CAUTION: DOMESTIC WATER-LINE BURIED BELOW."
- C. Warning tape for sanitary sewer pipes shall be green with black printing having the words "CAUTION: SANITARY SEWER BURIED BELOW."
- D. Warning tape for recycled water pipelines shall be purple with black printing having the words "CAUTION: RECYCLED WATER-LINE BURIED BELOW."

2.02 WARNING LABELS FOR RECYCLED WATER FIXTURES

- A. Labels shall be inert plastic film specifically formulated for prolonged exposure and shall be prepared with black printing on a purple field having the words: "CAUTION: RECYCLED WATER – DO NOT DRINK" and "AVISO: AGUA IMPURA – NO TOMAR." The minimum thickness shall be 4 mils for adhesive backed labels and 10 mils for tag type labels. Tag type labels shall have reinforced tie holes and shall be attached with heavy-duty nylon fasteners. The size, type of label and location will be dictated by each individual application and subject to acceptance by the Districts representative. The minimum printing size shall be 1/2-inch letters.

2.03 WARNING SIGNS FOR RECYCLED WATER FACILITIES

- A. Signs shall be metal or rigid plastic designed for outdoor installation, as approved by the District Engineer. Printing shall be black or white on a purple background. Wording shall be in English and Spanish: "CAUTION: RECYCLED WATER – DO NOT DRINK" and "AVISO: AGUA IMPURA – NO TOMAR." Size shall be as indicated on the Drawings. The minimum printing size shall be 1-inch letters.

2.04 WARNING TAGS FOR RECYCLED WATER FACILITIES

- A. Tags shall be weatherproof plastic, 3" by 4", purple in color, with the words "WARNING - RECYCLED WATER - DO NOT DRINK" in English and Spanish. Imprinting shall be permanent and black in color. Use tags manufactured by T. Christy Enterprises or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE WARNING TAPE

- A. Warning tapes shall be installed a minimum 1-foot above and centered on the pipe. The warning tape shall be installed continuously for the length of the pipe and shall be fastened to valve stem casings or other vertical appurtenances by plastic adhesive tape.

3.02 INSTALLATION OF WARNING LABELS

- A. Warning labels shall be firmly attached to all appurtenances using heavy-duty nylon fasteners.

3.03 INSTALLATION OF WARNING TAGS

- A. All recycled water sprinkler control valves, pressure regulators, quick couplers, and isolation valves shall be tagged with purple warning tags.
- B. One tag shall be attached to each appurtenance in one of the following manners:
 - 1. Attach to valve stem directly with plastic tie wrap, or
 - 2. Attach to solenoid wire directly with plastic tie wrap, or
 - 3. Attach to the body of the relative appurtenance with a plastic tie wrap.

3.04 INSTALLATION OF WITNESS MARKERS

- A. Witness markers shall be installed over pipe in unpaved open-space areas at intervals not greater than 200 feet. Place markers at appurtenances, including but not limited to valves, air release/vacuum breaks, dead ends, inflection points and tees.
- B. Witness markers shall be embedded into the soil at least 18-inches and shall be equipped with a barb or other such device to secure it in the surrounding soil.

END OF SECTION

SECTION 22 11 13

COPPER, BRASS, AND BRONZE PIPE FITTINGS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of copper, brass, and bronze pipe, fittings and appurtenances.

1.02 APPROVED MANUFACTURERS

- A. All materials shall be the appropriate model number specified as manufactured by the companies listed herein or approved equal.
- B. Copper Tubing
 - 1. Cambridge Lee
- C. Service Saddle
 - 1. Jones
 - 2. Mueller
 - 3. Ford
 - 4. A.Y. McDonald
- D. Corporation Stop
 - 1. Jones
 - 2. Mueller
 - 3. Ford
 - 4. A.Y. McDonald
- E. Insulating Pipe Bushings, Unions, or Couplings
 - 1. Pipeline Coating and Engineering Co.
 - 2. 1566 East Slauson Avenue, Los Angeles
 - 3. Smith Blair
 - 4. Pipe Seal and Insulator Company

PART 2 - MATERIALS

2.01 COPPER TUBING

- A. Copper tubing shall conform to the requirements of ASTM B 88 for seamless copper water tube. Piping located aboveground or suspended within vaults shall be Type L. Buried piping shall be Type K. Copper pipe shall be of domestic manufacture. Compression joints for connections are allowed if approved by the Engineer.

- B. If indicated in soils report, all copper lines shall be encased within an 8-mil polyethylene sleeve. Sleeves shall be color coded per Section 33 05 26.

2.02 BRASS PIPE, NIPPLES, AND FITTINGS

- A. Short threaded nipples, brass pipe and fittings shall conform to ASTM B 43, regular wall thickness, except that nipples and pipe of sizes 1-inch and smaller shall be extra strong. Threads shall conform to ANSI B2.1.

2.03 BRONZE APPURTENANCES

- A. All items specified herein shall be manufactured of bronze conforming to ASTM B 62, "Composition Brass or Ounce Metal Castings."
- B. All size service saddles shall be of the double-strap type for any type of pipe. The straps (or bails) shall be flat and shall be manufactured of bronze for ACP and of stainless steel for C900 PVC and ductile iron pipe. The body shall be manufactured of bronze and shall be tapped for an iron pipe thread. The seal with the pipe shall be affected with either a rubber gasket or an O-ring.
- C. Corporation stops shall be ball valve type and shall be manufactured of bronze. The inlet fitting shall be a male iron pipe thread when used with saddle and the outlet connection shall be a compression type.
- D. Copper setters shall be for 1-inch and 2-inch meter sizes or as approved by the Engineer and using lead free solder. The inlet and outlet service line connections shall be for 1-inch services and for horizontal connections using compression type connections. A dual purpose type connection may be used for the outlet service line connection. The meter connection shall have a key type inlet and outlet valve. When using a copper setter that is sized larger than the meter, use appropriate adaptors as approved by the Engineer. Copper setters shall be 15-inches in height with a lock wing.

PART 3 - EXECUTION

3.01 COPPER TUBING AND FITTINGS

- A. Cut tubing square using a cutter designed for cutting copper tubing and remove burrs. Clean both the inside and outside of fitting and pipe ends with steel wool and muriatic acid. Prevent annealing of fittings and tubing when making connections. Do not miter joints for elbows or notch straight runs of pipe for tees.
- B. Threads of fittings shall receive a liberal coating of pipe thread compound conforming with the requirements of ASTM B88, Type K.
- C. Any damage to the fitting including but not limited to evidence of overtightening, misaligned threads, burring or scarring of machined faces, or any evidence of leakage shall be cause for rejection. If a leak is found to be caused by debris, the debris shall be cleared and the fitting visually inspected for damage before being charged. If the leak recurs upon charging of the line, the fitting shall be removed and replaced whether or not the cause can be determined.

- D. Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point.
- E. Buried piping shall be installed with some slack to provide flexibility in the event of a load due to settlement, expansion or contraction. A MINIMUM COVER OF 24 INCHES BELOW THE FINISHED STREET GRADE SHALL BE ADHERED TO. The tubing is to be bedded and covered with sand or select material as determined by the Engineer.
- F. All domestic service laterals shall be 1-inch minimum size copper tubing. End connections shall be compression type.
- G. All 2-inch size services shall be installed with straight lengths of soft copper water tube Type K. End connections shall be compression type.
- H. The service line shall extend perpendicular to the centerline of the street from the water main to the meter stop or structure, except in a cul-de-sac, where the service shall run in a straight line from the water main to the meter stop.
- I. The service line shall be placed within an 8-mil polyethylene sleeve, color-coded for the type of service. The ends and splices in the sleeve shall be sealed with 20-mil tape.

3.02 SERVICE SADDLE

- A. The service saddle shall be no closer than 18 inches to a valve, coupling, joint, or fitting.
- B. The surface of the pipe shall be filed to remove all loose material and to provide a hard, clean surface before placing the service saddle.
- C. The service saddle shall be tightened per manufacturer's recommendation. Care shall be used to prevent damage or distortion of either the corporation stop or service saddle by over tightening.
- D. The tap into the pipe shall be made in accordance with the pipe manufacturer's recommendation.

3.03 INSTALLING FLANGE BOLTS AND NUTS

- A. Lubricate bolt threads with anti-seize compound prior to installation.
- B. Set flanged pipe with the flange bolt holes straddling the pipe horizontal and vertical centerlines.

3.04 INSULATING BUSHINGS AND UNIONS

- A. Pipe or fittings made of nonferrous metals shall be isolated from ferrous metals by nylon insulating pipe bushings, union, or couplings.

3.05 BACKFILL MATERIAL

- A. The pipe zone material for all service laterals shall be compacted sand per Section 31 23 00.

END OF SECTION

SECTION 22 11 23

CHLORINATION OF DOMESTIC WATER MAINS AND SERVICES FOR DISINFECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes requirements for disinfection of domestic water mains, services, appurtenances and connections by chlorination and all requirements for bacterial testing of the facilities, and obtaining subsequent clearances for operations issued by the District and all state and local health agencies having jurisdiction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Hydrostatic Testing of Pressure Pipelines: 33 05 05.31

1.03 REFERENCED STANDARD

- A. All domestic water mains, water services, attached appurtenances, and connections, if any, shall be disinfected in accordance with AWWA C601, C651-14 and as specified herein.

1.04 APPLICATION

- A. Before being placed in service or connected to existing facilities, all facilities shall be chlorinated. Chlorine may be applied by direct chlorine gas feed, direct liquid chlorine feed, or calcium hypochlorite tablets per AWWA C651.

1.05 RETESTING

- A. Retesting of the system may be required if 90 days have passed between the date of testing and acceptance by the District.

1.06 SUBMITTALS

- A. The Contractor shall submit a Disinfection Plan per Section 01 30 00. The Disinfection Plan shall address trench treatment, flushing, chlorination, sampling and bacteriological testing procedures, and dechlorination procedures per Section 22 11 23 and AWWA C651. The Contractor shall submit this plan 7 working days prior to beginning this work.

PART 2 - MATERIALS

2.01 CHLORINE GAS.

- A. Chlorine gas shall be supplied and converted from its liquid form to a gas as detailed in AWWA C651 Sections 2.1 and 5.2.

2.02 CALCIUM HYPOCHLORITE TABLETS

- A. Calcium hypochlorite tablets shall have an average weight of 0.009 pounds each and shall contain not less than 70% of available chlorine.

2.03 LIQUID CHLORINE

- A. Liquid Chlorine shall conform to AWWA C651 4.1.1 or AWWA C651 4.1.2.

PART 3 - EXECUTION

3.01 PROCEDURE

- A. Contractor shall notify the District two (2) working days prior to chlorination of facilities.
- B. All required corporation stops and other plumbing materials necessary for chlorination or flushing of the main shall be installed by and at the expense of the contractor.
- C. All mains shall be thoroughly flushed prior to disinfection. Only the direct chlorine gas fuel method shall be used if contaminating material has entered the line.
- D. Every service connection served by a main being disinfected shall be tightly shutoff at the curb stop before water is turned into the main. Care shall be taken to expel all air from the main and services during the filling operation.
- E. Clean all pipe, fittings and valves and swab with chlorine disinfection prior to assembly.
- F. Water shall be fed slowly into the pipeline with chlorine applied in amounts to produce a dosage of not less than 50 ppm nor more than 100 ppm in all sections of the pipeline and appurtenances.
- G. Open and close valves in lines being disinfected several times during the contact period to disinfect gates.
- H. Treated water shall be retained in the system for a minimum of 24 hours and shall contain a chlorine residual of not less than 25 ppm at the end of the retention period in all sections being disinfected.

3.02 CONCURRENT TESTING

- A. Disinfecting the mains and appurtenances, hydrostatic testing, and preliminary retention may run concurrently for the required 24-hour period, but in the event there is leakage and repairs are necessary, additional disinfection shall be made by injection of chlorine solution into the line as provided hereinafter.

3.03 ADDITIONAL DISINFECTION

- A. If the tests are not satisfactory the contractor shall provide additional disinfection as required by AWWA C651.

3.04 FLUSHING

- A. After chlorination, the water shall be flushed from the line, in accordance with AWWA C651, at its extremities until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. The chlorinated water may be used later for testing other lines, or if not so used, shall be disposed of by the contractor, as designated in AWWA C651, Section 6.2. The contractor shall be responsible for all costs to dechlorinate the water and shall obtain all permits before discharging water into storm drain or watercourse. Discharging shall be in accordance with State and local regulations. The District will not be responsible for loss or damage resulting from such disposal.

3.05 BACTERIOLOGICAL TESTING

- A. The sampling and bacteriological testing procedure for the newly disinfected facilities shall be in accordance with AWWA C651, Section 5.1. The sampling and bacteriological testing procedure for main repairs shall be in accordance with AWWA C651, Section 4.7. The contractor shall provide sampling containers approved by the District and the contractor shall notify the District two (2) working days prior to collecting samples. A District representative shall be present during the collection of the samples. The contractor shall deliver the samples to a California DOHS approved testing laboratory. The contractor shall be required to provide the District with signed copies of all test results and chain of custody documents.
- B. All mains and services must successfully pass bacteriological tests prior to connecting to the existing system. Services must be tested per the following procedure. A minimum of 10 percent of water services or 1 water service lateral, whichever is greater, must be tested. If this first water service test fails, then a minimum of 20 percent of water services or 2 water service laterals, whichever is greater, must be tested.

3.06 CUTTING INTO EXISTING MAINS

- A. Following the opening of an existing domestic water main, the interior of all accessible pipes and fittings shall be swabbed with a hypochlorite solution. The drained portion of the existing line and any new section shall be flushed from two directions toward the cut-in, if possible.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Roof-Mounted Exhaust Fans
- B. Thermostats
- C. Turbine ventilators

1.02 RELATED SECTIONS:

- A. Section 05 50 00 – Metal Fabrications
- B. Section 08 91 19 – Fixed Louvers

1.03 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI/AMCA 210, Laboratory Methods of Testing Fans for Rating.
 - 2. ANSI/AMCA 300, Test Code for Sound Rating.
 - 3. ANSI/AMCA 330, Laboratory Methods of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - 4. ANSI/ABMA 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 5. ANSI/ABMA 11, Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association (AMCA):
 - 1. AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 2. AMCA Publication 211, Certified Ratings Program — Product Rating Manual for Fan Air Performance
 - 3. AMCA Publication 311, Certified Ratings Program — Product Rating Manual for Fan Sound Performance
- C. National Electric Code (NEC).
- D. National Fire Protection Association (NFPA):
 - 1. 90A - Installation of Air Conditioning and Ventilating Systems.
 - 2. 820 - Fire Protection in Wastewater Treatment and Collection Facilities.
- E. National Roofing Contractors Association (NRCA).
- F. International Conference of Building Officials (ICBO):

1. Uniform Building Code (UBC).
 2. Uniform Mechanical Code (UMC).
- G. Underwriters' Laboratories, Inc. (UL).

1.04 SUBMITTALS

- A. Submittal data provided shall be of sufficient depth to illustrate compliance with these specifications, the plans and other specifications that may influence the proper operation of these fans/blowers.
- B. Submittal shall contain the following:
1. Fan Outline Drawings
 2. Motor Data
 3. Typical Installation Guides
 4. Performance Curves
 5. Detailed Description and Dimensions of All Accessories
 6. Detailed Electrical Data
 7. Parts Lists
 8. Printed Warranty
- C. No air handling equipment shall be shipped until the required drawings and curves have been submitted to and acknowledged by the Engineer as being of general compliance and conformance with the information in the contract documents.

1.05 QUALITY ASSURANCE

- A. Fans and blowers shall be run at the factory to assure proper operation of all rotating parts. Motors shall be tested for amperage draw to ensure that the motor selected will not overload at any condition.
- B. Equipment furnished and installed by the contractor shall bear the AMCA certified ratings seal for air performance.
- C. Testing: Blowers and fans shall be tested for performance at the factory to determine head versus capacity, efficiencies, and kilowatt draw required for the operating points specified. All tests shall be run in accordance with the latest edition of AMCA standards.
- D. Operation and Maintenance Manuals: The fan supplier shall provide operation and maintenance manuals for all equipment and accessories furnished. Where content of manuals includes manufacturers' catalog pages, clearly indicate the precise items included in this installation.
- E. Guarantee: Products furnished and installed under this section shall be guaranteed for a minimum period of five (5) years. Parts and labor for the first year of this guaranty period shall be provided in full, at no additional cost.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units in one piece, factory assembled, internally wired, and lubricated.
- B. Protect equipment from dust and atmospheric exposure.
- C. Provide temporary closures for equipment openings designed for air flow.

PART 2 - PRODUCTS

2.01 EXHAUST VENTILATOR FAN

- A. Downblast exhaust ventilator with axial belt drive, with the following:
 - 1. Duty point: 5100 SCFM at 0.125" static pressure
 - 2. Single phase motor, 115V, 0.75 HP
 - 3. 30-inch blade diameter
 - 4. Aluminum propeller, fan shroud and enclosure
 - 5. Galvanized steel bird screen
 - 6. Dayton Model 7A408 or equal
- B. Provide the following accessories, matched to the submitted fan:
 - 1. Fixed non-ventilated roof curb, galvanized steel, 8" height
 - 2. Backdraft damper

2.02 THERMOSTAT

- A. Exhaust fans shall be controlled by thermostat installed within the space being ventilated.
- B. Thermostats shall be wall mounted with the following parameters
 - 1. Single Pole Single Throw (SPST), close on temperature rise
 - 2. Minimum Temperature Range 30° to 90° F
 - 3. Line voltage type, 115V AC
 - 4. Johnson Controls Model A419AEC-1C, 120VAC, NEMA 1.

2.03 WIND DRIVEN TURBINE VENTILATORS

- A. Galvanized steel turbine ventilator with thrust-type bearings and integral roof base, size as shown on the Drawings

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Blowers and fans shall be installed in accordance with manufacturer's instructions.
- B. Provide anchorage to building walls and roof.
- C. Thermostat shall be installed in accordance with manufacturer's instructions. Mount thermostat 60-inches above floor of building, on interior of wall.

3.02 TESTING

- A. After installation, equipment shall be tested in the presence of the Engineer by an authorized manufacturer representative who shall certify, in writing, that the blowers and fans are operating in compliance with these specifications and are free from binding, scraping, overloading, vibration or other defects.
- B. Each air movement unit shall be continuously run and monitored for a minimum duration of four (4) hours during the test period.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Division 26, Electrical covers the work necessary for the complete electrical systems for the Marina Coast Water District at the A1/A2 Reservoirs – B/C Booster Pump Station Project (Project). Furnish all materials, labor, and equipment as specified herein, in other Division 26 Specification Sections as listed below, and the Drawings for a complete, operational, tested, and commissioned electrical system.
- B. The requirements of Division 26, Electrical in their entirety apply to all electrical work and equipment furnished on this project whether furnished or specified under this or other Divisions of these Specifications.
- C. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections. Where differences exist between the specific equipment Specification Sections of Division 26 and this Section, the specific equipment Specifications shall govern.
 - 1. 26 05 00 – Electrical - General Provisions
 - 2. 26 05 19 – Low Voltage Conductors and Cables
 - 3. 26 05 26 – Grounding and Bonding for Electrical Systems
 - 4. 26 05 33 – Raceways, Boxes, Fittings and Supports
 - 5. 26 05 43 – Underground Ducts and Raceways for Electrical Systems
 - 6. 26 05 53 - Electrical Identification
 - 7. 26 05 73 – Power System Studies
 - 8. 26 05 80 – Low Voltage Motors
 - 9. 26 05 90 – Miscellaneous Electrical Equipment
 - 10. 26 05 99 – Electrical and Instrumentation Demolition and Modifications
 - 11. 26 08 00 – Commissioning of Electrical Systems
 - 12. 26 22 13 – Low Voltage Distribution Transformers
 - 13. 26 24 13 – Switchboards
 - 14. 26 24 16 – Panelboards
 - 15. 26 24 19 – Motor Control Centers
 - 16. 26 27 26 – Wiring Devices – Power and Distribution
 - 17. 26 32 13 – Diesel Engine Driven Generators
 - 18. 26 50 00 – Lighting
- D. The work shall include the following:
 - 1. Furnishing and installing complete operational systems functionally in accordance with the intent of these Contract Documents including but not limited to:

- a. Short Circuit Study, System Protective Device Coordination Analysis, Arc Flash Calculations, and other electrical system modeling work.
 - b. Testing of the electrical equipment and making final settings for the electrical protective devices.
 - c. Startup and commissioning of the electrical system and components.
2. Coordinating the details of equipment layouts and construction for all Specification Divisions which affect the work covered under Division 26, ELECTRICAL.
 3. Furnishing and installing all incidental items not specifically shown or specified, but which are required by good practice and standards of the industry to provide complete functional systems.
 4. Coordination and work associated with equipment provided under technical Divisions of these Specifications including but not limited to: mechanical systems packaged with electrical equipment, motor operated valves with integral controls, pump motors with motor protection controls, field instrumentation.
 5. Coordination and work associated with Division 40 – Process and Instrumentation, for installation of plant control system including but not limited to: control networks and media converters, computers, control panels, conduit, wire, and terminations as required.
 6. Coordination and work associated with Division 23 - Heating, Ventilation, and Air Conditioning; provide power and control wiring for all heating, ventilating, and air conditioning equipment including disconnect switches, raceways, and wiring for 120 Volt (nominal) thermostats. Refer to HVAC Drawings for the locations of 120 Volt thermostats and provide at a minimum a 3/4-in C, 2 No. 12 and 1 No. 12 GRD between each device and its respective control thermostat unless shown otherwise on the Drawings.
 7. Electrical service from the Power Company; Telephone service from the Telephone Company.
 8. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other technical sections of these Specifications.
 9. Conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators, and control panels; lightning and surge protection equipment wiring at process instrumentation transmitters and analyzers; instrumentation disconnect switches; installation of vendor furnished cables specified under other Divisions.
 10. A complete raceway system for the data highway cables, fiber optic, and specialty cable systems. Install the data highway cables, fiber optic, and other specialty cable systems furnished under Division 40 in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the control or computer system supplier(s) and the cable manufacturer(s) to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install cables in separate raceways. Maintain an 8 foot (minimum) separation between raceways.
 11. Modifications to existing control systems including installation of auxiliary motor starter contacts, relays, switches, as required to provide the control functions or inputs as shown on the Drawings. Verify all existing wiring and connections for correctness. Trace the circuits in the field and develop the wiring diagrams necessary for completion of the work. Document all changes made to the wiring diagrams and return a marked-up set of Record Drawings to the Owner after the work is complete.

12. Seismic calculations, anchoring, and restraints for electrical equipment and systems requiring such restraints as required under Section 01 33 12.
 13. Wind loading calculations, anchoring, and restraints for electrical equipment and systems requiring such restraints as required under Section 01 33 14.
- E. Each bidder shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work is to be performed and inspect carefully the present installation. The submission of a proposal by a bidder shall be considered evidence that the bidder has visited the facility, buildings, and structures; noted the locations and conditions under which the work will be performed; and incorporated these locations and conditions into their proposal with respect to the factors governing the work.
- F. Sequencing and Scheduling
1. Coordinate electrical equipment installation with other building components.
 2. Arrange for chases, slots and openings in the building structures during the progress of construction to allow for the electrical installation.
 3. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
 4. Sequence, coordinate, and integrate the installation of electrical materials and equipment for efficient flow of the work. Coordinate the installation of large equipment requiring positioning prior to closing in the building.
 5. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.02 RELATED WORK

- A. Section 01 33 12 – Seismic Design Criteria
- B. Section 01 33 14 – Wind Design Criteria
- C. All trenching, drilling, backfill, compaction, and surface restoration shall be as indicated on the Drawings and as required under Division 31 of these Specifications.
- D. All concrete and reinforcement shall be as indicated on the Drawings and as required in Division 31 of these Specifications. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- E. Process, HVAC, and building support equipment requiring electrical work are specified in the other Technical Sections of these Specifications.
- F. Instrumentation and Controls are included in Division 40.

1.03 SUBMITTALS

- A. General
1. Submit manufacturers' descriptive information and shop drawings for all equipment, material, and devices furnished under Division 26 Sections. Prepare and format submittals in accordance with General Requirements Section 01 30 00 and as specified herein.

2. Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude information, products, options, or parts not applicable to the Project.
3. If the equipment installed during construction does not match the equipment that was approved by the Engineer during submittal review, the Contractor shall resubmit all documentation related to the installed equipment as specified. Should the unapproved equipment be found not to be in conformance with the Contract Documents, it shall be removed and replaced with suitable equipment at the Contractor's expense.
4. Review of submittal information by the Engineer shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless he has in writing at time of submission requested and received written approval from the Owner for specific deviations. Review of submittal information shall not relieve the Contractor from responsibility for errors and omissions in shop drawings or literature.
5. Where submittal documents are submitted in electronic format, the engineer reserves the right to request a hard copy of the package for review of complex drawings or shop drawing information. For large electronic packages over 50 pages in length, provide suitable electronic indexing or book marking to match the table of contents, tabulations, drawings, individual product material catalog cut sheets or other documents types provided. Indexing or bookmarking shall be used to facilitate navigation and review of the document. Large electronic packages submitted without such indexing shall be returned to the Contractor unreviewed.

B. Anchoring requirements:

1. Submit seismic mounting and anchorage calculations for electrical equipment as follows:
 - a. Where specifically called for in the specific Technical Sections of Division 26.
 - b. Where required under the requirements of Section 01 33 12.
2. Submit wind mounting and anchorage calculations for electrical equipment as follows:
 - a. Where specifically called for in the specific Technical Sections of Division 26.
 - b. Where required under the requirements of Section 01 33 14.
3. Installation of equipment shall not proceed until mounting and anchoring calculations have been submitted and approved.

C. Operation and Maintenance Data

1. Submit operations and maintenance data for equipment furnished under this Division. The manuals shall be prepared specifically for this Project. Include catalog data sheets, layout drawings, control drawings, equipment lists, functional descriptions, and bills of materials or parts lists with replacement part numbers.
2. Manual provided under this Section shall consist of the individual O&M information provided under the other technical sections of Division 26. Coordinate and organize this information into a single, comprehensive, electrical system O&M manual subject to the specified requirements.
3. Manuals shall include the following as a minimum:
 - a. A comprehensive index of the major equipment provided.
 - b. A functional description of the entire system with references to the individual system elements, schematic drawings, and instructions.
 - c. A complete "As-Built" set of approved shop drawings.
 - d. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

- e. A table listing sorted by equipment designation of the "as left" settings for all control, timing, and protective relays defining all timing, alarm, and trip setpoints.
- f. System schematic drawings "As-Built," illustrating all components electric connections of the systems supplied under this Section.
- g. Detailed service, maintenance and operation instructions for each item supplied.
- h. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
- i. Complete parts list with stock numbers, including spare parts.

1.04 STANDARDS, CODES, PERMITS, AND REGULATIONS

A. Electrical equipment, materials and installation shall comply with the National Electrical Code (NEC, NFPA 70) 2017 Edition, including the California Electrical Code (CEC-2019) Amendments. All references to the NEC included in the Contract Documents shall be interpreted to be referenced to this version with the California Amendments as specified.

A. Perform work; furnish, install, and test materials and equipment in full accordance with applicable rules, regulations, requirements, and specifications of the following. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.

1. Local Laws and Ordinances
2. State and Federal Laws
3. State Building Codes
4. State Fire Marshal
5. California Code of Regulations
 - a. Title 24, Part 3 – California Electrical Code (NEC with California Amendments))
6. California Division of Occupational Safety and Health (DOSH), Cal OSHA
7. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard C2: National Electrical Safety Code (NESC)
8. National Electrical Contractors Association (NECA)
 - a. National Electrical Installation Standards (NEIS)
9. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA Publication 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
10. National Fire Protection Association:
 - a. NFPA 820: Fire Protection in Wastewater Treatment and Collection Systems
11. InterNational Electrical Testing Association, Inc (NETA)
 - a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
 - b. Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems
12. Pacific Gas and Electric Company (PG&E), Electric & Gas Service Requirements (Green Book)

B. Where conflicts may occur between the above items the more stringent applicable requirements shall apply. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern.

Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with applicable codes and standards.

- C. Underwriters Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, Factory Mutual (FM) or other nationally recognized entity may be substituted for UL labeling and listing if approved by the Engineer. Provide UL service entrance labels for all equipment required by the NEC to have such labels.
- D. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. Obtain all permits and pay all fees required by any governmental agency or utility having jurisdiction over the work. Coordinate and arrange all inspections required by these agencies. On completion of the work, submit satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

1.05 INTERPRETATION OF CONTRACT DOCUMENTS

- A. The Contract Drawings indicate the extent, general location, and arrangement of equipment. Duct bank and conduit runs are diagrammatic and may not show the exact locations for installation. Verify locations of conduit stub-ups based upon conduit entry space of equipment furnished from the manufacturer's certified shop drawings, by inspection of the actual equipment to be installed, and coordinated with other trades. Stub-up conduits as near as possible to equipment terminal enclosures.
- B. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer. Obtain information relevant to the placing of electrical work including final equipment dimensions and installation criteria. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- C. Standard details are typical for all locations to which they apply regardless of whether a specific reference callout is shown on the Drawings or not.
- D. Unless otherwise approved by the Engineer, conduits shown exposed on the Drawings shall be installed surface mounted or suspended as applicable; conduit shown concealed on the Drawings shall be installed in walls, floor slabs, or ceilings as applicable.
- E. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.
- F. Conduit routing, layouts, or "home runs" shown on the Drawings are not intended to show the number of fittings or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown.
- G. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

- H. Number and size of wires which shall be installed in runs of conduit where not shown on the Drawings shall be determined from the one line, schematics, connection, interconnection, and control diagrams of the actual equipment furnished.
- I. Modifications or Substitution of Equipment
 - 1. Where a specific material or equipment is listed in the Specifications or on the Drawings, it is understood and construed as meaning to indicate a standard of quality. Unless specifically noted otherwise, such listing is not intended in any way to bar the use of any material or equipment that is of equal or better quality.
 - 2. The Electrical Drawings have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional work or material may be required to accommodate the second named equipment into the project. The Contractor desiring to use the second named equipment or any equal equipment is responsible for all costs, including cost of any engineering, material, or installation, incurred by using other than the first named equipment.
 - 3. Likewise, redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than that shown on the Contract Documents, shall be performed at the Contractor's expense. Contractor shall pay for all such changes including protective devices, bus ratings, conduit, wire, building modifications, etc.
 - 4. Contractor shall be responsible for preparing any required engineering documents specified under Division 26. Where indicated, submit documents stamped and signed by a Professional Electrical Engineer currently registered in the State of California.
 - 5. Changes from the layout shown to facilitate use of alternate equipment shall not be a basis for additional payment; neither shall changes in electrical controls or wiring or piping caused by the use of second named or equal equipment be a basis for additional payment.

1.06 PROJECT/SITE REQUIREMENTS

- A. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 500 feet above mean sea level.
- B. Temperature:
 - 1. Equipment located in exterior locations shall be suitable for operation at temperatures from 0° to +40° C degrees ambient.
 - 2. Equipment located in internal areas shall be suitable for operation:
 - a. In conditioned spaces from 15° to +25° C degrees ambient.
 - b. In unconditioned spaces from 0° to +30° C degrees ambient
 - 3. Where applicable, equipment shall be rated for extended storage temperatures ranges from 0° to 40° C degrees ambient.
- C. Relative Humidity: Equipment located in air conditioned spaces shall be suitable for 5 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- D. Provide equipment and devices suitable for continuous operation at the temperatures and elevations at the site and at the facility installation locations shown on the Drawings.

1. Provide equipment capable of continuous operation at the required rated output shown on the Contract Documents at the specified site conditions.
2. Provide any additional equipment such as passive thermal cooling, insulation, sunshades, heating, cooling equipment, or other means so that the rated performance requirements can be met. Such equipment shall be provided at no additional cost to the Owner.
3. Provide suitability derated equipment if required based on the site conditions. Derated equipment shall be provided with revised manufacturer's nameplates stating the equipment rating for continuous duty and the environmental conditions upon which the continuous rating applies. Deration of equipment shall only be allowed if the derated equipment rating conforms to the required equipment ratings as shown on the Contract Documents.
4. Provide supplementary equipment deration if required for both ambient temperature extremes and elevation as required by the manufacturer.

1.07 ENCLOSURE TYPES

1. NEMA 12: indoor, above grade locations subject to non-corrosive, dry or damp process areas, or dusty conditions including but not limited to:
 - a. Process mechanical equipment rooms
2. NEMA 4X: locations subject to corrosive or marine conditions including but not limited to:
 - a. Chemical feed or storage areas
 - b. All outdoor locations (marine environment)

1.08 UTILITY SERVICE AND METERING

A. Electrical Power Utility

1. The Electrical Utility serving this facility is Pacific Gas and Electric Company. Utility contact information is as follows:
 - Pacific Gas and Electric Company
 - Katrina Lopez
 - Office: 831-784-3581
 - Cell: 408-532-3812
 - Katrina.lopez@pge.com
 - Service Application Number: 119812695
2. The Utility Company will be providing the electrical service to the facility. The following equipment will be provided by the Utility Company:
 - a. Metering devices in switchboard
 - b. Primary conductors from power source pole or vault to pad mounted transformer.
 - c. Secondary conductors from pad mounted transformer to switchboard
 - d. Pad mounted transformer
 - e. Medium voltage switching equipment
 - f. Overhead line work
3. The Contractor shall provide the following for the facility:
 - a. Metering enclosure switchboard per Utility Standards
 - b. Primary service conduits from power source pole or vault to transformer including pole riser if required as shown on Drawing
 - c. Secondary service conduits from padmounted transformer pad to point of service
 - d. Concrete pad for padmounted transformer per Utility Company standards
 - e. Vault structure(s) per Utility Company standards

4. PG&E service details are under development by PG&E. PG&E service details shown on the Drawings are preliminary, represent the worst case conditions to the Engineer's best knowledge, and shall be used as the basis for bidding. Upon receipt of formal PG&E service details, the Contractor shall make suitable revisions and provide the required infrastructure improvements as required by PG&E.
5. Contractor shall provide all coordination with Utility Company and coordinate necessary shutdowns with the Owner.
6. The Owner will pay for all engineering, connection, and other fees associated with the new Utility Company work performed under this Contract.

1.09 HANDLING AND SIZE OF EQUIPMENT

- A. Investigate each route at the facility through which electrical equipment must pass to reach its final installed location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the facility and within structures.
- B. The equipment shall be kept upright at all times during storage and handling. Should the equipment require tilting for passage through restricted height areas, brace the equipment to insure that the tilting does not impair the structural or functional integrity of the equipment.

1.10 MAINTENANCE

- A. Spare Parts
 1. Spare parts shall be in accordance with 01 7 0 00 and as defined in the related technical specification sections. All spare parts shall be new and unused, provided in original packaging.
 2. All spare parts shall be individually packaged and labeled with the part designation and the associated end use equipment tag designation as shown on the Contract Documents.
 3. Provide one pint of touch-up paint, in one-quart containers for each type and color used for all cabinets, panels, consoles, etc, supplied under the related specification sections.
 4. The spares listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

1.11 RECORD DRAWINGS

- A. As the work progresses, clearly and legibly record all field changes on a set of project contract drawings, hereinafter called the "record drawings set". Record drawing set shall conform to the requirements of General Requirements 01 30 00.
- B. Record drawing set shall be kept at the job site and readily available for review by the Owner or the Engineer.
- C. Record drawings shall be updated daily by the Contractor to provide a accurate record of the current condition of the work.
- D. Record drawing set shall accurately show the installed condition of the completed project. The record drawing set shall accurately document the final locations and conditions of the following items:
 1. One-line Diagrams

2. Raceways and pull boxes
3. Conductor sizes and conduit fills
4. Lighting and distribution panelboard Schedules
5. Control wiring diagrams
6. Lighting fixtures, receptacles, and switches
7. Underground electrical system raceway and duct bank routing shown on the plan drawings. Routing shall include final installation depths below finished grade. Final locations of handholes and manholes shall be documented using the project coordinate system.
8. Plan views of switchboards, distribution transformers, substations, motor control centers and panelboards; include dimensioned outline of final installed location of the equipment.
9. Grounding system including location of ground rods and routing of grounding electrode conductors and ground grid components.

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.
- B. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

2.02 SEISMIC REQUIREMENTS

- A. General: All products to be furnished under this contract shall be designed, constructed, and installed in conformance with the seismic requirements of Section 01 33 10.
- B. Provide equipment seismically certified for application at the Project site where specifically called for in other Sections of Division 26.

2.03 EQUIPMENT IDENTIFICATION

- A. Provide as required under Section 26 05 53.
- B. Identify all equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 26 with the name of the equipment it serves unless otherwise noted. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.
- C. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

2.04 MARKINGS AND EQUIPMENT WARNING SIGNS

- A. Provide as required under Section 26 05 53.
- B. Electrical Safety and Working Clearance Identification
 - 1. Provide a painted outline about electrical equipment to identify areas that are to be kept clear of storage and debris. The painted outline shall consist of a 3 inch wide, neatly painted line, utilizing safety yellow paint appropriate for the surface being painted.
 - 2. The nearest edge of the line shall be 48 inches in front of electrical equipment rated 600V and lower. Line shall extend to the edge of the equipment or 15 inches from the centerline of the equipment, whichever is greater.
 - 3. Provide electrical switchboard electro-static matting in front, and rear when accessible from the rear, of electrical equipment. The matting shall be the minimum size specified, and extend to the edge of the yellow safety outline at the sides of the equipment.
- C. Provide arc flash warning labels on electrical power distribution equipment per Section 26 05 73.
- D. Provide high voltage warning labels and signage on electrical power distribution equipment in conformance with OSHA
- E. Permanent warning labels shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Labels shall be in accordance with OSHA regulations for personnel safety and shall be suitable for exterior use. The warning labels shall be self adhesive or fastened with stainless steel screws or bolts as required by the equipment mounting surface. Locate and mount labels as approved by the Engineer. Warning sign shall display the following:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL
- F. Permanent warning labels shall be mounted at all electrical equipment enclosures where a voltage sourced from outside the enclosure is present. Labels shall be yellow colored Lamicoid or equal material, engraved with a minimum ¼” lettering mounted on the front exterior of the panel approximately 5’ above finished floor or grade. The warning labels shall be self adhesive or fastened with stainless steel screws or bolts as required by the equipment mounting surface. Locate and mount labels as approved by the Engineer. Warning sign shall display the following:

CAUTION
FOREIGN VOLTAGES
PRESENT

2.05 FASTENERS

- A. Fasteners and anchors for securing equipment to walls and floors shall be either hot dip galvanized after fabrication or stainless steel unless noted otherwise.

PART 3 - EXECUTION

3.01 GENERAL

- A. Unless specified otherwise, electrical equipment and anchoring systems shall be designed to withstand seismic forces as specified in Section 01 33 12 and wind loading per Section 01 33 14.
- B. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade and conforming to standards of the industry. Provide work which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise shown in the Contract Documents.
- C. Coordinate electrical work with the Engineer and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.
- D. Check the approximate locations of light fixtures, 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 the Engineer in writing. The Engineer's decision shall govern. Make modifications and changes required to correct conflicts.
- E. Follow manufacturers' installation instructions explicitly, unless otherwise indicated on the Contract Documents. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's direction. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.

3.02 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect all equipment from the effects of weather.
- B. Prior to installation, store items in clean, dry, indoor or other locations suitably protected from the elements. Energize all integral equipment space heaters with temporary power as required. Provide temporary heating devices, sufficient to prevent condensation, for all other electrical equipment that does not have space heaters.
- C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided. Such protection methods shall be approved by the Engineer.
- D. Cap all conduit runs during construction with manufactured seals until installation of conductors is required. Keep openings in boxes or equipment closed during construction.

3.03 SERVICE CONTINUITY

- A. Maintain continuity of electric service to all functioning portions of the plant. Make no outages without prior written authorization of the Engineer. Include all costs for temporary wiring and overtime work required in the Contract price as required to meet the Project constraints defined in General Conditions. Remove all temporary wiring at the completion of the work.
- B. Provide temporary electric power used during construction including the use of standby generators for continuous operation as needed as required under Division 1.

3.04 EQUIPMENT IDENTIFICATION

- A. Provide identification nameplates for all electrical and instrumentation equipment provided under this Contract in accordance with Section 26 05 53. Provide nameplate designations as shown on the Drawings and as specified herein.
- B. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be fastened to the equipment using stainless steel wire or jack chain or permanently fastened to an adjacent mounting surface as directed by the Engineer.

3.05 EQUIPMENT SUPPORTS

- A. Provide equipment supports for all equipment in accordance with the mounting and anchorage requirements of Section 01 33 12 and per manufactures requirements.
- B. Installation of equipment shall not proceed until mounting and anchoring calculations have been submitted and approved.
- C. Free standing panels and enclosures shall be mounted on concrete pads having plan dimensions shown on the Drawings or larger if required by the mounting and anchorage calculations.

3.06 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all slots for electrical work and form before concrete is poured.
- B. Identify precise locations for stubbing-up and terminating concealed conduit prior to commencing conduit layout work. Obtain shop drawings and templates from equipment vendors or other subcontractors and properly locate the concealed conduit before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetration and slots as specified in Section 26 05 33.

3.07 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut, drill, or notch any structural member or building surface without specific approval of Engineer. Carefully carry out any 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.
- B. Following cutting and patching work, restore surfaces to original finished condition. Include all patching and painting of the surfaces to match original. Use skilled craftsmen of the trades involved.

3.08 LOAD BALANCE

- A. The Drawings and Specifications indicate circuiting to electrical loads and distribution equipment. Balance electrical load between phases as nearly as possible on lighting and distribution panelboards, etc. based on the load requirements of the actual equipment provided under this Contract.

3.09 TESTS

- A. Perform testing as specified in Section 26 05 73.

3.10 CLEANUP AND PAINTING

- A. The Contractor shall be responsible for the removal and legal disposal of all debris and unused equipment which he introduces to the project site during the execution of the Contract.
- B. Painting shall be in accordance with Section 09 90 00. Unpainted boxes, cabinets, and raceways mounted on walls that are painted or to be painted shall be painted the same color as the walls.
- C. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment.
- D. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.
- E. The interior of all electrical equipment, including windings of dry type transformers, shall be vacuumed and wiped free of dust, metal filings, and other debris. Cleaning shall be done prior to energization and again immediately before final inspection. De-energization of any equipment that is required to allow panel cleaning shall be approved in writing by the Engineer.

- F. Refer to the individual equipment technical specifications of Division 26 for additional requirements.

3.11 MANUFACTURER'S SERVICE AND TRAINING

- A. Provide manufacturer's services for equipment installation, startup, and testing. Provide training of plant personnel in operation and maintenance of the equipment furnished under other Sections of Division 26.

3.12 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer and District or their representatives. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.
- B. Before request for final inspection is made, the Contractor shall submit to the Construction Manager, in writing, a certificate stating that the Contractor has made his own thorough inspection of the entire project and that the installation is completed and in conformance with the applicable codes, and the contract plans and specifications.

END OF SECTION

SECTION 26 05 19

LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: This section covers furnishing and installing low voltage cable systems as specified herein, complete, and in operating condition.
- B. Raceway Schedules indicating conductor number and minimum required conductor sizes are provided with Specification Section 26 05 33, Appendices A1, A2, A3, and A4. The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufacture red cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such omissions in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.

1.02 RELATED SECTIONS:

- A. Refer to Division 40 for additional system testing requirements and network and data highway cable requirements
- B. Section 26 05 00 – Common Work Results for Electrical.
- C. Section 26 05 33 – Appendix A1 – Conduit Schedule: Reservoir A1/A2 and B/C Booster Pump Station
- D. Section 26 05 33 – Appendix A2 – Conduit Schedule: F Booster, Chlorination Building
- E. Section 26 05 33 – Appendix A3 – Conduit Schedule: Reservoir 2/Well 12
- F. Section 26 05 33 – Appendix A4 – Conduit Schedule: Promontory Lift Station
- G. Section 26 05 73 – Electrical System Studies
- H. Section 26 08 00 – Commissioning of Electrical Systems

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 30 00 and Section 26 05 00.
- B. Submit catalog data indicating manufacturer, insulation designation, and ratings in sufficient detail to determine conformance with these specifications:
 - 1. Power, control, and instrumentation wire.
 - 2. Termination and splicing materials.
 - 3. Pulling lubrication compound.
 - 4. Circuit identification system.

- C. Submit results of field testing for new conductors provided under this Contract and for existing conductors tested under this Contract as noted on the Drawings and as specified in Section 26 08 00.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B-3 - Standard Specification for Soft or Annealed Copper Wire.
 - 2. B-8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 3. B-33 – Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- B. International Cable Engineers Association (ICEA).
 - 1. S-95-658 – Non-Shielded Power Cable Rated 2000V or less
 - 2. S-61-402 – Thermoplastic Insulated Wire and Cable for Transmission and Distribution
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code (NEC).
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA WC 3, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 2. NEMA WC 5, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 3. NEMA WC 7, Cross-Linked- Thermosetting- Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- E. Telecommunications Industry Association (TIA)
 - 1. EIA-568-B.2-1 – Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
- F. Underwriters Laboratory (UL):
 - 1. Standard 44 – Thermoset Insulated Wires and Cables.
 - 2. Standard 83 – Thermoplastic Insulated Wires and Cables.
 - 3. Standard 444 – Communications Cables
 - 4. Standard 510 – Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - 5. Standard 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 - 6. Standard 1569 – Standard for Metal-Clad Cables
 - 7. Standard 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.
 - 8. Standard 1666 – Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
 - 9. Standard 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

1.05 CONDUCTOR COLOR CODING

- A. Color coding of multiconductor control and instrumentation cable is specified in the individual cable type specification.
- B. For power conductors, provide all single conductors and individual conductors of multiconductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by wrapping the conductor at each end and at all accessible locations with vinyl tape. Where this method of color coding is used, wrap at least six full overlapping turns of tape around the conductor covering an area 1 1/2 to 2 inches wide at a visible location at all conductor termination and pulling points.
- C. Phase A, B, C implies the direction of positive phase rotation.
- D. Mark conductors using the following colors for power conductors.

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/240 Volts, 1-Phase, 3-Wire	Line 1 Line 2 Neutral	Black Red White
208Y/120 Volts, 3-Phase, 4-Wire	Phase A Phase B Phase C Grounded Neutral	Black Red Blue White
480Y/277 Volts, 3-Phase, 4-Wire	Phase A Phase B Phase C Grounded Neutral (if used)	Brown Orange Yellow White, Black Tracer

- E. All conductors carrying AC foreign voltage over 100 Vac into control panels, switchboards, and other enclosures shall be yellow. Multi-conductor cables carrying such foreign voltage shall be marked with yellow tape at each termination point.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall inspect the reels as they are unloaded from the delivery truck, any visible damage shall be reported by the Contractor and the reel returned to the factory.
- B. The Contractor shall provide a crane, special lift truck or forklift suitably rated to unload the cable reels.
- C. Cables shall be packaged on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. General

1. All wire and cable conductors shall be annealed soft drawn copper with 98% conductivity. Aluminum conductors are not acceptable and shall not be used.
2. Provide Class B stranded conductors in all cases except that wiring for lighting and receptacle circuits may be solid.
3. Conductors shall be in accordance with applicable NEMA standards WC 3, NEMA WC 5, or NEMA WC 7. All conductors shall be UL Listed.
4. All conductors installed in tray shall be tray rated (Type TC) and run without splices in and out of the cable trays.
5. All conductors shall have ampacity ratings at 90° C in dry locations and 75° C in wet location minimum in accordance with the NEC unless noted otherwise.
6. Conductor sizes shown on the Drawings or schedules shall be the minimum size provided regardless of the type of conductor used.
7. Wire smaller than No. 12 AWG shall not be used for power feeders. Wire smaller than No. 12 AWG shall only be used for control, signal and instrumentation circuits,

B. 600 Volt Single Conductor Power and Building Wire

1. Wire for circuits over 150 Volts to ground shall be NEC type XHHW/XHHW-2 as manufactured by the Okonite Co.; Carol Cable Co. Inc.; Pirelli Cable Corp. or approved equal.
2. Wire for lighting and receptacles not exceeding 150 Volts to ground shall be NEC type THHN/THWN as manufactured by the Okonite Co.; Carol Cable Co. Inc.; Pirelli Cable Corp. or approved equal.

C. Single Conductor Control, Status, and Alarm Wire

1. Single conductor wiring shall be 600V, No.14 AWG NEC type XHHW/XHHW-2 and type MTW inside control panels as manufactured by the Okonite Co.; Carol Cable Co. Inc; Pirelli Cable Corp. or equal.

D. 600 Volt, Twisted, Shielded Pair Instrumentation Cable:

- a. General: Type TC, single pair instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in conduit, wireway, or other approved raceways. Minimum cable temperature rating shall be 90°C dry locations, 75°C wet locations.
- b. Individual Conductors: No. 16 AWG stranded bare annealed copper, Class B, 7 strand concentric per ASTM B-8, size as indicated on the drawings; 7 strand tinned copper drain wire.
- c. Insulation and Jacket: Each conductor 15 mil nominal PVC and 4 mil nylon insulation. Pair conductors pigmented black and red. Jacket flame retardant and sunlight and oil resistant PVC with 45 mil nominal thickness. Aluminum/polyester shield overlapped to provide 100 percent coverage.
- d. Acceptable Manufacturers:
 - 1) Belden No. 9342
 - 2) Alpha Wire Company
 - 3) Okonite

4) Approved equal

E. Category 6 Unshielded Twisted Pairs:

1. General: industrial grade Category 6 Unshielded Twisted Pairs (UTP) suitable for use in harsh environments as industrial Ethernet cable, 600 MHz Enhanced Category 6, Gigabit Ethernet, 100BaseTX, NTSC/PAL Component or Composite Video, RS-422, RJ-45 compatible, suitable for outdoor use and installation in conduit and other approved raceways.
2. Conductors: 4 pairs of conductors, 8 conductors total, 23 AWG solid bare copper conductors.
3. Insulation and Jacket: polyolefin insulation, individual conductors colored white/green and green, white/orange and orange, white/blue and blue, and white/brown and brown, center strength member, unshielded, industrial grade sunlight and oil resistant PVC jacket, outer jacket ripcord, 0.251 x 0.339 inch overall nominal diameter, 300 volts, -40 degrees C to +75 degrees C operating temperature.
4. Applicable Standards: NEC/UL CMR, UL Style 444, ANSI/TIA/EIA-568-B.2-1 CAT 6, UL Verified to Category 6, UL 1666 Riser Flame Test.
5. Acceptable Manufacturers:
 - a. Belden 7927A
 - b. Approved equal

F. Industrial Ethernet Passive Components:

1. Provide connectors, sockets, and couplings suitable for use in industrial Ethernet applications for 10 Gigabit Ethernet data transmission.
2. Components shall be rated for IP20 and IP67 class of protection in accordance with IEC 529.
3. Equipment shall be designed to withstand harsh industrial environments including high temperatures and damp locations. Housings shall be resistant to dirt and liquids.
4. Applicable Standards: NEC/UL CMR, TIA 568-C.2, ISO/IEC 11801 Class EA, UL 1666 Vertical Riser Flame Test.
5. Acceptable Manufacturers:
 - a. Phoenix Contact PLUSCON data
 - b. Weidmuller Steady Tec
 - c. Approved equal

G. Flexible Cords, Cables, and Fittings:

1. Where flexible cords and cables are required, provide Type SO, 600-volt, having the number and size of copper conductors shown on the Drawings.
2. Provide liquid-tight strain relief fittings for exposed flexible cord and power cable where cables enter electrical panels and enclosures. Provide strain relief as manufactured by Hubbell (Kellums), OZ Gedney, or approved equal

H. Electrical Tape for Color Coding:

1. Electrical tape shall be premium grade, not less than 7 mils thick, rated for 90 degree C minimum, flame-retardant, weather resistant, and available in suitable colors for color coding. The tape shall be resistant to abrasion, ultraviolet rays, moisture, alkalies, solvents, acids, and suitable for indoor and weather-protected outdoor use. The tape

shall be suitable for use with PVC and polyethylene jacketed cables, and meet or exceed the requirements of UL 510.

2. Acceptable Manufactures:
 - a. 3M 35 Scotch Vinyl Electrical Tape for Color Coding
 - b. Plymouth Rubber Company Premium 37 Color Coding Tape
 - c. Approved equal
- I. Low Voltage Splices, 600 volts and below:
1. Power Conductors
 - a. General: Provide low voltage splices consisting of 600 volt compression type connectors and connector insulators, suitable for indoor and outdoor field installations.
 - b. Provide two way, uninsulated, compression connectors, long barrel type, suitable for use with stranded copper conductors. Provide UL listed connectors rated 600 volts minimum. Acceptable manufacturers: Burndy, Thomas and Betts, Panduit, or approved equal.
 - c. Connector insulators shall be cold shrink type factory expanded and assembled tubular EPDM rubber sleeves, suitable for field installation. Insulators shall shrink over in line connections, forming a water proof seal. Provide insulators rated for 1000 volts, minimum.
 - d. Acceptable manufacturers:
 - 1) 3M
 - 2) Approved equal
 2. Control Conductors
 - a. Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.
 - b. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Technology, St Louis, MO; Ideal Industries, Inc., Sycamore, IL or approved equal.
- J. Low Voltage Terminations, 600 volts and below:
1. Power Conductors
 - a. Provide solderless, die type or set screw compression type lugs and connectors. Provide plated copper alloy terminations as manufactured by Thomas and Betts; Burndy; or approved equal. Provide lugs and connectors recommended by the manufacturer for the cable type used.
 - b. Motor connections shall be screw type insulated pressure connections terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and springwasher. Provide insulation by heat shrink boot especially made for motor termination use. Wire nuts, split bolts, etc., are not acceptable. Connections shall be insulated with a Raychem Type MCK, roll-on stub insulator or approved equal and shall be as recommended by the manufacturer for the cable type used.
 2. Control, Status, and Alarm Conductors
 - a. Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.

3. Instrumentation Cables
 - a. Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.
- K. Wire and Cable Markers
 1. Wire and cable markers shall be pre-printed, clip sleeve type as manufactured by the W.H. Brady Co.; Thomas & Betts Co.; 3M Co. or approved equal.
 2. Wire and cables with diameters exceeding the capacity of the clip sleeve type shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp. or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.
- B. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Pulling of cable shall be performed in such a manner that the cable outer jacket does not scrape against the edge of the conduit, at both the inlet and outlet ends of the conduit. Cable shall be free of sandy or gritty material during pulling. If cable is laid on ground during pulling, cable shall be wiped free of sandy or gritty material prior to entry of cable into conduit and prior to application of any pulling compound.
- C. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch pound requirements of the NEC and UL.
- D. Where single conductors and cables enter manholes, handholes, vaults, and other indicated locations bundle the conductors from each conduit throughout their exposed length with nylon, self-locking, releasable, cable ties placed at intervals not exceeding 18 inches on centers.
- E. Wrap exposed lengths of 480V feeders in manholes or handholes, #4/0 and higher, with fire resistant tape.
- F. Terminate no more than two control conductors per terminal point. Terminate all spare conductors on terminal blocks.
- G. When pulling low voltage power and control conductors in the same conduit, only combine conductors with no more than two wire sizes difference to prevent possible installation damage to the smaller conductors; otherwise use separate conduits.
- H. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with approved wire and cable marker systems as specified herein.

3.02 CONDUCTOR 600 VOLTS AND BELOW

- A. Provide conductor sizes indicated on drawings with no splices except as approved in writing by the Engineer.
- B. Wire nuts may be used only on 120 volt lighting and 120 volt receptacle circuits. Place no more than one conductor in any single-barrel pressure connection. Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors. Soldered mechanical joints insulated with tape will not be acceptable.
- C. Color coding on wire sizes larger than No. 6 AWG shall be by taping the individual conductors with the appropriate colored self adhesive vinyl electrical tape.
- D. Provide terminals and connectors recommended by the manufacturer for the type of material used.
- E. Arrange wiring inside control panels, motor starters, switchgear, etc., neatly cut to proper length, remove surplus wire, and bridle and secure in an acceptable manner. Identify all circuits entering switchgear, motor starters, control panels, etc., in accordance with the cable schedules on the drawings. Terminate cable conductors on the same side of the terminal blocks as shown on the drawings.
- F. Terminations for power conductors shall be die type or set screw type pressure connectors as specified. Splices for power conductors if specifically requested by the Contractor and approved in writing by the Engineer, shall be die type compression connector and waterproof with shrink fit rubber boot (as specified) or epoxy filling for copper conductors # 4 AWG and larger. Splices shall be solderless pressure connectors with insulating covers for copper conductors # 6 AWG and smaller. Approved splicing shall be performed only in enclosures approved for splicing in the NEC.
- G. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions. Where terminals provided will accept such lugs, terminate all control and instrumentation wiring (except solid thermocouple leads) with insulated, locking fork compression lugs. Control panel incoming field wireway sizes indicated on the Drawings are considered minimum. Contractor shall adjust wireway sizes to meet NEC percentage fill requirements.
- H. For terminals designed to accept only bare wire compression terminations use only stranded wire and terminate only one wire per terminal. Tighten all terminal screws with torque screwdriver to recommended torque values.
- I. Attach compression lugs with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.
- J. Where conductors pass through holes or over edges in sheet metal, remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors.

- K. For conductors that will have final terminations by Others, provide at least six feet spare conductor in freestanding panels and at least two feet spare in other assemblies. Provide sufficient spare conductor length in any particular assembly as required to reach the termination point plus an additional two feet of slack conductor.
- L. Cables passing through manholes and handholes shall be trained along the walls on cable racks. Allow two feet of slack in each run in a "drip loop" at least once along a wall. Loops and cables shall be organized, trained, bundled, and neatly installed.
- M. Do not strip cables more than eight inches from the nearest termination point of that cable.
- N. Cap spare conductors and conductors not terminated with UL listed end caps.
- O. All spare pairs shall be bundled and labeled with the cable designation. All individual pairs shall be tagged to enable identification of spare pairs when making future terminations.
- P. Splices will not be permitted except as accepted in writing by the Engineer.
- Q. Ends of cable shall not be exposed to the ambient environment more than 24 hours after pulling or splicing. After 24 hours the cable shall be purged with nitrogen or sealed with tape.

3.03 INSTRUMENTATION CABLES 600 VOLTS AND LESS

- A. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.
- B. Terminal blocks shall be provided at all instrument cable junction and all circuits shall be identified at such junctions. Direct splicing of signal and instrumentation circuits is not acceptable. Shielded instrumentation wire, coaxial, data highway, I/O and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels.
- C. Shields shall be grounded as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

3.04 LACING OF WIRES AND CABLES

- A. All wires and cables shall be laced in pull or junction boxes, manholes, handholes, wireways, and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit and the laced together circuit or cable shall be tagged with the cable number. All wiring entering and exiting the control panels or pull structure shall be bundled into groups. Power, lighting, control, alarm, and instrumentation wiring shall be bundled and laced as specified herein.

3.05 FIELD QUALITY CONTROL

- A. Provide acceptance testing of all of the low voltage cables per Section 26 08 00.
- B. Coordinate system loop checking including point to point cable continuity checking and verification in conformance with the requirements of Section 40 61 00.
- C. All data highway and special systems cabling shall be tested as required by the system manufacturer requirements. Testing shall be performed as specified in the individual Division 40 or Division 26 sections to verify satisfactory signal transmission and reception in conformance with manufacturer's published requirements.

3.06 SPARES

- A. Identify spare conductors with source location and other identifiers as shown on the Drawings. Provide a minimum of 5-feet of extra conductors for each spare circuit. Wrap excess conductor lengths, provide with plastic tie-wrap, and coil up in last pullbox location of the run.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the NEC, as shown on the Drawings and as specified herein.
2. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.
3. Provide grounding bus bars where shown on the Drawings.
4. Connect all hatches, metal stairs and handrails to system ground grid or system ground loop.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 73 – Electrical System Studies
- C. Section 26 05 33 – Raceways and Boxes for Electrical Systems.
- D. Section 26 08 00 – Commissioning of Electrical Systems

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 30 00 and Section 26 05 00.
- B. Submit product data for the following:
 1. Ground rods.
 2. Ground rod boxes.
 3. Exothermic welding materials and methods.
 4. Mechanical and compression type grounding clamps including installation requirements and materials.
 5. Grounding hubs and fittings.
 6. Grounding bars
- C. Submit results of grounding and bonding resistance testing as specified herein

1.04 REFERENCES

- A. American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

1. IEEE Std 142 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 2. IEEE Std 837 – IEEE Standard for Qualifying Permanent Connections used in Substation Grounding
- B. American National Standards Institute (ANSI)/National Science Foundation (NSF)
1. ANSI/NSF 60 – Drinking Water Treatment Chemicals – Health Effects
- C. American Society for Testing and Materials (ASTM).
1. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.
 2. ASTM B 187 – Standard Specification for Copper Bar, Bus Bar, Rod, and Shapes.
 3. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- D. California Code of Regulations.
1. Title 24, Part 3 – California Electrical Code (NEC), Article 250 (Grounding).
- E. Underwriters Laboratories (UL).
1. UL 467 – UL Standard for Grounding and Bonding Equipment.
 2. UL 224 – UL Standard for Extruded Insulating Tubing.
- F. InterNational Electrical Testing Association (NETA).
1. ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All grounding and bonding products shall be UL listed.
- B. All exothermically welded or compression-type terminal lugs for buried or embedded connections shall use materials qualified in accordance with IEEE 837.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Direct-buried, concrete encased, and exposed grounding conductors.
 1. Bare concentric stranded copper conductors conforming to ASTM B-8 with Class B stranding, size as indicated on the Drawings.
 2. Acceptable manufactures:
 - a. Southwire
 - b. General Cable
 - c. Approved equal
- B. Ground rods

1. 3/4 in by 8 ft copper clad steel constructed in accordance with UL 467. The copper thickness shall be 10 mil minimum, 15 mil average. Provide UL mark on ground rod.
 2. Acceptable manufacturers:
 - a. Harger
 - b. Eritech (Erico)
 - c. Approved equal
- C. Conduit grounding bushings
1. Insulated, rated for 150° Celsius, malleable iron type with a solderless set-screw lug.
 2. Acceptable manufacturers:
 - a. Appleton
 - b. Hubbell Electrical Products (Raco)
 - c. Approved equal
- D. Waterpipe ground clamps
1. Electroplated tinned bronze U-bolt style pipe clamp, sized as required for the pipe diameter and ground wire size specified.
 2. Acceptable manufacturers:
 - a. Harger
 - b. Blackburn (Thomas & Betts)
 - c. Approved equal
- E. Grounding system connections
1. Buried, encased, or in areas where connections will be not be readily accessible after completion of construction.
 - a. Buried, encased, or otherwise inaccessible grounding connections shall be made with exothermic welds. Molds, cartridge materials, and accessories shall be as specifically recommended by the manufacturer of the molds for the types of items to be welded. Molds and powder shall be furnished by the same manufacturer.
 - b. Acceptable manufacturers:
 - 1) Harger (Ultraweld)
 - 2) Erico (Cadweld)
 - 3) Approved equal
 2. Accessible connections to equipment, connections to exposed structural steel (e.g. steel columns), connections to reinforcing steel, connections made to ground rods located in ground rod boxes, and all other locations where the connections are readily accessible to maintenance personnel after completion of construction.
 - a. Mechanical connections to ground rods, equipment, structural steel, and other accessible connections shall be made using heavy duty, U-Bolt or two hole bolted copper or bronze clamps as required for the cable size used. U-Bolt and cap screws shall be stainless steel.
 - b. Specific type of connectors shall be selected to match the specific connections to be made (water pipes, building steel, etc.).
 - c. Acceptable manufacturers:
 - 1) Harger
 - 2) Blackburn (Thomas & Betts)
 - 3) Burndy
 - 4) Approved equal

- F. Pre-cast concrete boxes for ground-rod installation
 - 1. Provide where shown on the Drawings. Provide boxes with cast iron riser rings, and traffic covers inscribed "GROUND ROD". Provide H-20 traffic rated boxes and covers.
 - 2. Acceptable manufacturers:
 - a. Christy
 - b. Jensen Concrete Products
 - c. Approved equal
- G. Electrical joint inhibitor compound
 - 1. Use at all bolted grounding connections as a moisture and oxidizing seal.
 - 2. Acceptable manufacturers:
 - a. Sanchem Inc., NO-OX-ID (A-Special Electrical Grade)
 - b. Approved equal
- H. Manufactured Grounding Bus Bar: Grounding bus bar shall be a high conductivity copper alloy measuring 1/4-inch by 4-inches, minimum length of 12-inches or as shown on the Drawings. Bus shall be predrilled on 1-inch centers to accept grounding compression terminals bolted with brass bolts, nuts, and washers coordinated with the installation. Provide grounding bus bars by Burndy Type BBB; Chatsworth, or equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare and clean piping, rods, and conductors prior to exothermic welding in conformance with the specific requirements of the welding system.
- B. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and remake them with new fittings.

3.02 INSTALLATION

- A. General
 - 1. Bond all exposed steel building columns in new structures together and connect to the grounding electrode system as shown on the Drawings. Connections to exposed structural steel columns or other exposed structural element shall be made with mechanical connectors.
 - 2. Grounding of the pipe systems shall be provided per the requirements of NEC and as shown on the Drawings.
 - 3. Metal conduits stubbed into power distribution equipment, control panels, or other enclosure shall be terminated with insulated grounding bushings and mechanically bonded to the enclosure's ground bus. Size the bonding wire in accordance with the NEC, except that a minimum No. 12 AWG shall be used.
 - 4. Each separate building or structure shall have a grounding electrode or grounding electrode system per the requirements of the NEC.
 - 5. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and mechanically bonded in accordance with the NEC.

6. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
7. Liquid tight flexible metal conduit shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.
8. Run grounding electrode conductors in the building concrete slab/wall or as slab/wall-embedded unless otherwise shown on the Drawings.
9. Ground cable penetrations through building exterior walls shall enter within 3 feet below finish grade and shall be prepared with a water stop. Unless otherwise indicated, the water stop shall include filling the space between stands with solder and soldering a 12-inch copper disc over the cable.
10. Install equipment grounding conductors with all feeders and branch circuits. Each circuit shall have a dedicated equipment grounding conductor from source to load without splicing or “tee tapping” (e.g., three different receptacle circuits in a common home-run conduit back to a lighting panelboard shall have three separate equipment grounding conductors back to the lighting panelboard).
11. Ground metallic poles supporting outdoor lighting fixtures to a supplemental grounding electrode (rod) in addition to the separate equipment grounding conductor run with the supply branch circuit.
12. Ground metallic masts supporting radio antennae to a supplemental lightning protection grounding rod in addition to the separate equipment grounding conductor incorporated into the antennae signal cable as shown on the Drawings.
13. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with ground clamp connectors.
14. Mechanically bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters and HVAC equipment. Use braided-type bonding straps.
15. Install driven ground rods in manholes and handholes close to wall and set rod depth at 4 to 6-inches above finished floor. Protect ground rods with double wrapping of pressure-sensitive tape or heat shrunk insulating sleeve from 2-in above to 6-in below concrete floor with connections of grounding conductors fully visible and accessible. Seal floor opening with waterproof, non-shrink grout. Where ground rods are installed outside of manhole or handhole, provide a No. 4/0 AWG bare copper conductor from ground rod into manhole or handhole through a waterproof sleeve in the wall. The ground rod shall be connected to the duct bank grounding electrode conductor where available.
16. Concrete encased duct banks shall include a grounding electrode conductor. Duct bank grounding electrode conductors shall connect to the facility grounding electrode system, including the grounding system of all manholes and handholes.
17. Direct-burial grounding grid electrode conductors shall be installed at a minimum depth of 24 inches below subgrade unless otherwise shown on the Drawings. Care shall be exercised at cable crossings to avoid damage to the cable. Damaged cable shall be replaced with new cable.

B. Ground connections

1. Electric Motors and Electrical Equipment
 - a. Grounding conductors for motors and electrical equipment shall be connected by a solderless terminal and a 5/16-inch, minimum, bolt tapped to the motor frame or equipment housing.

- b. Large motors (over 100 HP) and major equipment items shall have at least 2 ground-pad-type connections and shall be attached to the main ground-grid at a minimum of 2 locations. Unless otherwise specified, connections of conductors to the equipment shall be with NEMA type, 2-hole, bolt-on bar lugs, and connections shall be made in accordance with the manufacturer's printed recommendations.
 - c. Paint, dirt, or other surface coverings shall be completely removed at the connection points of grounding conductors so that good metal-to-metal contact is made.
 - d. After grounding connections are made, areas around the connection point shall be prepared and the coating system repaired in accordance with Section 09 90 00. Surfaces shall be restored to their original condition before the grounding connections are made.
 - e. Ground connections to smaller motors or equipment may be made by fastening the terminal to a connection box.
 - f. Junction boxes shall be connected to the equipment grounding system with 0.375-inch silicon-bronze machine screws.
2. Ground transformer neutrals, UPS neutrals, generators, and other separately derived sources to the nearest grounding electrode system as shown on the Drawings. The grounding electrode conductor shall be sized in accordance with the NEC unless otherwise specified on the Drawings. The grounding conductor shall be running continuous to the neutral (X/O) connection or run via an intermediate exposed bus bar located as shown on the Drawing or field located with the approval of the Engineer.
 3. Ground instrumentation cable shields at a single point inside of the control panel at the signal grounding bus bar, unless grounding at the device is specifically required by the instrument manufacturer. Grounding of instrumentation shields shall conform to the requirements of Section 40 61 00.
 4. Ground data highway and network cables as required by the manufacturer of the communication equipment.
 5. Grounding electrode conductors shall be exothermically welded to the foundation reinforcing steel grid as shown on the Drawings.
 6. Seal exposed connections between different metals with electrical joint inhibitor compound. All buried connections shall be cleaned and coated with electrical joint inhibitor compound before backfilling.
 7. Bolted connections shall not be buried or embedded. For compression-type connectors, the tool for crimping shall emboss the die index number into the connector as the crimp is completed. Each compression-type connector shall have an inspection port for use in checking proper conductor insertion. Compression connections shall be installed in strict accordance with manufacturer's printed recommendations using tools and dies of the proper size and type for the conductors, lug, and grounding electrode.
 8. Molds used for exothermic welding shall be new. The number of welds made per mold shall not exceed the manufacturer's published recommendations.
 9. Where pipe flange or piping is grounded by means of a clamp or lug, the pipeline coating shall be repaired, except the grounding connection area, as shown on the project Drawings or as specified under Section 09 90 00.
 10. Intersections: Intersections of grounding cables shall be bonded together.
 11. Grounding taps and ground rods shall be connected by separate bonds to the main ground mat.

C. Ground rods

1. Install grounding electrodes at locations shown on the Drawings.
2. Drive ground rods to the depth shown on the Drawings. Interconnect ground rods and other grounding system components with the grounding conductor size shown on the Drawings.

D. Grounding Conductors

1. Unless otherwise specified, provide continuous, unspliced equipment grounding conductors.
2. Lay all underground grounding conductors' slack within 10 feet from the footing and, where exposed to mechanical injury, protect by PVC schedule 40 conduit or other approved physical protection. If guards are steel pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified in this Section.
3. Where grounding conductors extend beyond the perimeter of the building to site structures, the grounding electrode system shall be continuous, and the grounding conductor shall be encased in concrete ductbanks. Provide a minimum 2 layers of Aqua Seal over the taped assembly.
4. Conductors to equipment enclosures/tanks shall be neatly run along the face of concrete footings or structural steel, following surfaces closely to the point of connection. Conductors shall be supported and secured with cable fasteners at intervals no greater than 5 feet.
5. Conductors shall be mechanically bonded to metallic enclosures at each end and to intermediate metallic enclosures such as pullboxes.
6. Grounding conductors shall be connected to grounding bushings on raceways.
7. Where equipment contains a ground bus, grounding conductors shall be extended and connected to that bus. The enclosure of the equipment containing the bus shall also be connected to the bus.
8. Expansion Fittings: To relieve shearing and pulling action at structural expansion joints, cables shall be run in expansion joint fittings as shown on the Drawings.

E. Fasteners

1. Clean the connector and conductor surfaces with a wire brush or emery cloth to a shiny, bright surface. For plated surfaces, compatible solvent cleaning shall be used in order not to remove any portion of the plating.
2. Immediately after cleaning, apply an oxide-inhibiting compound with suspended copper particles on the threads of the connectors, ground plate, bolts, and other hardware used for making mechanical grounded connections.
3. All fasteners shall engage a minimum of four full threads for electrical connections and equipment mounting.
4. All bolts shall be coated with electrical joint inhibitor compound.
5. Torque fasteners to manufacturer's requirements and NETA specifications.

F. In addition to those items specified to be grounded above, the following metallic items shall also be grounded using a minimum of No. 2 AWG wire:

1. HVAC equipment and duct work.
2. Stairs and ladders.
3. Door frames for person access doors and rollup doors.

4. Building sheathing and exposed vertical structural elements.
5. Non-electrical metallic items in close proximity to exposed electrical equipment.
6. Frames and railings supporting push-button stations, receptacles, instrument cabinets, and raceways carrying circuits to these devices.

3.03 INSPECTION AND TESTING

- A. Inspect the grounding and bonding system conductors and connections for tightness, proper installation, and proper application of electrical joint inhibitor compound.
- B. Testing shall be performed before energizing the distribution system per Section 26 08 00.
- C. A separate grounding system test shall be conducted for each building or system.
- D. Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms or if the resistance to ground for a substation is greater than one ohm.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. This section covers the work necessary to furnish and install, complete raceways and boxes for electrical systems.
2. Raceway Schedules indicating conductor number and minimum required conductor sizes are included in:
 - a. Section 26 05 33 – Appendix A1 – Conduit Schedule: Reservoir A1/A2 and B/C Booster Pump Station
 - b. Section 26 05 33 – Appendix A2 – Conduit Schedule: F Booster, Chlorination Building
 - c. Section 26 05 33 – Appendix A3 – Conduit Schedule: Reservoir 2/Well 12
 - d. Section 26 05 33 – Appendix A4 – Conduit Schedule: Promontory Lift Station
3. The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufacturers cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such items not included in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.
4. Home runs indicated are to assist the Contractor in identifying raceways to be installed concealed or exposed. Raceways identified to be installed exposed on the Drawings shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.
5. Raceway supports and restraints indicated on the Drawings are shown only to convey the general intent of the design and not intended to represent a complete system for all locations. The absence of location and specific details of the supports, additional restraints, and other mounting details on the Drawings shall not relieve the Contractor of the responsibility for providing them as specified. Raceway support layouts, supporting calculations, and required hardware for the raceway system are included in the Contractor's Scope of Work.

1.02 RELATED SECTIONS:

- A. Section 26 05 00 – Common Work results For Electrical
- B. Section 26 05 33 – Appendix A1 – Conduit Schedule: Reservoir A1/A2 and B/C Booster Pump Station
- C. Section 26 05 33 – Appendix A2 – Conduit Schedule: F Booster, Chlorination Building
- D. Section 26 05 33 – Appendix A3 – Conduit Schedule: Reservoir 2/Well 12

- E. Section 26 05 33 – Appendix A4 – Conduit Schedule: Promontory Lift Station
- F. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.03 SUBMITTALS

- A. Submit data in accordance with Section 01 30 00 and Section 26 25 00.
- B. Submit manufacturers' names, product designation, and catalog numbers with marked cut sheets clearly and uniquely identifying all materials to be provided under this Section. Submit data for conduits, raceways, fittings, boxes, hardware, identification systems, and other materials specified in this Section.
- C. Submit specific details and methodology for water sealing around conduits entering structures below grade. Submittal shall include plan showing locations of entries, method of entry (core drill, block out, etc.), method for sealing against entry of water into the building or structure, and sealing materials or devices.

1.04 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI C80.1: Electrical Rigid Steel Conduit (ERSC).
 - 2. ANSI C80.3: Steel Electrical Metallic Tubing
 - 3. ANSI C80.4: Fittings for Rigid Metal Conduit and Electrical Metal Tubing.
- B. California Code of Regulations
 - 1. Title 24, Part 3 – California Electrical Code (NEC)
- C. National Electrical Manufacturer's Associate (NEMA)
 - 1. NEMA FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - 2. NEMA RN 1: Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - 3. NEMA TC2: Electrical Polyvinyl Chloride (PVC) Conduit
 - 4. NEMA TC3: Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
- D. Federal Specifications (FS)
 - 1. FS W-C-586D (A-A-50563): Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal
 - 2. FS W-C-1094: Conduit and Conduit Fittings Plastic, Rigid
- E. Underwriters Laboratory (UL)
 - 1. UL 6: Electrical Rigid Metal Conduit - Steel
 - 2. UL 514B: Fittings for Conduit and Outlet Bodies
 - 3. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 4. UL 1660: Liquid-Tight Flexible Non-Metallic Conduit

1.05 CONDUIT SCHEDULES

- A. General: Conduit schedules are included in 26 05 33 Appendix A.
- B. Identification: Conduits are identified on the Drawings using a tagging scheme as follows:

XX###A

where

XX: one or two letter designating function per the table below

###: conduit number including equipment number where available

A: for parallel power feeder conduits, merged control conduits, parallel fiber optic conduits, or otherwise as required to ensure uniqueness

- C. Functional Designation Table

Conduit Designator Table

Letter Designator	Function
C	Control and Monitoring 120V
EL	UPS 120V Circuit - UPS Sourced
L	240/208/120V Panelboard Circuit
N	Other Network or Data Link
P	Power, <=480V
S	Low Voltage Signal (4-20mA)
U	Utility Service Conduits
X	Spare (e.g., PX##### = spare power conduit)

PART 2 - PRODUCTS

2.01 STEEL CONDUIT AND FITTINGS

- A. Galvanized Rigid Steel Conduit (GRS)
 - 1. Hot-dipped galvanized rigid steel conduit, including threaded type couplings, elbows, nipples, and other fittings, shall meet the requirements of ANSI C80.1, ANSI C80.4, UL and the NEC. Do not use setscrew or threadless type couplings, bushings, elbows, nipples, and other fittings, except when approved in writing by the Engineer.
- B. Acceptable Manufacturers:
 - 1. Allied Tube and Conduit
 - 2. Western Tube & Conduit Corporation
 - 3. Cal Pipe Industries, Inc

4. Approved equal

2.02 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. PVC conduit shall be Schedule 40 UL listed for concrete encased, underground direct burial, concealed, and direct-sunlight, weather-exposed use. Provide PVC conduit manufactured from virgin PVC compounds conforming to UL 651, listed and marked for use with 90° C insulated conductors.
- B. PVC conduits, couplings, elbows, nipples, and other fittings shall meet the requirements of NEMA TC 2 AND TC 3, Federal Specification W-C-1094, NEC Article 352, and ASTM D-1784 specified tests for the intended use.
- C. Provide conduits having a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable.
- D. Acceptable Manufacturers:
 1. Carlon/Thomas and Betts (Lamson & Sessions) Plus 40 Rigid PVC Nonmetallic Conduit
 2. PW Eagle (PW Pipe)
 3. Allied Tube and Conduit (Tyco)
 4. Approved equal

2.03 PVC COATED RGS CONDUIT AND FITTINGS

- A. PVC-coated rigid steel conduit shall be hot-dipped galvanized rigid steel conduit meeting the requirements of NEMA RN 1, UL/6, and ANSI C80.1. Provide a factory installed PVC coating, 40 mils nominal thickness, and applied over and permanently bonded to the galvanized surface. Coating shall include an interior 2 mil urethane coating.
- B. All male threads on conduit, elbows, nipples and other fittings shall be protected by an application of a urethane coating; they shall be threaded and galvanized with integral plastic sleeves overlapping the plastic-coated conduit.
- C. Provide PVC coated conduit suitable for conductors with 75°C insulation.
- D. Product shall bear the ETL PVC-001 certification mark.
- E. Acceptable Manufacturers:
 1. Robroy, Plasti-Bond Red
 2. Perma-Cote Industries, Supreme Conduit System
 3. Approved equal

2.04 MISCELLANEOUS RACEWAY FITTINGS

- A. Rigid Steel Fittings
 1. Watertight hubs for rigid steel conduit shall be male thread type zinc-plated malleable iron with recessed "O" ring seal.
 - a. Acceptable Manufacturers:

- 1) OZ Gedney Type CHM
 - 2) Appleton HUB Series
 - 3) Myers Scru-Tite Hubs
 - 4) Approved equal
2. Provide insulated throat grounding bushings at each end of every metal conduit. Provide threaded zinc-plated malleable iron grounding bushings with solderless bonding screw and insulated throat rated for 150°C.
 - a. Acceptable Manufacturers:
 - 1) Thomas & Betts Grounding and Bonding Bushings
 - 2) OZ Gedney Type BLG
 - 3) Appleton Threaded Grounding Bushings
 - 4) Approved equal
 3. Provide all malleable iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets.
 - a. Acceptable Manufacturers:
 - 1) Appleton Form 35 threaded Unilets
 - 2) Kilark
 - 3) Approved equal
 4. Conduit End Caps: Provide PVC end caps to plug spare conduits and protect against entry of rodents, water, or dirt into the spare conduit. Provide end caps designed to fit into the end of standard conduit trade sizes and include integral cap eyelet for tying off spare conduit pull ropes or string.
- B. PVC-Coated Rigid Steel Conduit Fittings:
1. General: All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel conduit. The ends of couplings and fittings shall have a minimum of one pipe diameter PVC overlap to cover threads and provide a seal.
 2. Products shall bear the ETL PVC-001 certification mark where applicable.
 3. Provide insulated throat grounding bushings with threaded zinc-plated malleable iron grounding bushings with bonding screw and insulated throat rated for 150 degrees C.
 - a. Acceptable Products:
 - 1) Thomas & Betts Grounding and Bonding Bushings
 - 2) OZ Gedney Type BLG
 - 3) Appleton Threaded Grounding Bushings
 - 4) Approved equal
 4. Provide watertight and corrosion resistant hubs with a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves.
 - a. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Type ST Hub
 - 2) Perma-Cote Industries Supreme Type ST Hub
 - 3) Approved equal
 5. Provide corrosion resistant conduit bodies sized as required by the NEC. Provide cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating, 2 mil (nominal) internal urethane coating, and pressure sealing sleeves on all conduit openings.
 - a. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Conduit Bodies
 - 2) Perma-Cote Industries Supreme Conduit Bodies

- 3) Approved equal

C. Liquid-Tight Flexible Metal Conduit Fittings:

1. Throat Connectors:
 - a. In NEMA 4X areas, provide zinc-plated malleable iron or galvanized steel insulated throat connectors suitable for use in wet locations, with a minimum 40 mil PVC exterior coating and pressure sealing sleeves.
 - b. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Liquid Tight Connectors
 - 2) Perma-Cote Industries Supreme Liquidtight Connectors
 - 3) Approved equal
2. Hubs:
 - a. In NEMA 4X areas, provide watertight and corrosion resistant hubs with a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves.
 - b. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Type ST Hub
 - 2) Perma-Cote Industries Supreme Type ST Hub
 - 3) Occidental Coating Company OCAL-Blue Double-Coat Type ST Hub
 - 4) Approved equal
3. Conduit Bodies:
 - a. General: Provide conduit bodies sized as required by the NEC. Provide integral rollers and bushings to facilitate pulling and protect wire insulation for conduit bodies greater than 1-inch; provide mogul type conduit bodies for sizes greater than 2-inch.
 - b. For areas not designated NEMA 4X, provide cast iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets. Acceptable manufacturers:
 - 1) Appleton Form 35 threaded Unilets
 - 2) Crouse-Hinds Form 7 threaded condulets
 - 3) OZ Gedney Form 7 threaded conduit bodies
 - 4) Approved equal
 - c. For NEMA 4X areas, provide corrosion resistant conduit bodies sized as required by the NEC. Provide cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating and nominal 2 mil internal coating, and pressure sealing sleeves on all conduit openings. Acceptable manufacturers:
 - 1) Robroy Plasti-Bond Red Conduit Bodies
 - 2) Perma-Cote Industries Supreme Conduit Bodies
 - 3) Approved equal
4. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.
5. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

2.05 BOXES

A. NEMA 1 and NEMA 12 Utility Boxes:

1. Provide pressed steel switch and outlet device boxes hot-dipped galvanized after fabrication. Provide extra-depth boxes with knockouts, size and style suitable for the application.
 2. Small boxes used for junction boxes or pull boxes 100 cubic inches and smaller shall be constructed of minimum 14 USS gage sheet steel, galvanized after fabrication. Provide boxes with minimum depth of 2-1/8-inches with overall size, style, and knockouts to match the application. Provide blank covers affixed with round head brass or stainless steel machine screws.
 3. Boxes used for junction or pull boxes larger than 100 cubic inches shall be constructed of minimum 14 USS gage sheet steel, galvanized after fabrication. Provide boxes without knockouts with overall size and style to match the application. Provide blank covers affixed with round head brass or stainless steel machine screws. All joints shall be welded and edges ground smooth.
 4. Acceptable Manufacturers:
 - a. Raco Manufacturing Co.
 - b. O.Z. Manufacturing Co.
 - c. Approved equal
- B. NEMA 1 and NEMA 12 Terminal Boxes
1. Provide terminal boxes fabricated of sheet steel unless otherwise shown on the Drawings. Boxes shall have continuous welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 14 gauge metal. Covers shall be continuously hinged, gasketed with rolled lip, and fastened with stainless steel latches or clamps. Boxes shall be furnished with terminal mounting straps and brackets.
 2. Acceptable Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Lee Products Co.
 - c. Keystone/Rees, Inc.
 - d. Approved equal
- C. NEMA 4 Utility Boxes
1. Provide Type FD switch and outlet device boxes of cast or malleable iron or cast copper-free aluminum as required by the application. All device boxes shall be extra depth and gasketed. Covers shall be with cadmium-zinc finish with cast iron or aluminum covers and stainless steel screws.
 2. Boxes shall be UL514 listed 514 conforming to NEMA FB-1 and Federal Specification W-C-586D standards.
 3. Acceptable Manufacturers:
 - a. Hubbell-Killark
 - b. Appleton
 - c. Crouse-Hinds Co.
 - d. Approved equal
- D. Provide NEMA 4X terminal boxes, junction boxes, pull boxes, etc. manufactured of fiberglass reinforced plastic with stainless steel hardware unless otherwise noted. Covers shall be continuously hinged and gasketed. Terminal boxes shall be furnished with terminal mounting straps and brackets.

1. Acceptable Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Lee Products Co.
 - c. Keystone/Rees, Inc.
 - d. Approved equal

2.06 WIREWAYS

- A. For areas designated NEMA 1, or NEMA 12 on the Drawings, provide UL listed, hinged cover, NEMA 12 wireway bodies and covers fabricated from 16 gauge steel minimum, with an enamel or epoxy finish.
 1. Acceptable Manufacturers:
 - a. Square D Square-Duct Wireway
 - b. Hoffman
 - c. Approved equal
- B. For all other areas or where NEMA 3R, NEMA 4, or NEMA 4X is shown on the Drawings, provide UL listed, raintight, hinged cover NEMA 4X wireway bodies and covers fabricated from stainless steel.
 1. Acceptable Manufacturers:
 - a. Square D
 - b. Hoffman
 - c. Approved equal

2.07 RACEWAY SUPPORTS AND FITTINGS

- A. General: Raceways shall be supported using trapeze hangers, flush mounted hardware, conduit racks, and conduit hangers as shown on the Drawings and as required.
- B. For areas not designated as NEMA 4X on the Drawings, supports and fittings for support systems for electrical equipment and raceways shall be channel supports sized to meet specified seismic requirements. Finish shall be hot-dipped galvanized after fabrication for strut, pipe straps, clamp back spacers, hanger rod, strut nuts, u-bolts, beam clamps, and all other supports and fittings.
 1. Acceptable Manufacturers:
 - a. Unistrut
 - b. B-Line
 - c. Power Strut
 - d. Approved equal
- C. For areas designated as NEMA 4X on the Drawings; supports and fittings for support systems for electrical equipment and raceways shall be channel supports sized to meet seismic requirements. Materials of construction shall be 40 mil PVC coated hot-dipped galvanized steel, 316 stainless steel, or self-extinguishing fiberglass which meets UL94V-0 flammability tests, for strut, pipe straps, clamp back spacers, hanger rod, strut nuts, U-bolts, beam clamps, and other supports and fittings. However, selection of support material used shall be resistant to the material(s) stored or resident in the location where installed.
 1. Acceptable Manufacturers:
 - a. Robroy Plasti-Bond-Red PVC Coated Steel Strut and accessories

- b. Perma-Cote Supreme PVC Coated Steel Channel and accessories
- c. Approved equal

2.08 EXPANSION AND DEFLECTION COUPLINGS

- A. General: Provide expansion and/or deflection couplings for use where shown and wherever conduit crosses an expansion joint. The couplings shall alleviate longitudinal, angular, and shear conduit stress caused by thermal expansion and/or differential settlement.
- B. Couplings shall be suitable for either rigid metallic or non-metallic conduits and for embedded or exposed applications.
- C. Requirements:
 - 1. Suitable for wet locations, corrosion resistant
 - 2. Axial expansion or contracting up to 3/4 inch
 - 3. Angular misalignment of the axes of the coupled conduit runs in any direction up to 30 degrees
 - 4. Parallel misalignment of the axes of coupled conduit runs in any direction up to 3/4 inch
 - 5. Watertight flexible neoprene corrosion resistant outer jacket
 - 6. Integral flexible copper braid grounding straps to assure grounding continuity
 - 7. Stainless steel jacket clamps
 - 8. Integral Erickson union
 - 9. Couplings shall comply with UL standard 514B.
 - 10. Acceptable Manufacturers:
 - a. Crouse-Hinds Type XD
 - b. Appleton, Type DF
 - c. O.Z. Gedney Co. Type AXDX
 - d. Thomas and Betts, Type XD
 - e. Approved equal

2.09 CONDUIT TAGS

- A. Provide in accordance with Section 25 05 53.

2.10 CONDUIT WALL AND SLAB PENETRATION SEALS AND SLEEVES

- A. General
 - 1. Conduit penetrations into buildings or structures shall be sealed to prevent infiltration of water into or out of the structure.
 - 2. Provide modular, mechanical type conduit penetration seals consisting of fanged rubber type or interlocking synthetic rubber (EPDM) links shaped to continuously fill the annular space between the conduit and the opening or cast sleeve. The elastomeric element shall be sized and selected per the manufacturer's recommendations for the application shown on the Drawings. At a minimum, the seals shall be suitable for use in standard service applications (-40° F to 250° F) unless noted otherwise.
 - 3. Sleeves shall be thermoplastic with water stops, suitable for poured wall construction.

4. Conduit penetration seals and sleeves shall be complete assemblies supplied by a single manufacturer.
5. Provide suitable seal for either conduit sleeve application or direct in core drilled wall or slab penetration as required or as shown on the Contract Documents.
6. Acceptable products: O-Z Gedney Type CSM; Thunderline Corporation Link-Seal and Plastic Sleeves; Calpico Inc. Pipe Linx and Plastic Sleeves; or approved equal.

2.11 DUCT SEAL

A. General Penetration Sealant

1. Provide non-hardening compound designed as a waterstop and moisture barrier for sealing the conduit annular space between conduit and electrical conductors. Material shall also be suitable for use around conduit entrance points including service conduits wood, metal, or other materials where shown on the Drawings. Seal material shall be asbestos free, non-toxic, and non-corrosive to metals and plastic, including wire insulation. Material shall be reusable, paintable. And suitable for locations with thermal expansion and contraction.
2. Acceptable Products:
 - a. O-Z Gedney DUX
 - b. Rainbow Technology, Duct Seal Putty
 - c. Approved equal

PART 3 - EXECUTION

3.01 GENERAL

- A. Check the approximate locations of raceway 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, consult the Engineer. Make modifications and changes required.
- B. Protection during construction: Prior to installation, store all products in a dry location. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured seals during construction. Cover PVC conduit, elbows, and PVC coated rigid steel conduit, nipples, elbows, and fittings from exposure to sunlight.
- C. Material and equipment installation: Follow manufacturer's installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturer's installation instructions, codes and regulations, and these contract documents, follow Engineer's decision. Keep copy of manufacturer's installation instructions on the jobsite available for review at all times.
- D. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

3.02 INSTALLATION

- A. Minimum size conduit shall be 3/4-inch.
- B. Raceway type for location and installation method unless otherwise noted:
 - 1. Exterior, exposed, higher than 6-inches above grade unless noted otherwise:
 - a. Galvanized rigid steel conduit
 - 2. Interior, exposed unless noted otherwise:
 - a. Galvanized rigid steel conduit
 - 3. Interior, concealed, not embedded in concrete:
 - a. Galvanized rigid steel conduit
 - 4. Embedded within or below structure concrete slabs or floors; installed within concrete or CMU walls:
 - a. PVC Schedule 40
 - 5. Risers through concrete pads:
 - a. PVC Coated rigid steel conduit.
 - 6. NEMA 4X areas:
 - a. PVC Coated rigid steel conduit.
 - 7. Exterior direct buried or concrete encased ductbanks (refer also to Section 26 05 43)
 - a. PVC Schedule 40
 - 8. PVC coated rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups.
 - 9. Conduits shall be installed using threaded fittings except for PVC. The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.
 - 10. PVC coated rigid galvanized steel conduit shall be used for elbows at risers at the utility pole for electrical and telephone service conduits. Rigid galvanized steel conduit shall be used at utility pole for electrical and telephone service and fire alarm conduits to a height of 10-ft above finished grade. Furnish and install weather heads at service pole riser if required by utility company.
 - 11. Provide PVC coated rigid steel conduit under equipment mounting pads unless encased in concrete as specified herein.
 - 12. In exterior light pole foundations; extend PVC schedule 40 conduit 6 inches above the top of the foundation or as shown on the Drawings.
 - 13. Where conduit changes from underground direct burial to exposed; extend PVC coated rigid steel conduit up to 6 inches above finished grade or as shown on the Drawings.
 - 14. Where exterior conduit transition through concrete walls, slabs, and floors to exposed runs, provide PVC coated rigid steel conduit with factory manufactured elbows. Extend PVC coated rigid steel conduit a minimum of 6-inches beyond the concrete walls, slabs, or floors or as shown on the Drawings.
- C. PVC Coated Rigid Steel Conduit:
 - 1. Suitable UL listed PVC coated conduits, boxes, and fittings only shall be used. Galvanized conduits with a subsequent or field application of PVC material is not acceptable.

2. Install in strict accordance with the manufacturer's instructions. Touch up any damage to the coating with conduit manufacturer acceptable patching compound. PVC boot shall cover all threads. Where belled conduits are used, bevel the unbelled end of the joint before joining. Leave no metallic threads uncovered. Clean field threads with solvent and coat with urethane touch-up. Keep two cans of urethane touch-up at each threading station.

D. Location, Routing, and Grouping:

1. Conceal or expose raceways as indicated on the Drawings. Group raceways in same area together. Locate raceways at least 12 inches away from parallel runs of heated piping for other utility systems.
2. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible. No diagonal runs will be allowed. All conduits shall be run plumb, straight, and true.
3. Run concealed raceways with the minimum of bends in the shortest practical distance considering the building construction and other systems.
4. In block walls, do not route raceways in the same horizontal course with reinforcing steel.
5. In outdoor, underground, or wet locations, use watertight couplings and connections in raceways. Install and equip boxes and fittings so as to prevent water from entering the raceway.
6. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Engineer.
7. Do not run raceways horizontally in equipment foundation pads.
8. Separate raceway in slabs not less than three times the largest raceway outside diameter minimum, except at raceway crossings, and then only with the approval of the Engineer. Embed conduits in walls, floors, slabs, or overhead in the middle one-third of the concrete and at least 3-inches from the concrete surface; thicken slabs where necessary to accommodate conduits in a manner as approved by the Engineer.
9. Do not route raceways exposed across walkways unless approved conduit threshold coverings are provided.
10. Route conduits within the furring lines of building walls and ceilings unless specifically noted to be exposed.
11. Provide all necessary sleeves and chases required where conduits are routed through floors or walls; seal all openings and finish to match adjacent surfaces.
12. Where conduit routing changes from concrete embedded within floors, slabs, or equipment pads to exposed, maintain a minimum separation of 6-inches between the closest wall, pad, or structure face and the outer edge of the exposed conduit.
13. Where conduits are routed through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke in accordance with UL requirements and the details shown on the Drawings. The sealing method shall have a UL fire rating, which equals or exceeds the fire rating of the wall or floor construction.
14. Conduits shall not be routed to cause obstruction of passageways to pedestrian or vehicular traffic. Conduits shall not be routed across pipe shafts, access hatches or

vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

15. Conduits routed from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.
16. Conduits shall be routed a minimum of 3-in from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least 1-in from the covering of the pipe crossed.
17. A mandrel shall be pulled through all existing conduits to be reused under this Contract and through all new conduits 2-in in diameter and larger. Conduits shall be proved with the mandrel prior to installation of any conductors.
18. Emergency (generator) source and normal (power company) source feeders shall not be run through the same pull box.

E. Box Applications

1. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.
2. Pull boxes, junction boxes, or terminal boxes shall be used in any conduit run where a splice is required. Pull boxes shall be provided every 200 feet of straight run, every 150 feet with 90 degrees of bends, every 100 feet with 180 degrees of bends, and every 50 feet with 270 degrees of bends.
3. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of the NEC. Enclosure type and material shall be as specified herein.
4. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast or malleable iron, except that cast aluminum shall be used with aluminum conduit and non-metallic PVC shall be used with PVC.
5. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel.
6. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 26 05 00.
7. Boxes flush in block, brick or tile walls shall be located at a course line and provided with square tile covers. Flush boxes shall not project beyond the finished surfaces nor shall surfaces project more than 1/8-in beyond the box enclosure. Wiring devices located in close proximity to each other shall be installed in one solid gang box with single cover.
8. All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-in and larger. Where left or right side opening conduit bodies may be required for larger size conductors, provide pull boxes or other means where mogul style is not available. In no case shall the listed fill size cross sectional area for the conduit body be exceeded by the installed wire.
9. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings
10. PVC conduit to non-metallic box connections shall be made with PVC socket to male thread terminal adapters with neoprene O-ring and PVC round edge bushings.
11. PVC boxes, conduit fittings, etc, with integral hubs shall be solvent welded directly to the PVC conduit system.

12. Non-metallic boxes with field drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.
- F. Final connection to equipment subject to movement or vibration:
1. Provide liquid-tight, PVC-jacketed flexible conduit for final connection to motors, wall or ceiling mounted fans and unit heaters, dry type transformers (primary and secondary terminations), generator terminations, valves, local instrumentation, and other equipment where flexible connection is required for vibration and to facilitate removal or adjustment of equipment.
 2. Provide 18-inch minimum, 60-inch maximum lengths unless otherwise approved by the Engineer. Provide flexible conduit size for installations of 4 inches or less. For larger sizes, use rigid steel conduit as specified.
 3. The flexible conduit length shall be sufficient to allow the connected equipment to be withdrawn and fully moved off its base.
 4. Non-metallic flexible conduit may be used for such connections when part of rigid PVC conduit systems.
 5. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.
- G. Wireways: Mount wireways securely in accordance with the NEC and manufacturer's instructions. Orient cover on accessible vertical face of wireway to allow removal of all fasteners and complete removal or rotation of cover for installation of conductors.
- H. Raceway Supports
1. General:
 - a. Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Supports shall be provided to ensure a rigid and durable installation.
 - b. Support all raceways from structural members only. Do not support from pipe hangers or rods, cable tray, or other conduit.
 - c. Support flexible metal conduit with conduit clamps, except where the flexible metal conduit is fished and where sections less than 4 feet in length are used in concealed areas to supply lighting fixtures in accordance with the NEC. Adjustable steel and plastic band hangers, adjustable band hangers, adjustable swivel ring hangers and J-hangers are not acceptable.
 - d. Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.
 - e. Do not use nails anywhere or wooden plugs inserted in concrete or masonry as a base for raceway or box fastenings. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.
 - f. All reinforcing bars shall be located by the Contractor with the use of a rebar locator prior to installing adhesive capsule type anchors. Mark the location of all reinforcing bars in an area bounded by a line drawn at least 18-in from the edge of the support bearing/weld plates on all four sides of the bearing/weld plates prior to fabricating and installing bearing/weld plates.
 - g. Where interference occurs, adjust anchor locations to clear reinforcing bars and alter support configuration at no additional cost to the Authority.
 - h. Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed. Channel supports shall be ground smooth and fitted with plastic end caps.

- i. Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc, for a rigid installation. Channel supports shall be ground smooth and fitted with plastic end caps.
 - 2. PVC conduit shall be supported with non-metallic clamps, non-metallic racks and stainless steel hardware.
 - 3. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface.
 - 4. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.
 - a. Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.
 - b. Lateral restraints (sway bracing) shall be spaced 30-ft or less.
 - c. Horizontal restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.
 - d. Trapeze attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used when required for seismic restraints only.
 - 5. Conduit Racks
 - a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
 - b. Horizontal seismic restraints shall be spaced at 30-ft or less.
 - 6. Conduit Hangers
 - a. Conduit hangers shall be vertical supported 10-ft or less.
 - b. Lateral seismic restraints (Sway Bracing) shall be spaced 20-ft or less.
 - c. Horizontal seismic restraints shall be spaced at 30-ft or less. There shall be at least one horizontal restraint per horizontal run.
 - d. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.
- I. Bends
 - 1. Make changes in direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible, but where necessary, make with an acceptable hickey or conduit bending machine. Do not heat metal raceways to facilitate bending.
 - 2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel, concentric, and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.
 - 3. For PVC Schedule 40 conduits, use factory made elbows for all bends 30 degrees or larger. Use acceptable heating methods for forming smaller bends.
 - 4. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.

J. Threaded Joints

1. Paint all field-cut threads with zinc rich paint or liquid galvanizing compound for rigid steel conduit and for PVC-coated rigid steel conduit after removal of chips and cleaning with solvent. Touch up after assembly to cover nicks or scars.
 2. Use approved, highly conductive jointing compound on all joints, Appleton Type TLC, or approved equal.
- K. Bushings, Hubs, and Insulating Sleeves:
1. Where rigid steel conduit, PVC coated rigid steel conduit, or liquid-tight flexible metal conduit enters metal cabinets/enclosures, install an insulated throat grounding bushing on the end of each conduit. Install a bonding jumper from the bushing to suitable equipment ground bus or ground pad. Ground pads designated for instrumentation signal grounds as specified in Division 13 shall not be used for this purpose.
 2. Interconnection or daisy-chaining of bonding jumpers from each conduit grounding bushing to the equipment ground bus or ground pad is acceptable.
 3. If neither a ground bus nor ground pad exists, connect the bonding jumper to the metallic enclosure with a listed bolted-lug connection.
 4. All connections between conduits and NEMA 1, 1A, and 12 enclosures shall be made with hubs outside and bushings on the inside.
 5. Conduit connections to NEMA 3R, NEMA 4, or NEMA 4X enclosures, junction boxes, terminal junction boxes, or device outlet boxes, shall be made with watertight, corrosion resistant hubs. The conduit connections shall maintain the integrity of the enclosure NEMA rating.
- L. Raceway Penetrations:
1. Seal the interior of all raceways entering structures or buildings at the first box or outlet with duct seal to prevent the entrance into or exit from the structure of gases, liquids, or rodents.
 2. All underground conduit penetrations at walls or other structures shall be sealed watertight using wall seals in core drilled openings or with specified conduit wall sleeves. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions and the details shown on the Drawings.
 3. Below Grade Penetrations or Penetrations Through Walls of Water Bearing Structures.
 - a. Where conduit enters a new structure below grade through a concrete slab or wall, or where conduit penetrates a new wall of a water bearing structure, install a watertight mechanical conduit penetration seal and sleeve. Cast the conduit sleeve directly into the concrete wall or floor slab as shown on the Drawings. Install the sealing assembly such that it may be tightened at any time from the interior or dry side.
 - b. Where conduit enters an existing structure below grade through a concrete wall, slab, or where conduit penetrates a new wall of a water bearing structure, core drill through the existing wall and install a watertight conduit penetration seal. Install the sealing assembly such that it may be tightened at any time from the interior side.
 - c. For wall thicknesses less than 12-inches, dry pack around the conduit and the sealing assembly on the exterior side with non-shrink grout as shown on the Drawings. Provide double sealing for walls thicknesses 12-inches and greater.
 - d. For concrete surfaces having moisture membranes, provide dual seals with suitable membrane clamp as shown on the Drawings.

4. Above Grade Penetrations
 - a. Seal all above grade penetrations of concrete, CMU, metal, or wooden walls or roofs with duct seal. Install duct seal around conduit penetrations and inside conduits for sealing the annular space between conduit and conductors.
5. Liquid Chemical Containment Area Sealing: Internally and externally seal each conduit entering or leaving any liquid chemical containment areas to prevent chemical migration or drainage via the conduit system. Sealing shall be in accordance with the typical details shown on the Drawings. Seal conduits with a polyurethane elastomeric caulking material installed in accordance with the manufacturer's instructions. The material shall be SikaFlex-2C used with the primer No. 449 or No. 260 as appropriate for the conduit or approved equal.

M. Expansion Joints:

1. Provide expansion/deflection fittings for raceways crossing expansion joints in structures, between structures and walkways or concrete slabs to compensate for expansion, contraction, and deflection. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required. See Structural Drawings for locations of expansion joints.
2. Provide expansion only fittings on exposed, rigid steel conduit runs a minimum of every 200 feet or as required for the specific thermal characteristics of the application.
3. Provide bonding jumpers around expansion joint fittings.

N. Preparation for Pulling in Conductors

1. Do not install crushed or deformed raceways. Do install conductors in cruised or deformed raceways.
2. Install raceways to avoid introduction of traps.
3. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them.
4. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
5. For concrete-encased raceways (after the concrete envelope has set), and for direct buried conduits, pull a mandrel through each raceway to remove debris. Pull a mandrel of a diameter approximately 1/4 inch less than the raceway inside diameter, through each raceway. Use cleanout or flexible mandrels for conduit sizes greater than 2-inches; use rubber/foam mandrel for conduit sizes 2-inches and below.
6. For all raceways which contain less than 50 percent of the NEC allowed fill of control cables or individual conductors, install a nylon pull rope with the conductors.

3.03 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty, spare raceways.
- B. Raceways noted as spare shall be capped or plugged at both ends with easily removable conduit cap fittings

- C. Provide a fabricated, listed removable cap over each end of empty raceways. Provide cap with eyelet for tying off pull rope.
- D. 3/16-in polypropylene pull lines shall be installed in all new or existing unused conduits noted as spares or designated for future equipment. Provide a nylon pull rope with a minimum of 3-feet of slack length at each end of each empty raceway. Tie off the pull rope at the conduit end cap eyelet.

3.04 IDENTIFICATION

- A. Attach conduit identification tags to conduits with 304 stainless steel hose clamps and/or stainless steel jack chains.
- B. Provide conduit identification tags for all conduits at each end of conduit and at least once in every 50 feet of exposed conduit runs.
- C. Provide conduit identification tags for each conduit inside all manholes and handholes.
- D. Conduits installed higher than 15 feet above finished grade or finished floor elevations shall be provided with large plastic identification nameplates at these locations. Attach plastic nameplates with plastic ties.

3.05 PAINTING

- A. Paint exposed metal raceway systems in accordance with the requirements of Section 09 90 00.

END OF SECTION

APPENDIX 26 05 33-A

CONDUIT SCHEDULES

The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufactured cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such items not included in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.

Project: Marina Coast Water District, Res A1/A2 & Booster Station
 TJCAA #: 119038
 By: HT/PJG
 Date: 1/4/2021
 Revision: 100%

Fill Legend
 (X)TYPE-USE
 X = Quantity
 TYPE = Conductor Type
 USE = Usage (see right)

Usage Types
 Blank = Load
 N = Neutral
 G = Ground
 C = Control
 S = Spare

CONDUIT SCHEDULE

Conduit Tag	Size [in.]	Fill	From	To	Comments
C001A	3/4	(2)#14-C, (1)#12-G	ZSH-001A	Main Control Panel (MCP)	
C001B	3/4	(2)#14-C, (1)#12-G	ZSH-001B	Main Control Panel (MCP)	
C001C	3/4	(2)#14-C, (1)#12-G	ZSH-001C	Main Control Panel (MCP)	
C002A	3/4	(1)Cat6-C	CCTV1	Main Control Panel (MCP)	Power over Ethernet
C002B	3/4	(1)Cat6-C	CCTV2	Main Control Panel (MCP)	Power over Ethernet
C002C	3/4	(1)Cat6-C	CCTV3	Main Control Panel (MCP)	Power over Ethernet
C002D	3/4	(1)Cat6-C	CCTV4	Main Control Panel (MCP)	Power over Ethernet
C002E	3/4	(1)Cat6-C	CCTV5	Main Control Panel (MCP)	Power over Ethernet
C010	3/4	(2)#14-C, (1)#12-G	PSLL-010	Main Control Panel (MCP)	
C210	1	(16)#14-C, (1)#12-G	P210 -75 HP Pump	Motor Control Center (MCC)	
C220	1	(16)#14-C, (1)#12-G	P220 -75 HP Pump	Motor Control Center (MCC)	
C230	1	(16)#14-C, (1)#12-G	P230 -75 HP Pump	Motor Control Center (MCC)	
C310	1	(16)#14-C, (1)#12-G	P310 -150 HP Pump	Motor Control Center (MCC)	
C320	1	(16)#14-C, (1)#12-G	P320 -150 HP Pump	Motor Control Center (MCC)	
C330	1	(16)#14-C, (1)#12-G	P330 -150 HP Pump	Motor Control Center (MCC)	
C340	1	(16)#14-C, (1)#12-G	P340 -150 HP Pump	Motor Control Center (MCC)	
C400	3/4	(4)#14-C, (1)#12-G	Fan Control Panel (FCP-1)	Main Control Panel (MCP)	
C400A	3/4	(2)#14-C, (1)#12-G	Fan Control Panel (FCP-1)	Room Thermostat	
C110	3/4	(6)#14-C, (1)#12-G	Service Switchboard	Motor Control Center	Spare conductors
C120B	3/4	(8)#14-C, (1)#12-G	ATS	Generator	ATS Generator Call and Monitoring
C130	3/4	(10)#14, (1)#12-G	ATS	Main Control Panel (MCP)	ATS position monitoring
C150A	1 1/4	(16)#14-C, (1)Cat6-C, (1)#12-G	Standby Generator	Main Control Panel (MCP)	Generator Status and Network
C150B	1	Pull Rope	Standby Generator	Main Control Panel (MCP)	Spare
L100	3/4	(2)#12, (1)#12-G	FIT-100	Lighting Panel (LP-1)	
L101	3/4	(2)#12, (1)#12-G	AIT-101	Lighting Panel (LP-1)	
L200	3/4	(2)#12, (1)#12-G	FIT-200	Lighting Panel (LP-1)	
L300	3/4	(2)#12, (1)#12-G	FIT-300	Lighting Panel (LP-1)	
L400	3/4	(3)#10, (1)#10-N, (1)#12-G	Lighting Panel (LP-1)	Fan Control Panel	
L400A	3/4	(2)#12, (1)#8-G	Fan Control Panel (FCP-1)	Roof Fan 1	
L400B	3/4	(2)#12, (1)#8-G	Fan Control Panel (FCP-1)	Roof Fan 2	
L400C	3/4	(2)#12, (1)#8-G	Fan Control Panel (FCP-1)	Roof Fan 3	

Conduit Tag	Size [in.]	Fill	From	To	Comments
L410	3/4	(3)#10, (1)#8-G	Lighting Panel (LP-1)	Slide Gate Operator Motor	
L150A	3/4	(2)#12, (1)#12-G	Standby Generator	Lighting Panel (LP-1)	240Vac, 1P Generator Space Heater
L150B	3/4	(6)#12, (1)#12-G	Standby Generator	Lighting Panel (LP-1)	120Vac Battery Charger, Light, Receptacle
N010	1 1/4	(4)Cat6-C	Motor Control Center (MCC)	Main Control Panel (MCP)	Ethernet from MCC to MCP
P210	1 1/4	(3)#1, (1)#6-G	Motor Control Center (MCC)	P210 -75 HP Pump	
P220	1 1/4	(3)#1, (1)#6-G	Motor Control Center (MCC)	P220 -75 HP Pump	
P230	1 1/4	(3)#1, (1)#6-G	Motor Control Center (MCC)	P230 -75 HP Pump	
P310	2	(3)#4/0, (1)#2-G	Motor Control Center (MCC)	P310 -150 HP Pump	
P320	2	(3)#4/0, (1)#2-G	Motor Control Center (MCC)	P320 -150 HP Pump	
P330	2	(3)#4/0, (1)#2-G	Motor Control Center (MCC)	P330 -150 HP Pump	
P340	2	Pull Rope	Motor Control Center (MCC)	P340 -150 HP Pump	FUTURE (CONDUIT ONLY)
P110A	4	(3)#500KCMIL, (1)#1/0-G	Service Switchboard	ATS	
P110B	4	(3)#500KCMIL, (1)#1/0-G	Service Switchboard	ATS	
P110C	4	(3)#500KCMIL, (1)#1/0-G	Service Switchboard	ATS	
P110D	4	Pull Rope	Service Switchboard	ATS	Spare
P130A	4	(3)#500KCMIL, (1)#1/0-G	ATS	Motor Control Center (MCC)	
P130B	4	(3)#500KCMIL, (1)#1/0-G	ATS	Motor Control Center (MCC)	
P130C	4	(3)#500KCMIL, (1)#1/0-G	ATS	Motor Control Center (MCC)	
P150A	4	(3)#500KCMIL, (1)#1/0-G	Standby Generator	ATS	
P150B	4	(3)#500KCMIL, (1)#1/0-G	Standby Generator	ATS	
P150C	4	(3)#500KCMIL, (1)#1/0-G	Standby Generator	ATS	
S003	2	(2)TSP-C, (1)#12-G	Antenna Mast	Main Control Panel (MCP)	or as required by radio syste,m
S020	3/4	(1)TSP-C	TIT-400	Main Control Panel (MCP)	Room temp
S100	3/4	(1)TSP-C	FIT-100	Main Control Panel (MCP)	
S101A	3/4	MFGR CABLE	AIT-101	AE-101	
S101	3/4	(1)TSP-C	AIT-101	Main Control Panel (MCP)	
C111	3/4	(1)TSP-C	LIT-110	Main Control Panel (MCP)	
C121	3/4	(1)TSP-C	LIT-120	Main Control Panel (MCP)	
S200	3/4	(1)TSP-C	FIT-200	Main Control Panel (MCP)	
S300	3/4	(1)TSP-C	FIT-300	Main Control Panel (MCP)	
S401A	1	Pull Rope	Slide Gate Operator Accessory Board	Keypad	Provide conductors for key pad power nad control as required by gate system supplier
S401	1 1/4	(2)TSP-C	Main Control Panel (MCP)	Slide Gate Operator Accessory Board	
U001A	5	Pull Rope	PG&E Riser Pole (90563)	PG&E Transformer	Route through PG&E handhole and below grade vault per plans. Provide conduit riser up pole per PG&E Standards Primary Conductors by PG&E
U001B	5	Pull Rope	PG&E Riser Pole (90563)	PG&E Transformer	Route through PG&E handhole and below grade vault per plans. Provide conduit riser up pole per PG&E Standards Spare
U100A	5	Pull Rope	PG&E Transformer	Service Switchboard	Secondary Conductors by PG&E

Conduit Tag	Size [in.]	Fill	From	To	Comments
U100B	5	Pull Rope	PG&E Transformer	Service Switchboard	Secondary Conductors by PG&E
U100C	5	Pull Rope	PG&E Transformer	Service Switchboard	Secondary Conductors by PG&E
U100D	5	Pull Rope	PG&E Transformer	Service Switchboard	Secondary Conductors by PG&E
U100E	5	Pull Rope	PG&E Transformer	Service Switchboard	Secondary Conductors by PG&E

Project: Marina Coast Water District, F-Booster/Chlorination Building
 TJCAA #: 119038
 By: HT/PJG
 Date: 1/4/2021
 Revision: 100%

Fill Legend
 (X)TYPE-USE
 X = Quantity
 TYPE = Conductor Type
 USE = Usage (see right)

Usage Types
 Blank = Load
 N = Neutral
 G = Ground
 C = Control
 S = Spare

CONDUIT SCHEDULE

Conduit Tag	Size [in.]	Fill	From	To	Comments
C502	3/4	(4)#14-C, (1)#12-G	Altitude Valve Solenoid	Chlorination Panel LCP-7A	
C510	3/4	(8)#14-C, (1)#12-G	Metering Pump P510	Chlorination Bldg Control J-box	4 Spares
C520	3/4	(8)#14-C, (1)#12-G	Metering Pump P520	Chlorination Bldg Control J-box	4 Spares
C530	3/4	(8)#14-C, (1)#12-G	Metering Pump P530	Chlorination Bldg Control J-box	4 Spares
C540	1	(24)#14-C, (1)#12-G	Chlorination Bldg Control J-box	Chlorination Panel LCP-7A	metering pump controls
C550	1	(10)#14-C, (1)#12-G	Standby Generator	Chlorination Panel LCP-7A	Generator Status points
L503	3/4	(2)#12, (1)#12-G	PNL Panelboard	Chlorination Panel LCP-7A	
L505	3/4	(2)#12, (1)#12-G	Zone A Flow FIT500	MLC-1 Panelboard	
L510	3/4	(3)#12, (1)#12-G	MLC-1 Panelboard	Metering Pump P510	
L520	3/4	(3)#12, (1)#12-G	MLC-1 Panelboard	Metering Pump P520	
L530	3/4	(3)#12, (1)#12-G	MLC-1 Panelboard	Metering Pump P530	
L550	3/4	(10)#12, (1)#12-G	Standby Generator	MCC Ltg Panel (LP-1)	Gen Skid Aux. Loads, reuse ex. ckts
N500	3/4	(1)Cat6-C	RTU -7 (LCP-7)	LCP-7A	
P500	3/4	(3)#8, (1)#8-G	Feeder Breaker Panel 4P	MLC-1 Panelboard	
P550	3	(3)#600KCMIL, (1)#1/0-G	Standby Generator	ATS	
S501A	3/4	MFGR CABLE	Hypo Tank LE500	Hypo Tank LIT500	
S501	3/4	(1)TSP-C	Hypo Tank LIT500	Chlorination Bldg Signal J-box	
S503	2 1/2	(10)TSP-C	Chlorination Bldg Signal J-box	Chlorination Panel LCP-7A	
S505	3/4	(1)TSP-C	Zone A Flow FIT500	Chlorination Panel LCP-7A	
S510	1 1/4	(3)TSP-C	Metering Pump P510	Chlorination Bldg Signal J-box	1 Spare
S520	1 1/4	(3)TSP-C	Metering Pump P520	Chlorination Bldg Signal J-box	1 Spare
S530	1 1/4	(3)TSP-C	Metering Pump P530	Chlorination Bldg Signal J-box	1 Spare
S550	3/4	(1)Cat6-C	Standby Generator	Chlorination Panel LCP-7A	Generator network monitoring

Project: trict, Well 12/Marina BPS/Reservoir 2
TJCAA #: 119038
By: HT/PJG
Date: 1/4/2021
Revision: 1

Fill Legend
(X)TYPE-USE
X = Quantity
TYPE = Conductor Type
USE = Usage (see right)

Usage Types
Blank = Load
N = Neutral
G = Ground
C = Control
S = Spare

CONDUIT SCHEDULE

Conduit Tag	Size [in.]	Fill	From	To	Comments
C450	2	(1)Cat6-C	Reservoir 2 Antenna	Marina BPS Control Panel	Or as required by radio system

Project: Promontory Lift Station
 TJCAA #: 119038
 By: HT/PJG
 Date: 1/4/2021
 Revision: 100%

Fill Legend
 (X)TYPE-USE
 X = Quantity
 TYPE = Conductor Type
 USE = Usage (see right)

Usage Types
 Blank = Load
 N = Neutral
 G = Ground
 C = Control
 S = Spare

CONDUIT SCHEDULE

Conduit Tag	Size [in.]	Fill	From	To	Comments
L70	1	(3)#8, (1)#8-G	Lighting Panel	G70	Lift Arm Gate, 120Vac from Lighting Panel
C70	1	Pull Rope	Lift Station	G70	Spare Conduit
L71	1	(3)#8, (1)#8-G	Lighting Panel	G71	Rolling Gate, 120Vac from Lighting Panel
C71	1	Pull Rope	Lift Station	G71	Spare Conduit
				4	

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish and install a complete underground system of raceways, handholes, fittings, and hardware as shown on the Drawings and as specified herein.
2. Where referred to in this Section, raceways are underground conduits and fittings; ductbanks are a collection of underground raceways; the underground electrical system is the collection of underground ductbanks, handholes, hardware, and other below and at grade structures as specified.
3. Install ductbanks and handholes locations and depths coordinated with other utilities, yard piping, yard structures and field conditions per the Contract Documents. Underground electrical systems shall be installed to avoid interferences with other utilities, structures, and site features.
4. All underground electrical raceway systems shall be encased in concrete, reinforced ductbanks unless specifically indicated otherwise on the Drawings. Ductbanks shall be concrete encased and structurally tied to buildings, vaults, handholes, or other structures where shown on the Drawings and where specified.
5. Related Work: Underground electrical systems for electrical power, telephone, or other utility shall be in conformance with the requirements of the serving utility as applicable and per the requirements of Section 26 05 00.

1.02 RELATED SECTIONS

- A. All trenching, drilling, backfill, compaction, and surface restoration shall be as indicated on the Drawings and as required under Division 31 of these Specifications. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- B. All concrete and reinforcement shall be as indicated on the Drawings and as required in Division 03 of these Specifications. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- C. Section 03 38 00 – Concrete Encasement Electrical Instrumentation Duct
- D. Section 26 05 00 – Common Work Results for Electrical
- E. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- F. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 30 00 and Section 26 05 00.
- B. Concrete mix design for ductbank concrete encasement shall be submitted per the requirements of Section 03 38 00.
- C. Submit the following:
 - 1. Raceway and conduit product catalog data indicating material, fittings, accessories, and sizes to be provided.
 - 2. Handhole and splice boxes catalog data including details of the structures and lids including material of construction, design loadings, knockout locations, internal and external dimensions, sump locations, and accessories.
 - 3. Catalog data for underground raceway installation accessories including conduit spacers, cable racks, pull rope, pulling lubricants, sealants, identification warning tape, and other underground system components as specified herein.

1.04 REFERENCES

- A. Pacific Gas and Electric Company (PG&E), Electric & Gas Service Requirements (Green Book)
- B. American National Standards Institute
 - 1. ANSI C80.1: Electrical Rigid Steel Conduit (ERSC).
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - 2. ASTM D1784: Standard Specification for Rigid Poly (Vinyl-Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl-Chloride) (CPVC) Compounds
 - 3. ASTM F512: Standard Specification for Smooth-Wall Poly (Vinyl-Chloride) (PVC) Conduit and Fittings for Underground Installation
- D. California Code of Regulations.
 - 1. Title 24, Part 3 – California Electrical Code (NEC)
- E. Federal Specifications (FS)
 - 1. FS W-C-1094: Conduit and Conduit Fittings Plastic, Rigid
- F. National Electrical Manufacturer’s Associate (NEMA)
 - 1. NEMA RN1: Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 2. NEMA TC2: Electrical Polyvinyl Chloride (PVC) Conduit
 - 3. NEMA TC3: Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
 - 4. NEMA TC6 and 8: Polyvinyl chloride (PVC) Plastic Utilities Duct for Underground Installations

- G. The American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO T 180: Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- H. Public Utilities Commission State of California
 - 1. General Order No.128, Rules for Construction of Electric Supply and Communication Systems.
- I. United States Department of Agriculture: Rural Utilities Service (RUS)
- J. Underwriters Laboratories (UL)
 - 1. UL 6: Electrical Rigid Metal Conduit - Steel
 - 2. UL 514B: Fittings for Conduit and Outlet Bodies
 - 3. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit
- K. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Raceways, fittings, and other underground electrical system components shall be UL listed where such listings are available.

PART 2 - PRODUCTS

2.01 RACEWAYS AND FITTINGS

- A. Rigid Polyvinyl Chloride Conduit (PVC) and Fittings
 - 1. PVC conduit shall be Schedule 40 UL listed for concrete encased, underground direct burial, concealed, and direct-sunlight, weather-exposed use. Provide PVC conduit manufactured from virgin PVC compounds conforming to UL 651, listed and marked for use with 90° C insulated conductors.
 - 2. PVC conduits, couplings, elbows, nipples, and other fittings shall meet the requirements of NEMA TC 2 AND TC 3, Federal Specification W-C-1094, NEC Article 352, and ASTM D-1784 specified tests for the intended use.
 - 3. Provide conduits having a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable.
 - 4. Provide factory elbows and large radius sweep bends with standard radii for all underground installations. Elbows and bends shall be by the same manufacture as the straight conduit and match PVC requirements as specified herein.
 - 5. Acceptable Manufacturers:
 - a. Carlon/Thomas and Betts (Lamson & Sessions) Plus 40 Rigid PVC Nonmetallic Conduit
 - b. PW Eagle (PW Pipe)
 - c. Allied Tube and Conduit (Tyco)
 - d. Approved equal

B. PVC Coated RGS Conduit:

1. PVC-coated rigid steel conduit shall be hot-dipped galvanized rigid steel conduit meeting the requirements of NEMA RN 1, UL/6, and ANSI C80.1. Provide a factory installed PVC coating, 40 mils nominal thickness, and applied over and permanently bonded to the galvanized surface. Coating shall include an interior 2 mil urethane coating.
2. All male threads on conduit, elbows, nipples and other fittings shall be protected by an application of a urethane coating; they shall be threaded and galvanized with integral plastic sleeves overlapping the plastic-coated conduit.
3. Provide PVC coated conduit suitable for conductors with 75°C insulation.
4. Product shall bear the ETL PVC-001 certification mark.
5. Acceptable Manufacturers:
 - a. Robroy, Plasti-Bond Red
 - b. Perma-Cote Industries, Supreme Conduit System
 - c. Approved equal

C. Connectors, Couplings, and Fittings

1. Connectors, couplings, fittings and ancillary materials shall be by the same manufacturer as the supplied conduit.
2. End Bells: Provide PVC bell ends to fit on conduit termination points. End bells shall be installed at all termination points for mitigation of potential damage to conductor insulation during wire pulling and installation. End bells shall be smoothly tapered without sharp or rough edges to minimize chance of insulation damage.
3. End Caps: Provide PVC end caps to plug spare conduits and protect against entry of rodents, water, or dirt into the spare conduit. Provide end caps designed to fit into the end of standard conduit trade sizes and include integral cap eyelet for tying off spare conduit pull ropes or string.

2.02 IDENTIFICATION WARNING TAPE

- A. Provide underground detectable warning tape. The tape shall be constructed of solid aluminum core that is laminated with a protective clear film on both sides, sealing and protecting the graphics from underground moisture, acids and alkalis. Tape color shall be red and be 6-inch minimum width, with black lettering, for use in trenches containing electric circuits. Use tape with printed warning "CAUTION-BURIED ELECTRIC LINE BELOW" or similar for single, telephone, fiber, network or other wiring systems.
- B. Warning tape shall be as manufactured by Seton Inc., Panduit Corporation or approved equal.

2.03 CONDUIT SPACERS

- A. Conduits installed in concrete encased ductbanks shall include spacers to provide uniform support and protection of conduits prior to concrete encasement or soil/sand backfill. The spacers shall be made of high density polyethylene and be of the interlocking module type.
- B. The spacers shall be arranged such that the centerline distance between the conduits is as shown on the Drawings

- C. Spacers shall be manufactured by Carlon/Thomas and Betts (Lamson & Sessions); Underground Devices Inc.; Formex Manufacturing, or approved equal.

2.04 CONDUIT WALL PENETRATION SEALS AND SLEEVES

- A. Refer to Section 26 05 33.

2.05 DUCT SEAL

- A. Refer to Section 26 05 33.

2.06 EXPANSION/DEFLECTION COUPLINGS

- A. Refer to Section 26 05 33.

2.07 CABLE RACKS

- A. Provide nonmetallic high load capacity cable racks for installation within handholes or other structures. Cable racks shall consist of wall mounted stanchion with adjustable mounting locations for rack arms. Rack arms shall lock into the stanchion piece. Provide cable arms with suitable lengths for individual mounting of power cables without bundling and as appropriate for the internal dimensions of the underground structure. Cable arms shall include manufactured slots for installation of cable ties. Cable racks shall have sufficient mechanical strength for the size cables shown installed on the Drawings. Provide stainless steel mounting and anchoring hardware for installation of the cable racks. Provide cable racks as manufactured by Underground Devices Incorporated or approved equal.

2.08 HANDHOLES

- A. Provide type and size of handhole per the Handhole Schedule included in the Drawings. Minimum size handhole provided shall be 24" x 36" internal dimensions (nominal) unless otherwise noted.
- B. Supports, pulling in irons, and hardware shall be galvanized steel.
- C. All handholes shall have solid bottoms with sump knockouts for drainage of water.
- D. Provide extensions as required such that the depth of the handhole is coordinated with the depth of the ductbank and finished grade.
- E. Metal covers and other exposed conductive surfaces within the handhole shall be bonded per NEC Article 250. Provide grounding strap between metal cover and metal frame or other metal surface in handhole for continuity of grounding system within the handhole. Ground rods where shown on the Drawings and other grounding materials and methods shall be as specified under Section 26 05 26.
- F. Handholes shall be precast concrete, heavy duty type, designed for a HS20-44 wheel load plus the weight of the soil above (using 120 pcf for the soil weight), impact loads, and hydrostatic loads in accordance with ASTM C857. Handhole covers shall be [concrete, hinged steel, hinged steel with spring assist] and include penta head type lock-down cover bolts.

- G. Cover functional identification shall be included on every handhole cover. Identification shall be permanently engraved on the cover and shall indicate the handhole identification number as shown on the Drawings and the following as applicable:
 - 1. "Electrical" for 600V and below circuits
 - 2. "Signal" for instrumentation signals and network systems including fiber optic, CCTV, and 24VDC signal cables.
- H. Precast units shall be as manufactured by Oldcastle Precast, Inc; Jensen Precast; or approved equal and constructed to dimensions as shown on the Drawings.
- I. Conduit Identification: Provide conduit identification tags as specified in Section 26 05 33.

PART 3 - EXECUTION

3.01 GENERAL

- A. Prior to trenching and installing underground conduits and/or underground ductbanks the Contractor shall verify field conditions and address all potential conflicts with other underground utilities, structures, or features.
- B. Protection during construction:
 - 1. Store all products in a clean, dry location prior to installation. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured end caps during construction. Cover and protect PVC conduit, elbows, and PVC coated rigid steel conduit, nipples, elbows, and fittings from exposure to sunlight.

3.02 REQUIRED RACEWAY TYPE FOR LOCATION AND INSTALLATION METHOD

- A. Refer to Section 26 05 33.

3.03 INSTALLATION REQUIREMENTS FOR UNDERGROUND RACEWAYS

- A. General:
 - 1. Trenching, shoring, backfill, compaction, and finished exterior surfaces shall conform with the requirements of Division 31.
 - 2. Coordinate installation of underground raceways with other outside and building construction work. Maintain existing outside utilities in operation unless otherwise authorized by the Engineer.
 - 3. Remove entirely and properly reinstall all raceway installations not in compliance with these requirements.
 - 4. Union type fittings shall not be used in underground installation.
 - 5. Provide a minimum cover of 24-inches over all underground direct buried raceways or top of concrete encasement envelope unless otherwise indicated on the Drawings.
 - 6. Concrete encasement and/or backfill of underground raceways shall not commence until inspected by the Engineer.
 - 7. Warning Tape: Bury warning tape approximately 12 inches below finished grade. Align parallel to and within 6 inches of the centerline of runs that are 2 feet wide or less. Provide

two tapes and align parallel to and within 6 inches of the centerline of each side of runs that are more than 2 feet wide.

8. Perform bends in raceways as follows:
 - a. Except at conduit risers, accomplish changes in direction of duct runs exceeding a total of 10 degrees, either vertical or horizontal, by long utility duct sweep bends having a minimum radius or curvature of 12-1/2 feet; utility duct sweep bends may be made up of one or more curved or straight sections or combinations thereof.
 - b. For direct buried conduit, accomplish changes in direction runs exceeding a total of 10 degrees, either vertical or horizontal by using 5 degree PVC-40 couplings.
 - c. At conduit risers use manufactured bends having a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
9. Install conduit seals in below grade core drilled openings or cast conduit sleeves as shown on the Contract Documents and per the submitted conduit penetration sealing submittal.
10. Plug spare raceways and seal them watertight at all handholes, buildings and structures.
11. Raceways installed under slab floors shall lie completely under the slab with no part of the horizontal run of the raceway embedded within the slab. Raceway shall be a minimum of 4" below the building or equipment slab.
12. Install concealed, embedded, and buried raceways so that they emerge at right angles to and flush with the finished surface. None of the curved portion of the bend shall be exposed at the entry point.
13. Raceway terminations at handholes shall include end bell connectors for PVC conduit and insulated throat grounding bushings for steel conduit.
14. Patch all duct knockouts and openings in handholes with non-shrink grout.

B. Separation and Support:

1. Separate runs of two or more parallel raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install spacers at intervals not greater than that specified in the NEC for support of the type raceways used, and in no case greater than 5 feet.
2. Support raceways installed in fill areas to prevent accidental bending until final concrete is set or backfilling/compaction is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.
3. When separate parallel duct banks are shown on the Drawings, provide a minimum horizontal separation between the parallel runs.
 - a. Power ductbank (over 100 Volts ground): Provide nominal 48-inch horizontal separation between adjacent duct bank sides or as much as allowable by the physical constraints of the site.
 - b. Signal ductbank (less than 100 Volts to ground): Provide nominal 24-inch horizontal separation between adjacent duct bank sides or as much as allowable by the physical constraints of the site.

C. Arrangement and Routing:

1. Arrange multiple conduit runs substantially in accordance with applicable details shown on the Drawings. Locate and route underground conduits as indicated on the Drawings.
2. Make minor changes in location or cross section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, inform the Engineer for

resolution before continuing with the work. Determine precise ductbank alignment and depth as required to avoid other utilities, structures, or features.

3. Where piping systems are encountered by means of potholing or installed under this Contract along a ductbank route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Engineer for instructions before continuing with the work.
4. Duct bank alignments shown on Drawings are diagrammatic. Actual alignments shall contain no sharp bends and shall be installed with long sweep bends. In no case shall minimum radius bends exceed values as defined in the NEC.
5. In multiple conduit runs, stagger raceway coupling locations so that couplings in adjacent raceways are not in the same transverse line.
6. Flare out incoming duct bank raceways at building walls or other structures sufficient to allow installation of conduit seals and sleeves with separation as recommended by the manufacturer. Coordinate core drill or conduit block-out locations for conduit entrances with the Structural Drawings.

D. Concrete Encasement:

1. Encase conduits in a red reinforced concrete envelope as indicated on the Drawings. Minimum reinforcement steel and concrete envelope shall be provided as shown on the Drawings. Concrete for ductbank encasement, where required, shall be at least 2,500 psi concrete with 1-inch maximum aggregate conforming to the requirements of Section 03305.
2. Maintain a grade of at least 4 inches per 100 feet, either from one handhole or pull box to the next, or from a high point between them, depending on the surface contour. Install raceways to drain away from buildings.
3. Hold conduits for concrete encased raceways securely in place by acceptable window type spacer supports as specified. Where, in the opinion of the Engineer, ground conditions are such as to require concrete forms, install forms constructed of materials and in a manner acceptable to the Engineer. No variations greater than 12-inches in 50 feet will be permitted from a straight line.
4. Envelopes may be poured directly against the sides of trenches if the cut is clean, even, and free of loose material. Remove loose material from trenches before and during pouring of concrete to ensure sound envelopes. Carefully spade concrete during pouring to eliminate all voids under and between raceways and honeycombing of the exterior surface.
5. Do not use power driven tampers or agitators unless they are specifically designed for the application, in order to ensure that the watertight integrity of the raceways is maintained.
6. Generally, pour an entire concrete envelope in one continuous pour. Where more than one pour is necessary, terminate each pour in a sloped plane, and insert 3/4 inch reinforcing rod dowels extending into the concrete 18 inches minimum on each side of the joint. Obtain Engineer's approval for the number and location of dowels.
7. Where connections to existing duct lines are indicated, remove existing cables which constitute interference with the work. Excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the ducts before new concrete encased ducts or handholes are installed. Provide a reinforced concrete collar, poured not less than 5-feet along the new duct line, to take the shear at the joint of the duct lines. Abandon in place those disused ducts and cables which do not interfere with the work.

- E. Backfill Installation above Conduit Zone of Direct Burial Conduit or above Concrete Envelope of Concrete Encased Conduit:
 - 1. Backfill material above the conduit zone of direct burial conduit or above concrete envelope of concrete encased conduit may be selected from the excavated material if it contains no particles larger than 3 inches in diameter and is free from roots or debris in conformance with Division 31. Imported material meeting these same requirements may be used in lieu of material from the excavation. Compact backfill in maximum 12 inch layers to at least 95 percent of the maximum density at optimum moisture content as determined by AASHTO T 180 and as specified in Division 31.

3.04 INSTALLATION REQUIREMENTS FOR HANDHOLES

- A. Install handholes and accessories as shown on the Drawings and per the manufacture's recommendations.
- B. Final ductbank, handhole, and other structure locations and depths vary based on installed depths and underground conditions. Set handholes and other structures at the proper elevation such that the slope of raceways shall be towards handholes and away from structures, vaults and buildings.
- C. Provide synthetic rubber expansion joint material around duct bank envelopes at entry point to structures and handholes. Fill gaps at expansion joint between duct bank and structure or handhole with synthetic rubber sealing compound.
- D. For duct or conduit line connections to existing handholes or splice boxes, core drill or break the handhole or splice box wall out to the dimensions required. Preserve the steel in the wall. Provide epoxy dowels into the existing concrete of the handhole or splice box and backfill with concrete to achieve unitized construction.
- E. Unless shown otherwise on the Drawings, the handholes shall be laid on a minimum of 12" thick crushed rock base. Install structures flush with the final finished surface in paved areas and a nominal 3-inches above the final graded surface in non-paved or landscaped areas as shown on the Drawings. Install extension rings as necessary to establish the specified elevation of the handhole top with the finished grade.
- F. Install pulling-in irons anchored to the concrete and opposite all raceway entrances to handholes.
- G. Install cable racks on opposing wall faces on each handhole. Install cable racks along the long dimension of handhole, anchored in accordance with the manufacturer's requirements.
- H. Install sump pumps where shown on the Drawings in the box sump. Where no sump pump is provided, break out the concrete at the bottom of the box sump to act as a drain.
- I. Clean and remove any excess concrete, asphalt, dirt or other material to ensure that handhole tops, lids and hatches are flush to the surface, unobstructed, and can be fully open for access. Handhole tops that are damaged, cracked, bent, or "sprung" (inoperable spring assist cover) shall be replaced at the completion of the project at no additional cost to the Owner.
- J. Handhole top identification lettering shall be clear and fully legible at the completion of the project.

3.05 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways. Avoid traps in raceways. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
- B. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.
- C. For concrete-encased raceways (after the concrete envelope has set), and for direct buried conduits, pull a mandrel through each raceway to remove debris. Pull a mandrel of a diameter approximately 1/4 inch less than the raceway inside diameter, through each raceway. Use cleanout or flexible mandrels for conduit sizes greater than 2-inches; use rubber/foam mandrel for conduit sizes 2-inches and below.
- D. For all raceways which contain less than 50 percent of the NEC allowed fill of control cables or individual conductors, install a nylon pull rope with the conductors.
- E. Unless otherwise shown on the Drawings, install conductors in lower layers of conduits in handholes leaving upper layers of conduits as spares for future conductor installations.
- F. Install plastic cable spacers or shoes on cable racks for supporting and tying off cables pulled into the structures.
- G. Installation of conductors shall conform to the requirements of Section 26 05 19 as applicable.

3.06 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty raceway. Provide a fabricated, listed removable cap over each end of empty raceways. Provide a nylon pull rope with a minimum of 3-feet of slack at each end in each empty raceway. Provide cap with eyelet for attaching the nylon pull rope.

3.07 CABLE DUCT SHIELDS

- A. Provide shields where cables enter and leave handholes and other entrances. Shields shall be of a suitable type manufactured for the purpose of protecting the cable from abrasion or other damage.

3.08 FIELD PAINTING

- A. Clean cast-iron frames and covers not buried in masonry or mortar of mortar, rust, grease, dirt, and other deleterious materials, and give a coat of bituminous pain. Clean steel frames not buried in masonry and steel covers of mortar, dirt, and grease by an approved blasting process. Clean surfaces that cannot be cleaned satisfactorily by blasting process. Clean surfaces that cannot be cleaned satisfactorily by blasting by wire brushing or other

mechanical means to bare metal. Wash surfaces contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly cleaned.

- B. Immediately after cleaning, coat surfaces with a pretreatment coating or give a crystalline phosphate coating.
- C. As soon as practicable after the pretreatment coating has dried, prime treated surfaces with a coat of zinc chromate primer and one coat of synthetic exterior gloss enamel as described in Section 09 90 00.
- D. Rigid galvanized steel conduits buried in earth or encased in concrete shall be completely painted with bitumastic based coating.

3.09 IDENTIFICATION

- A. Provide engraved conduit identification tags at each underground structure as specified in Section 26 05 53.

3.10 RECONDITIONING OF SURFACES

- A. Restore paved and unpaved surfaces disturbed during the installation of duct or conduit to their original elevation and condition in accordance with Division 31.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for identification of electrical, safety, measurement, monitoring, control, and related equipment

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 05 19 – Motor Control Centers (Low voltage)
- C. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems
- D. Section 26 05 99 – Electrical and Instrumentation Demolition and Modifications
- E. Section 26 08 00 – Commissioning of Electrical Systems
- F. Section 26 24 16 – Panelboards
- G. Section 40 61 00 – Common Work Results - Process Instrumentation and Controls
- H. Section 40 67 00 – Control Panels and Hardware

1.03 SUBMITTALS

- A. Product Data – Submit per Section 01 30 00 and Section 26 05 00.
- B. Submit database or spreadsheet identifying all identification nameplates, labels, and tags as specified the Specifications or shown on the Drawings.
- C. Provide a sample of each type and size of nameplate, label, tag, and means of attachment specified for approval by the City.
- D. Quality Assurance/Control Submittals
 1. The Contractor shall be responsible for submitting a data base of all identification nameplates, labels, and tags required for the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Standard nameplates/labels shall have black background with white engraved letters suitable for use from 40°F to 150°F, and shall be self-extinguishing and resistant to oil, water, and solvents. Emergency function nameplates/labels will use red background with white engraved letters. Nameplates/labels shall attach utilizing an adhesive backing that is appropriate for the surface of the equipment mounting base, surface of the equipment itself, or, if required, a separate but adjacent mounting point. The adhesive backing shall be appropriate for environmental conditions. Rivets or screws shall not be used.
- B. Sizes shall be:
 - 1. 2-inch-high nameplate/label with 1-inch-high letters.
 - 2. 1-inch-high nameplate/label with 3/8-inch-high letters.
 - 3. 3/4-inch-high nameplate/label with 1/4-inch-high letters.
- C. Identification tags physical construction shall be as follows:
 - 1. Stainless steel.
 - 2. 2-inch-round: .025-.050 inches thick.
 - 3. Text shall be center justified.
 - 4. Numbers, letters, and characters shall be 0.25-inch size.
 - 5. Numbers, letters, and characters shall be black filled.

2.02 CONDUIT TAG SYSTEM SHALL COMPLY WITH THE FOLLOWING:

- A. Provide permanent, stamped brass round tags conduit numbers as designated on the conduit schedule, pressure stamped onto the tag. Stamped conduit identification numbers shall have a minimum height of 1/4-inches. Tags shall be fabricated from minimum 19 gauge brass with minimum diameter of 1-1/2-inches and predrilled mounting top hole.
- B. Tags relying on adhesives or taped-on markers are not acceptable. Attach tags to conduits with 316 stainless steel clamps at each end and at least once in every 50 feet near the midpoint of exposed conduit in ceiling spaces, surface mounted, and inside manholes and handholes.
- C. Conduits installed higher than 15 feet above finished grade or finished floor elevations shall be provided with large plastic identification nameplates at these locations.
- D. Conduits shall be identified with one line of text that matches that used in the conduit schedule. Minimum character size shall be 1/2" black engraved lettering on white plastic nameplate.
- E. Acceptable products
 - 1. Seton Identification Products
 - 2. National Band and Tag Company
 - 3. Emedco

4. Approved equal.
- F. Conduit trench marker tape shall comply with the following:
1. Minimum of 6 inches wide, polyethylene tape manufactured for this purpose.
 2. Tape shall be manufactured by SETON Identification Products or approved equal.
 3. Color and text shall be as follows:
 - a. Buried conduit containing any type of communication cabling (DCS, phone, network, etc.) shall have marker tape that is orange in color and shall read, "Caution Communication Cabling Buried Below."
 - b. Buried conduit containing instrument cabling shall have marker tape that is orange in color and shall read, "Caution Instrument Cabling Buried Below."
 - c. Buried conduit containing electrical conductors shall have marker tape that is red in color and shall read, "Caution Electric Line Buried Below."

2.03 CONDUCTORS, CIRCUITS, AND CABLES

- A. Electrical conductor color coding shall comply with Section 26 05 19.
- B. Wire insulation colors for the Programmable Automation Controller Input/Output (PAC I/O) modules shall comply with Section 40 67 00.
- C. Conductors, circuits, and cables identification methods shall be provided as specified under Section 40 61 00 and Section 26 05 19.

2.04 VAULT, HANDHOLE, MANHOLE IDENTIFICATION SYSTEM SHALL COMPLY WITH THE FOLLOWING:

- A. Provide structure identification engraved on the structure lid as specified in Section 26 05 43.
- B. In addition, provide self-adhesive yellow reflective characters measuring 1.75 inches wide by 3 inches tall, installed on a 4 inch by 12 inch smooth aluminum plate attached to the center top of the hatch cover with .25 inch diameter stainless steel bolts.

2.05 ARC FLASH LABEL

- A. Refer to Section 26 05 73.

2.06 OPERATOR CONTROL CONSOLE PUSHBUTTON AND INDICATOR LIGHTS:

- A. Operator pushbutton construction and color required for intended use shall be as indicated in the Table listed below:

Function	Operator	Color
Motor (equipment) Start	Flush Head	Green
Motor (equipment) Stop	Extended Head	Red
Emergency Stop	Mushroom Head	Red
All Others	Flush Head	Black

- B. Lens colors for operator control consoles shall be as indicated in the Table listed below:

Function	Color
Motor (equipment) Running	Red
Valves Open	Red
Motor (equipment) Stopped	Green
Valves Closed	Green
Fault and Warning	Amber
Power On	White

PART 3 - EXECUTION

3.01 INSTALLATION

A. Panel Schedule Identification

1. Panel schedule shall be permanently printed and trimmed to fit the panel. Schedule shall be installed in the sheet metal pocket on the inside of the panel door and as specified in Section 26 24 16.
2. UPS circuits and Security circuits will be typed in Bold Text for easy identification.
3. Panel schedule shall provide the data indicated on the panel schedules in the Drawings.

B. Circuit Identification

1. Circuits shall be uniquely identified as specified in Section 26 05 00). Circuit cables and conductors shall be identified at each termination point and interim pull structure for the entire circuit route.
2. Provide permanent circuit identification labeling per Section 26 05 19.
3. Identification shall be provided for existing circuits at each existing and interception handholes as field verified by the Contractor per Section 26 05 00 and Section 26 05 99. All circuits shall be identified with the permanent labeling prior to splicing and reconnections as required under Section 26 05 00.

C. Conduit Identification

1. Conduits shall be identified with stainless steel marker plates attached with stainless steel ties near its points of termination. The identification marker plates shall be attached in a manner that ensures it is readable.
2. Conduits installed flush with interior vault walls shall be identified with the phenolic tags specified and attached to the vault wall directly above the conduit with epoxy gel.
3. The identification shall be as the indicated on the conduit schedules located in the drawings. Conduits not indicated on the conduit schedules shall be added to the as-built conduit schedules and plan drawings and labeled accordingly.
4. Conduit identification markers shall be provided for both new conduits provided under this Contract and existing conduits modified, intercepted, or accessed under this Contract.

D. Vault, Handhole, Manhole Identification:

1. Install self-adhesive yellow reflective characters on a 4 by 12-inch smooth aluminum plate attached to the center top of the hatch cover with .25 inch diameter stainless steel bolts.

E. Electrical Safety and Working Clearance Identification

1. Provide a painted outline about electrical equipment to identify areas that are to be kept clear of storage and debris. The painted outline shall consist of a 3-inch-wide, neatly painted line, utilizing safety yellow paint appropriate for the surface being painted. The nearest edge of the line shall be 48 inches in front of electrical equipment and extend to the edge of the equipment or 15 inches from the centerline of the equipment, whichever is greater.
2. Provide electrical switchboard matting in front and rear, when accessible from the rear, of electrical equipment as specified in Section 26 05 90. The matting shall be the minimum size specified or coordinated with the edge of the yellow safety outline at the sides of the equipment whichever is greater.

F. Nameplate and Tag Identification

1. Nameplates shall generally be used to provide a common identification name of the distribution equipment or control panel as shown on the Drawings. Nameplates shall be a phenolic type.
2. Tags shall generally be used to give the field equipment, instrument, component, conduit, etc. a common identification name as shown on the Drawings. Tags shall be a round stainless-steel type.
3. Nameplates shall attach utilizing an adhesive backing that is appropriate for the surface of the equipment mounting base, surface of the equipment itself, or, if required, a separate but adjacent mounting point. The adhesive backing shall be appropriate for environmental conditions. Rivets or screws shall not be used.
4. Nameplates and tags shall be located on or next to equipment (and valves if required) in a manner that ensures that the nameplate/label is readable from the access point without interfering with the operation of the equipment or valve or any other equipment. Whenever possible nameplate/label shall be attached to a non-removable part of the equipment or valve.
5. General equipment, electrical equipment, boxes, enclosures, valves, instruments, etc. shall be identified as indicated on the Drawings for equipment requiring identification. The nameplates shall be the largest size specified that will reasonably fit on the product being identified. Nameplates shall be mounted at the top and centered on the equipment when possible.
6. Identification tags shall be attached to equipment, valves, or pipes utilizing a stainless-steel beaded chain. The chain shall provide two to three inches of slack when the tag is attached to the item. Identification tags shall be attached to equipment, valves, or pipes in a manner that ensures that the tag is readable from the access point without interfering with the operation of the equipment, valve, pipe, or any other equipment. Whenever possible identification tags shall be attached to a non-removable part of the equipment or valve. The identification shall be as indicated on the Drawings for equipment requiring identification.
7. Operator switches and panel mounted instruments, operator interfaces, etc. identification shall utilize ¾-inch-high phenolic nameplate for process function

description per the Contract Documents. Provide manufacturer escutcheon plates for the standard hand, off, auto, start, stop, etc. description.

8. Control panels shall have a one-inch-high nameplate consisting of two lines of text. Line 1 shall be the panel equipment identification as indicated on the Contract Documents and line 2 shall be text describing the process that is being controlled by the unit.
9. The equipment identification label for the MCC shall be two-inch-high nameplate. The label shall be located at the top of the main feeder section on the face of the MCC. The label shall be one line of text identifying the MCC as indicated on the Contract Documents.
10. Individual MCC buckets shall each have a nameplate. The bucket identification label for the MCC unit shall be a one-inch-high nameplate consisting of two lines of text. Line 1 shall be the equipment identification tag and line 2 shall be text describing the process that is being controlled by the MCC unit or per the MCC elevation nameplate schedule as shown on the Drawings.
11. Switchgear and switchboards shall have nameplates installed for the overall equipment lineup and individual unit bucket sections or circuit breakers. Labels for the switchgear or switchboard be provided in the same manner and size as for MCC.

G. Tape Labeling Identification Requirements

1. Terminal strips shall be identified within each enclosure in the following manner. Terminal strips shall be numbered as TB1, TB2, etc. with each contiguous terminal strip in the panel numbered in sequence. Terminal strips can be mounted vertical or horizontal with the first strip, TB1, located as the upper most left terminal. Each succeeding contiguous terminal strip shall be numbered, TB2, TB3, etc. running top to bottom if mounted horizontal, or left to right if mounted vertical. Each terminal shall be numbered in sequence for each strip with the sequence beginning from number one on each strip. No individual terminals in a contiguous terminal strip will be numbered with identical numbers.
2. Labels shall be installed to identify all components within control enclosures of every type. Labels shall not be placed directly on devices or wireway covers. Labels shall be placed on backpanels for relays, fused, terminal strips, etc. and the back side of the enclosure doors for pushbutton switches, selector switches, operator interface terminals, etc. and shall be attached in areas free of wiring to ensure clear visibility without moving wires or other devices. Labels shall be identical with component designation as shown on the Drawings of the system (i.e. 1CR, 2SS, 5LT, 3FU, etc.).
3. Provide tape style labels for device cover plates. Cover plates for data, phone, and speakers shall be identified as per the drawings. Cover plates for receptacles and switches shall be identified by the panel and circuit number supplying power to the device. An example might be LP-H-15. These labels shall be 0.5-inch white tape with black text.
4. Provide tape style for light fixtures. The label shall be 0.5-inch white with black text and indicate the power supply for the fixture. The tag shall be located inside the fixture adjacent to the ballast or electrical connection. An example might be LP-H-15.

END OF SECTION

SECTION 26 05 73

ELECTRICAL SYSTEM STUDIES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Perform electrical analyses using computer based electrical modeling software. Submit summary reports of the results of the analyses and use these results as the basis for final equipment settings and adjustments, system documentation, and labeling. All new, modified, and existing equipment shall be included in the electrical analyses as specified herein.
- B. Studies shall be performed for Reservoir A1/A2/Booster B/C, Intermediate Reservoir/Booster F, and Promontory Lift Station sites. Studies to be performed shall include:
 - 1. Short-circuit
 - 2. Coordination Studies.
 - 3. Arc Flash Hazard Studies
- C. Provide all material, equipment, labor, and technical supervision to perform electrical studies including acquiring all necessary input data.
- D. The term “major electrical equipment” when used in this Section shall include but not be limited to:
 - 1. 480V Switchboards
 - 2. Motor Control Centers
 - 3. Motors and drives
 - 4. Standby generator including associated circuit breakers, relaying, and other protective devices
 - 5. Distribution dry-type transformers and lighting panels
 - 6. Other equipment as necessary to comply with the coordination and arc flash requirements as specified in these Specifications and as per applicable standards and industry recommended practices.
- E. Results of the final electrical system studies shall be used to establish protective device settings, protective device programming, arc flash label documentation, and other requirements of the electrical system testing and commissioning procedures specified in Section 26 08 00.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 08 00 – Commissioning of Electrical Systems

1.03 SUBMITTALS

- A. All submittals shall be in accordance with Sections 01 30 00 and 26 05 00.
- B. Submit Electrical Equipment Analyses Plan a minimum of four (4) weeks after award of contract. Submittal shall include the following at a minimum:
 - 1. Qualifications of firm or individual(s) proposed to perform the analytical studies confirming that the specified qualifications are met including professional engineering registration and experience requirements.
 - 2. Details of analytical software proposed for performing the studies including technical details illustrating compliance with referenced standards and protocols.
 - 3. Resume of Professional Engineer and/or lead electrical modeler responsible for the technical approach and accuracy of the finished studies. Resumes shall include details of professional registration of the Engineer in Responsible Charge for the studies, educational background, relevant software training, and experience performing electrical modeling studies for systems of equal or more complexity.
 - 4. Proposed equipment and bus naming conventions to be used for the electrical analyses prior to preparation of the computer model. Bus naming shall incorporate electrical equipment naming conventions shown on the Drawings.
 - 5. Representative samples of analytical reports for short circuit studies, coordination studies, arc flash studies, arc flash labeling, and harmonic studies indicating conformance with the specified study requirements.
- C. Submit draft electrical study reports including results for short circuit, coordination, and arc flash a minimum of twelve (12) weeks prior to scheduling any field testing as specified in Section 26 08 00. Report shall include proposed arc flash label content and design.
- D. Following submittal and favorable review of the studies, submit electronic copies of final reports and electronic copies of the final analytical databases in native format for the analytical package used for the analyses. Database shall be submitted on CD-ROM, thumb drive or similar mass storage device. Final report shall include settings and results used to establish protective device field settings and content of arc flash labels provided for the Project.
- E. Incorporate electrical study results as part of the O&M Manuals per Section 01 70 00 and as required per NFPA 70E for Arc Flash Labeling documentation.

1.04 REFERENCE STANDARDS

- A. All analyses shall be in accordance with the following codes and standards.
 - 1. American National Standards Institute
 - a. ANSI C2 – National Electrical Safety Code
 - b. ANSI C.37.010 – Standard Application Guide for AC High-Voltage Circuit Breaker
 - c. ANSI C37.5 – Calculation for Fault Currents for Application of Power Circuit Breaker
 - d. ANSI C37.13 – Low-Voltage AC Power Circuit Breaker (600-Volt Insulation Class)
 - 2. Institute of Electrical and Electronic Engineers - IEEE

- a. IEEE 141 – “Recommended Practice for Electrical Power Distribution for Industrial Plants”
 - b. IEEE 242 – “Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems”
 - c. IEEE 399 – “Recommended Practice for Industrial and Commercial Power System Analysis”
 - d. IEEE 519 – “Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems”
 - e. IEEE 1584 – “Guide for Performing Arc-Flash Hazard Calculations”
- 3. InterNational Electrical Testing Association
 - a. NETA ATS – Acceptance Testing Specifications (latest edition)
 - 4. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code
 - b. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - c. NFPA 70E: Standard for Electrical Safety in the Workplace
 - d. ANSI/NFPA 101: Life Safety Code
 - 5. Occupational Safety and Health Administration – OSHA
 - a. OSHA 29-CFR, Part 1910 Subpart S - Electrical
 - 6. Other applicable State and local codes and ordinances.
- B. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALIFICATIONS

- A. The electrical analytical studies shall be performed by a registered professional electrical engineer in the state of California with a minimum of five years’ experience in the performance of such studies. Engineer shall have attended standard training sessions on the analytical package specified for use on this project.

1.06 FINAL SYSTEM DOCUMENTATION

- A. Incorporate final versions of electrical analyses reports and studies into the project operations and maintenance manuals as specified under Section 01 70 00 and Section 26 05 00.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 ELECTRICAL ANALYTICAL STUDIES

- A. General
 - 1. All analyses in the study shall be performed using SKM Power*Tools ©, ETAP ©, EasyPower © with required bus capabilities and analytical add-on modules as necessary to facilitate a comprehensive analysis of the electrical system as shown on the Drawings.
 - 2. The database for the study to be performed under this Contract shall match nomenclature and identification approaches used on the Drawings and as submitted by the Contractor.

3. The final electronic database and library for the approved final study shall be submitted to the Engineer on CD, thumb drive or other mass storage device in the native format of the analytical package used for the study. Engineer will verify compatibility of CD submitted files with the software provided under this Section.
- B. The study shall be in full compliance with all applicable ANSI and IEEE Standards.
 - C. The firm performing the study shall be responsible for obtaining any and all data required to complete the study and determine recommended setpoints. Data to be obtained shall include available utility short circuit duty; utility protective device make, model, and setting; all new and existing equipment characteristics and ratings; feeder sizes and lengths; new and existing loads and motor characteristics; and all other input data necessary to complete the study per the requirements of this Section.
 - D. Record drawings and other information of the existing electrical distribution system will be made available upon request from the Owner after Notice of Award. However, the accuracy of the existing documentation has not been confirmed. Contractor shall be responsible for field verification of all new and existing input data used for the study to achieve an accurate and comprehensive model of the electrical distribution system.
 - E. All studies shall be stamped and signed by a Professional Electrical Engineer currently registered in California.

3.02 SHORT CIRCUIT AND PROTECTIVE DEVICES COORDINATION STUDY

- A. Provide a complete short circuit study and protective device coordination study for the power distribution system including both modified existing and new system elements included under this Contract.
 1. 480V switchboards.
 2. MCC, distribution switchboards, and motor controllers.
 3. Motors and drives. Model each individual motor fault contributions for each motor larger than 50hp. Motors smaller than 50hp may be modeled as combined or composite loads as defined in ANSI C37.010 and C37.5.
 4. Standby generator including associated circuit breakers, relaying, and other protective devices.
 5. Distribution dry-type transformers and lighting panels
 6. Other equipment as necessary to comply with the coordination and arc flash requirements as specified in these Specifications.
- B. The study shall at a minimum:
 1. Present the overall electrical distribution single line diagram, including utility, generators, transformers, cables, motor control centers, VFDs, and all other source and end use equipment included in the limits of the study. The diagram shall identify each bus, transformer, reactor, etc., by name and corresponding node number using the approved bus tagging scheme. The available fault currents, Thevenin impedance and X/R ratio for each node, shall be indicated on the diagram. The single line diagram shall include cable sizes, lengths, transformer voltage, and transformer kVA.
 2. Document available three phase and ground fault asymmetrical and symmetrical fault currents at each piece of electrical equipment, bus, transformer, etc.

3. Provide a system impedance diagram. The diagram shall include the power company's impedance and X/R ratio, circuit element impedances (e.g. transformers, generators, motors, VFDs, feeders, distribution buses, etc.).
4. Identify and list the available fault current at each bus confirming the short circuit duty is within the limits of the equipment.
5. List the momentary and interrupting rating of all elements of the distribution system. The maximum available fault current available at each element shall be calculated.
6. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the Engineer.
7. Provide a complete set of time-current coordination curves on log paper. Limit the number of protective devices shown on any drawing to a maximum of four. A single line diagram depicting the portion of the distribution system under study shall appear with the curve. The minimum size log paper to be submitted shall be 11.5-in by 18-in.
8. Prepare time current plots including transformer ANSI damage and inrush points, cable damage curves, motor damage curves, capacitor damage curves, generator damage curves, circuit breaker and fuse ratings and settings, protective relay settings and any other information required by ANSI and good design practices. At a minimum provide curves for:
 - a. Time current curves demonstrating system coordination and selectivity under normal operation as well as modified or altered curves reflecting the impact of any arc flash mitigation strategies included in the design. Assumption made for pickup or timing alterations as part of arc flash mitigation schemes shall be clearly documented on the relevant time current curves.
 - b. Utility protective device and facility service entrance main protective device.
 - c. Each low voltage feeder down to 480 Volt main switchboard, motor control center, variable frequency drives or other end use device.
 - d. Each main and worst-case representative feeder circuit breaker(s) located in the 480 Volt main switchboard, motor control center, variable frequency drives, or other end use device.
 - e. Each ground fault protective device provided for the 480 Volt or 208V distribution systems.
 - f. Motor starting profile for the largest motor connected at each main distribution point.
 - g. Transformer damage curves in accordance with ANSI C57.109.
 - h. Transformer excitation current
 - i. Motor, generator and cable damage curves in accordance with the manufacturer's data.
9. Develop a complete set of coordination curves for every protective relay, circuit breaker, fuse, timer, etc., serving or located in the electrical equipment furnished for the project including the utility protective devices.
10. Summarize protective device settings for every over current protective device, timer, power system relay (e.g. ANSI 25, 27, 32, etc.), circuit breaker, recommended fuse and current transformer ratings, etc.
11. Recommend final relay and settings for implementing the coordination and protection scheme. Define specific relay types and protective features (i.e. inverse, very inverse,

extremely inverse, over current with or without voltage restraint, timers, etc.), current transformer ratings and types, fuse, residual or zero sequence connected ground fault protection, etc., that will allow the system to be protected within the equipment fault ratings and provide the maximum possible coordination between the protective devices.

12. Prepare an executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information, identify all assumptions made in the preparation of the study, identified any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.
 13. Generate PDF files or printouts of all input data
 14. Generate PDF files or printouts for the three phase, single phase and ground fault studies. Printouts shall indicate the fault current available at each major equipment and distribution bus.
 15. Generate PDF files or printouts of tables listing all the electrical distribution and utilization equipment, the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment and the ability of the equipment to interrupt and/or withstand the fault.
- C. Prepare a short circuit and system coordination report coordinated with the approved submitted equipment shop drawings. The report shall confirm equipment is being applied within design ratings and electrical protective devices will coordinate.
1. Provide recommended coordination settings for all protective devices.
 2. The coordination study shall be submitted in PDF format or hardcopy bound in a standard 8-1/2-in by 11-in format, 3-hole punch binder. The selection of all protective relay types, current transformers, fuse types, and ratings shall be the responsibility of the equipment manufacturer or system integrator and shall be based on the preliminary draft of the coordination study.
 3. The complete study shall be favorably reviewed by the Engineer before any equipment is shipped.

3.03 ARC FLASH HAZARD STUDY

- A. Perform an arc flash hazard study after the short circuit and protective device coordination study has been completed. The arc flash hazard study shall include operation during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard.
- B. Perform the arc flash hazard analysis for all equipment (including 120V control panels) provided or modified under this Contract having a nominal operating voltage greater than 50 Volts AC to ground as required per NFPA 70E.
- C. Arc flash hazard analysis need not be based solely on results of the computerized electrical distribution system model. However, if other alternative methods as allowed under NFPA 70E are used for the hazard analysis, provide complete documentation, details, and calculations used for establishing the resulting arc flash hazards.
- D. Pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the report.

- E. The study shall be prepared in accordance with applicable NFPA 70E, OSHA 29-CFR, Part 1910 Subpart S, and IEEE 1584 Standards.
- F. The study shall include as a minimum the following:
 - 1. Flash Hazard Protection Boundary
 - 2. Limited Approach Boundary
 - 3. Restricted Boundary
 - 4. Prohibited Boundary
 - 5. Incident Energy Level or required Personal Protective Equipment Class
 - 6. Type of Fire Rated Clothing
- G. Submit Arc Flash Warning labels listing items above for all equipment analyzed in the study. Labels shall include the bus name and voltage. Provide permanent thermal transfer type, factory manufactured labels in conformance with NFPA 70E and ANSI Z535. Labels shall be made of high adhesion polyester and have electronic generated characters with no field markings. Labels shall be printed in color.
- H. Produce individual Bus Detail sheets for each location where an Arc Flash Warning label is provided. The sheets shall list the items from above and the following additional items:
 - 1. Bus Name
 - 2. Upstream Protective Device Name, Type, and Settings
 - 3. Bus Line to Line Voltage
- I. Produce Arc Flash Evaluation Summary Sheet listing the following additional items:
 - 1. Bus Name
 - 2. Upstream Protective Device Name, Type, and 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
 - 15. Required personal protective equipment (PPE) blast rated clothing energy rating or protection class
- J. The complete study and arc flash warning label design shall be submitted and approved by the Engineer at least 30 Days prior to energizing the electrical equipment.

- K. Submit the arc flash label design for approval. At a minimum, label shall contain details as specified herein.

END OF SECTION

SECTION 26 05 80

LOW VOLTAGE MOTORS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide three-phase and single-phase AC induction motors 600V or less, rated 500HP or less and operating at greater than 75% load for equipment as shown on the Contract Documents.
- B. Provide all motor accessories, features, and enclosures as specified herein.
- C. Motors furnished under other Sections, shall be in conformance with the requirements listed in this Section unless otherwise noted.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Electrical and Instrumentation General Provisions
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 30 00 and 26 05 00.
- B. Submittal of motor data shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1 Part 12 and, in addition, the following for motors typical of the units furnished:
 - 1. Efficiency at 1/2, 3/4 and full load
 - 2. Power factor at 1/2, 3/4 and full load
 - 3. Motor outline, dimensions and weight
 - 4. Descriptive bulletins, including full description of insulation system
 - 5. Bearing design data
 - 6. Special features (i.e., space heaters, temperature detectors, etc.)
 - 7. Power factor correction capacitor rating, type, and mounting method
 - 8. Dimensional drawings for each item of couplings and motor to be furnished for motors to be replaced under this Contract
- C. For inverter duty rated motors, provide certification that the motor is in compliance with NEMA MG-1, Part 31.

1.04 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 43: IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery

2. IEEE 841: IEEE Standard for Petroleum and Chemical Industry – Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up To and Including 370 KW (500 HP).
 3. IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators.
 4. IEEE 114: Standard Test Procedures for Single-Phase Induction Motors.
- B. National Electrical Manufacturers Association (NEMA):
1. NEMA MG1: Motors and Generators
- C. American Bearing Manufacturers Association (ABMA)
1. ABMA 20: Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types – Metric Design

1.05 QUALITY ASSURANCE

- A. Unless noted otherwise herein, routine tests shall be performed on representative motors in accordance with IEEE Standard 112, and shall include the information described in NEMA MG1-Part 12 and manufacture’s standard testing. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors. Certification shall be provided that motors have passed the factory tests.

PART 2 - PRODUCTS

2.01 RATING

- A. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.
- B. All motors shall be rated for continuous duty suitable for operation in a 40 degrees C ambient and not less than minus 15 degrees C with altitudes less than 1,000 meters unless otherwise noted.
- C. Motors shall be rated for frequency variation within plus/minus 5%.
- D. Specific motor data such as HP, rpm, enclosure type, etc, are specified under the detailed specification for the equipment with which the motor is supplied.
- E. Provide motors 1 horsepower and above with service factor of 1.15 at 40°C under sinusoidal operation unless specifically noted otherwise.
- F. Motors specified for operation under variable frequency drives shall be inverter duty rated in compliance with NEMA MG-1, Part 31 and shall have a nameplate service factor of 1.15 (sinusoidal operation) and 1.0 when driven from a non-sinusoidal source.

2.02 ENCLOSURES

- A. Motors specified herein will conform to one of the following NEMA standard enclosure designs:
 - 1. Open Drip Proof (ODP): Motor shall be constructed with ventilated openings such that drops of liquid and solid particles striking or entering the enclosure at any angle 0 – 15 degrees downward from vertical do not interfere with the successful operation of the motor.
 - 2. Totally enclosed fan cooled (TEFC) Motors shall have a steel or cast iron frame, cast iron end brackets, cast iron conduit box, drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance. Fan for cooling the motor shall be integral.
- B. Motors shall have a steel or cast iron frame and a cast iron or stamped steel conduit box.
 - 1. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions.
 - 2. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover.
 - 3. Where available for the enclosure type specified, motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material.
 - 4. A frame mounted pad with drilled and tapped hole, not less than 1/4-in diameter, shall be provided inside the conduit box for motor frame grounding.

2.03 NAMEPLATES

- A. Provide motor manufacturer's nameplates engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

2.04 CONDENSATION HEATERS

- A. Provide condensation winding space heaters for every 3-phase motor provided under this Contract unless specified otherwise under the detailed equipment specifications. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required or as recommended by the motor manufacturer for the specific application. The heater wattage and voltage shall be embossed on the motor nameplate. Power leads for heaters shall be brought out at the motor lead junction box or auxiliary termination box if available.

2.05 TEMPERATURE DETECTORS

- A. Provide stator winding temperature detectors for all motors 40 hp and larger, when driven by variable speed drives, where specified under the detailed mechanical specifications for individual equipment, or where shown on the Drawings.
- B. Provide factory installed, embedded, bi-metallic switch type. Device shall protect the motor against damage from overheating caused by single phasing, overload, high

ambient temperature, abnormal voltage, locked rotor, frequent starts or ventilation failure. The switch shall have normally closed contacts. Not less than three detectors shall be furnished with each motor, one for each phase.

- C. Detector leads shall be terminated in the motor main conduit termination box or auxiliary termination box on the motor frame if available.

2.06 SINGLE PHASE MOTORS

- A. Unless otherwise specified, motors smaller than 1/2 Hp shall be single phase, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.
- B. Single-phase motors shall be rated for operation at 115 Volts, 208 Volts, or 240 Volts, single phase, 60 Hz, as shown on the Drawings.
- C. Locked rotor current shall not be greater than specified in NEMA Standard MG1, Part 12, Design "N".
- D. Motors shall be totally enclosed in conformance with NEMA Standard MG1, Part 1. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.
- E. Motors shall be provided with sealed ball bearings lubricated for 10 years normal use.
- F. Motors shall be by Nidec-U.S. Motors; or equal.

2.07 THREE PHASE MOTORS-FRAMES 143T THROUGH 449T

- A. General
 - 1. Unless otherwise specified, motors 1/2 Hp and larger shall be 3 Phase, squirrel cage induction type, premium efficiency.
 - 2. All motors 3/4 Hp and larger shall be a NEMA frame 143T or larger. 1/2 Hp motors and 3/4 Hp motors rated 1800 and 3600 rpm, shall be a 56 frame. Motors shall be designed and connected for operation on a 480 Volt, 3 Phase, 60 Hz alternating current system. Dual voltage (230/460) rated motors are acceptable.
 - 3. Unless otherwise required by the load, all motors shall be NEMA Design B, normal starting torque. Locked rotor kVA/Hp shall not exceed Code Letter G as described in NEMA Standard MG1-10.37 for motors 20 Hp and larger.
 - 4. Motors with a 180 frame and larger shall have provisions for lifting eyes or lugs capable of a safety factor of 5.
 - 5. Motors shall be by Nidec-U.S. Motors; or equal.
- B. Bearings
 - 1. Anti-friction motor bearings shall be designed to be regreasable and initially shall be filled with grease suitable to ambient temperature of 40 degrees C. Bearings shall be AFBMA Types BC or RN, heavy duty, or shall otherwise be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.

2. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with an easily accessible grease supply, flush, drain and relief fittings including an externally visible sight glass to view the oil level. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type by the Alemite Division of the Stewart-Warner Corporation.
3. Grease lubricated bearings shall be designed for electric motor use. The grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
4. Bearings shall be rated for a minimum of 26,280 hours L-10 life at full-load direct-coupled, except vertical high thrust motors.
5. Vertical motors shall be capable of withstanding a momentary up-thrust of at least 30% of normal down-thrust.

C. Insulation

1. Insulation systems shall be Class B (130 degrees C) and shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalies and mechanical or thermal shock. Maximum temperature rise by resistance at rated HP shall not exceed Class B limits (80 degree C)
2. For motors at 1.15 Service Factor, the maximum temperature rise by resistance shall not exceed Class F limits of 115 degree C.
3. Motors for severe duty service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.
4. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

D. Vibration

1. Vibration shall not exceed 0.15 inch per second, unfiltered peak.

E. Motor Efficiencies (Three Phase Motors)

1. Motor efficiencies shall meet the requirements of the Energy Independence and Security Act (EISA) and be manufactured to meet the following efficiency standards:
 - a. General purpose motors (subtype I) with a power rating of 1 Hp through 200 Hp shall have a nominal full-load efficiency that is not less than as defined in NEMA MG- 1 (2006) Table 12-12 ("NEMA Premium®") efficiency levels. Subtype I motors include:
 - 1) Foot-mounted 3-digit frame sizes with C-face and foot mount
 - 2) Includes ODP, TEFC, TENV, explosion-proof, etc.
2. Efficiency values shall be based on tests performed in accordance with IEEE 112, Method B. Motors with horsepower or rpm's not listed shall conform to comparable standards of construction and materials as those for listed motors.

**Table 12-12
NEMA Premium Full Load Efficiencies¹
OPEN MOTORS**

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2.0	85.5	82.5	86.5	84.0	87.5	85.5
3.0	85.5	82.5	89.5	87.5	88.5	86.5
5.0	86.5	84.0	89.5	87.5	89.5	85.7
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	96.2	95.4	96.2	95.4
450	95.8	95.0	96.2	95.4	96.2	95.4
500	95.8	95.0	96.2	95.4	96.2	95.4

Notes

- 1. Values included in the table above were taken from the NEMA Standards MG 1-2006.**

**Table 12-12
NEMA Premium Full Load Efficiencies¹
ENCLOSED MOTORS**

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2.0	85.5	82.5	86.5	84.0	88.5	86.5
3.0	86.5	84.0	89.5	87.5	89.5	87.5
5.0	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

Notes

- 1. Values included in the table above were taken from the NEMA Standards MG 1-2006.**

PART 3 - EXECUTION

3.01 GENERAL

- A. Install all motors in accordance with the manufacturer's printed recommendations and as required under the specific specification sections for the driven equipment.

3.02 INSTALLATION

- A. Motors shall be stored indoors in a clean, dry location with space heaters energized to preclude moisture buildup.
- B. Bolt the motor to the equipment or rigid foundation using bolts of the largest size permitted by the holes in the motor bracket. Do not install motors in such a way as to restrict motor ventilation.
- C. Motor enclosure type shall be used in the following locations unless otherwise specified in the technical specifications:
 - 1. ODP: Non-hazardous, relatively clean, dry, well ventilated area, indoors.
 - 2. WPI: Indoor/Outdoor, relatively clean area, minimal rain and snow.
 - 3. WPII: Indoor/Outdoor, severe rain and snow, dirty environment.
 - 4. TEFC: Indoor/Outdoor, wet, dirty or dusty environment.

3.03 FIELD QUALITY CONTROL

- A. Submit field test procedures for the Construction Manager's approval before testing begins. Test and submit test results for each motor.
- B. Field tests and inspections: Field testing shall be as specified in Section 26 05 00.

END OF SECTION

SECTION 26 05 90

MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. All miscellaneous electrical equipment as shown on the Drawings and as specified in these Specifications.
- B. This Section provides the requirements for miscellaneous equipment typically employed in a facility; however, not all components specified in this Section are necessarily utilized on this Project.
- C. The following equipment is included under this Section:
 - 1. Disconnect switches.
 - 2. Manual motor starters.
 - 3. Control stations.
 - 4. Corrosion inhibitors.
 - 5. Equipment identification nameplates.
 - 6. Insulating rubber floor mats
 - 7. Equipment mounting stands.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 30 00 and Section 26 05 00. Submittals shall contain detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified.

PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty, horsepower rated, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle.
- B. Provide disconnect switch with current ratings as shown on the Drawings, 30 Amperes minimum. Provide fused type where shown on the Drawings.

- C. Switch assembly and operating handle shall be integral with the enclosure base. Provide means for padlocking disconnect switch in the OFF position using standard 3/8-inch shank locks.
- D. Provide switches UL Listed as Service Entrance equipment where shown on the Drawings.
- E. NEMA 12 and NEMA 3R switch enclosures shall be factory painted steel, ANSI 61 gray
- F. NEMA 4 enclosures shall be 316 stainless steel.
- G. NEMA 4X enclosures shall be high impact strength fiberglass reinforced polyester.
- H. Switches shall be as manufactured by the Eaton Corporation Heavy Duty Safety Switches; Square D Co.; General Electric (ABB); or equal.

2.02 MANUAL MOTOR STARTERS

- A. Manual starters shall be suitable for the voltage and number of phase shown on the Drawings and shall be non-reversing, reversing or two speed type as shown on the Drawings. NEMA sizes shall be as required for the horsepower's shown on the Drawings. Manual starters shall have motor overload protection in each phase when used as motor disconnect switches; overload protection is not required when used for device or instrumentation disconnects as specified under Section 40 41 00.
- B. NEMA 12 and NEMA 3R switch enclosures shall be factory painted steel, ANSI 61 gray
- C. NEMA 4 enclosures shall be 316 stainless steel.
- D. NEMA 4X enclosures shall be high impact strength fiberglass reinforced polyester.
- E. Manual motor starters shall be as manufactured by the Eaton Corporation; Square D Co.; General Electric (ABB); or equal.

2.03 CONTROL STATIONS

- A. Control stations shall be heavy-duty or industrial-duty type, sized to accommodate full size operators (30mm) as specified under Section 40 67 00.
- B. Control station operators noted for use as local emergency stop (LES) on the Drawings shall be maintained contact, push to stop/pull to release type.
- C. Provide control stations sized for the number and type of pilot devices as shown on the Drawings. Control station dimensions shall be adequate to accommodate device contact blocks and a minimum of one additional auxiliary contact block for remote monitoring of pilot operator positions.
- D. Provide permanent engraved escutcheon plates for all devices labeled with the specific functions as shown on the Drawings or as specified (e.g., RUN, HAND-OFF-AUTO)
- E. NEMA 12 and NEMA 3R control stations shall be factory painted steel, ANSI 61 gray
- F. NEMA 4 enclosures shall be 316 stainless steel.

- G. NEMA 4X enclosures shall be high impact strength fiberglass reinforced polyester.
- H. Control stations shall be by General Electric (ABB) Co.; Eaton Corporation; Square D; or equal.

2.04 CORROSION INHIBITORS

- A. All equipment enclosures, terminal boxes, etc, located in a corrosive rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.
- B. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M or equal.

2.05 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. All field mounted electrical equipment such as disconnects, push button stations, etc, shall be provided with a weather resistant engraved Laminoid equipment identification nameplate screwed or bolted adjacent to the device. Nameplate shall identify the mechanical equipment controlled exactly as shown on the electrical single line drawings (i.e., P-95 Cooling Water Pump No. 1).

2.06 INSULATING RUBBER FLOOR MATS

- A. Furnish and install a non-conductive elastomer compound rubber floor mat extending the full length and placed in front of and in back of each indoor 480 volt distribution panel (e.g., switchboard, motor control center) provided under this Contract.
- B. Mats shall be in accordance with ASTM D178 specification, Type II, ozone, flame and oil resistant, 36-in wide with corrugated surface and shall be branded continuously on the back.
- C. 480V applications: Class 1, 3/16-in thick minimum
 1. Maximum Use Voltage phase to phase: 7,000 V
 2. AC Proof – Dielectric Test Voltage: 20,000 V
- D. Mats shall be stored without distortion, free from direct sun light or sources of ozone and at a temperature not to exceed 95 degrees F (35 degrees C).
- E. Provide insulating rubber floor mats by The Mat King, or equal.

2.07 EQUIPMENT MOUNTING STANDS

- A. Equipment mounting stands shall be custom fabricated from steel plate and steel supports, as shown on the Drawings.
- B. Steel plates and supports shall be hot dip galvanized after fabrication.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Rubber Floor Mats

1. Install mats in one continuous piece in front of the entire length of the switchgear, switchboard, or other equipment as specified. Extend mat length 1 foot beyond the end of the equipment up to any fixed or structural obstruction.
2. Where equipment faces each other and is less than 6-ft apart, provide one width of mat across the entire width of the aisle-way between the equipment faces.

B. Mounting Stands

1. Field mounted disconnects, pushbutton control stations, etc, shall be mounted on steel stands as shown on the Drawings. Where clearance requirements for stands may not be maintained, the Construction Manager may direct equipment to be wall-mounted adjacent to the equipment, but in no case shall the distance from the equipment to the control station exceed 3-ft.

END OF SECTION

SECTION 26 05 99

ELECTRICAL AND INSTRUMENTATION DEMOLITION AND MODIFICATIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Section Includes: All labor, materials, and incidentals required to demolish, modify and/or remove the electrical and instrumentation systems and equipment as shown on the Drawings and/or specified herein. Unless specifically noted as being reused, all conduit, wire, boxes, etc. detailed on the Drawings shall be new equipment installed under this Work.
- B. The electrical modifications and removals work shall generally consist of the following:
 - 1. Modifications at the existing B/C Zone Booster Pump Station:
 - a. Disconnect the existing generator and automatic transfer switch and relocate them to the new B/C Zone Booster Pump Station
 - 2. Modifications at the Intermediate Reservoir Site:
 - a. Demolish the existing generator and replace with a new generator connected to the existing automatic transfer switch
 - b. Demolish the existing chlorine dosing pumps and replace with a new dosing pump system.
 - c. Demolish existing panel 2TP and replace with a new chlorination control panel.
 - d. Modify the existing 120V distribution within the existing chlorination building.
 - 3. Modifications at the Marina Booster Pump Station/Reservoir 2:
 - a. Provide a new antenna on Reservoir 2
 - b. Modify the existing repeater radio panel to add the new antenna.
 - 4. Modifications at the Promontory Lift Station:
 - a. Provide two new feeders for serving two new access gate operators.
 - 5. Modifications at the SCADA Central Location:
 - a. Software and programming changes only. No physical modifications are required at this site.
 - 6. Any electrically powered or controlled equipment indicated as being removed in this Contract and associated electrical appurtenances.
 - 7. Existing electrical equipment or electrical equipment associated with mechanical or process equipment which must be removed or relocated due to conflicts with new construction.
 - 8. Electrical control devices, starters, wiring, and other miscellaneous devices associated with equipment that will be modified or reused under this Contract.
 - 9. Instrumentation and control equipment and related conduit and wire associated with equipment being modified or removed under this Contract.

1.02 RELATED WORK

- A. Division 02 – Existing Conditions
- B. Section 26 05 00 – Common Work Results for Electrical

1.03 SUBMITTALS

- A. Submit in accordance with Sections 01 30 00 and 26 05 00.
- B. Submit detailed time schedule for equipment which will be either modified or removed under this Work. Include details of work to be done, anticipated duration of the work, impact of the work on plant operations, and coordination with other trades, per the requirements of the overall project schedule per Division 01.
- C. All modifications made to existing Switchgear, MCCs, and other panels shall be fully described in shop drawing submittals. The submittals shall include the following as a minimum:
 - 1. Panel elevation drawings clearly and unambiguously identifying the specific equipment that will be removed.
 - 2. Revised panel wiring diagrams clearly and unambiguously indicating the specific modifications to the equipment internal and external circuiting of the new or modified devices.
 - 3. Technical details and catalog cut sheets for the new equipment including electrical characteristics, physical sizing, and installation requirements.
 - 4. Revised enclosure or housing dimensioned plan and elevation drawings clearly and unambiguously indicating the required alterations to the enclosure physical dimensions and characteristics.
 - 5. Engraving schedule and details for all new nameplates, escutcheon plates, and equipment tagging.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 MODIFICATIONS

- A. All MCCs, switchboards, switchgears and other panels requiring modification under this Work shall comply with the following general requirements:
 - 1. Equipment removed from service shall have suitable metallic covers placed over any unused exterior panel holes. Covers shall be painted to match the existing panel and shall be securely retained on the panel with stainless steel machine screws, nuts, and other hardware.
 - 2. Newly installed equipment shall be mounted, connected, and identified consistent with the other equipment in or on the panel. Nameplates shall also be provided for all new equipment mounted on the exterior of existing panels. At motor control centers, provide nameplates matching existing including nameplates for "SPARE" devices created by work under this Contract. Conform to the nameplate requirements of Section 26 05 00.
 - 3. In lighting and distribution panels, the circuit card or listing shall be replaced with a newly typed, comprehensive circuit card showing the as-left condition (i.e. both changed and unchanged circuits) of the panel.

4. All modifications made to panels shall be retrofit with components furnished by the original panel manufacturer to maintain all original UL and NEMA labeling and certifications. Devices installed in compartmentalized panels shall be provided with new doors and interior mounting pans as required to match the existing panel construction style and enclosure environmental ratings.
5. Mounting holes required for new equipment shall be neatly cut and deburred. Take care to mitigate deposits of metal cuttings deposited inside of the modified panel.
6. Interior panel wiring for newly added devices shall match the existing panel wiring type, mounting, and identification scheme.

3.02 EQUIPMENT TO BE REMOVED

- A. Only the major electrical and instrumentation equipment to be removed are shown or noted on the Drawings and failure to detail all equipment removal requirements exactly shall not relieve the Contractor from the responsibility for its removal as directed by the Engineer. Removal items such as individual wire, conduit, junction boxes, etc. are in general not detailed on the Drawings.
- B. Where removal of electrical, instrumentation, or any other equipment with wired connections is called for, include the removal of the associated electrical hardware as specified herein unless noted otherwise.
- C. In general, all conductors shall be removed from the conduits; boxes and fittings and all exposed conduit shall be removed to the point of termination. Concealed conduits shall be cut flush with the floor, wall, or ceiling and plugged with non-shrink grout or other permanent material and as detailed on the Drawings.
- D. Electrical power, control, or instrumentation equipment, exposed conduit, wiring, etc. rendered inoperative by modifications to existing equipment under these Contract Documents shall be removed unless specifically noted that it is to be abandoned in place.
- E. Not all existing conduits are shown on the Drawings. In general, existing conduits are shown only where they may be reused; or where they potentially affect or may be affected by new work under this Contract; or for providing useful background information to the Contractor regarding the existing electrical installation.
- F. Where existing conduit or wire associated with removed equipment is to be reused, it will be specifically noted on the Drawings. Where portions of an existing conduit route to be reused (including buried or embedded portions) is clearly required to be removed or relocated due to new construction, it shall be included in work under this Contract even if not specifically detailed or noted as such on the Drawings.
- G. No existing conduits, wiring, or electrical appurtenances shall be removed, modified, or in any way damaged unless allowed by the provisions of this Section. Any existing conduits, conductors, or other electrical appurtenances that are encountered as an obstruction to new construction which are not covered by the provisions of the Contract Documents shall be brought to the attention of the Engineer.
- H. Where functions of existing cables and/or conduits are replaced by new cable and/or conduits because of additions of new panels, instruments, revision to control strategy, etc.,

the existing cables and exposed conduits shall be removed unless noted otherwise. Concealed conduits shall be retained and marked as spares unless noted otherwise.

- I. Equipment removed shall not be reused under this Contract unless specifically noted on the Drawings or Specifications.
- J. To minimize disruptions to the existing plant operations, the schedule for modifications and removal of existing equipment shall be submitted to, coordinated with, and approved by the Engineer.
- K. Where any existing circuits are disconnected due to abandonment or removal of existing equipment, the remaining motor starters or circuit breakers for these circuits shall be retagged as spares.

3.03 CIRCUIT RELOCATION

- A. Prior to relocation of circuits as required the Contractor shall trace all wires from the source to the destination. The wires shall be tagged to include an identification number as specified in Section 26 05 19. The Contractor shall provide all testing equipment and hardware necessary to gain access and locate circuits to determine their source and origin. The conduit schedules provided in the Contract Documents were developed based on available as-built documents and site investigations during design, however, the Contractor shall provide field verification of the conduits including their circuits prior to relocation.
- B. For underground ductbanks the Contractor shall trace and pot hole around the area of work to field locate the approximate location of the ductbanks prior to excavation. The Contractor shall hand dig around the electrical ductbank to expose a section of the duct for access. Access to existing circuits located in existing reinforced concrete ductbanks shall include chipping away of the concrete envelope as necessary to expose rebar prior to cutting or torching to allow access to the conduits. Once the conduits are exposed the Contractor shall carefully cut the conduit to access the conductors for circuit verification, reconnection, and/or reinstallation as detailed on the Drawings. Contractor shall use the utmost care to expose circuit conductors within existing concrete ductbanks without damaging the conductor insulation where indicated for reuse.
- C. Excess slack conductor length shall be maintained where required to reuse the existing conductor for termination at a Terminal Junction Box where shown on the Drawings. Provide a minimum of 10-foot slack conductor length unless noted otherwise on the Drawings.
- D. Where new conductors are replacing existing conductors in existing ductbanks the ducts/conduits shall be swabbed clean and mandreled prior to installation of the new conductors.
- E. Where existing ductbanks are to remain in place and conduits become "Spares" or "Empty" the Contractor shall provide a polyethylene pull rope as specified in Section 26 05 33.

3.04 DEMOLITION

- A. The Contractor shall survey the existing electrical systems and equipment identified for removal with representatives from the other trades and the Engineer prior to performing

any demolition work. Prior to removal, identify all conduit and equipment to be removed with tags or paint. Equipment to be removed shall be identified a minimum of three (3) weeks before demolition is scheduled to allow sufficient review time by the Engineer for possible salvage.

- B. Remove all electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused. Where a piece of equipment is to be removed, all associated ancillary components (e.g. seal water solenoid valves, pressure switches, etc.) and associated wiring and conduit shall also be removed.
- C. Building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect all electrical power, communications, alarm and signal systems included in the demolished structure.
- D. Remove exposed conduit and conductors to be demolished back to the point of concealment including abandoned conduit above accessible ceiling finishes. Completely remove demolished conductors in concealed conduits back to the source or nearest point of maintained usage.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank covers for abandoned outlet boxes which are not removed. Covers shall match the same NEMA rating as the abandoned boxes.
- F. Disconnect and remove abandoned panelboards, disconnect switches, control stations, distribution equipment, etc.
- G. Disconnect and remove abandoned lighting fixtures. Remove brackets, stems, hangers and other accessories. Repair adjacent construction and finishes damaged during demolition and extension work. Paint areas of equipment and hardware removal in conformance with Section 09 90 00.
- H. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.
- I. Coordinate outages in systems with the Engineer in accordance with Section 01010. Where duration of proposed outages cannot be allowed by the requirements of the Contract Documents provide temporary connections or power sources as required to maintain service.
- J. Trace out existing wiring that is to be relocated or removed and perform the relocation or removal work as required for a complete operating and safe system.
- K. Continuous service is required on all circuits and outlets affected by these changes, except where the Engineer will permit an outage for a specific time as defined in the Contract Documents. Obtain the approval of the Engineer before removing any circuit from continuous service.

- L. Remove exposed conduits, wireways, outlet boxes, pull boxes, and hangers abandoned or made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and repaint as specified under Section 09 90 00.
- M. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc., furnished and installed to temporarily keep circuits energized shall be removed when the permanent installation is fully operational. Any surfaces or finishes damaged by the temporary installations shall be returned to its condition prior to the commencement of the work.

3.05 DISPOSITION OF REMOVED MATERIALS AND EQUIPMENT

- A. In general, all the material and equipment indicated to be removed and disposed of by the Contractor shall, upon removal, become the Contractor's property and shall be properly disposed of off the site by the Contractor, unless otherwise directed by the Engineer. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be submitted to the Engineer.
- B. Ballasts in each existing lighting fixture shall be assumed to contain PCB's unless specifically marked with a label indicating "No PCBs."
- C. All equipment containing PCBs or equipment contaminated by PCBs shall be removed, packaged, shipped and disposed of in accordance with all applicable State and Federal regulations. Provide the services of a firm licensed and regularly engaged in the removal of PCBs and PCB contaminated equipment. The firm shall be licensed in the State or States in which the contaminated material is handled, shipped and disposed. Include all fees associated with the removal, packaging, shipping, and disposal of the contaminated material and equipment in the Contract Bid Price. Submit documentation to the Engineer showing acceptable disposal.
- D. Should PCB contaminated equipment be discovered that was not identified in the Contract Documents, cease work on or about the equipment and notify the Engineer immediately. The Contractor shall then proceed with the work as directed by the Engineer.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Test systems and equipment furnished under Division 26 and repair or replace all defective work and equipment. All new, modified, and existing protective devices shall be tested and adjusted per the requirements of this Contract Documents.
- B. Employ the services of a third party Testing Firm or the equipment manufacturer as the Testing Entity responsible for providing the major electrical components and systems to perform the tests specified in this Section.
- C. Field testing and commissioning shall be performed in accordance with the latest revisions of the following NETA Standards unless otherwise modified by this Section:
 1. ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems"
- D. Submit field test reports for each component tested for the project record files. Test report forms shall be in compliance with NETA standards.
- E. It is the intent of the specified tests to assure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications. Tests shall help determine suitability for energization.
- F. Provide all material, equipment, labor, and technical supervision to perform electrical acceptance testing.
- G. Adjust all protective devices to the settings recommended in the short circuit coordination study, arc flash study, and other analyses per Section 26 05 73.
- H. The term "major electrical equipment" when used in this Section shall include all equipment operating above 480V and other equipment specified in this Section, including but not limited to:
 1. 480V Switchboards
 2. Motor Control Centers
 3. Motors and drives.
 4. Standby generator including associated circuit breakers, relaying, and other protective devices.
 5. Distribution dry-type transformers and lighting panels
 6. Other equipment as necessary to comply with the coordination and arc flash requirements as specified in these Specifications and as per applicable standards and industry recommended practices.

- I. Additional electrical distribution equipment testing is specified under the technical equipment specification Sections of Division 26.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 05 73 – Electrical System Studies
- C. Additional electrical distribution equipment testing is specified under the technical equipment specification sections of Division 26.

1.03 SUBMITTALS

- A. All submittals shall be in accordance with Sections 01 30 00 and 26 05 00.
- B. Submit Electrical Equipment Testing Plan a minimum of twelve (12) weeks before any testing of equipment. Submittal shall include the following at a minimum:
 1. Submit qualifications of the firm performing the system commission and field testing confirming that the specified qualifications are met including NETA certification at the specified levels.
 2. Schedule of Electrical Commission Field Testing prepared using Microsoft Project, including:
 - a. Dates of submittal and Engineer review of all electrical analytical study reports as specified under Section 26 05 73.
 - b. Projected delivery and installation dates of major electrical equipment to the site
 - c. Testing dates for each piece of major electrical equipment and for each type of test specified
 - d. Startup and commissioning date for each major piece of electrical equipment
 3. Commission and field-testing procedure narratives describing the sequence, type, and method of all tests.
 4. Proposed testing forms and signoff sheets to be used for all electrical equipment where testing is required.
- C. Submit commission and field test reports for each testing cycle containing each component tested. Reports shall include
 1. Cover sheet with the name of the testing firm and technician names performing the tests. Dates of the testing shall be included.
 2. Table of Contents organized by equipment type and tag name.
 3. Summary page explaining the purpose of the test, description of equipment, equipment identification tag matching the convention shown on the Drawings, technical specification reference of the equipment, and the specific testing requirement met by the test report. Individual equipment cross reference describing the equipment, location of the component and a report page sheet number on which the technical information is presented.
 4. Test data sheets with each piece of equipment or component on a dedicated, unique sheet; page number; the name of the component under test, the major piece of equipment in which the component is located; weather conditions at the time of the test.

5. Opinion whether or not the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. Three complete copies field testing, an officer of the firm performing the tests and an officer of the Electrical Subcontractor.
- D. Incorporate testing results as part of the O&M Manuals per Section 01 70 00 and as required per NFPA 70E for Arc Flash Labeling documentation.

1.04 REFERENCE STANDARDS

- A. Testing required under this Section shall be per the guidelines specified in the NETA publication "Acceptance Testing Specification for Electric Power Distribution Equipment and Systems." Testing requirements in this Section are specifically referenced to the edition of this publication issued at time of bid opening.
- B. All inspections and tests shall be in accordance with the following codes and standards. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
 1. InterNational Electrical Testing Association
 - a. NETA ATS – Acceptance Testing Specifications (latest edition)
 2. American National Standards Institute
 - a. ANSI C2 – National Electrical Safety Code
 3. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code
 - b. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - c. NFPA 70E: Standard for Electrical Safety in the Workplace
 - d. ANSI/NFPA 101: Life Safety Code
 4. Occupational Safety and Health Administration – OSHA
 - a. OSHA 29-CFR, Part 1910 Subpart S - Electrical
 5. Other applicable State and local codes and ordinances

1.05 QUALIFICATIONS

- A. Testing shall be performed by a third party Testing Firm or the equipment manufacturer responsible for providing the major electrical components and systems to perform the tests specified in this Section.
- B. Qualifications of a third party Testing Firm shall include the following:
 1. The Testing Firm shall have been continuously engaged in the testing of the type of electrical equipment furnished on this Project for a minimum of ten years.
 2. The Testing Firm shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Parts 1907, 1910, and 1936. Full membership in the International Electrical Testing Association constitutes proof of such criteria.
- C. Testing Entity shall utilize only full-time technicians who are regularly employed and NETA certified. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians and/or linemen may assist but may not perform testing and/or inspection services.

- D. All instruments used by the Testing Entity to evaluate electrical performance shall meet NETA's Specifications for Test Instruments.
- E. The Testing Entity shall submit appropriate documentation to demonstrate that it satisfactorily complies with these requirements.

1.06 FINAL SYSTEM DOCUMENTATION

- A. Incorporate final versions of electrical test reports into the project operations and maintenance manuals as specified under Section 26 05 00 and 01 70 00.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL TESTING PROCEDURES

- A. The testing agency instruments shall be maintained in calibration per the requirements of NETA.
- B. The test reports shall be in accordance with NETA except that reports shall be completed no later than 30 days after completion of testing on each piece of equipment.
- C. Safety procedures as documented in CAL OSHA, NETA, and other applicable industry safety standards shall be adhered to.
- D. Where ground fault protection is included on the main service disconnect, performance testing shall be provided. Testing shall occur on the installed ground fault protection equipment at the site. Testing shall be in accordance with the manufacturer's instructions of the provided equipment. A written record of this test shall be provided to the District.

3.02 FIELD TEST EQUIPMENT

- A. All test equipment shall be in good mechanical and electrical condition.
- B. Selection of metering equipment should be based on the waveform of the variable being measured. Digital multimeters shall be RMS sensing type unless another type is required to accurately measure the variable under test.
- C. Field test metering used to check power system meter calibration must have accuracy higher than that of the instrument being checked.
- D. Accuracy of metering in test equipment shall be appropriate for the test being performed.
- E. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.
- F. Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
 - a. Maintained in good visual and mechanical condition.
 - b. Maintained in safe operating condition.
 - c. Portable multimeters shall be true RMS measuring.
 - d. Test equipment should have operating accuracy equal to, or better than, the accuracy as recommended by NETA standards.

G. Test Instrument Calibration

1. The Testing Entity shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: 12 months maximum.
 - b. Leased specialty equipment: 12 months.
 - c. Dated calibration labels shall be visible on all test equipment.
 - d. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
 - e. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
 - f. Calibrating standard shall be of higher accuracy than that of the instrument tested.

3.03 COMMISSION AND FIELD TESTING APPROACH AND DOCUMENTATION

A. General Requirements

1. Testing and commissioning shall be performed in accordance with the latest revision of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
2. Testing shall be performed in three separate and totally independent steps.
3. Test reports:
 - a. A printed report shall be submitted after each testing step is completed. The report shall be submitted to the Engineer for review, comment and record purposes.
 - b. The report shall include a separate data sheet for each component (i.e. cable, circuit breaker, transformer, relay, etc.) tested. Each data sheet shall include the weather conditions at the time of the test (i.e. temperature, humidity, sunny, rain, etc.), the tester's observation and findings, discrepancies, any remedial work performed or act to resolve problems, technical parameters obtained during the tests, as left settings of all devices, and a statement indicating the equipment is ready to be energized.
 - c. The report shall be organized in a three-ring binder and provided with a table of contents and index.
 - d. The report shall contain a statement indicating the equipment was tested in accordance with the procedures outlined in the latest edition of The International Testing Association Acceptance Testing Specifications.

B. Test sequence summary: The following describes the testing steps to be performed:

1. Step No. 1 – Contractor's Preliminary Test: Before the electrical equipment is energized, the Contractor shall test the equipment and set all protective relays, timers,

- etc., in accordance with the approved Short Circuit and Coordination Study and Arc Flash Hazard Study.
2. Step No. 2 – Manufacturer’s Field Tests where required under the detailed technical specifications included in Division 26
 3. Step No. 3 – Commissioning testing
- C. The Engineer shall be notified in writing immediately of any and all components that have unsatisfactory test results. The notification shall be accompanied with a proposed remedy, remedy schedule, and impact to the project schedule.
- D. Step No. 1 – Contractor’s Preliminary Tests: Testing requirements to be performed by the Contractor before the equipment is energized:
1. Inspect and mechanically operate all air interrupter switches, circuit breakers, power disconnect switches, switches supplied on transformers, and circuit breakers/disconnect switches installed within equipment furnished under other divisions of these specifications.
 2. Set, calibrate and test all protective devices including but not limited to, circuit breakers, protective relays, timing devices, motor overload, electrical protective devices located with equipment furnished under other Sections of these specifications.
 3. Verify that protective relay, current transformers, ground sensing devices, transformer grounding resistors, fuses, interrupter switches, transfer switches, transformers and motor starters furnished are in accordance with the approved shop drawings and the Short Circuit and Coordination Study and Arc Flash Hazard Study.
 4. Megger test all low voltage power system cables.
 5. Test transformer insulating oil, check connections and proper torque and tightness of cables and bushings and perform high potential testing.
 6. Verify that all power and control power fuses installed are in accordance with the manufacturer’s approved shop drawings, the Short Circuit and Coordination Study and the NEC. Replace fuses found to be of the incorrect rating.
 7. Verify control circuits and functionality of the controls for all motors, automatic transfer systems, remote protective device (i.e. wiring for differential protection relays, alarm systems, safety interlocks, emergency stop controls, and motor, transformer and generator protective devices). The functionality shall be in accordance with the approved control schematics, wiring diagrams or functional descriptions.
 8. Check motor nameplates for correct phase and voltage; verify motor phase rotation.
 9. Verify the resistance to ground of all power distribution equipment is 5 ohms or less.
 10. Verify all terminations at the main switchboard, motors, and VFDs, are correctly made and properly torqued.
 11. Refer to the individual equipment and material specification sections for additional testing requirements.
 12. Verify all circuit breaker ratings and settings are as required by the Contract Documents or as amended during shop drawing review. Advise the Engineer of discrepancies and make changes as directed by the Construction Manager.
 13. Verify proper operation of accessories, devices and motor interlocks.
 14. Submit comprehensive test report.

- E. Step No. 2 – Manufacturer’s Field Tests: Where required under the detailed technical specifications included in Division 26.

- F. Step No. 3 – Either a third-party electrical power systems testing company (Testing Firm) or the equipment manufacturer (the Testing Entity) shall perform a final acceptance test of the completed electrical systems. “Third Party” shall mean a testing firm that is not affiliated with the Contractor or Electrical Subcontractor.
 - 1. The Testing Entity shall obtain the test reports for testing previously submitted along with the approved/corrected Short Circuit and Coordination Study and Arc Flash Hazard Study per Section 26 05 73 and become familiar with the approach, conclusions, and recommendations. All potential discrepancies noted in the analytical studies by the Testing Entity shall be addressed before the testing begins.
 - 2. Test all new and modified equipment, components, controls, systems, and hardware provided under this Contract.
 - 3. Testing shall follow the specific NETA ATS procedures, including “optional” items, for the equipment being tested.
 - a. Testing shall follow all NETA procedures for the particular equipment or systems being tested.
 - b. Standard NETA test forms or equivalent shall be utilized in conformance with the favorably reviewed test plan.
 - c. All visual and mechanical inspections and electrical tests shall be performed in accordance with the latest edition of the NETA requirements.
 - d. Perform inspections and testing for all the equipment in conformance with NETA guidelines including all inspections and testing requirements listed as “optional”.
 - e. The NETA requirements for visual and mechanical inspections of equipment are considered the Contractor's responsibility under this Work. At the Contractor's discretion, however, the work may be included under this Section.

END OF SECTION

SECTION 26 22 13

LOW-VOLTAGE DRY TYPE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included

1. Distribution transformers shall be provided where shown on the Drawings, single-phase or three-phase and with rated kVA.
2. Distribution transformers shall be installed within motor control centers as specified in Section 26 24 19.

1.02 RELATED WORK

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 08 00 – Commissioning of Electrical Systems
- C. Section 26 24 19 – Motor Control Centers

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 30 00 and Section 26 05 00.
- B. Submit the following for review:
 1. Manufactures literature including equipment data sheets.
 2. Plan, front, and side view drawing including overall dimensions, weights, and anchoring details
 3. Load center schedules for each load center showing circuit allocations, breaker rating, spare, short circuit and bus ratings
 4. Mounting bracket design for wall-mount applications
 5. Installation and O&M manuals
 6. Certified factory test reports

1.04 REFERENCES

- A. American National Standards Institute
 1. ANSI Z55.1: Gray Finishes For Industrial Apparatus and Equipment
- B. Department of Energy
 1. DOE 10 CFR 429 – Certification, compliance, and Enforcement for Consumer Product and Commercial and Industrial Equipment
 2. DOE 10 CFR Part 431 – Energy Efficiency Program for Certain Commercial and Industrial Equipment

- C. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE C57.12.01: Standard General Requirements for Dry-Type Distribution and Power Transformer
 - 2. IEEE C57.110: Recommended Practice for Establishing Transformer Capability When Supplying Non Sinusoidal Load Currents
- D. National Electrical Manufacturers Association (NEMA).
 - 1. TP-1: Guide for Determining Energy Efficiency for Distribution Transformers.
- E. Underwriters Laboratories (UL)
 - 1. UL 1561: Standard for Dry-Type General Purpose and Power Transformers
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide transformers as manufactured by:
 - 1. Schneider/Square D
 - 2. Eaton Corporation
 - 3. ABB/General Electric
 - 4. Approved equal

2.02 DISTRIBUTION TRANSFORMERS

- A. General
 - 1. Transformers shall be designed, manufactured and tested in accordance with applicable ANSI, NEMA and IEEE standards and shall be UL listed.
 - 2. Transformer shall be DOE 10 CFR 429 and DOE 10 CFR part 431 compliant, energy efficient for kVA rating 15kVA and higher.
 - 3. Transformer shall be of the two winding, self-cooled type with kVA ratings as indicated on the drawings.
 - 4. Insulation system shall be a 220°C (Class R) winding insulation system with 115°C rise and be capable of 15% continuous overload. Performance shall be based on 40°C ambient.
 - 5. Coils shall be wound of electrical grade copper and be continuous wound construction. BIL (Basic Impulse Level) shall be 10kV.
 - 6. Enclosure shall be made of heavy gauge steel and with ANSI 61 coating color and shall be UL recognized for outdoor use. Enclosure construction shall be ventilated, NEMA 2, drip proof. For outdoor use provide a weather shield.
 - 7. The transformer shall include a wiring compartment for conduit entry. The maximum temperature on top of the transformer shall not exceed 90°C.
 - 8. Sound level shall not exceed the NEMA ST-20 maximum average sound level for dry type transformers.

9. Primary and secondary voltage, phase, and kilovolt-ampere shall be as indicated on the Drawings. Provide four full capacity taps, two for 2-1/2 percent above and two for 2-1/2 percent below rated primary voltage.

2.03 MINI LOAD CENTERS

A. General

1. Where shown on the Drawings, provide integrated unitized mini-load centers comprised of a primary main circuit breaker, encapsulated dry-type transformer, and a load center panelboard with a secondary main circuit breaker. Unitized mini-load center components shall be integrated into a common enclosure.

B. Rating

1. Unitized mini-load center kVA and voltage ratings shall be as shown on the Drawings.
2. Load centers shall be fully rated for the specified fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.
3. Provide load centers including a primary main breaker/disconnect and be UL Listed for service entrance applications where required.
4. Transformer noise level shall not exceed the following values when measured in accordance with NEMA ST20:
 - a. 1-9 kVA – 40 dBA
 - b. 10-50 kVA – 45 dBA

C. Construction

1. Transformer shall have copper windings. Transformer core and coil shall be completely resin encapsulated and shall have a minimum 185° C insulation with 115° C rise. Provide Class H insulation.
2. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.
3. Provide unitized load centers allowing circuit breaker replacement without disturbing adjacent units, without removing the main bus connectors, and without machining, drilling or tapping.
4. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.
5. A nameplate shall be provided listing manufacturer's name, panel type and rating.
6. Construction of panel shall be door-in-door type.

D. Buses

1. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
2. Neutral bussing shall have dedicated lugs for each outgoing feeder circuit requiring a neutral connection.
3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fit into them.

4. Provide manufacturer's integral equipment grounding terminal bar for all grounding and bonding conductor connections as required under Article 450. Field retrofit of ground bus bars for neutral grounding shall not be acceptable.
- E. Boxes
1. Surface mounted boxes and trims shall have an internal and external finish as hereinafter specified below. Surface mounted boxes shall be field punched for conduit entrances.
 2. Provide at least 4 studs for mounting the load center interior.
- F. Trim
1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
 2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.
 3. Trim shall be fabricated from code gauge sheet steel.
 4. All exterior and interior steel surfaces of the load center shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
 5. Trim for flush panels shall overlap the box by at least 3/4-in all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.
- G. Components
1. Load centers shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
 2. Circuit breakers shall be molded case, bolt-in type. Handle ties are not acceptable for multi-pole breakers.
 3. Secondary circuit breakers shall have an interrupting capacity of not less than 10,000 amperes RMS symmetrical.
 4. Circuit breakers shall be as manufactured by the unitized miniload center manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Transformers shall be installed within the Motor Control Center as specified under 26 24 19.

3.02 FACTORY TESTS

- A. Transformer shall be tested in accordance with IEEE C57.12.01:
1. Resistance measurements of all windings on the rated voltage connections and on all tap connections of each transformer
 2. Ratio tests on the rated voltage connections and on all tap connections
 3. Phase relation and polarity tests on the rated voltage connection
 4. No-load losses and excitation current at rated voltage on the rated voltage connections

5. Impedance and load losses at rated current and rated frequency on the rated voltage connections of each transformer
6. Potential tests
7. Regulation and Efficiency at rated load and voltage
8. Insulation resistance tests for high voltage to ground, low voltage to ground, and high voltage to low voltage
9. Temperature tests

3.03 FIELD QUALITY CONTROL

- A. Site Tests, Inspections: acceptance testing shall be as specified in Section 26 08 00.
- B. Adjust primary taps so that secondary voltage is within 2 percent of rated voltage.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish, install and test the switchboards as shown on the Drawings in accordance with these Specifications.
2. Switchboards shall be sized to include all equipment, spares and spaces as shown on the Drawings.
3. The Contractor shall coordinate the size of the switchboard foot print with the size of the equipment pad.
4. The Contractor shall provide anchorage calculations as specified herein.
5. Switchboard shall include metering and pull section and be coordinated with the power company requirements as described in Section 26 05 00 and as shown on the Drawings.

B. Related sections:

1. Section 01 33 12 – Seismic Design Criteria
2. Section 26 05 00 – Common Work Results For Electrical
3. Section 26 05 73 – Electrical System Studies
4. Section 26 08 00 – Commissioning of Electrical Systems
5. Section 26 09 13 – Electric Power Monitoring
6. Section 26 24 19 – Motor Control Centers

1.02 QUALITY ASSURANCE

- A. The switchboards shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers and fused switches included in the switchboards.
- B. All units and sections shall be UL labeled. Switchboards containing service entrance equipment shall be UL labeled "Suitable for Use as Service Equipment".
- C. Equipment shall be qualified for use in seismic areas as specified in Section 01 33 12

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01 30 00 and Section 26 05 00.
- B. The Contractor shall furnish submittals for approval as outlined below:

1. Manufacture's equipment shop drawings showing elevation, dimensions and plan views including anchorage pattern. The drawings shall show compartment arrangement, weight and shipping splits.
 2. Single line diagrams, point-to-point compartment wiring diagrams for metering, relay and control circuits. Show wire and terminal numbers.
 3. Bus material, ratings and insulation details.
 4. NEMA rating of enclosure.
 5. Product data sheets and catalog numbers for circuit breakers and fused switches. List all options, trip adjustments, and accessories furnished specifically for this project. Submit time current characteristic curves for each protective device provided.
 6. Itemized bill of material for metering, protective relays, accessories and control equipment.
- C. Submit anchoring calculations for the actual equipment being provided per the requirements of Section 01 33 12.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Refer to Common Work Results for Electrical, Section 26 05 00.

1.05 REFERENCE STANDARDS

- A. The switchboards shall be designed, built, and tested in accordance with the latest editions and revisions NEMA Standard PB-2, and Underwriters' Laboratories (UL) Standard No. UL-891. Switchboards shall also comply with any applicable ANSI and IEEE Standards and the requirements of the National Electric Code (NEC).
- B. UL 1066, Power Circuit Breakers
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 MANUFACTURER'S FIELD SERVICES

- A. Installation.
1. Manufacturer's representative shall be present at the site for a minimum of 4 hours for assistance, startup, testing and certification. Travel time not included.
 2. Submit a manufacturer's certificate of proper installation upon successful completion of the field testing and startup effort per the requirements listed in Part 3.
- B. Testing.
1. The manufacturer's service technician shall provide calibration, inspection and adjustments per the requirements in Part 3.

1.07 JOB CONDITIONS

- A. Refer to Common Work Results for Electrical, Section 26 25 00.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The switchboard shall be front accessible deadfront type and shall have individually mounted main breakers with group mounted feeder breakers. The switchboard shall be a fully integrated system that provides distributed power as shown on the single line diagrams.
- B. The switchboard and components shall be of the same manufacturer.
- C. Isolated compartments shall be provided for main circuit breaker device and metering equipment.
- D. A cable pull section shall be furnished where shown on the Drawings.
- E. The switchboard shall be service entrance rated as required or where shown on the Drawings.

2.02 SWITCHBOARD

- A. Ratings.
 - 1. Service: As shown on the Drawings.
 - 2. The switchboards and protective devices shall be fully rated for a short circuit current of 65,000 rms symmetrical amperes or as shown on the Drawings, whichever is greater. Systems employing series connected ratings shall not be used.
 - 3. The manufacturer shall design the switchboard, including devices, for continuous operation at its rated current in a 40 degree C ambient temperature.
 - 4. Switchboards shall be UL listed.
- B. Construction.
 - 1. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
 - 2. Side, top and rear covers shall be code gauge steel, bolted to 12 gauge frame structure members. Front doors shall be flush, hinged, with screw fasteners.
 - 3. Switchboard Service Entrance sections shall comply with UL Service Entrance requirements including a UL service entrance label, incoming line isolation barriers, neutral disconnecting link, and a main bonding jumper that bonds the neutral bus to the switchboard ground bus for solidly grounded wye systems.
 - 4. All metal surfaces shall be chemically cleaned and primed. The finishing coat of paint shall be ANSI Z55.1 No. 61, light gray enamel.
 - 5. NEMA 1 type switchboards shall be indoor type, free standing, front accessible, [front and] rear aligned and suitable for against-the-wall mounting. Side access shall not be required. All connections and bus maintenance shall be from the front or the top.
 - 6. Incoming Section
 - a. Incoming section shall be utility pull section.

- b. Furnish switchboard(s) arranged for bottom entry of incoming cable.
- c. Provide mechanical lugs in the quantity and size required per the contract drawings. All lugs shall be tin-plated aluminum and UL listed for use with copper cable. Lugs shall be rated for 75 degree C. Cable.
- d. Furnish switchboard(s) where indicated on the drawings with a transition for close - coupled connection to a transformer.

7. Utility Metering Section

- a. Provide utility metering section where indicated on drawings. Pull section and metering compartment shall comply with EUSERC and Pacific Gas and electric (PG&E) requirements.
- b. Compartment shall be barriered from the rest of the section, have a hinged lockable front cover, removable bus links with provisions for mounting current transformers, and when required, provisions for mounting voltage transformers. Current and voltage transformers shall be supplied and installed by the utility company.

C. Buses

- 1. All buses shall be tin-plated copper. The bus bars shall have sufficient cross-sectional area and separation to meet UL 891 temperature rise and insulation requirements.
- 2. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
- 3. Buses shall be braced for the specified equipment short circuit current rating, but in no case less than 65KA rms symmetrical.
- 4. All bus joints shall be connected with high tensile steel bolts and conical spring-type or Belleville washers.
- 5. Provide a copper ground bus sized to meet UL 891 extending throughout the entire length of the switchboard, equipped with lugs for external ground connections, sized for cables shown on the Drawings.
- 6. Unused spaces, or spaces indicated for future devices shall include doors, bus, device supports or mounting plates and connections.
- 7. Main horizontal bus bars shall be standard tapered per UL.

D. Manufacturers:

- 1. Schneider Electric, Square D QED Series
- 2. ABB/General Electric, Spectra Series.
- 3. Eaton Corporation, Pow-R-Line C.
- 4. Approved equal.

2.03 COMPONENTS

A. Circuit Protective Devices

- 1. Acceptable Manufacturers:
 - a. Schneider Electric, Square-D, Type PJ
 - b. ABB/General Electric, Spectra RMS or Power Break II (Power Break II used for 1200A and larger only)
 - c. Eaton Cutler Hammer, Series C
 - d. Approved equal.

2. Device trip setting and frame rating shall be as shown on the Drawings.
 3. Main circuit breaker shall be individually mounted, insulated case circuit breaker for ratings 1200A and greater. Circuit breakers shall be listed to UL489, 3 Pole, 600 Volt, 100 percent rated, bolt-on type with electronic trip device. Provide with ground fault protection for services greater than 1000A per NEC. Interrupting rms symmetrical ampere rating shall at minimum be 65 kAIC.
 4. Insulated case circuit breakers
 - a. Insulated case circuit breakers shall be individually mounted.
 - b. Main breaker shall be manually operated, stationary mounted.
 - c. Breakers shall be constructed of a high dielectric strength, glass reinforced insulating case. The interrupting mechanism shall be arc chutes. Steel vent grids shall be used to suppress arcs and cool vented gases. Interphase barriers shall isolate completely each pole.
 - d. Breakers shall contain a true two-step stored energy operating mechanism which shall provide quick make, quick break operation with a maximum five cycle closing time. Breakers shall be trip free at all times. Common tripping of all poles shall be standard.
 - e. Insulated Case circuit breakers shall be rated to carry 100 percent of their frame ampacity continuously.
 - f. A charging handle, close push-button, open push-button, and Off/On/Charge indicator shall be located on the breaker escutcheon and shall be visible with the breaker compartment door closed.
 - g. Breaker digital electronic trip units shall be as specified.
 5. Electronic trip devices
 - a. Electronic trip device shall be a digital solid state type with true rms current sensing to provide protection from overloads, short circuits and ground faults. Device shall include short circuit, overload and ground fault indicators. At a minimum the following adjustable trip parameters shall be included:
 - 1) Long time pickup, adjustable from 50% to 100% of the rating plug value.
 - 2) Adjustable long time delay with inverse time characteristics.
 - 3) Switchable, adjustable short time pickup and delay with I^2t .
 - 4) Adjustable instantaneous pickup
 - 5) Where required provide adjustable ground fault pickup and delay with I^2t .
 - b. Electronic trip device shall be Square D Micrologic, General Electric (ABB) EntelliGuard TU or MicroEntelliGuard, Eaton Corporation/Cutler Hammer Digitrip 310 or approved equal.
 6. Provide arc flash energy reduction maintenance switch for all switchboard circuit breakers 1200A and higher as required by the NEC. Maintenance function shall act to minimize circuit breaker tripping time during equipment maintenance functions. Provide local status indication for each circuit breaker when energy reducing maintenance function is activated.
- B. Metering Transformers
1. All instrument transformers shall be UL listed and classified as indicated in drawings.
 2. Current Transformers shall be as shown on drawings with burden and accuracy to support connected meters and relays as required by ANSI/IEEE C57.13.
 3. Potential transformers shall be provided where indicated on drawings with burden and accuracy to support connected meters and relays as required by ANSI/IEEE C57.13.

C. Surge Protective Device (SPD)

1. The SPD shall be mounted integrally with the switchboard and shall be manufactured by the same manufacture as the switchboard.
2. The Voltage Protection Rating (VPR) shall be tested in accordance with the latest revision of UL-1449. Where an integral disconnect is provided, the VPR shall be determined with the integral disconnect included. The VPR rating shall not exceed the values of the following tables.
3. UL 1449 3rd Edition Voltage Protection Ratings (VPR) with integral disconnect.

SPD Voltage Rating	System Configuration	L-N	N-G	L-G	L-L
120/208-240	WYE (or) Single-Split Phase	900	900	900	1200
277/480	WYE	900	900	900	1200
347/600	WYE	1500	1500	1500	2000
240	Delta	1500	1500	1500	3000
480	Delta			1500	2000

4. UL 1449 3rd Edition Voltage Protection Ratings (VPR) without integral disconnect.

SPD Voltage Rating	System Configuration	L-N	N-G	L-G	L-L
120/208-240	WYE (or) Single-Split Phase	700	700	700	1200
277/480	WYE	700	700	700	1200
347/600	WYE	1200	1200	1200	2000
240	Delta	1500	1500	1500	3000
480	Delta			900	1800

5. Surge Life Rating shall be determined by the application of an 8x20us, 10kA short circuit Category C High test waveform across the SPD as defined by ANSI/IEEE C62.41.2-2002. The test wave shall be injected at one-minute intervals until the conclusion of the test or device failure. A failure is defined as either performance degradation or more than 10% deviation of clamping voltage at the specified surge current.
6. The SPD shall have maximum surge current rating based on testing of a complete SPD unit including fuses and all components that make up the SPD system using an IEEE C62.41, 8x20us current wave applied at the maximum, per mode rated value of the SPD. Devices that derive a maximum surge current rating by adding test results of individual components are not acceptable.
7. Surge Current Ratings shall be as follows for service entrance locations:
 - a. Maximum Single Impulse Surge Current Rating: 200kA per mode.
 - b. UL 1449 Nominal Discharge Current Rating (In): 20kA
 - c. Minimum Surge Life Rating: 10,000 IEEE C62.41 C-High (C3) impulses
8. SPD shall be UL witness tested to a fault current rating equal to or greater than the fault current rating of the distribution equipment. The SPD short-circuit current (SCCR) rating shall be marked on the SPD in accordance with the requirements of UL 1449 and NEC Article 285.
9. The Maximum Continuous Operating Voltage (MCOV) for all voltage configurations shall be at least 115% of nominal on 480/277 volt systems and 125% of nominal on 240-208/120 volt systems.

10. The SPD fusing system shall be capable of allowing the rated Maximum Single Impulse Surge Current to pass without premature fuse operation. SPDs utilizing a fusing system that opens at or below the Maximum Single Impulse Surge Current rating are unacceptable.
11. SPDs shall include integral fusing for each suppression component. Designs that rely solely on an electrical panel's main breaker to interrupt fault currents resulting from a shorted suppression component are not allowed.
12. SPDs installed in switchboards shall have an integral non-fused disconnect.
13. SPDs shall be factory-mounted integral to the electrical distribution equipment and shall not violate the equipment manufacturer's UL label.
14. Provide status indicator light, form C status relay for remote monitoring, and audible alarm with enable/disable switch.
15. Provide SPD by Schneider/Square D, Type IMA; ABB/General Electric Tranquell Series; Eaton Corporation, Clipper Power System, Visor Series, or approved equal.

D. Wiring

1. Low voltage instrument and control wiring shall be copper, Type SIS, flameproof switchboard wire identified with shrink-on marker sleeves at each end. Low voltage wiring terminal blocks shall have marking strips and shall be mounted vertically in an accessible location. All terminal lugs shall be of the full loop type.

E. Marking and Identification

1. Nameplates shall be provided on all hinged doors for unit load description and for each control or indicating device. Nameplates shall be engraved as shown on the Drawing or as directed, using lettering approximately 3/8-in high for unit identification nameplates and 1/4-in high elsewhere. The nameplates shall be black and white laminated phenolic material. The engraving shall extend through the white exterior lamination to the black core. Nameplates shall be screw fastened.
2. A manufacturer's plaque shall be fastened to the front of the switchboard. The plaque shall indicate model number, serial number, amperes, volts, short circuit rating, etc.
3. Each switchboard shall be furnished with a sign marked "DANGER - 480 VOLTS KEEP OUT". Letters shall be not less than 1-in high, 1/4-in stroke. Signs shall be adhesive backed mylar, OSHA approved.

F. Spare Parts

1. Provide the following spare parts in the quantities specified for the switchboards:
 - a. Six each size of cover bolts, cage nuts and door fasteners.
 - b. One can of aerosol touch-up paint.
 - c. 50 percent replacement fuses, all types and sizes.
 - d. One of each color replacement lens caps for pilot lights.
2. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.

PART 3 - EXECUTION

3.01 GENERAL

- A. Factory quality control.
 - 1. Perform manufacturers standard production testing and inspection in accordance with NEMA and ANSI standards.
- B. Power monitoring equipment shall be incorporated into the power distribution equipment as shown on the drawings and specified herein. Provide all mounting hardware, CTs, VTs, control power transformers, and installation details including grounding requirements to ensure that the power monitoring equipment are installed in conformance with the manufacturer and the supplier of the equipment.
- C. Power monitoring equipment installation within the equipment shall not violate the manufacturer's warranty for the power monitor or the respective equipment.

3.02 INSTALLATION

- A. Switchboard floor sills shall be bolted directly to the finished floor or equipment pad. Structure shall be leveled and plumb. Anchor bolts shall be as sized per Section 01 33 12. Provide hardware and shims for installation.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.
- C. In general, all conduit entering or leaving a switchboard shall be stubbed into the bottom or top horizontal wireway directly below or above the vertical section in which the conductors are to be terminated.
- D. Install the equipment in accordance with the manufacturer's instructions.
- E. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.
- F. Make wiring interconnections between shipping splits.
- G. Install bus splice plates and torque connections.
- H. Seal all seams, cracks, or openings in outdoor enclosures.
- I. Install arc flash warning labels[in conformance with Section 26 05 37.
- J. Perform final cleanup of panel interior with vacuum. Compressed air shall not be used.

3.03 FIELD QUALITY CONTROL

- A. The Contractor shall make the following minimum tests and checks before the testing agency's representative is called in for testing and adjustment per the requirements of Section 26 05 73.

1. Megger incoming line terminals and buses, phase-to-phase and phase-to-ground after disconnecting devices sensitive to megger voltage.
 2. Remove current transformer shunts after completing secondary circuit. Check polarity and continuity of metering and relaying circuits.
 3. Check mechanical interlocks for proper operation.
 4. Test ground connections for continuity and resistance.
 5. Adjust unit compartment doors.
 6. Check control circuit interlocking and continuity with starters in the TEST position. Provide external source of control power for this test.
 7. Adjust voltage trip devices to their correct settings.
- B. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service.
- C. All as-built drawings shall be corrected and verified for correctness of in-field changes by the Contractor prior to submittal to the Engineer for final review.

3.04 ADJUSTMENT

- A. The switchboards manufacturer shall provide the services of a factory trained service technician for start-up and training of the District's personnel. The first trip shall be coordinated with the equipment start-up. The second trip shall include any necessary follow-up or punch list work and shall also include instructions to the District. The manufacturer's service technician shall demonstrate and test all operational features of the installed equipment to the satisfaction of the Engineer. Submit a certified copy of the field inspection to the Engineer. No equipment shall be energized without the approval of the Engineer.
- B. The switchboard manufacturer's factory service technician shall make the following inspection, tests and adjustments:
1. Calibrate and test main and feeder circuit breaker trip devices per the Coordination Study specified in Section 26 05 73.
 2. Inspect the installation for compliance with the manufacturers recommended installation practices and report all deviations to the Engineer.

3.05 CLEANING

- A. Remove all rubbish and debris from inside and around the switchboard. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work included.
 - 1. Furnish all labor, materials, equipment and incidentals required and install all lighting and distribution panelboards as shown on the Drawings and as specified herein.
 - 2. Panelboard shall be installed within Motor Control Centers specified in Section 26 24 19.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 08 00 – Commissioning of Electrical Systems
- C. Section 26 22 13 – Low-Voltage Dry Type Distribution Transformers
- D. Section 26 24 19 – Motor Control Centers
- E. Related work:
 - 1. Panelboard schedules are shown on the Drawings.
 - 2. Unitized mini-load centers are specified under Section 26 22 13

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01 30 00 and Section 26 05 00.
- B. The Contractor shall furnish submittals for approval as outlined below:
 - 1. Submit catalog cuts and descriptive literature for each type of panelboard and breaker provided.
 - 2. Submit panelboard directory for each panelboard showing circuit allocations, breaker rating, poles, spare, short circuit, and continuous bus ratings.
 - 3. Submit outline drawings showing panel layouts, dimensions and weights. Panel layout shall show circuit breakers allocation and available space.

1.04 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI)
 - 1. ANSI Z55.1 - Gray Finishes for Industrial Apparatus and Equipment
- B. Institute of Electrical and Electronics Engineers (IEEE)

1. ANSI/IEEE C37.90 – IEEE Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
 2. ANSI/IEEE C62.41 – IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
 3. ANSI/IEEE C62.45 – IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
 4. IEEE 693 – IEEE Recommended Practice for Seismic Design of Substations
- C. National Electrical Manufacturers Association (NEMA):
1. PB-1 – Panelboards
- D. National Fire Protection Association (NFPA):
1. NFPA 70 – National Electrical Code (NEC).
- E. Underwriters Laboratories (UL).
1. UL 50 – UL Standard for Enclosures for Electrical Equipment
 2. UL 67 – UL Standard for Panelboards
 3. UL 1449 – UL Standard for Surge Protection Devices
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 PROJECT SITE REQUIREMENTS

- A. Refer to Section 26 05 00

PART 2 - PRODUCTS

2.01 GENERAL

- A. Panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings are not acceptable.
- B. Provide panelboards UL listed as suitable for service entrance equipment where noted on the Drawings or as required by the NEC. Service entrance type UL Label shall be factory installed.
- C. Construction
 1. Panelboard construction shall be per the requirements of UL 50 and UL 67.
 2. Provide panelboards with factory assembled interiors complete with bussing, circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type, suitable for copper or aluminum wire of the sizes indicated on the Drawings.
 3. Provide interiors designed so that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors. Circuiting changes shall be field executed without machining, drilling or tapping.

4. Branch circuits shall be arranged using double row construction except when column-type construction is indicated. Branch circuits shall be numbered by the manufacturer.
5. Provide manufacturer's nameplate listing manufacturer's name, panel type, and ratings. A second identification nameplate shall be provided on the front of each panelboard with the panelboard designation shown on the Drawings. Designation nameplates shall be as specified in Section 26 05 00.
6. Hinged doors covering all circuit breaker handles shall be included in all panel trims. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All panelboard locks shall be keyed alike.
7. Provide directory frame and card having a transparent cover on the door interior.
8. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
9. Trim for flush panels shall overlap the box by at least 3/4-in all around. Surface trim shall have the same width and height as the box. Trim shall be fastened with quarter turn clamps. Fabricate trim from code gauge sheet steel.
10. Provide at least 4 studs for mounting the panelboard interior.

D. Buses

1. Provide copper phase and neutral bus bars. Provide full-height/full-rating phase and neutral bussing without tapering or reduction. Cross connectors shall be copper.
2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
3. Spaces for future circuit breakers shall be bussed for the maximum number devices for the panelboard as shown on the Drawings.
4. Provide copper panelboard ground bus.

E. Boxes

1. Panelboard boxes and enclosures shall conform to the NEMA ratings as specified in Section 26 05 00.
2. Recessed or flush mounted boxes shall be made from galvanized code gauge steel with multiple conduit knockouts.
3. Surface mounted boxes and trim shall have an internal and external finish as specified. Surface mounted boxes have blank ends, field punched for conduit entrances.
4. Boxes shall be of sufficient size to provide a minimum wire gutter space of 4-in on all sides.

2.02 LIGHTING AND AUXILIARY LOAD PANELBOARDS

- A. Application: Provide lighting and auxiliary load panelboards (generally referred to as Lighting Panels on the Contract Documents) for serving lighting, receptacles, and ancillary project loads operating at less than 250V to ground, single or three-phase.
- B. Ratings:

1. Voltage rating: 208Y/120V, 3 phase, 4 wire
 2. Continuous bus current rating: as shown on the Drawings
 3. Minimum short circuit current rating: or as shown on the Drawings
- C. Circuit Breakers
1. Lighting panelboards shall be equipped with circuit breakers with frame size, number of poles, and trip settings as shown on the Drawings.
 2. Circuit breakers shall be as manufactured by the lighting panelboard manufacturer.
 3. Two and three-pole circuit breakers shall be constructed as a single unit with common handle. The use of single pole breakers with handle-ties, special brackets, other “ganging” means are not acceptable.
 4. Lighting panel main and feeder circuit breakers shall be thermal-magnetic type. Provide bolt-on, heavy-duty breakers with toggle handles or other means to visually indicate when the unit has tripped. Provide circuit breaker interrupting rating matching or exceeding the required rating of the panelboard where installed.
 5. GFCI (ground fault circuit interrupter) shall be provided for circuits where shown on the Drawings. GFCI units shall be 1 pole, 120 Volt, or 2 pole, 240 Volt as shown on the Drawings. Provide molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and a minimum interrupting capacity of 10,000 amperes RMS.
- D. Acceptable Manufactures:
1. Schneider/Square D, Type NQ
 2. ABB/General Electric, A-Series Panelboard
 3. Eaton Corporation, Pow-R-Line Series Panelboard
 4. Approved equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboard shall be installed within the Motor Control Center as specified in Section 26 24 19.
- B. Connect panelboard branch circuit loads so that the load is balanced and distributed as equally as possible between the phase busses based on the actual installed equipment characteristics.
- C. Before energizing, verify and tighten all connectors, lugs, and mounting screws. Vacuum out all extraneous scraps of wire, plaster, dust, and other foreign material from inside the panelboard. Install dead-front shield.
- D. Complete circuit directory cards giving clear, evident, and specific nature of each load served. Description shall have sufficient detail to uniquely distinguish each circuit from all others. Completed circuit directory cards shall be type written. Install circuit directories in each panelboard.

E. Perform final cleanup of panel interior with vacuum. Compressed air shall not be used.

3.02 FIELD QUALITY CONTROL

A. Acceptance testing of the panelboard shall be per the requirements of Section 26 08 00.

B. Periodically inspect panelboard during startup while under load. Verify temperature of panelboard cover surface. If surface is excessively hot, de-energize panelboard and notify the Engineer.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish, install and test the motor control centers as shown on the Drawings in accordance with these Specifications.
2. Motor control centers shall be sized to include all equipment, spares and spaces as shown on the Drawings.
3. The Contractor shall coordinate the size of the motor control center footprint with the size of the equipment pad and the size of the buildings in which the MCCs are to be installed.
4. The Contractor shall coordinate conduit stub up locations with the size and footprint of the motor control centers provided.
5. Motor control centers shall be fully configured for network integration into the Owner's SCADA system. Starters, network switches, power meters, and other networkable equipment shall be provided with network ports which support Modbus TCP or Ethernet/IP protocol and are fully compatible with the Owner's SCADA system as shown on the Contract Documents.

B. Related sections:

1. Section 01 33 12 – Seismic Design Criteria
2. Section 40 61 00 – Process Instrumentation and Controls – General Provisions
3. Section 25 05 00 - Common Work Results for Electrical
4. Section 26 05 73 – Power System Studies
5. Section 26 08 00 - Commissioning of Electrical Systems
6. Section 26 24 16 – Panelboards
7. Section 26 22 13 – Low Voltage Dry Type Distribution Transformers
8. Section 40 61 00 – Process Instrumentation and Controls – General Provisions

1.02 QUALITY ASSURANCE

- A. The motor control centers shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches, motor starters, reduced voltage solid state starters, etc. which are included in the motor control centers.
- B. Motor control centers shall be designed, assembled and tested by the manufacturer of the motor control equipment included in the control center assembly.
- C. System integrators or fabrication shops that provide custom control wiring for motor control centers shall be a UL listed and certified shop.

D. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 30 00 and Section 25 05 00.

B. The Contractor shall furnish submittals for approval as outlined below:

1. Equipment outline drawings showing elevation and plan views, dimensions, weight, shipping splits, conduit entrance and metering layouts. Indicate all options, special features, and ratings
2. Itemize and define any proposed deviations from the Specifications.
3. Unit summary tables showing detailed equipment description and nameplate data for each compartment.
4. Product data sheets and catalog numbers for all integral components such as overcurrent protective devices, motor starters, control relays, control stations, meters, pilot lights, etc. List all options, trip adjustments and accessories furnished specifically for this Project.
5. Single line diagram and interconnection diagrams showing wire and terminal identification numbers.
6. Drawing indicating final IP addresses for each device and conform to specified Owner addressing requirements. Standard or generic diagrams will not be acceptable.
7. Details of the remote network communications interface. Submit network module data sheets and memory mapping. Submit device parameter list with all data variables available for remote monitoring over the network interface. List shall include variable internal name, descriptive field that fully describes the contents and use of the variable, memory address and bit size, variable type (analog, discrete, text), engineering units, and function (e.g., status, alarm, internal diagnostic, etc.). Include complete configuration instructions including addressing, register allocation, data mapping, and options.
8. Network access requirements including method for accessing equipment variables, software features, and physical hardware interface details.
9. Submit network communications factory testing procedures. Procedures shall include method for 100% testing of all variables associated with each motor starter, power monitor, and other equipment associated with the MCC as specified. Procedure shall include factory test forms with sign-off sheets indicating proper transmittal and receipt of each variable, properly scaled, and addressed in conformance with the manufacturer's standard documentation. Include verification of each device IP address conforming to District standards.
10. Submit details of configuration software used for intelligent overloads, and starters. All software specified or provided shall be licensed to the Owner.
11. Submit detail and test plan for field verification of the network communications interface including verification of data receipt to the designated server as shown on the Drawings.

C. Submit anchorage calculations per the requirements of Section 01 33 12.

D. Operations and maintenance manual

1. Instruction and renewal parts books.
2. Itemized list of spare parts furnished specifically for this Project, including quantities, description and part numbers.
3. Protective device time-current characteristics.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Refer to Common Work Results for Electrical, Section 26 05 00.

1.05 REFERENCE STANDARDS

- A. Motor control centers shall be designed, built and tested in accordance with the latest editions and revisions of NEMA Standard ICS-2 and Underwriters' Laboratories Standard No. UL-845. Equipment shall conform to ANSI C19.3 test standards and the requirements of the National Electric Code.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- C. Institute of Electrical and Electronic Engineers/American National Standards Institute
 1. IEEE/IEEE 62.45 – Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) Power Circuits
 2. IEEE/ANSI 62.62 – Standard Test Specifications for Surge-Protective Devices (SPDs) For Use On The Load Side of the Service Equipment in Low-Voltage (1000 V and Less) Power Circuits
- D. National Electrical Manufacturers Association (NEMA):
 1. NEMA ICS 18 – Motor Control Centers
- E. Underwriters Laboratories (UL).
 1. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
 2. UL 508 – Industrial Control Equipment
 3. UL 845 – Motor Control Centers
 4. UL 1499 – Transient Voltage Surge Suppressors
 5. UL 1066 – Insulated Case, Power Circuit Breakers

1.06 JOB CONDITIONS

- A. Refer to Common Work Results for Electrical, Section 26 05 00.

1.07 SPARE PARTS

- A. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.
- B. Provide the following spare parts in the quantities specified for motor control centers:
 1. Six each size of cover bolts, cage nuts and door fasteners.

2. One can of aerosol touch-up paint.
3. 50 percent replacement fuses, all types and sizes.
4. One of each color replacement lens caps for LED pilot lights.
5. One motor starter control module of each type provided.

1.08 MANUFACTURER'S FIELD SERVICES

A. Installation.

1. Manufacturer's representative shall be present at the site for a minimum of 8 hours for assistance, startup, testing and certification. Travel time not included.
2. Submit a manufacturer's certificate of proper installation upon successful completion of the field testing and startup effort per the requirements listed in Part 3.

B. Testing.

1. The manufacturer's service technician shall provide calibration, inspection and adjustments per the specified requirements.

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTERS

A. Ratings.

1. Service type and voltage ratings shall be as shown on the Drawings.
2. The overall short circuit withstand and interrupt rating of the equipment and devices shall be as shown on the Drawings. Main and feeder circuit protective devices shall be fully rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL labeled for the specified short circuit duty in combination with the motor branch circuit protective device.
3. The continuous current rating of the main horizontal bus shall be as shown on the Drawings. Vertical busses shall be sized for the structure and electrical loads installed in the section and shall have a minimum rating of 300 amperes. Bus bracing shall equal or exceed the specified equipment short circuit rating.
4. Motor control centers, including devices, shall be designed for continuous operation at rated current in a 40 degree C ambient temperature.

B. Construction.

1. Enclosure type shall be NEMA Type 12.
2. Motor control centers shall consist of a series of metal enclosed, free-standing, dead front vertical sections bolted together to form double wall construction between sections. Individual vertical sections shall be nominally 90-in high, 20-in wide and 20-in deep unless otherwise shown on the Drawings. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full width of each shipping split. Top of each section shall have removable plates with lifting angle. Make provisions for field installation of additional sections to each end and provide

full depth cover plates (rodent barriers) at each end of the motor control center channel sills.

3. Provide continuous top and bottom horizontal wireways extending the full width of the line-up, isolated from the horizontal bus. Provide a 9-in high horizontal wireway at the top and at the bottom in each section. Provide a 4-in wide, full height, vertical wireway in each section, equipped with a hinged door and cable supports. Vertical wireway shall be isolated from the bus and device compartments. Wireways openings shall have rolled edges or protective grommets.
4. Provide individual, flange formed, pan type door with concealed hinges and quarter turn latches for each device compartment and future space. Doors shall be removable. Door removal shall not be required to withdraw starter units or feeder tap devices.
5. Motor control centers shall be designed for against-the-wall mounting or back-to-back mounting if shown on the Drawings. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.
6. Enclosures mounted on a raised concrete housekeeping or equipment pad shall include operator extension handles for the upper operator controls to comply with the NEC "Two Meter" rule.

C. Unit Compartments

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Each vertical section shall accommodate a maximum of six compartments. Steel barriers shall isolate the top, bottom and sides of each compartment from adjacent units and wireways. Removable units shall connect to the vertical bus in each section with tin plated, self-aligning, pressure type copper plug connectors. Size 5 and larger starter units may be wired directly to the bus. Removable units shall be aligned in the structure on guide rails or shelves and secured with a cam latch mechanism or racking screw.
2. Provide individual, isolated compartments for fixed mounted devices such as circuit breakers, cable lugs, metering, relaying and control devices. Main and bus tie circuit breakers shall be wired directly to the main horizontal bus. All bus connections shall be fully rated.
3. Provide the following features:
 - a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.
 - b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.
 - c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
 - d. Mechanical split-type terminal blocks for disconnecting external control wiring.
 - e. Disconnect operating handles and control devices mounted on the removable doors or device panels.
 - f. Compartments containing motor starters shall have wiring diagrams and heater tables fastened to the compartment door. Compartments containing panelboards shall have circuit directories fastened to the compartment door.

D. Bus Systems

1. Main horizontal bus: Silver plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup. Rating of the horizontal bus shall be per the rating of the MCC.
2. Vertical section bus: Tin plated copper, full height, totally insulated and isolated by glass polyester barriers with shutters to cover stab openings when units are withdrawn. Provide fish tape barriers to isolate bottom wireways from lower ends of vertical bus. Vertical bus rating shall be 300.
3. Vertical buses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.
4. Horizontal ground bus: Provide a tin-plated copper ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors. Connect to ground bus in adjacent sections with splice plates where shipping splits are present. Minimum ground bus rating shall be 300A.
5. Neutral bus: For four wire systems provide a fully rated neutral bus along the entire length of the MCC lineup.

E. Wiring

1. Wiring: Stranded copper, minimum size No. 14 AWG, with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II, Type B. Line side power wiring shall be sized for the full rating or frame size of the connected device.
2. Identification: Numbered sleeve type wire markers at each termination point, color coding per NEMA Standards and the NEC. Foreign voltage control wiring shall be yellow.
3. MCC shall have Ethernet cabling integrated throughout the MCC in accordance with UL 845 procedures and practices. Each motor starter, AC drive, soft starter, and spare unit compartment in the MCC shall be supplied with a means to communicate via Ethernet, Modbus TCP, and have the capability of monitoring all the required control and status inputs/outputs as shown on Drawings.
4. The Ethernet data communications system shall be fully integrated into the factory lineup. The Ethernet system shall be installed, configured, and tested prior to on-site installation of the switchgear equipment. Ethernet network testing shall include testing of all required data from the I/O termination points.
5. All Ethernet network transmission media for the equipment shall be provided for a complete system, including network cable, terminations, T-taps and all network hardware. MCC Ethernet network cable shall be as required by the MCC manufacturer to maintain the UL listing of the motor control center. All units shall be interwired and tested as Class II type B MCC.
6. The addition and removal of a unit from the Ethernet network shall not interrupt the other operation of other units within the system.
7. Ethernet cable shall have an insulating rating equal to at least the maximum circuit voltage applied to any conductor within the enclosure or raceway. Special separation, barriers, or internal conduit for the Ethernet conductors are not acceptable. Ethernet cabling shall be routed through the MCC sections behind barriers protecting the network cable from mechanical damage during MCC installation or maintenance.

8. Provide MCC resident network Ethernet switches for interconnecting MCC Ethernet components. Provide additional MCC control power transformers and network power supplies if required to meet Ethernet requirements as required by the Contract Documents.

F. Signage

1. Each motor control center shall be furnished with a sign marked "DANGER - 480 VOLTS - KEEP OUT". Letters shall not be less than 1-in high, 1/4-in stroke. Signs shall be laminated plastic, engraved white letters with a red background.
2. Compartments with voltages from sources outside of the compartment shall have a sign mounted inside the compartment door marked "CAUTION - THIS UNIT CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE". Letters shall be white on a high visibility red background.

G. Surface Preparation and Shop Coatings

1. All non-current carrying metal parts of the control center assembly shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
2. Indoor equipment shall be finish painted with one coat of manufacturers standard electrocoated, heat cured enamel.
3. Outdoor equipment shall be finish painted with two coats of polyurethane or epoxy enamel, 2 to 3 mil thickness. Exterior color shall be ANSI 49 light grey.
4. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion.

H. Manufacturers:

1. Square D/Schneider Electric "Model 6"
2. Eaton Corporation "Freedom 2100".
3. ABB/General Electric "Evolution Series E9000"
4. Approved equal

2.02 COMPONENTS

A. General

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the NEMA size starter, circuit breaker trip ratings, and control power transformers ratings matched to the motors and control equipment actually supplied, in compliance with the National Electrical Code. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.

B. Main Circuit Breaker

1. Main circuit breaker, shall be molded case type circuit breaker, individually mounted, 3 Pole, 600 Volt, 100 percent rated with a removable electronic trip plug in type device.
2. Main circuit breaker shall meet UL489 listing requirements.

C. Electronic Trip Device

1. The device shall be a digital solid state type with true rms current sensing to provide protection from overloads, short circuits, and ground fault protection. Device shall include short circuit, overload, and ground fault indicators. At a minimum the following adjustable trip parameters shall be included:
 - a. Long time pickup, adjustable from 50% to 100% of the rating plug value.
 - b. Long time delay with inverse time characteristics.
 - c. Short time pickup and delay with I^2t .
 - d. Adjustable instantaneous pickup
 - e. Ground fault pickup adjustable from 40% to 100% of the rating plug value.
 - f. Ground fault delay with inverse time characteristics.
2. Electronic trip device shall be Schneider Electric/Square D, Eaton Corporation Digitrip 310, ABB/General Electric MicroEntelliGuard, or Equal.
3. Acceptable Manufactures:
 - a. Schneider Electric
 - b. Eaton Cutler Hammer, Series C or Magnum DS (Magnum DS used for insulated case power circuit breaker)
 - c. General Electric (ABB) Spectra RMS or Power Break II (Power Break II used for insulated case power circuit breaker)
 - d. Approved equal.

D. Feeder Circuit Breakers

1. Feeder circuit breakers with a trip rating greater than 150A shall be molded case, group mounted, 3 Pole, 600 Volt, 80 percent equipment rated, plug-in type with electronic trip device.
 - a. Electronic trip device shall be a digital solid state type with true rms current sensing to provide protection from overloads, short circuits and ground faults. Device shall include short circuit, overload and ground fault indicators. At a minimum the following adjustable trip parameters shall be included:
 - 1) Long time pickup, adjustable from 50% to 100% of the rating plug value.
 - 2) Long time delay with inverse time characteristics.
 - 3) Short time pickup and delay with I^2t .
 - 4) Adjustable instantaneous pickup
 - b. Electronic trip device shall be General Electric (ABB) MicroEntelliGuard, Eaton Corporation/Cutler Hammer Digitrip 310 or Equal.
2. Feeder circuit breakers less than or equal to 150A rating shall be molded case, group mounted, 3 Pole, 600Volt, plug-in type with fixed thermal magnetic type breaker.
3. Feeder circuit breaker shall meet UL489 listing requirements.
4. Trip unit and frame rating shall be as shown on the Drawings.
5. Acceptable Manufactures:
 - a. Schneider Electric/Square D,
 - b. Eaton Corporation, Series C
 - c. ABB, General Electric, Spectra RMS
 - d. Approved equal.

E. Combination Starter Units

1. Combination starters shall be plug-in type including a motor circuit protector (MCP) in series with a motor controller and an overload protective device. The MCP shall have an adjustable magnetic trip range of rated continuous current and a trip test feature. MCPs shall be labeled in accordance with UL 489.
2. Motor starters: 3 pole, 600 volt, electrically operated, of the types shown on the Drawings. Provide NEMA sizes as required for the horsepower shown on the Drawings. Minimum size shall be NEMA Size 1. Fractional size starters are not acceptable. Starters shall have 120 volt encapsulated operating coils; individual control power transformers with primary and secondary fuses and silver cadmium oxide renewable line contacts.
3. Two-speed and reversing starters shall include two motor rated contactors mechanically and electrically interlocked so that only one device may be energized at any time. Two-speed starters shall be suitable for two-winding motor control.
4. Contactors: Electrically held, 120 VAC coil operator, suitable for tungsten, ballast, or resistive non-motor loads, with over current protection, control transformer and contact ratings and poles as shown on the Drawings.
5. Electronic Overload Relay: Thermal overload protection shall be provided using microprocessor electronic overload relays. Electronic overload relays shall be equipped with the following features:
 - a. Integral Ethernet I/P or Modbus TCP communication
 - b. LEDs for status indication
 - c. Test/Reset button
 - d. Adjustable trip class (5 to 30)
 - e. General purpose I/O (minimum 2I/1O)
 - f. Protective functions with programmable trip level, warning level, time delay and inhibit window:
 - 1) Thermal overload
 - 2) Underload
 - 3) Jam
 - 4) Stall
 - 5) Phase loss
 - 6) Ground Fault
 - g. Voltage monitoring functions and summary including phase magnitude, over voltage condition, under voltage condition, and percent imbalance
 - h. Current monitoring functions and summary including phase average magnitude, percent of full load, and percent imbalance
 - i. Power monitoring functions and summary including real, reactive, apparent, power factor and maximum monitored power demand
 - j. Energy – kWh
 - k. Diagnostic information:
 - 1) Run time and start history
 - 2) Device status
 - 3) Warning status
 - 4) Time to reset
 - 5) Trip status
 - 6) Time to overload trip
 - 7) History of last 5 warnings and trips
 - l. Acceptable Manufactures:

- 1) Schneider Electric (Square D) Type LR
 - 2) Allen Bradley, E3 Plus series
 - 3) General Electric (ABB), MM300 series
 - 4) Eaton Corporation, C440 series
 - 5) Approved equal.
6. Auxiliary contacts: Form C, NEMA 600A rating, as required by the control schemes on the Drawings. Provide 1-normally open and 1-normally closed spare contacts on each starter. Additional auxiliary contacts shall be furnished as shown on the Drawings or as required by the control schematic and Specifications.
 7. Control power transformers: Two winding type, 120 VAC secondary, with primary and secondary fuses in accordance with the NEC. Provide a minimum 50% extra capacity.
- F. Digital Multimeter (DMM)
1. Provide power meter with multiple configurable digital readouts. Meter shall be capable of monitoring and displaying individual phase voltage, individual phase current, kilowatts, kilovars, kilovars reactive, power factor, or energy as selected by the user. Accuracy shall be at least ± 0.25 % of full scale for voltage and current; ± 0.50 % of full scale for power and energy.
 2. Provide user configurable 4-20 mA analog output and three user configurable discrete alarm output contacts. User configuration shall allow selection of desired variables and alarm trip point.
 3. Provide fuse protected potential transformer and current transformers rated as required the feeder circuit monitored. Provide fuse protected 120V control power transformer for source power for the meter derived from the 480V or 240V feeder circuits.
 4. Provide any required configuration software for the meter licensed to the District. Provide Ethernet/IP or Modbus TCP protocol and communication port for interfacing to the existing SCADA system for remote monitoring as specified under Section 40 61 00.
 5. Acceptable Manufactures:
 - a. Schneider Electric, PM 5500
 - b. Eaton Cutler Hammer, IQ Series
 - c. General Electric (ABB), Power Leader EPM
 - d. Approved equal.
- G. Reduced Voltage Solid-State Starter (RVSS)
1. General: Provide reduced-voltage solid state motor starter housed in the Motor Control Center Structure complete with enclosure thermostatically controlled space heater and ventilation fan. RVSS components shall be tested in accordance with UL 508. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing.
 2. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV. Units using triacs or SCR/diode combinations shall not be acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick

- disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.
3. Starter shall be rated for operation between -10 to 50 degrees C ambient and suitable at altitudes up to 3300 feet without deration. Provide conformally coated logic boards for addressing site specific environmental concerns.
 4. Provide paralleling run bypass contactor that energizes when the motor reaches 90% of full speed and close/open under rated full load motor current. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
 5. Digital interface module mounted on the face of the unit shall be used to program the soft starter. Display shall include six line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions.
 6. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via digital interface module. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting or the device keypad. Units using bimetal overload relays are not acceptable.
 7. Starter shall be capable of either an electronic or mechanical reset after a fault.
 8. Overtemperature protection (on heat sink) shall be standard.
 9. Starters shall provide protection against:
 - a. Improper line-side phase rotation as standard executing and orderly shutdown if a line-side phase rotation other than A-B-C exists.
 - b. Phase loss or unbalance condition, shutting down if a 50% current differential between any two phases is encountered.
 - c. Motor stall condition
 - d. Motor jam condition
 - e. Protection features shall be able to be enabled or disabled via the RVSS digital interface module.
 10. Reduced voltage starter shall be provided with UL listed, heavy duty industrial type power factor correction capacitors mounted as part of the motor control center lineup either in dedicated MCC buckets or in a separate enclosure mounted above the associated MCC section as required by the manufacturer.
 - a. Power factor correction capacitors shall be as recommended, selected, and furnished by the motor control center manufacturer to raise the motor power factor to approximately 95 percent.
 - b. Capacitors shall be dry film or liquid insulated and shall be hermetically sealed in steel enclosures.
 - c. Each capacitor unit shall be furnished with three high interrupting capacity current limiting fuses. Fuses shall be equipped with "blown-fuse" indicators.
 - d. Provide dedicated switching contactors for the capacitor banks integrated with the RVSS starting logic to switch the capacitors into the motor circuit upon completion of the RVSS startup ramping with motor receiving full voltage and at full speed.

11. Provide the following control function adjustments from digital interface module:
 - a. Selectable Torque Ramp Start or Current Limit Start
 - b. Adjustable Kick Start Time: 0–2 seconds
 - c. Adjustable Kick Start Torque: 0–85%
 - d. Adjustable Ramp Start Time: 0.5–180 seconds
 - e. Adjustable Initial Starting Ramp Torque: 0–85%
 - f. Adjustable Smooth Stop Ramp Time: 0–60 seconds
12. Provide linear pump ramp logic option to allow linear ramping of centrifugal pump load based on ramping parameters entered from the RVSS keypad.
13. Maximum continuous operation shall be at 115% of continuous ampere rating
14. Starter shall be provided with the following Form C digital output contacts:
 - a. Run
 - b. Fault
 - c. High Temp
 - d. In Bypass
 - e. Ready
15. Unit shall have Ethernet/IP or MODBUS TCP communication option.
16. Acceptable manufactures:
 - a. Schneider Electric/Square D, “Altivar”
 - b. Eaton Corporation, “S811”
 - c. ABB, General Electric, “ASTAT IBP”
 - d. Approved equal.

H. Relays and Timers

1. Control relays and timers: 300 volt, industrial rated, plug-in socket type, housed in a transparent polycarbonate dust cover, designed in accordance with UL Standard 508 for motor controller duty. Continuous contact rating shall be 10 amperes resistive, 1/4 HP, at 120 VAC, operating temperature minus 10 to plus 55 degrees C. Relays and timers shall be Potter & Brumfield KRP Series or approved equal with neon coil indicator light and calibrated timing knob or DIP settable controls.

I. Distribution Transformer

1. Provide dry type distribution transformer within the motor control center enclosure. Provide transformer as specified under Section 26 22 13.

J. Lighting Panelboard

1. Provide lighting panelboard within the motor control center enclosure. Provide panelboard as specified under section 26 24 16.

K. Miscellaneous Units

1. Elapsed time hour meters: Five digit, non-reset type, with 120 volt synchronous motor.

2.03 MCC COMMUNICATION INTERFACE

- A. MCC shall have Ethernet IP or Modbus TCP cabling integrated throughout the MCC in accordance with UL 845 procedures and practices. Network implementation requirements shall be as specified in Section 40 61 00.

- B. Provide manufacturers standard configuration and programming software for the intelligent devices provided. A single software package shall be used for all intelligent overloads, starters, and drives. Provide software with all licenses and authorization assigned to the District. Software shall be used by the Contractor for configuration, testing, and commissioning. Software shall be turned over to the District prior to acceptance for installation on a District standard machine.
- C. Each motor starter, drive, soft starter, power meter, and spare unit compartment in the MCC shall be supplied with a means to communicate via Ethernet I/P or Modbus TCP, and have the capability of monitoring all the required inputs as specified and per the manufacturer's standard interface.
- D. Ethernet I/P or Modbus TCP I/O interface module shall be pre-wired to each unit. Module shall be configured with a minimum auxiliary input output capacity of 4 discrete inputs and 2 discrete outputs.
- E. The communications system shall be fully integrated into the factory lineup and shall be installed, configured, and tested prior to on-site installation of the switchgear equipment. All network transmission media for the MCC shall be provided for a complete system, including network cable, terminations, switches, and all required network hardware.
- F. Network cable shall be Category 5 or better and conforming to the requirements of UL 845. All units shall be interwired and tested as Class II type B MCC. Ethernet cable shall have an insulating rating equal to at least the maximum circuit voltage applied to any conductor within the enclosure or raceway. Special separation, barriers, or internal conduit for the network conductors are not acceptable.
- G. The addition and removal of an MCC motor control component from the lineup or the Ethernet network shall not interrupt the network operation of other units.
- H. Ethernet cabling shall be routed through the MCC line-up, behind barriers that isolate the cabling unit space and wireways to prevent accidental mechanical damage during MCC installation.
- I. Panel Mounted (Industrial Grade) Ethernet Switches
 - 1. Provide industry-standard ultra wide IEEE 802.3u 100Base-TX and 100Base-FX autosensing Ethernet switches supporting Fast Ethernet communications over both fiber optic (FO) and copper cables. Provide managed Ethernet switches with a minimum of 20% spare ports or sixteen 100Base-TX ports and two 100Base-FX ports whichever is greater.
 - 2. FO ports shall be single-mode type with type ST connectors.
 - 3. Switch shall be standard DIN rail mount type for industrial application having a minimum operating temperature of 60 degree C, and listed for installation in a UL508 control panel.
 - 4. Switches shall include an alarm relay contact output rated for 1 amp at 24VDC.
 - 5. Switches shall be Moxa, Stratix, N-Tron, or equal as recommended by the MCC manufacturer.

- J. Provide Ethernet power supplies for serving the monitoring requirement of the installed starters, spare, and space units on the MCC. Full monitoring of the built out MCC lineup shall be available without additional power supplies.
- K. The Ethernet TCP address shall be assigned to each unit during factory configuration. IP addressing shall conform to District standards as specified in Section 40 61 00.
- L. Each MCC installed network interface component (electronic overload, breaker trip unit, drive, etc.) shall have the following features at a minimum where applicable:
 - 1. On-board Ethernet, Modbus TCP communication
 - 2. LEDs for status indication
 - 3. Test/Reset button
 - 4. Adjustable trip class (5 to 30)
 - 5. General purpose I/O (minimum 2I/1O)
 - 6. Protective functions with programmable trip level, warning level, time delay and inhibit window:
 - a. Thermal overload
 - b. Underload
 - c. Jam
 - d. Stall
 - e. Phase loss
 - f. Ground Fault
 - 7. Voltage monitoring functions and summary including phase magnitude, over voltage condition, under voltage condition, and percent imbalance
 - 8. Current monitoring functions and summary including phase average magnitude, percent of full load, and percent imbalance
 - 9. Power monitoring functions and summary including real, reactive, apparent, power factor and maximum monitored power demand
 - 10. Energy – kWh
 - 11. Diagnostic information:
 - a. Run time and start history
 - b. Device status
 - c. Warning status
 - d. Time to reset
 - e. Trip status
 - f. Time to overload trip
 - g. History of last 5 warnings and trips
- M. Power meter variables and monitoring delivered to the District’s SCADA interface shall be as specified herein.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Motor control center floor sills shall be bolted directly to the finished floor or equipment pad per submittal approved anchorage calculations. Structure shall be leveled and plumb. Anchor bolts shall be as sized per Section 01 33 12. Provide hardware and shims for installation.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.
- C. In general, all conduit entering or leaving a motor control center shall be stubbed into the bottom or top horizontal wireway directly below or above the vertical section in which the conductors are to be terminated.
- D. Housekeeping pads shall be included for the motor control centers as detailed on the Drawings.
- E. Install the equipment in accordance with the manufacturer's instructions.
- F. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.
- G. Make wiring interconnections between shipping splits.
- H. Install bus splice plates and torque connections.
- I. Provide arc flash labels per Section 26 05 73.
- J. Seal all seams, cracks, or openings in outdoor enclosures.

3.02 FACTORY QUALITY CONTROL

- A. The motor control center shall be tested per the manufacture's standard factory tests.
- B. Factory testing shall include full testing of the motor control center communications network proving full connectivity and monitoring of each intelligent device installed within the motor control center lineup.

3.03 FIELD QUALITY CONTROL

- A. The Contractor shall make provisions for acceptance testing and final protective device settings per the requirements of Section 26 08 00.
- B. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service.

- C. All as-built drawings shall be corrected and verified for correctness of in-field changes by the Contractor prior to submittal to the Engineer for final review.

3.04 CLEANING

- A. Remove all rubbish and debris from inside and around the control center. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES – POWER AND DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, and equipment and install wiring devices as shown on the Drawings and as specified herein.
2. Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

1.02 RELATED SECTIONS:

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 05 33 – Raceway and Boxes
- C. Section 26 50 00 – Lighting Systems

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 30 00 and Section 26 05 00.
- B. Submit annotated catalog cuts for all wiring devices provided under this contract. Annotation shall indicate the specific product type, rating, and application for each device provided.

1.04 REFERENCE STANDARDS

- A. Wiring devices shall comply with the requirements of the 2019 California Electrical Code (NEC).
- B. Federal Specifications (FS)
 1. FS WS 896: Switches, Toggle (Toggle and Lock), Flush Mounted General Specification
 2. FS WC 596: Connector, Electrical Power, General Specification For
- C. American National Standards Institute (ANSI)/National Electrical Manufacturer's Association (NEMA)
 1. ANSI/NEMA WD1: General Color Requirements for Wiring Devices
 2. ANSI/NEMA WD6: Wiring Devices/Dimensional Requirements
- D. American Society for Testing and Materials (ASTM)
 1. ASTM A193: Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications

- E. Underwriters Laboratories (UL)
 - 1. UL 20: General Use Snap Switches
 - 2. UL 498: Attachment Plugs and Receptacles
 - 3. UL 514A: Metallic Outlet Boxes
 - 4. UL 514C: Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
 - 5. UL 943: Ground-Fault Circuit-Interrupters
 - 6. UL 1449: Surge Protection Devices
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 WALL SWITCHES

- A. Switches shall be heavy duty, industrial specification grade, toggle action, flush mounting quiet type with ground screw terminal. Provide switches in conformance with NEMA WD1, FS WS-896, and UL 20.
- B. Provide 1-pole switches unless multi-pole switches are shown on the Drawings or if required to achieve the lighting control requirements indicated.
- C. Toggle switch shall be ivory color.
- D. Rating shall be 20A, 120/277 Volt with maintained contacts. Where shown on the Drawings provide momentary contact, 3-position, 2-circuit with center off style switches for application with lighting contactors as specified in Section 26 50 00.
- E. Provide switches with back and side wire terminals accepting up to #10 AWG stranded or solid conductors. Provide grounding screw terminal.
- F. Acceptable manufacturers:
 - 1. Cooper Wiring Devices, Inc. type E-1
 - 2. Hubbell, Inc.
 - 3. Approved equal

2.02 DUPLEX RECEPTACLES – GENERAL PURPOSE TYPE

- A. Duplex receptacles shall be, industrial specification grade, straight blade, 2 pole, 3 wire grounding type with contact made on two sides of the inserted blade. Provide in conformance with ANSI/NEMA WD1, FS WC 596, and UL 498. Provide isolated ground type where shown on the Drawings.
- B. Rating shall be 20A, 125Volt.
- C. High impact and chemical resistant nylon face. Provide corrosion resistant marine duty type where located in NEMA 3R, NEMA 4, or NEMA 4X locations as shown on the Drawings and in conformance with Section 26 05 00. Provide face color ivory for standard

applications; orange face for isolated ground applications; red face when powered from emergency or uninterruptible power sources.

- D. NEMA configuration 5-20R per ANSI/NEMA WD6.
- E. Acceptable manufactures:
 - 1. Cooper Wiring Devices, Inc. type G-7; type G-9 for isolated ground applications; type M-1 for corrosion resistant, marine grade units.
 - 2. Hubbell, Inc.
 - 3. Approved equal

2.03 DUPLEX RECEPTACLES – GROUND FAULT CIRCUIT INTERRUPTER (GFCI) TYPE

- A. Provide GFCI type, industrial specification grade, 20 Amp, 125 Volt, 2 Pole, 3 Wire, feed thru type with "test" and "reset" buttons in conformance with UL 943. Units shall trip at 5mA.
- B. Provide corrosion resistant marine duty type where located in NEMA 3R, NEMA 4, or NEMA 4X locations as shown on the Drawings and in conformance with Section 26 05 00.
- C. NEMA 5-20R configuration per ANSI/NEMA WD6. Units shall fit standard size boxes and be compatible with standard device plates.
- D. Acceptable Manufactures:
 - 1. Cooper Wiring Devices, Inc. type GFCI
 - 2. Hubbell, Inc.
 - 3. Approved equal

2.04 DUPLEX RECEPTACLES – SURGE SUPPRESSION TYPE

- A. Provide transient voltage surge suppression (TVSS) type receptacles where shown on the Drawings. Provide 20A, 125Volt, 2 Pole, 3 Wire grounding type in NEMA 5-20R configuration, hospital grade conforming to UL 1449.
- B. Provide hot to neutral and hot to ground surge protection with clamping voltage of 400 Volts maximum and providing a minimum of 280 Joules of surge protection in each mode.
- C. Provide units having visual indication of the functionalities of the TVSS receptacle. Units shall have an audio alarm indication upon loss of ground or when surge protection is no longer functioning. Audio alarm shall include a front accessible alarm mute function.
- D. Acceptable manufacturers:
 - 1. Cooper Wiring Devices, Inc. Type J1
 - 2. Hubbell
 - 3. Approved equal

2.05 DEVICE PLATES

- A. Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be applied where shown on the Drawings and per Section 26 05 00 as follows:
 - 1. NEMA 4X, 4, and 12: Stainless steel, brushed with stainless steel mounting screws.
- B. Plates for devices surface mounted outdoors shall be weatherproof.
 - 1. Weatherproof receptacles shall have a gasketed weatherproof coverplate. Mounting screws shall be Type 304 stainless steel.
 - 2. Weatherproof switches shall have a gasketed, weatherproof, cast metal cover plate incorporating an external operator for the internal switch. Mounting screws shall be Type 304 stainless steel in accordance with ASTM A193.
- C. Provide plates for device boxes by the same manufacturer as the device and of the same material as the box (metallic or non-metallic) per Section 26 05 33.
- D. Multiple surface mounted devices shall be ganged in a single, common box and provided with an adapter, if necessary, to allow mounting of single gang device plates on multi-gang cast boxes.
- E. Provide engraved device plates indicating function, circuit name, or characteristics where specified.
- F. Provide UL Listed weather protected “Constant Use” cover over plug ends of cord connected equipment located in NEMA 3R, NEMA 4, and NEMA 4X locations. Provide single or two gang box cover made of polycarbonate configured in a vertical arrangement. Provide protective cover having neoprene covers, gaskets, and suitable for application on 120V, 3 Wire, 20 A devices or other configuration where required. Provide Constant Use covers by same manufacture as the receptacles.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The locations of devices are shown diagrammatically on the Drawings and may be varied within reasonable limits to avoid piping, equipment, or other obstruction. Coordinate the final installation location of the devices with piping and equipment clearances and to conform to the requirements of the NEC. Any such relocation of wiring device locations shall be coordinated with the Owner and shall be performed at no addition to the Contract bid price.
- B. Devices shall be installed in conformance with manufacturer’s recommendations. Manufacturer’s recommended fittings and hardware shall be used in all cases.
- C. Devices installed in areas designated NEMA 3R, 12, 4, or 4X on the Drawings shall be surface mounted.
- D. Provide weatherproof device covers for all wiring devices installed in areas designated NEMA 3R, NEMA 4, or NEMA 4X on the Drawings and per Section 26 05 00.

- E. Provide GFI receptacles with “Constant Use” covers for cord connected equipment operated in areas which are, or may be damp or locations near water sources. Examples are sump pumps, sample pumps, analyzers, etc. or where shown on the Drawings.
- F. Mount receptacles as follows unless noted otherwise on the drawings:
 - 1. 48-inches above the finished floor or grade in below grade vaults, structures, and other areas.
- G. Device Plates
 - 1. Plates shall fit closely and tightly to the box on which they are installed.
 - 2. Plates on surface-mounted boxes shall not extend beyond the sides of the box unless the plates do not have sharp corners or edges.
 - 3. The plate material shall be compatible with the box material to prevent galvanic corrosion.
 - 4. Oversized plates shall be installed where standard plates do not fully cover the wall opening.
- H. GFCI Installation
 - 1. Use of feed-through circuiting through receptacles may be used where ground-fault circuit protection is required for groups of receptacles. Feed through circuiting shall only be used for up to three receptacles maximum

END OF SECTION

SECTION 26 32 13

DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, and equipment required; and install, place in operation, and field test complete factory-assembled skid-mounted diesel-engine-driven generator sets and required supporting systems as shown on the Drawings and as specified herein. Generator set shall be new, complete in all respects and shall include all equipment and controls necessary for a fully operational system.
2. All equipment and controls specified in this Section shall be new and be considered part of the generator set package. The genset manufacturer shall be responsible for furnishing the package in its entirety as specified herein. Various components of the package, including wiring and interconnected piping shall be installed by the Contractor.
3. The diesel generators shall have continuous standby power ratings of not less than the kW rating shown on the Drawings at 80% lagging power factor at 480V, 3 phase, 4 wire, 60 Hertz.
4. The diesel generators shall be arranged for automatic starting and stopping and load transfer upon failure of the normal source of power as sensed and signaled from the existing automatic transfer switch as shown on the Drawings.
5. The generator sets shall be classified as Legally Required Standby Power Systems and be used to provide backup power at Booster Station F.
6. The equipment to be provided under this Section includes, but shall not be limited to the following:
 - a. Skid-mounted diesel-engine-driven generator sets
 - b. Exhaust system
 - c. Skid-mounted fuel system, including double-walled base-mounted main fuel supply tank, transfer piping, fill system, valves, leak detection system and appurtenances
 - d. Engine-mounted alternator with skid-mounted battery system
 - e. Spring vibration isolators for the support of the generator skid frame
 - f. Weatherproof and acoustically rated generator set enclosure
 - g. Radiator shroud and all required ductwork for venting radiator fan air
 - h. Skid-mounted generator set control panel and appurtenances housed within the generator enclosure
 - i. Skid-mounted generator set circuit breaker
 - j. Skid-mounted radiator and cooling fans
 - k. Spare parts and special tools
 - l. Services of a manufacturer's representative for field service, testing, startup, and training
7. Connect new generator to existing automatic transfer switches (ATSS) as shown on the Drawings.

8. Provide factory test startup services and on-site testing of the backup power systems. The supplier shall review and certify installation and site testing of the installed equipment.
9. Coordinate, obtain, and pay for applicable air permitting for the new generator sets on behalf of the District. Provide permits, certifications, additional air quality studies, mitigation equipment, and components as required to achieve conformance with the site-specific air quality regulations.

B. Related sections:

1. Section 01 33 12 – Seismic Design Criteria
2. Section 01 33 14 – Wind Design Criteria.
3. Section 26 05 00 – Common Work Results for Electrical

1.02 QUALITY ASSURANCE

A. Performance requirements:

1. The voltage regulation shall be within plus or minus 1% from no load to full-rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5%. Upon application or removal of full-rated load in one step, the transient voltage and recovery to steady-state operation shall be within 3 seconds.
2. Frequency regulation shall be isochronous from steady-state no load to steady-state full load. Random frequency variation shall not exceed plus or minus 0.25% (0.15 Hertz).
3. The diesel-engine-driven generator sets shall be capable of load pick up of 100% nameplate kW and power factor, at site conditions, with the generator set at the temperature as maintained by the engine jacket water heater. Load steps shall be as shown on Table 26 32 13-A.
4. Motor starting capability shall be as required by the loads indicated on the Drawings and Table 26 32 13-A. The diesel generators shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
5. The diesel generators shall be capable of starting the loads with a maximum of 20% starting voltage dip and frequency dip.
6. Emissions shall meet the requirements the U.S. Environmental Protection Agency (EPA) approved for emergency non-road use.
7. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples.
8. The generator sets shall be certified by the genset manufacturer to be suitably rated for use at the installed location and shall meet all applicable site-specific exhaust emission requirements at the time of commissioning.
9. The generator sets, complete with sound attenuated enclosure, shall be tested by the generator set manufacturer per ANSI/ASA S1.13. Data documenting performance shall be provided with submittal documentation.

B. Noise requirements:

1. The diesel-engine-driven generator sets shall be enclosed in sound-attenuated enclosures that achieve decibel (dBA) levels no greater than the values shown in Table 26 32 13-A at full load at any point around the unit.

2. It shall be the responsibility of the Contractor to meet the specified sound criteria. Perform noise tests and submit certification.
- C. Equipment anchorage requirements:
1. The Contractor shall design the anchorage for all the generator sets' skids. Design shall account for wind and seismic forces as noted in Section 01 33 12 and Section 01 33 14.
- D. Workmanship:
1. The diesel-engine-driven generator sets shall be a standard product, as modified by these Specifications, of a manufacturer regularly engaged in the production of this type of equipment.
 2. Mechanical equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation without overheating or excessive vibration or strain, and require only that degree of maintenance generally accepted as peculiar to the specific type of equipment required. Parts and components of all units shall be designed and built for interchangeability so that replacement parts may be installed without any additional fitting or machining.
 3. All items of the same size/type shall be identical and under this Section shall be furnished by a single supplier. The supplier shall have sole responsibility for furnishing all the items required for a complete and operable system. All components of the system need not be manufactured by a single vendor.
 4. The generator sets shall be of such physical dimensions to fit into the space provided as indicated on the Drawings.
- E. Experience:
1. The generator set supplier shall be regularly engaged in the design and the installation of backup power systems and their associated subsystems as they are applied to the municipal water or wastewater industry. The supplier shall be an organization that complies with all the following criteria:
 - a. Maintains a permanent service organization and supply of spare parts in place at the time of the bid within 200 miles of the project site.
 - b. Supplies service and warranty work for the engine and generator portion of the gensets with their own employees.
 - c. Employs design, fabrication, testing and field service personnel on this project who have successfully completed a manufacturer's training course on the specific generator set proposed for this project.
 - d. Is an authorized distributor for the specified manufacturer of the generator set.
 - e. Furnishes a unit assembled from components with proven compatibility, reliability and are coordinated to operate as a unit.
 - f. Owns and operates service trucks dedicated to the purpose of providing field service on the diesel generator and associate components.
 - g. Has performed work of similar or greater complexity on at least five previous projects.
 2. The generator set manufacturer shall be certified to the international standard ISO 9001 for a quality management system (QMS) and shall have third-party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01 30 00.
- B. Submit the following:
 - 1. Shop drawings, catalog cuts, internal wiring schematics and other materials required to completely describe the systems and equipment being furnished.
 - 2. Identification, description and dimensions for each separately installed subassembly or piece of equipment and associated piping and electrical connection schematics.
 - 3. Seismic and wind anchoring information and calculations per Section 01 33 12 and Section 01 33 14 respectively. Calculations shall be stamped and signed by a Civil or Structural Engineer registered in the State of California.
 - 4. Designated Seismic System Certification.
 - 5. Performance specifications of all items of equipment.
 - 6. Generator enclosure panel layout drawings showing location of control panel, human machine interface (HMI), instruments, and access to generator equipment such as the radiator, batteries, and related equipment. The layout drawings shall also include dimensions and paint finish specifications.
 - 7. Layout drawings of the integral fuel tank, including leak detection equipment, fill point, valves, pressure switches, and related devices.
 - 8. Sound attenuation and weatherproof enclosure details including:
 - a. Dimensional plan drawings showing equipment layout arrangements.
 - b. Elevation drawings showing access doors and panel locations, louver locations, and all electrical and ventilation clearance requirements.
 - c. Internal electrical and piping diagrams.
 - d. Sound attenuation tables showing sound pressure levels (dBA) at one, five, and fifteen meters at normal operation.
 - e. Ventilation and internal heat rise calculations showing conformance with generator operating data and ambient air flow requirements.
 - 9. Submit information on the fuel tank and indicate that the outer shell shall have a volume of 110%.
 - 10. Arc flash warning label analysis and designation per the requirements of NFPA 70 and Section 26 05 73.
 - 11. Complete electrical, instrumentation, control and wiring diagrams of instrumentation and controls and electrical components. Specifically, the following is required:
 - a. Complete electrical circuit schematics, including generator control, alarms and power to all motors, accessories, and instruments furnished with the unit. Schematics shall include all termination points in each control panel. Wiring shall be identified by numbers and every termination point shall be assigned a number. Termination point number (including wire number) shall appear on the schematics for each wiring termination shown. Submit written description of the operational control theory with the schematics.
 - b. Complete external electrical interconnection diagrams detailing exact terminals of connection, conduit sizes, stub up locations/cutouts, and recommended wire sizes.
 - 12. Details of the hardware, software, and connections for the network communications. Include the protocol used, interface module, variable memory addresses, and English language descriptions of all input and output signals provided on the communication link.

13. All hardware and software interface requirements to allow remote engine start and stop control from the ATS per Section 26 36 23.
 14. Complete Operations and Maintenance Manuals, as required in Sections 01 70 00 and 26 05 00.
 - a. The manuals shall be prepared specifically for the installation and shall include all relevant catalog cuts, drawings, equipment lists, descriptions, as-built wiring diagrams, and related documentation that are required to instruct operations and maintenance personnel unfamiliar with such equipment.
 - b. Three copies of the Operations and Maintenance Manual shall be submitted.
 - c. Operations and Maintenance Manuals shall include successfully completed test results for the diesel-engine-driven generator set including operational integration with the existing automatic transfer switch.
 - d. Initial Operations and Maintenance Manuals submittal: An initial submittal is required and shall include Shop Test results which have been given favorably reviewed status. Initial Operations and Maintenance Manuals shall include all information required to install the systems properly and for training of District personnel.
 - e. Final Operations and Maintenance Manuals submittal: The Final Operations and Maintenance Manual submittal shall include successfully completed Field Test results and shall be favorably reviewed as a requirement for final acceptance of the system.
- C. Submit specific design data for the following components:
1. Engine Data:
 - a. Manufacturer and model
 - b. Engine type
 - c. Number and arrangement of cylinders
 - d. Rated rpm
 - e. Governor type including make and model
 - f. Maximum power (kW) at rated rpm and site temperature and altitude conditions
 - g. Main bearings, quantity, and type
 - h. EPA Tier certification as required for the unit kW rating and location
 - 1) Certification of emissions for the engines, including data on nitrogen oxides (NO_x), non-methane hydrocarbons (NMHC), carbon monoxide (CO), and particulate matter (PM)
 2. Generator Data:
 - a. Manufacturer and model
 - b. Generator type
 - c. Exciter type
 - d. Voltage regulator
 - e. Rated kVA
 - f. Rated kW
 - g. Voltage
 - h. Insulation rating and temperature rise data
 - i. Frequency
 - j. Generator efficiency, including excitation losses, at 80% PF
 - 1) Full load
 - 2) Three-quarters load
 - 3) Half load
 - k. Guaranteed fuel consumption rate as shown in Table 26 32 13-A for the following:

- 1) Full load, gph
 - 2) Three-quarters load, gph
 - 3) Half load, gph
3. Generator Set, Enclosure, and Accessories:
 - a. Weight of skid-mounted unit including fuel and tank
 - b. Overall length
 - c. Overall width
 - d. Overall height
 - e. Fuel tank details including construction, capacity, leak and fuel level detectors
 - f. Exhaust pipe size, silencer manufacturer and silencer attenuation curve
 - g. Size and locations of conduit stub-up areas
 - h. Details of the battery system including calculations for sizing batteries that indicates compliance with battery load and environmental starting requirements listed herein.
 - i. Dimensional drawings, bill of materials, color selection chips, and sound attenuation data for the weatherproof sound enclosure.
 - j. Details of the control panel and graphical user interface.
- D. Operational Certification
1. Submit certification that the unit is guaranteed to be adequate for motor starting as required by this Section and the loads shown on Table 26 32 13-A.
 2. Factory generator assembly test reports.
- E. Test Reports
1. Furnish copies of the certified shop test and field test records of the complete diesel-engine-driven generator set assemblies.
- F. Air Emission Certification
1. The diesel generators shall comply with the particulate and combustion gas emission limits of the Monterey Bay Air Resources District (MBARD) in effect at time of bid. Any pollution mitigation devices or modifications required to permit the specified testing time shall be included in the Contract price.
 2. The Contractor shall provide all required backup documentation including risk assessment analyses, details of the engine and its components, and other similar documents that is required by the MBARD for the air emission installation and operating permits.
 3. The Contractor shall apply and pay for all required forms and permits on behalf of the District. The Contractor shall be responsible for completing and submitting the required forms for the engine generator set Authority to Construct/Permit to Operate].
 4. The Contractor shall submit verification that the permits have been secured from the MBARD.
- G. Dynamic shake table testing and short-circuit testing certified results.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Product delivery, storage, and handling shall be in accordance with Sections 01 55 00 and 26 05 00.

- B. After successful completion of factory tests and other required milestones, ship equipment, materials, and spare parts complete, except where partial disassembly is required by transportation regulations or for protection of components.
- C. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
- D. Mechanical and electrical equipment shall be coated, wrapped, and otherwise protected from snow, rain, drippings of any sort, dust, dirt, mud, flood, and condensed water vapor during shipment and while stored before construction. The protective coverings shall remain in place until the work areas are substantially free of all construction dust and debris. Generator space heaters shall be energized at all times during storage.

1.05 REFERENCES

- A. Design, manufacturing, and assembly of elements of the equipment specified herein shall be in accordance with but not limited to published standards of the following, as applicable. Where multiple revisions of a document are available, the current version at time of bid opening shall apply.
 - 1. American Bearing Manufacturers Association (ABMA)
 - a. ABMA 20 – Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types – Metric Design
 - 2. American National Standards Institute (ANSI) / Acoustical Society of America (ASA)
 - a. ANSI/ASA S12.18 – Outdoor Measurement of Sound Pressure Level
 - b. ANSI/ASA S1.13 – Measurement of Sound Pressure Levels in Air
 - 3. ASTM International (ASTM)
 - a. ASTM A36 – Standard Specification for Carbon Structural Steel
 - b. ASTM A106 – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - c. ASTM D975 – Standard Specification for Diesel Fuel
 - 4. Monterey Bay Air Resources District (MBARD)
 - a. MBARD Air District Rules
 - 5. California Air Resources Board (CARB)
 - a. Title 17, California Code of Regulations (CCR), Section 93115 – Airborne Toxic Control Measure for Stationary Compression Ignition Engines
 - b. Title 17, California Code of Regulations (CCR), Section 93116 – Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 Horsepower and Greater
 - 6. Code of Federal Regulations (CFR)
 - a. 40 CFR 60 – Standards of Performance for New Stationary Sources
 - b. 40 CFR 89 – Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines
 - c. 47 CFR 15 – Federal Communications Commission (FCC) Radio Frequency Devices
 - 7. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE C50.12 – IEEE Standard for Salient-Pole 50 Hz and 60 Hz Synchronous Generators and Generator/Motors for Hydraulic Turbine Application Rated 5 MVA and Above

- b. IEEE 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
- 8. International Organization for Standardization (ISO)
 - a. ISO 3046 – Reciprocating Internal Combustion Engines – Performance
 - b. ISO 6798 – Reciprocating Internal Combustion Engines – Measurement of Sound Power Level Using Sound Pressure
 - c. ISO 8528 – Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets
 - d. ISO 9001 – Quality Management Systems – Requirements
- 9. National Electrical Contractors Association (NECA)
 - a. NECA/EGSA 404 – Recommended Practice for Installing Generator Sets
- 10. National Electrical Manufacturers Association (NEMA)
 - a. NEMA MG1 – Motors and Generators
 - b. NEMA MG2 – Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
- 11. National Fire Protection Association (NFPA)
 - a. NFPA 30 – Flammable and Combustible Liquids Code
 - b. NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
 - c. NFPA 54 – National Fuel Gas Code
 - d. NFPA 70 – National Electrical Code (NEC)
 - 1) Article 240 – Overcurrent Protection
 - 2) Article 445 – Generators
 - 3) Article 701 – Legally Required Standby Systems
 - e. NFPA 79 – Electrical Standard for Industrial Machinery
 - f. NFPA 101 – Life Safety Code
 - g. NFPA 110 – Standard for Emergency and Standby Power Systems
- 12. State of California, Department of Industrial Relations
 - a. California Code of Regulations (CCR), Division of Occupational Safety and Health (DOSH), better known as Cal/OSHA – Title 8, Safety Orders
- 13. Underwriters Laboratories (UL)
 - a. UL 142A – Standard for Special Purpose Aboveground Tanks for Specific Flammable or Combustible Liquids
 - b. UL 508A – Standard for Industrial Control Panels
 - c. UL 1236 – Standard for Battery Chargers for Charging Engine-Starter Batteries
 - d. UL 2080 – Standard for Fire Resistant Tanks for Flammable and Combustible Liquids
 - e. UL 2200 – Standard for Stationary Engine Generator Assemblies

1.06 SPARE PARTS

- A. Provide spare parts and maintenance tools according to manufacturer’s recommendation. Parts shall include but not be limited to the following:
 - 1. Two air filter elements.
 - 2. Two lube oil filter elements.
 - 3. Two fuel oil filter elements.
 - 4. One set of hoses and belts including one of each different size and type.
 - 5. Three complete replacement sets of fuses of each different size and type.

- 6. Two complete change of lube oil plus one gallon of makeup lube oil supplied in unopened containers.
 - 7. Six pilot lamps of each type and voltage.
 - 8. One quart of touch-up paint in each color used on the main assembly and housing.
- B. The spare parts and maintenance tools shall be packed in containers, permanently labeled by description and part number for easy identification of the items. Provide label for parts identified as “For Use Only for the 300 kW Diesel Generator installed at the Booster F Pump Station” and properly packed for an extended period of storage before use.
 - C. Spare parts and tools shall be packaged to prevent damage during extended periods of storage. All packages shall be sealed to prevent from drying out. All packages shall be legibly and properly identified with indelible markings on the exterior identifying the project and a listing of the contents, with a copy fastened to the inside of the packaging/containers.

1.07 MANUFACTURER’S FIELD SERVICES

- A. The generator manufacturer shall provide the field services of a factory technician as necessary to supervise and inspect installation, test, and start up all equipment provided as part of the price proposal. The price shall include all travel and living expenses in addition to the technician’s time required to complete supervision of the installation, testing and start-up. All equipment required for testing, start-up and performance verification shall be provided by the manufacturer’s technician.
- B. At a minimum, the manufacturer shall provide the following technician person hours:

Description	Person Hours
Inspection	4
Installation Assistance	12
Settings, Adjustments	8
Start Up and Testing	8
Training	8

1.08 JOB CONDITIONS

- A. The diesel-engine-driven generator sets and associated equipment shall be suitable for continuous operation at the intended site conditions in Marina, California. The generator sets shall be provided with weatherproof sound-attenuated enclosures and will be installed outdoors.

1.09 WARRANTY

- A. Provide manufacturer’s standard two-year warranty.
- B. The warranty shall cover all system parts and labor.

- C. The Contractor shall warrant all equipment provided under this Section, so that there is one source for warranty and product service. Technicians trained and certified by the manufacturer to support the product and employed by the Contractor shall service the generator sets.

1.10 MAINTENANCE CONTRACT

- A. Provide to the District at no additional cost a separate written two-year manufacturer's standard routine and preventative Maintenance Contract for the diesel-engine-driven generator set, commencing on the date of beneficial occupancy of the generator installation at the F Booster site.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Equipment and controls specified in this Section shall be new and be considered part of the diesel-engine-driven generator set. The Contractor shall be responsible for integrating and furnishing the system in its entirety as specified herein.
- B. The diesel generators and related equipment shall be designed and constructed in conformance with the requirements of UL 2200, Standard for Stationary Engine Generator Assemblies.
- C. Mechanical equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation without overheating or excessive vibration or strain, and require only that degree of maintenance generally accepted as peculiar to the specific type of equipment required. Parts and components of all units shall be designed and built for interchangeability so that replacement parts may be installed without any additional fitting or machining.
- D. The generator sets shall allow easy access to the various parts for maintenance purposes. All parts shall be properly enclosed to prevent the throwing or dripping of oil.
- E. The gensets shall be pre-piped and pre-wired insofar as possible.
- F. Provide terminals housed in an enclosure for connection of all remote alarm, control and status signals to and from the generator control panel. Generator 480 Vac power output cables shall be connected directly to the generator output breaker terminals.
- G. All conductors shall be installed in UL-listed rigid or flexible conduits as specified in Section 26 05 33. Provide grounding bushings at conduit entrances to terminal boxes and enclosures on the unit.
- H. Supporting Structure: The diesel generator shall be directly bolted and aligned on a rigid, fabricated steel base, suitably sized to maintain the correct alignment, supported by heavy duty spring type vibration isolators. Isolators shall be suitable for anchoring to the level surface of a concrete pad as shown on the Drawings. Provide anchorage in accordance with the seismic calculations provided under Section 01 33 12 and wind loading calculations provided under Section 01 33 14.

2.02 MANUFACTURERS

- A. Caterpillar no equal to match existing District generator sets.

2.03 RATINGS

- A. The complete generator sets shall be rated per ISO 8528-1 as shown on the Drawings at 0.8 PF, standby rating, based on site conditions of:
 - 1. Altitude 100 feet, ambient temperature of 35 degrees C, measured at the air inlet closest to the alternator for outdoor equipment.
- B. The generator set rating and design shall be based on Legally Required Standby Power Systems per NEC Article 701. Furthermore, the rating shall be based on EPSS use and marked as such per NFPA 110.

2.04 EQUIPMENT

- A. Engine and Governor
 - 1. The generator set shall be a factory-assembled unit, specifically designed and equipped for operation on No.2 diesel fuel oil with a radiator and fan cooled. The engine and generator shall be directly connected with a semi-flexible steel coupling, shall be free from injurious torsional or other vibration and shall be vibro-mounted to a heavy steel sub base.
 - 2. The diesel engine shall be six cylinders maximum, four stroke cycle, turbo-charged, and arranged for direct connection to an alternating current generator. The unit shall operate at a rotative speed of not more than 1800 rpm. Units offered at ratings in excess of their published ratings are not acceptable and will not be approved.
 - 3. The governor shall be electronic, powered from the engine starting batteries and capable of maintaining isochronous regulation from no load to full rated load within 0.25% of rated frequency. It shall have the capacity for manual adjustment of speed setting and speed droop. Speed droop shall be adjustable from 0 to 5% from no load to full load. It shall be designed and installed to eliminate all electromagnetic interference and non-sinusoidal waveforms.
 - 4. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating-to-start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.
 - 5. Furnish a separate overspeed shutdown device which shall, in case of predetermined overspeed or the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.
 - 6. At a minimum, units shall be meet MBARD requirements and low emission units per U.S. EPA, and California Code of Regulations (CCR) Title 17 requirements for stationary sources.
- B. Generator and Excitation System
 - 1. The generator shall be of the open drip-proof bracket type, designed for connection to the engine and shall be for three-phase, 60-hertz, 4-wire, 277/480 Volt operation. The generator shall have Class H insulation rated for 125 degree C temperature rise. The generator shall have amortisseur windings.

2. The generator shall have a forged or cast alloy steel flanged shaft for direct connection through a suitable flywheel type coupling to the engine, or with suitable adapter and disc coupling and shall be of the single bearing type with anti-friction bearing.
3. The generator windings shall be braced to withstand short stresses and shall be designed to withstand overheating or stresses caused by harmonics generated by up to 15% non-linear loads. The unit influence shall be Radio Interference Proof (RIP) and the telephone influence factor (TIF) shall be within the limits of IEEE Std C50.12.
4. The generator shall be brushless with a rotating permanent magnet generator type exciter system, 3-phase solid-state voltage regulator with filters and associated controls. The exciter shall have Class H insulation rated for Class F temperature rises.
5. The generator stator core shall be built of low carbon steel laminations, precision-punched, deburred and individually insulated. Stator coils shall be random wound and inserted in insulated core slots. The wound core shall be insulated. Armature lamination followers and frame ribs shall be welded integral with frame. The enclosure shall be drip-proof guarded.
6. Generator rotor poles shall be built up of individually insulated steel punchings. Poles shall be wet layer wound and insulated with VPI/epoxy resin. Cage connections shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be securely bolted to the rotor shaft.
7. A directional blower shall be mounted to draw cooling air from the exciter end, over rotor poles, and through louvered openings in the drive end.
8. The generator shall have grease lubricated anti-friction bearings. The designed bearing life, B10, per the American Bearing Manufacturers Association (AFBMA), shall be not less than 40,000 hours.

C. Diesel Fuel System

1. The engine fuel injection system shall include replaceable element type fuel oil filters, integral fuel supply pump, and flexible connectors for both fuel supply and return piping.
2. The diesel fuel system shall include a base-mounted diesel storage tank with leak detection monitor, fuel piping and fittings and isolating ball valves as specified herein.
 - a. Tank capacity shall provide for 24-hour operation at 75% load or shall not exceed 660 gallons capacity, whichever is smaller. The tank shall have dual shells (primary and secondary) with continuous welds and an annular space for monitoring leaks. The outer shell shall completely enclose the inner tank and have a volume of 110% of the inner tank. The tank piping and fittings shall meet the requirements of UL 142A and NFPA 37, 79, and 110.
 - b. The tank shall be equipped with the following:
 - 1) Leak detection system with monitoring panel. The leak detector shall monitor the annular space between the walls of the fuel tank and shall include an auxiliary contact for remote alarm at the generator control panel.
 - 2) Tank low level alarm switch; tank low-low level alarm and shutdown switch.
 - 3) Fill assembly with 4-inch fill, cap, minimum 7-gallon UL-listed overflow/spill containment with automatic shutoff valve on overflow. There shall be a manual drain back to the main tank.
 - 4) Vent pipe and appurtenances. Vent package shall meet NFPA 30.
 - 5) Mechanical fuel level gauge.
 - 6) Electronic fuel level transducer and transmitter.
 - c. The internal and external tank shall pass a 24-hour factory pressure test at a pressure rating recommended by the tank supplier and applicable codes.

- d. The fuel piping, fittings, and valve shall be Schedule 40 black steel or stainless-steel tubing.
 - e. Provide isolating valves for the fuel lines at the engine. The valve shall be ball type with lever handles bronze, and stainless-steel construction suitable for diesel fuel service.
 - f. Provide a pressure relief valve designed to limit fuel line pressure to a maximum of 2.5 psi. The relief valve shall vent outside the enclosure and be oriented to avoid potential spraying of personnel with diesel fuel.
 - g. Provide a fuel line check valve or other means to maintain prime in the fuel line and ensure immediate starting capability.
 - h. The tank shall be labeled "Diesel Fuel Only" and have the NFPA placard. An NFPA placard shall be placed on the enclosure door. H=0, F=2, R=0.
 - i. Tanks shall comply with UL 2080 and UL 142A.
3. The engine-driven fuel supply pump shall discharge through a series filtration system, consisting of a 10-micron particle removal cartridge, followed by a water separation cartridge. A pressure relief valve shall be furnished and installed upstream of the filters and arranged to discharge into the fuel tank. The excess fuel supplied to the engine shall be returned to the tank.

D. Electric Battery Starting System

- 1. Starting shall be accomplished by an engine-mounted, solenoid shift electric starter, capable of withstanding four consecutive continuous cranking periods of 15 seconds duration each separated by 15 seconds rest periods before shutting down completely and providing an alarm to the control system.
- 2. The starting battery(ies) shall be low-maintenance, long-life, nickel cadmium (NiCd) type, specially designed for diesel engine cranking service and of a capacity as recommended by the battery manufacturer for compliance to NFPA 110 starting requirements. The starting batteries shall be capable of cranking the engine being furnished, for the necessary break-away current as required and the spinning current for four consecutive starts of 15 seconds of cranking on each start, without being recharged, with the system at the site conditions. An insulated protective covering, skid-mounted battery rack and suitable cables shall be provided. The rack shall be finished with an acid and fire-resistant epoxy coating.
- 3. Cell containers shall be sealed, shock-absorbing, heat-resistant plastic with sprayproof, flame-arresting type vents. The battery shall be furnished with all connectors, hardware, a lifting device, cables, and grease.
- 4. The battery charger shall be a UL 1236-listed device, fully automatic, filtered, float-type charger suitable for mounting within the generator enclosure. The chargers shall be designed for heavy-duty industrial service. The DC output shall be regulated to within 1% with plus or minus 10% fluctuations of the input voltage and shall be current limited at 120% of rated output.
- 5. The charge rate shall be temperature compensated to provide proper charging in ambient conditions from negative 20 degrees Celsius to positive 55 degrees Celsius.
- 6. The charger unit shall include a DC ammeter and voltmeter, adjustable float and equalize controls, AC and DC circuit breakers, an AC power failure alarm relay, and low DC voltage alarm relay output contacts. Provide fault condition outputs per NFPA 110. Include light-emitting diode (LED) indication of charger status, fault, and equalize. Liquid-crystal display (LCD) shall include charge rate, battery voltage, configuration menu, and commands.

7. A separate 120-volt ac power source for the battery charger shall be provided as shown on the Drawings.

E. AC Alternator

1. The AC alternator shall be synchronous, four pole, 2/3 pitch, brushless, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct-drive centrifugal blower fan, and directly connected to the engine with a flexible drive disc. The alternator design shall prevent the shaft current from flowing and eliminate the need for insulated bearings. All insulation system components shall meet NEMA MG1 requirements for Class H insulation systems. The actual temperature rise measured by the resistance method at full load shall not exceed 105 degrees C in a 40 degrees C ambient.
2. The alternator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage up to 5% above or below rated voltage.
3. The alternator shall be supplied with a dedicated, independent power source for the voltage regulation system, which provides sufficient excitation for the alternator to supply 300% of rated output current for 10 seconds.
4. The subtransient reactance of the alternator shall not exceed 12%, based on the standby rating of the generator set.
5. Provide an anti-condensation heater for the alternator. Power to the alternator heater shall be provided from a separate 120-volt ac power source as shown on the Drawings.

F. Air Intake System

1. The engine shall be equipped with a suitably sized dry-type air intake filter(s) to protect working parts of the engine from dirt and grit with a replaceable-type filter element. A crankcase breather shall be included.

G. Lubrication System

1. The engine shall be provided with a full-pressure lubricating oil system arranged to cool the pistons and to distribute oil to all moving parts of the engine including the turbocharger bearings and including full flow filter of the replaceable element type and a suitably sized shell and tube type oil cooler and an automatic temperature regulator if required.
2. An engine-driven lubricating oil circulating pump shall be provided for the engine. This pump shall be of the positive-displacement type and shall have ample capacity to circulate the amount of lubricating oil and cooling oil required by the engine and turbocharger. The engine shall be provided with a sump type crankcase arrangement of sufficient capacity to suit the requirements of the engine.

H. Engine Cooling System

1. Provide a skid-mounted radiator and cooling system rated for full-load operation in 50 degrees C ambient as measured at the generator air inlet, based on 0.5-inch H₂O external static head. The radiator shall be sized based on a core temperature which is 10 degrees C higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. The radiator shall be provided with a duct adapter flange. The cooling system shall be filled with an ethylene glycol/water (50:50) mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.

I. Exhaust System

1. The exhaust silencer shall be of the critical-grade type. The exhaust pipe shall be ASTM A106 with a wall thickness of 0.250 inches, black steel with flanged fittings and of the size recommended by the engine manufacturer. Suitable expansion joints shall be provided and installed where required to provide for expansion of the pipe caused by a 1,000 degrees F temperature change. The exhaust line shall be connected to the engine by a suitable section of flexible stainless-steel metal exhaust corrugated tubing suitable for the maximum temperature condition which may be encountered. Provide long-radius exhaust line elbows.
2. Furnish and install suitable silencer equipment for the engine exhaust to attenuate the sound as specified herein.
3. The exhaust silencer shall be factory mounted to the top or inside of the enclosure. The exhaust pipe shall terminate in a device to prevent the entrance of rain.
4. A suitable drain with valve shall be installed at the low point of the exhaust line.

J. Generator Output Circuit Breaker

1. The circuit breaker shall be a manually operated, 3-pole, molded-case circuit breaker with a solid-state trip device. The frame and trip rating shall be as shown on the Drawings.
2. The circuit breaker shall have the following adjustments as a minimum: long time, short time and instantaneous (amps pickup and time delay), and ground fault (amps pickup and time delay).
3. The Contractor shall recommend the setpoints of the breakers based on the characteristics of the equipment furnished. Breaker interrupting ratings shall be suitable for the generator furnished and shall be 25,000 AIC minimum.
4. The circuit breaker shall be UL-listed to be applied at 100% of its rating.
5. The circuit breaker shall be housed in the NEMA-rated enclosure mounted on the generator skid.

K. Weatherproof Acoustic Enclosure

1. A weatherproof enclosure for the generator set and appurtenances shall be provided and shall be complete with locking access doors, fixed-type louvers and screens, exhaust ventilators and screens, and other appurtenances as required for a complete installation.
2. The enclosure shall be factory mounted to the generator set skid base by the genset supplier and shipped to the site as an integral component of the generator set system.
3. The enclosure shall be an all-welded, formed sheet metal type, custom fabricated from ASTM A36 galvanized sheet steel. The wall and roof skin thickness shall be a minimum of 14-gauge panels and shall be welded along 1-inch support flanges for added strength.
4. The access panels shall be constructed of 14-gauge galvanized sheet steel with the same thickness as the wall panels and shall include hinged doors or a lift-off feature to access all adjustable or maintainable components. The access panel hardware shall be zinc-plated and use a keyed alike 2-point locking system. The number and location of the access panels shall be provided as required to allow servicing of the generator set.
5. Provide a roof exhaust pipe opening and collar with rain cover as required by the engine.
6. All electrical components internal to the enclosure shall be arranged to ensure conformance with NEC-required minimum working space.

7. The enclosure shall be factory wired insofar as possible. Provide terminal boxes' connections of all alarm, control, and power conductors to the enclosure. Separate boxes shall be provided for 480 V ac, 120 V ac, and DC wiring as applicable. All conductors within the enclosure shall be installed in UL-listed rigid or flexible conduit. Provide grounding bushings at conduit entrances to terminal boxes and other panels on the genset.
 8. The enclosure coating preparation, prime, and finish shall be manufacturer's standard suitable for an aggressive marine environment. The color shall be as selected by the District.
 9. Within the enclosure housing, provide a 20-amp, 120-volt GFCI receptacle for maintenance purposes and an LED light with manual light switch. A separate 120-volt power source shall be provided to the receptacle and light as shown on the Drawings.
- L. Jacket Water Heaters
1. Provide an automatic thermostatically-controlled heater(s) rated 120 or 240 volts, single phase to maintain not less than 90 degrees F temperature with an ambient temperature of 25 degrees F for the engine jacket water.
 2. The heaters shall be automatically deactivated when the generator is in operation.
 3. A separate 120 or 240-volt power source shall be provided to the jacket heaters as shown on the Drawings.

2.05 GENERATOR SET CONTROLS

A. General

1. The diesel-engine-driven generator set shall include an integrally mounted generator set control system. The components of this system shall be shop mounted inside of the weatherproof enclosure. If required by space or clearance constraints, components may be provided with individual NEMA 4X-rated enclosures and shop mounted on the exterior of the overall generator enclosure or remotely where shown on the Drawings. The controls shall include, but not be limited to, the following:
 - a. Generator voltage regulator control potentiometer. The regulator may be located within the genset enclosure at the manufacturer's discretion.
 - b. Powered from the generator battery.
 - c. Battery charger.
 - d. Alarm and status human machine interface (HMI) annunciator system.
 - e. Engine start and stop controls.
2. The control system including the enclosure, covers, barriers, and supports shall be listed and labeled under the requirements of UL 508A.
3. The generator set shall be provided with a microprocessor-based control system designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall be designed to allow local monitoring and control of the generator set at the HMI. The control system shall also allow remote monitoring and control as described herein.
4. Indicators, pilot devices, HMI, alarms and controls shall be housed in a control panel mounted within the generator enclosure. The control panel shall have nameplates adjacent to each device to identify the device's function. A wiring diagram shall be mounted to the inside of the door.

5. Control system equipment shall be factory mounted and wired on or within the generator set enclosure. Wiring shall be numbered in accordance with the numbering system used on the wiring/connection diagrams.
6. Panel wiring shall be stranded copper conductor, 600-volt, insulation type SIS, or approved equal. The minimum size shall be No. 14 AWG for AC power wiring and No. 16 AWG for DC control wiring.
7. Control relays and timers shall be heavy-duty plug-in socket type with a transparent cover. The relays shall have 10-ampere minimum and 120/230 V ac contacts. The mechanical life of the relay shall be 10,000 operations minimum.

B. Control Functions and Components

1. Provide a fully solid-state, microprocessor based, generator set control system with HMI or standalone control and monitoring components. The control panel shall be designed and built by the engine manufacturer. The control system shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls. The control system shall contain the following components and functions at a minimum:
 - a. Generator output frequency meter, ammeter and voltmeter. The voltmeter and ammeter shall display all three phases. The output display shall be via the HMI or digital in either LED bar graph or LCD.
 - b. Running time meter and start counter.
 - c. Engine mode selector switch: The controls shall include a three-position RUN-OFF-AUTO switch. In RUN, the engine shall start and run without load transfer; in OFF, the engine shall stop and will not start; in AUTO, the engine shall start and run and stop from the remote engine start contact provided by hardwired contact from the existing automatic transfer switch.
 - d. Reset push-button with indicator. Indicator shall flash to indicate that generator set is locked out due to a fault condition.
 - e. Lamp test push button. Operation of this push button shall cause all lamps on the panel to be simultaneously tested. As an alternative, provide push-to-test type pilot lights or digital indicators.
 - f. Emergency stop push button. The emergency stop push button shall be a red, mushroom head push button which maintains its position until manually reset.
 - g. Precision voltage and frequency adjust raise/lower switches or potentiometers. Switches or potentiometers shall allow the generator set frequency and voltage to be adjusted plus or minus 5%. Voltage and frequency adjustment switches shall be located inside of the control panel or shall be sealed in a manner to prevent unauthorized adjustment.
 - h. Provide local operator interface panel with display for viewing engine and alternator data and providing setup controls and adjustments.
2. Functional Requirements
 - a. The following functionality shall be integral to the control panel:
 - 1) Graphical user color display minimum 6-inches diagonal screen.
 - 2) Audible horn for alarm and shutdown with horn silence switch.
 - 3) Standard ISO labeling.
 - 4) Multiple language capability.
 - 5) Remote start/stop control.
 - 6) Local run/off/auto control integral to system microprocessor.
 - 7) Cooldown timer.
 - 8) Speed adjustment.

- 9) Lamp test.
 - 10) Emergency stop push button.
 - 11) Voltage adjustment.
 - 12) Voltage regulator V/Hz slope — adjustable.
 - 13) Password-protected system programming.
3. Digital Monitoring Capability
- a. The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units. Engine, Generator and Voltage Regulation controls/readings shall include but not be limited to:
 - 1) Engine
 - a) Engine oil pressure.
 - b) Engine oil temperature.
 - c) Engine coolant temperature.
 - d) Engine rpm.
 - e) Battery volts.
 - f) Engine hours.
 - g) Engine crank attempt counter.
 - h) Engine successful start counter.
 - i) Service maintenance interval.
 - j) Real time clock.
 - k) Engine exhaust stack temperature.
 - l) Engine main bearing temperature.
 - 2) Generator
 - a) Generator AC volts (line-to-line, line-to-neutral, and average).
 - b) Generator AC current (average and per phase).
 - c) Generator AC frequency.
 - d) Generator kW (total and per phase).
 - e) Generator kVA (total and per phase).
 - f) Generator kvar (total and per phase).
 - g) Power factor (average and per phase).
 - h) Total kWh.
 - i) Total kvar h.
 - j) % kW.
 - k) % kVA.
 - l) % kvar.
 - m) Generator bearing temperature.
 - n) Generator stator winding temperature.
 - 3) Voltage Regulation
 - a) Excitation voltage.
 - b) Excitation current.
4. Alarms and Shutdowns
- a. The control system shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:
 - 1) Engine Alarm/Shutdown
 - a) Low oil pressure alarm/shutdown.
 - b) High coolant temperature alarm/shutdown.
 - c) Loss of coolant shutdown.

- d) Overspeed shutdown.
 - e) Overcrank shutdown.
 - f) Emergency stop shutdown.
 - g) Low coolant temperature alarm.
 - h) Low battery voltage alarm.
 - i) High battery voltage alarm.
 - j) Control switch not in auto position alarm.
 - k) Battery charger failure alarm.
- 2) Generator Alarm/Shutdown
 - a) Generator phase sequence.
 - b) Generator over voltage.
 - c) Generator under voltage.
 - d) Generator over frequency.
 - e) Generator under frequency.
 - f) Generator reverse power (real and reactive).
 - g) Generator overcurrent.
 - 3) Voltage Regulator Alarm/Shutdown
 - a) Loss of excitation alarm/shutdown.
 - b) Instantaneous over excitation alarm/shutdown.
 - c) Time over excitation alarm/shutdown.
 - d) Rotating diode failure.
 - e) Loss of sensing.
 - f) Loss of permanent magnetic generator (PMG).
5. Inputs and Outputs
- a. Programmable Digital Inputs: The controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.
 - b. Programmable Relay Outputs: The control system shall include the ability to operate programmable relay output signals, integral to the controller. The output relays shall be rated for 2 A at 30 V dc and consist of six Form A (Normally Open) contacts and two Form C (Normally Open & Normally Closed) contacts.
 - c. Programmable Discrete Outputs: The control system shall include the ability to operate two discrete outputs, integral to the controller, which are capable of sinking up to 300 mA.
6. Maintenance
- a. All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control system:
 - 1) Engine running hours display.
 - 2) Service maintenance interval (running hours or calendar days).
 - 3) Engine crank attempt counter.
 - 4) Engine successful starts counter.
 - 5) Minimum of 40 events are stored in control panel memory.
 - 6) Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
 - a) Day of week.
 - b) Time of day to start.

- c) Duration of cycle.
7. Remote Communications
- a. The control system shall include Modbus TCP or Ethernet/IP communications as standard for integration into the District's SCADA system as specified under Section 40 61 00. The control system communication interface shall provide monitoring software with the following functionality:
 - 1) Monitor up status and alarms from the generator set provided.
 - 2) Provide access to all data and events on the generator set communications network.
 - 3) Provide capability for future remote control for the generator set(s).
8. Engine Control Functions
- a. The control system provided shall include a cycle cranking system, which allows for user-selected crank time, rest time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest periods between cranking periods.
 - b. The control system shall include an engine governor control, which functions to provide steady-state frequency regulation as noted in this Section. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the generator is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - c. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - d. Engine warning conditions shall be grouped to provide a common alarm. All shutdown alarms shall be grouped to provide a common alarm. Provide a status indication for generator run status. These items shall be available for remote monitoring via the network communications.
 - e. Provide complete engine start control which operates on closing contact and stop control which operates on hardwired contact from the ATS.
 - f. Provide cranking limiter to disconnect the starting motor from the battery supply after completing a total of four 15-second cranking periods separated by 15-second rest periods before shutting down completely and alarming.
 - g. Adjustments shall be broad range, and made via digital raise/lower switches, potentiometers, or with a laptop, with an alpha-numeric LED readout to indicate setting level. If software is required to make adjustments, the Contractor shall furnish a copy of all required software, cables, and accessories, licensed to the District.
 - h. Provide an AC over/under voltage monitoring system which responds only to true root mean square (RMS) voltage conditions. The system shall initiate alarm and shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when the voltage exceeds 130%. Under voltage shutdown and alarm shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - i. Provide a battery monitoring system which initiates alarms when the DC control and starting voltage is less than 25 V dc or more than 32 V dc. During engine starting, the low voltage limit shall be disabled.
 - j. Controls shall be provided to monitor the output current of the generator and initiate an overcurrent warning alarm when the load current exceeds 110% of the rated current of the generator on any phase for more than 60 seconds. The controls shall shut down and lock out the generator when the output current level

approaches the thermal damage point of the alternator (overcurrent shutdown). The protective functions provided shall be in compliance with the requirements of NFPA 70, Article 445.

- k. Controls shall be provided to individually monitor all three phases of the output current for 1, 2, or 3-phase short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator when output current level approaches the thermal damage point of the alternator (short circuit shutdown).
- l. Controls shall be provided to monitor the kW load on the generator and initiate an overload alarm condition when the total load on the generator exceeds the generator rating for a period of 5 seconds or more. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator is overloaded.
- m. The control system shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps and include an adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator. Provide a relay that will function correctly in the system as installed and comply with the generator set's bonding and grounding requirements.

C. DC Control Power

- 1. Control power for the system shall be derived from the generator set starting batteries.

D. Remote Status Signals

- 1. Provide dry contact status monitoring points including at a minimum Generator Ready to Load, Generator Run, Generator Fail, Low Fuel, and Composite Generator Alarm for remote monitoring by the District's supervisory control and data acquisition (SCADA) system as specified under Section 40 61 00.
- 2. Provide Form "C" dry contacts rated 2 A at 30 V dc. Generator Ready to Load shall operate when the voltage and frequency are greater than 90% of rated condition.
- 3. Provide a 4-20 mA fuel level monitoring signal for remote monitoring by the District's SCADA system.
- 4. A fused 10-amp switched, 24-V dc power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator is running.
- 5. A fused 20-amp, 24-V dc power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
- 6. Provide a generator network communication module to allow real time communication with the generator set controls with the District SCADA system under Modbus TCP or Ethernet/IP protocol. The network link shall communicate all engine and alternator data; alarm, shutdown and status conditions; and allow future starting and stopping of the generator via the network in both test and emergency modes.

2.06 SURFACE PREPARATION AND SHOP PAINTING

- A. Diesel-engine-driven generator set and associated equipment shall be shop cleaned, primed, and finished coated per the manufacturer's standard practice for aggressive marine environments prior to shipment.

2.07 WARNING SIGNS

- A. A sign shall be posted at the service entrance equipment indicating type and location of the power source.
- B. The signs shall be made of 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black against a White background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable. Nameplates shall be affixed to the panels using #4-40 hex drive stainless steel button head socket cap screws.

PART 3 - EXECUTION

3.01 FACTORY ACCEPTANCE TESTING

- A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. All testing shall be performed with calibrated metering. Provide two weeks advance notice of scheduled test dates.
- B. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include at a minimum:
 - 1. Startup Testing: The generator shall be tested through warm-up, idle speed, rated speed and rated speed with load to ensure proper startup.
 - 2. Steady-State Stability: Tests shall be performed at both no load and full load to verify frequency and voltage are within expected parameters.
 - 3. Full-Load Pickup: Test that the generator can achieve full nameplate rating in one step.
 - 4. Run at full load over a minimum 4-hour period; monitor and record phase voltages, currents, power output (kW and kvar), water temperature, and other variables monitored by manufacturer's standard factory test procedures.
 - 5. Maximum power.
 - 6. Voltage regulation.
 - 7. Transient and steady-state governing.
 - 8. Single-step load pickup.
 - 9. Function of safety shutdowns.
 - 10. Factory testing shall include any applicable weatherproof enclosure(s) provided by the manufacturer.
 - 11. Strip Chart documenting product performance through various transient events including full load pick up.
 - 12. Extended run testing operation of the generator set at the manufacturer's facility for an extended period (2 hours minimum).
 - 13. Safety shutdown test simulating generator set control safety shutdowns.
 - 14. District reserves the right to witness all the factory tests. Provide a minimum of two weeks' notice to the District prior to performing the factory tests.
- C. Submit certified test report for review.

3.02 GENERATOR SYSTEM SHOP TESTS

- A. Before shipment to the project site, the complete diesel-engine-driven generator set, including generator control panel, weatherproof enclosure, and silencers, shall be shop tested. Tests shall be performed at the supplier's service shop. Provide advanced notification to allow, at the District's option, to witness the test. The District shall be notified at least two weeks prior to the proposed testing dates. The supplier's shop shall be a facility which is located within 150 miles of the installation site.
- B. The supplier shall have successfully performed their own quality assurance adjustments, tests and checks prior to requesting the witnessed shop tests. The purpose of the witnessed shop test shall be to demonstrate unit performance and conformance with all Contract requirements and shall not be utilized to perform routine adjustments or modifications to the unit.
- C. Shop tests for the system shall be sufficient to demonstrate that the system will operate successfully and meet all specified operational requirements.
- D. The supplier shall furnish all necessary instruments, starting air, fuel, cooling water, electric power, and load banks for the test.
- E. During shop testing, all automatic safety and shutdown devices shall be tested, and their respective activation points shall be recorded.
- F. Voltage and frequency regulation and transient response shall be tested and recorded to show full compliance with this Section. Display graphs of the response upon application of the generator rated load in a single step shall be submitted with the test documentation. The graphs shall be annotated to indicate the calibration of each axis. The transient response shall be demonstrated and recorded a minimum of three times. The initial transient test shall be performed with a cold engine. The final transient test shall be performed on the engine at the completion of the four-hour load test.
- G. Secondary factory testing shall be performed on any the Generator assembly incorporating the custom weatherproof enclosure to ensure the assembly performs as expected.
- H. The Shop Test shall consist of, but not be limited to, four continuous hours of operation. During the Shop Test, readings shall be taken and recorded every thirty minutes for each of the following parameters at a minimum:
 1. Time
 2. Ambient temperature
 3. Under no load conditions: Volts for each phase
 4. Under loaded conditions:
 - a. Amps for each phase
 - b. Voltage for each phase
 - c. kW
 - d. Power factor
 - e. Frequency
 - f. Engine jacket water temperature
 - g. Cooling water temperature (in and out)
 - h. Lubricating oil pressure

- i. Lube oil temperature
 - j. Exhaust gas temperature
 - k. Gallons of fuel consumed per hour
 - l. Transient voltage dip and response
 - m. Voltage and current balance
- I. Shop tests shall include verification of network communication and parameter delivery. Provide suitable equipment such as laptop, cables, terminators, programming, and auxiliary equipment to allow verification of the communication scheme. Verification of all alarm, status, and shutdown points specified and fuel tank level shall be included at a minimum.
 - J. Shop tests shall include sound tests.
 - K. After completion of the Shop Test, the supplier shall perform the following:
 - 1. The load limit shall be sealed. The seal shall be applied, using a seal press which embosses the manufacturer's initials on the lead seal.
 - 2. All entrapped water shall be drained, and protection applied to prevent the entry of water during shipment or a long period in storage while waiting for installation.
 - 3. The diesel generator shall be given proper treatment for its protection for extended storage while waiting for installation.
 - L. Certified test records for the generator system shall be submitted to the District for review. Systems shall not be shipped to the installation sites unless results have been given 'No Exceptions Noted' or 'Make Corrections Noted' status. The testing shall be repeated, and certified results resubmitted for review at no extra cost to the District as often as necessary for the test results to be considered 'No Exceptions Noted' or 'Make Corrections Noted' by the District.
 - M. Beginning at the time when the Shop Tests have been completed and favorably reviewed, the supplier shall make the generator sets available for delivery to the Contractor. The supplier shall reserve the tested equipment for installation at the required District facilities and shall not sell any tested systems.

3.03 INSTALLATION

- A. The equipment shall be installed by the Contractor in accordance with the final submittals and the Contract Documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL-listed products.
- B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the backup power system. The Contractor shall also perform interconnecting wiring between equipment sections when required, under the supervision of the equipment supplier.
- C. The equipment shall be installed on concrete housekeeping pads. The equipment shall be anchored to the pad in accordance with manufacturer's instructions and specified requirements.

- D. The equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as recommended by the manufacturer following review by the Engineer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- F. On completion of the installation by the Contractor, the manufacturer shall conduct a site evaluation and certify that the equipment is installed per manufacturer's recommended practice.

3.04 FIELD START-UP AND TESTING

- A. Field start-up and testing shall be provided for the diesel-engine-driven generator sets by the manufacturer. Field start-up and testing will be a joint effort with the Contractor as necessary to assure that the system functions as specified. All tests shall be performed in the presence of the District.
- B. After the supplier's field service technician's check of the installed system, the generator sets shall be tested to demonstrate its ability to operate continuously without vibration, jamming, leakage, or overheating and to perform specified functions. During start-up and operation, the Contractor shall comply with the manufacturer's operating and maintenance instructions.
- C. The Field Test shall consist of two separate steps, the generator set Load Test and the Backup Power System Test. The Load Test shall demonstrate the capability of the installed diesel generator and related systems to produce rated power and operate in accordance with manufacturer's recommendations. The Backup Power System Test shall demonstrate the capability of the installed diesel generator to function as a part of the backup power system.
 - 1. Load Test
 - a. A cold start test shall be performed for validation of the generator starting system, load readiness, and operation of starting aids i.e., coolant heater, lube oil heater, and other related items.
 - b. Full load acceptance and operation testing shall be performed to validate that the generator can achieve full nameplate rating in one step and achieve acceptable steady-state operation. The test duration shall be for two continuous hours at the full-rated load of the generator. If required, the supplier shall supply a portable resistive load bank for this test.
 - c. During the test, all parameters recorded during the Shop Test shall be taken and recorded at 30-minute intervals.
 - d. During the test, all the automatic shutdown devices shall be retested, and the actuation values shall be recorded. Field adjustments shall be made as required to make the operating values correspond to those recommended by the generator set manufacturer and as recorded during the Shop Test.
- D. Power System Test
 - 1. After the field Load Test has been completed, additional testing shall be performed by the supplier to demonstrate the backup power system's ability to meet the motor starting

requirements. Field testing to demonstrate generator automatic start, load stepping, and load transfer shall be performed by the Contractor at the same time. Baseline performance deviations in frequency and voltage deviations at various step loads shall be tested and noted.

2. Generator set shall be tested by the supplier to demonstrate the automatic startup, transient response, load carrying, cool down and shutdown modes of operation.
 3. The supplier shall test the network communication link from the diesel-engine-driven generator sets as described under Shop Test. Test shall include positive proof of delivery if all status and alarms to the District SCADA system site RTU as specified.
- E. Provide a pressure test port with threaded plug in the double-wall piping termination fitting of the double-wall fuel oil line or tank. Containment structures and piping shall be subjected to an air test of 10 psig with a zero allowable leakage rate.
- F. Field tests shall include vibration tests.
- G. If the backup power system fails to fulfill the performance requirements of this specification, corrective action shall be taken, and the system retested to assure full compliance. Expenses associated with the field tests, including any corrective action, shall be at no additional cost to the District.
- H. The Contractor shall be responsible for all fuel and other fluids required by the diesel-engine-driven generator sets for the field tests and shall refill the tank upon completion of testing.
- I. Perform sound testing on the fully-assembled product as it is installed on site.

3.05 TRAINING

- A. Training for the diesel-engine-driven generator sets shall be complete as a condition for Substantial Completion.
- B. Training shall include at a minimum, 4 hours of instruction delivered as two classes to allow for attendance by shift personnel. The training shall include how to operate the generator set and all equipment related to the generator including the switchover equipment. Maintenance instructions shall be included in the training session. Location for the training shall be held at the generator installation location and coordinated with the District.

TABLE 26 32 13-A

A1/A2 Reservoir and B/C Booster Pump Station Booster Station F Standby Generator Requirements

Equipment Requirement	Booster F Pump Station
Rating	277/480 V ac, 0.8 PF, 3 phase, 4-wire
Load Step 1	Ancillary Station Loads: <ul style="list-style-type: none"> • 5 kVA, 3-phase, misc. Station F loads • Exhaust Fan: 1.5 HP • 5 kVA, 3 phase, misc. Chlorination Bldg loads
Load Step 2	Booster F Pump 1, 150 HP RVAT Starter: Siemens, Size 5, wiring diagram: 25-306-564-415
Load Step 3	Booster F Pump 2, 150 HP RVAT Starter Siemens, Size 5, wiring diagram: 25-306-564-415
Estimated Generator Rating	300 kW
Maximum Sound Level	74 dBA at 23 feet
Fuel Tank Capacity	24 hours at 75% average load (660 gallons maximum)

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a complete lighting system ready for operation as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Lighting fixture types referenced on the Drawings and associated descriptions are included under Appendix 26 50 00-A – Lighting Fixtures.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 30 00 and Section 26 05 00.
- B. The submittals shall contain the following product information as a minimum:
 - 1. Fixtures: Manufacturer, model number, materials of construction, finish type and color, total fixture wattage (ballast plus lamp), mounting hardware.
 - 2. Drivers: operational and control features, total harmonic distortion, power factor.
 - 3. Lamps: Manufacturer, model number, wattage, color temperature, color rendition index, mean lumen output, rated life.
 - 4. Fixture photometric data in ANSI/IESNA LM-63-02 standard format.
- C. All light-emitting diode (LED), fluorescent fixtures (except compact fluorescent), and ballasts shall be provided with certification from the manufacturer that they bear the Environmental Protection Agency (EPA) and the Department of Energy (DOE) ENERGY STAR® label and California Code of Regulations (CCR) Title 20 self-certification.
- D. LED fixture submittals shall include manufacturer's standard LED Lighting Facts label.

1.04 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. C78.377 – Specifications for the Chromaticity of Solid-State Lighting Products
 - 2. ANSLG C82.11 – High-Frequency Fluorescent Lamp Ballasts
 - 3. ESD S20.20 – Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
- B. California Code of Regulations (CCR)
 - 1. Title 20 – Public Utilities and Energy

2. Title 24 – California Building Standards Code
 - a. Part 1 – California Administrative Code
 - b. Part 6 – California Energy Code

- C. California Energy Commission (CEC)
 1. Building Energy Efficiency Standards – Title 24 Parts 1 and 6
 2. Department of Energy (DOE) Determination: The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1

- D. DesignLights Consortium (DLC)
 1. Product Qualifications Criteria
 2. Qualified Products List

- E. Environmental Protection Agency (EPA)
 1. Energy Star for Luminaires Version 2.0

- F. Federal Communications Commission (FCC)
 1. Code of Federal Regulations (CFR), Title 47- Telecommunication, Part 15 – Radio Frequency Devices

- G. Illuminating Engineering Society of North America (IESNA)
 1. ANSI/IESNA LM-63-02 – ANSI Approved Standard File Format for the Electronic Transfer of Photometric Data and Related Information
 2. National Electrical Contractors Association (NECA)/IESNA 500 – Standard for Installing Indoor Lighting Systems

- H. Institute of Electrical and Electronics Engineers (IEEE)
 1. IEEE C62.41.2 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
 2. IEEE 1789 – IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers

- I. International Electrotechnical Commission (IEC)
 1. IEC 61000-4-2 – Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test

- J. National Electrical Manufacturers Association (NEMA)
 1. SSL 1 – Electronic Drivers for LED Devices, Arrays, or Systems

- K. National Fire Protection Association (NFPA)
 1. NFPA 70® – National Electrical Code®
 2. NFPA 101® – Life Safety Code®

- L. Underwriters Laboratories Inc. (UL)
 1. UL 924 – Standard for Emergency Lighting and Power Equipment
 2. UL 1310 – Standard for Class 2 Power Units
 3. UL 1598 – Luminaires

4. UL 1598C – Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
5. UL 8750 – Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. Company with not less than ten years of experience manufacturing luminaires, dimming ballasts, dimming drivers, and lighting control systems.
 2. ISO 9001 certification, including in-house engineering for product design activities.
 3. Manufacturing facility employing electrostatic discharge reduction practices in compliance with ANSI/ESD S20.20 or equivalent.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.07 SPARE PARTS AND MAINTENANCE

- A. All spares shall be delivered in manufacturer's packaging suitable for protection from damage during long-term storage.
- B. Lenses and Louvers: 5 percent of total quantity but not less than one of each type provided.
- C. Extra Lamps: 10 percent of total quantity but not less than one of each type provided.
- D. External Drivers: 5 percent of total quantity but not less than one of each type provided.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All lighting fixtures shall be in accordance with the National Electrical Code (NEC) and shall be constructed in accordance with the latest edition of the applicable Underwriters Laboratories Inc. (UL) standards. All lighting fixtures shall be UL labeled.
- B. Drivers and lamps shall comply with the requirements of the National Energy Policy Act.
- C. Provide products listed and classified by UL as suitable for the purpose specified and indicated.
 1. Provide products that are listed and labeled as complying with UL 1598, where applicable.
 2. LED Luminaire Components: UL 8750 recognized or listed as applicable.

- D. All devices shall comply with FCC requirements as listed in CFR, Title 47, Part 15 for commercial applications.
- E. All LED products shall bear the LED Lighting Facts label.
- F. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- G. Provide all ancillary hardware required including conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- H. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc. for the location and service specified and shown on the Drawings.
- I. Emergency Power Supply Units: Suitable for use with indicated luminaires, complying with NFPA 101 and applicable state and local codes, listed and labeled as complying with UL 924.
- J. Ballasts, drivers, lamps, and controls shall comply with applicable portions of the California Code of Regulations (CCR) Titles 20 and 24.

2.02 MATERIALS

A. Lighting Fixtures

- 1. Lighting fixture types shall be furnished as required by the Lighting Fixtures descriptions in Appendix 26 50 00-A. The catalog numbers are given as a guide to the design and quality of fixture desired. Equivalent designs proven with reviewed and approved calculations and equal quality fixtures of other manufacturers will be acceptable upon approval by the Engineer.
- 2. All LED fixtures and luminaires shall be listed on the DesignLights Consortium (DLC) Qualified Products List.

B. Lamps

- 1. Light-Emitting Diode (LED) Lamps
 - a. Initial LED Lumen Output: 100 percent rated lumen output as specified on the Drawings
 - b. Light Output Depreciation Category: Category 1, Initial at 90%, 25% rated life
 - c. Failure Fraction: F10 (10%)
 - d. Color Temperature:

Correlated Color Temperature (CCT) Per ANSI C78.377	
Nominal CCT (K)	Allowable Tolerance (K)
2700	2725±145
3000	3045±175
3500	3465±245
4000	3985±275

4500	4503±243
5000	5028±283
5700	5665±355
6500	6530±510

- e. Minimum Color Rendering Index Value: 80
- f. Maximum Color Rendering Index Value Shift: 10%
- g. Power Factor: 85% minimum
- h. Indoor Fixture Ambient Operating Temperature Rating/Range: 25 °C / 0 °C to 40 °C
- i. Outdoor Fixture Ambient Operating Temperature Rating / Range: 15°C / -15 °C to 40 °C
- j. LED lamps shall be manufactured by Cree, Samsung, Nichia Corporation, Luma LEDs, or equal.

C. LED Fixture Drivers

1. Provide constant-current or constant-voltage drivers compatible with the selected fixture rated for operations for a minimum of 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
2. Provide thermal protection with automatic power output reduction to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions. Reduction shall be applied when temperatures approach or exceed the LED driver's maximum operating temperature at calibration point.
3. Protective Features
 - a. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2 or equivalent.
 - b. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
 - c. Meet NEMA 410 inrush requirements for mitigating inrush currents with solid-state lighting sources.
 - d. Employ integral fault protection and overvoltage protection up to 277 V for constant-voltage type; provide short-circuit, open-circuit, and overload protection for constant-current type.
4. UL Type TL rated or UL Class P listed where specified. Suitable for field replacement as applicable; listed in accordance with UL 1598C or UL 8750; Class P where specified.
5. Class A Sound Rating: Inaudible in a 27 decibels (dBA) maximum ambient.
6. No visible change in light output under a variation of plus or minus 10 percent change in line-voltage input.
7. Provide LED drivers designed to evenly track across multiple fixtures of the same family or series at all light levels. UL Class 2 output suitable for hot swap of LED lamps.
8. 3-Wire Control: Provide integral control circuitry where specified. Control operation shall be from input voltage of 120 V through 277 V at 50/60 Hz.
9. Dimming type where specified in the Lighting Fixtures descriptions. Provide dimming range 100 to 1 percent measured output current unless otherwise specified. Provide pulse width modulation (PWM) output dimming frequency meeting IEEE 1789 requirements or constant-current reduction method.
10. Paired with LEDs and rated at least 20 percent greater than the maximum wattage rating of the driven fixture.

11. Meet requirements for solid-state devices for power factor, transient protection, power consumption, start time, and operating frequency per Energy Star Luminaires. Total harmonic distortion less than 20 percent at maximum power.
- D. Flexible Fixture Hangers: Flexible fixture hangers used in non-hazardous areas shall be type ARB and flexible fixture supports used in hazardous areas shall be type ECHF as manufactured by Crouse-Hinds by Eaton; Appleton, Hubbell-Killark, or approved equal.
- E. Emergency Lighting Battery Units
1. Emergency lighting units and remote lighting heads shall be as specified in the Lighting Fixtures descriptions and as shown on the Drawings.
 2. Provide units conforming to UL 924.
 3. Battery units shall be of the self-contained, full- automatic type with sealed lead-acid batteries, voltmeters and time delay relays where used in high-intensity discharge (HID) lighted areas. Batteries shall be sized to provide 90 minutes minimum of lighting.
 4. Unit enclosures shall be compatible with their environment.
 5. All necessary mounting hardware shall be provided.
- F. Emergency Exit Lighting and Signage
1. Emergency exit lighting and signage shall be installed at designated locations shown on Drawings.
 2. Emergency lighting fixtures in process and industrial areas shall be self-powered units with corrosion-resistant enclosures rated NEMA 4X, temperature compensated, sealed 12-Volt maintenance-free nickel-cadmium (NiCad) batteries, high-intensity incandescent light source, battery charger with LED indicator light, sealed push-to-test switch, and time delay.
 3. Emergency exit signs for non-process or non-industrial areas shall be similar, except with NEMA 1 enclosures.
 4. Provide units conforming to UL 924.
 5. Emergency exit signs shall utilize LED-style lights for illumination.

2.03 LIGHTING CONTROL DEVICES

- A. Photocells
1. The photocells shall be suitable for power duty with individual fixtures or for pilot duty with contactors as detailed on the Drawings. Enclosures shall be NEMA 3R or 4. Contacts shall be rated for 1800 VA continuous at 120 Volts. On-off light levels shall be adjustable with adjustable delay of up to two minutes. Orient eye to the north. Adjust the unit to turn on at 1.5 footcandles and off at 5.5 footcandles with a 30-second delay.
 2. Photocell shall operate on 120-Volt power input.
 3. Photocells shall be TORK Photocontrols (NSi Industries) or approved equal.
- B. Exterior Motion Sensors
1. Provide fixture motion sensors suitable for exterior mounting as part of the pole-mounted fixtures. Provide exterior motion sensors as shown on the Drawings and per the Lighting Fixtures descriptions for installation as part of the pole-mounted fixtures. Provide UL listed switch suitable for wet locations rated for 120 VAC. Provide sensor compatible with relay pilot operation for control of groups of fixtures from a common control panel.

Control scheme shall be as shown on the Drawings. Motion sensor shall have 360-degree detection pattern and adjustable time delay nominally from 5 seconds to 15 minutes.

2. Provide motion sensors as manufactured by RAB Lighting or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Each fixture shall be a finished unit with all components, mounting and/or hanging devices necessary for the proper installation of the specific fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.
- B. Interior installations shall be in accordance with IESNA 500.
- C. Coordinate the installation of luminaires with mounting surfaces as shown on the Drawings. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
- D. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts provided under other sections.
- E. All flush-mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.
- F. Install luminaires plumb and square, aligned with building lines and with adjacent luminaires. Provide extension rings to bring outlet boxes flush with finished services.
- G. Flexible fixture hangers shall be used for all pendant-mounted fixtures. Fixtures two feet long and larger shall be supported with a minimum of two fixture hangers. Pendant fixtures shall be supported from rigid conduit. The use of threaded rods is not acceptable. Provide separate grounding conductor connected to a ground bushing or lug in the outlet box.
- H. Fixture locations are shown on the Drawings in approximate locations; however exact locations shall be coordinated in order to avoid conflicts with heating ventilation and air conditioning (HVAC) ducts, equipment and other obstacles.
- I. Photocells shall be mounted facing north and in a location that is unaffected by light fixture sources.
- J. Motion sensors shall be mounted and configured to track motion in main egress locations or in areas as necessary for ensuring site security.

3.02 AJUSTMENT

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by the Engineer. Adjust luminaires to avoid glare and light leakage to areas outside of the facility property lines.

3.03 STARTUP

- A. Operate each luminaire after installation to verify proper operation.
- B. Test emergency power supply units to verify proper operation upon loss of power. Replace drivers or ballasts that exceed the manufacturer's rated noise levels or that exceed project-specified noise limits.
- C. Protect installed luminaires from subsequent construction. Replace any damaged or failed lamps prior to substantial completion.
- D. All lamps used during construction, except for LED lamps, shall be removed and replaced with new lamps two weeks from completion of the work.

3.04 CLEANING UP

- A. Plastic dust cover bags that are provided with new parabolic reflector lighting fixtures shall be removed after all construction activity that may cause dust formation on reflector surfaces has been completed.
- B. Clean surfaces according to IESNA 500 and manufacturer's instructions to remove dirt, fingerprints, paint, foreign spatter or materials. Restore finishes to match original factory finish. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

END OF SECTION

APPENDIX 26 50 00-A

LIGHTING FIXTURES

Note: Fixture letter designations used in this Appendix are referenced on the Drawings. The manufacturer and part numbers listed are intended as a guide to the Contractor and are not intended to preclude selection and use of equivalent fixtures made by an alternative manufacturer.

APPENDIX 26 50 00 - A

Fixture Type: A

Indoor/Outdoor Channel Luminaire - LED

General: Indoor channel lighting fixture, power coat finish, gasketed, precision molded acrylic lens night time friendly. Certified to UL 1598 & UL 2108, IP65.

Description:

Manufacturer and Model:

Hubbell: Columbia Type LXEM with accessories and features as noted or approved equal.

Lamp Type:

4000K LED, ~10000 Lumens

Ballast Type:

LED Light Engine

Mounting Arrangement:

Ceiling, surface or pendant mount as required. Length as shown on Drawings.

Input:

Max Wattage (including ballast):

100 W

Voltage:

120 VAC

Notes:

1. Operating ambient temperature range of -20 to 50°C or better.
2. Wide light distribution.
3. Provide battery backup system where indicated as an emergency egress lighting fixture on Drawings. Integral battery backup system shall include charger, charging indicator light, status indicator, and test switch. Battery shall support fixture for a minimum of 1-1/2 hours.
4. Length of fixture is 4'.

Fixture Type: B

Indoor Wall Luminaire - LED

General: Exterior wall mounted LED lighting fixture, power coat finish, precision molded acrylic lens night time friendly, CSA certified to U.S. standards.

Description:

Manufacturer and Model:

Lithonia: CSXW LED with accessories and features as noted or approved equal.

Lamp Type:

4000K LED, 7068 Lumens

Driver Type:

LED Light engine, 0-10V, dimmable

Photoelectric Cell

Mounting Arrangement:

Wall mount

Input:

Max Wattage (including ballast or driver):

65W

Voltage:

120 VAC

Notes:

1. Operating ambient temperature range of 0 to 40°C or better

Fixture Type: C

Indoor Self-Contained Emergency Battery Powered Light Fixture - LED

General: Emergency lighting unit. Integral battery backup system with charger, charging indicator light, status indicator, and test switch. Constructed for indoor damp locations. Certified to UL 924.

Description:

Manufacturer and Model:

Lithonia: Type EU2-LED with accessories and features as noted or approved equal.

Lamp Type:

(2) 2.8W LED lamp heads

Ballast Type:

LED Light Engine

Mounting Arrangement:

Wall mount.

Input:

Max Wattage (including ballast):

10 W

Voltage:

120 VAC

Notes:

1. Operating ambient temperature range of 0 to 50°C or better.
2. Unit shall be capable of operating for a minimum 1-1/2 hour on internal battery.

Fixture Type: D

Indoor/Outdoor Emergency Exit Sign - LED

General: Emergency exit sign. Integral battery backup system with charger, charging indicator light, status indicator, and test switch. Constructed for indoor damp locations. Red sign color. Certified to UL 924.

Description:

Manufacturer and Model:

Lithonia: Type LQC with accessories and features as noted or approved equal.

Lamp Type:

LED (Light Emitting Diode)

Ballast Type:

LED Light Engine

Mounting Arrangement:

Top, back, or side mount as required.

Input:

Max Wattage (including ballast):

1 W

Voltage:

120 VAC

Notes:

1. Operating ambient temperature range of 10 to 40°C or better.
2. Unit shall operate for a minimum of 1-1/2 hours on internal battery.

Fixture Type: E

Outdoor Architectural Area Lighting - LED

General: Area LED fixture with rugged, die-cast, single-piece aluminum housing. Die-cast doorframe with impact-resistant, tempered glass lens, fully gasketed with one-piece tubular silicone. Corrosion-resistant and weatherproof exterior coating, dark bronze finish. UL Listed.

Description:

Manufacturer and Model:

Eaton: McGraw-Edison Type GLEON LED with accessories and features as noted or approved equal.

Lamp Type:

4 light squares, 4000K LED, ~22000 Lumens

Driver Type:

LED light engine, 0-10V, dimmable

Field adjustable output

Integral photocell

Normal dim (low output) on initial photocell activation

High output override on motion detection.

Mounting Arrangement:

Pole mount

Input:

Max Wattage (including ballast or driver):

240 W

Voltage:

120 VAC

Notes:

1. Operating ambient temperature range of -40 to 40°C or better.
2. Photocell control: normal dim (low output).
3. Motion detector for high output override.
4. Round aluminum pole with height as shown on drawings and finish to match luminaire, designed to withstand 90 mph steady winds, hinged for ease of maintenance.
5. Pole mounting hardware.
6. Type II light distribution.

SECTION 26 42 00

CATHODIC PROTECTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. A sacrificial anode cathodic protection system shall be designed and installed in each water tank according to the requirements of AWWA Standard D106. The system shall be designed and installed by a cathodic protection contractor. The work of the cathodic protection contractor shall include all engineering services, materials, equipment, labor, and supervision for the installation of a galvanic sacrificial anode cathodic protection system to provide corrosion control for the interior submerged surface of the tank.
- B. Tank contractor shall coordinate with the cathodic protection contractor. Locations of access openings for vertical anode suspension shall be coordinated.
- C. All work furnished shall be in accordance with N.A.C.E. Standard RPO196 and ANSI/NSF 61.
- D. Cathodic protection contractor shall have expertise in the design and installation of galvanic sacrificial anode cathodic protection systems in potable water carbon steel tanks and have the following qualifications:
 - 1. The system shall be designed by a corrosion specialist with experience in cathodic protection for water storage tanks. Corrosion specialist shall be accredited by the national association of corrosion engineers international as a senior corrosion technologist, corrosion specialist or cathodic protection specialist. An affidavit of compliance with all applicable provisions of AWWA D106 signed by corrosion specialist and the installer shall be provided to the Owner.
 - 2. The constructor shall have a minimum of five (5) years experience installing and servicing the types of system described in this specification. The system shall be installed by personnel specifically trained by the constructor to provide all workmanship required for corrosion control performance.

1.02 DESIGN CRITERIA

- A. The criteria for protection shall be based on a tank-to-water potential within a range of -0.850 volts to -1.050 volts relative to a copper-copper sulfate reference electrode. The corrosion specialist shall also base system capacity and performance on:
 - 1. Total submerged surface area of the tank to the MOL (Maximum Operating Level).
 - 2. Type of coating and condition of coating. Total bare surface area to be protected will be a minimum of 2% of total submerged surface area.
 - 3. Minimum current density of 3.0 mA/ft² bare surface area.
 - 4. Chemical analysis of water including resistivity expressed in ohm-cm.
 - 5. Minimum anode design life of ten (10) years.
 - 6. Selection, dimensions, and layout of system components specified herein.

1.03 SUBMITTALS

- A. Submit the following information for approval by the Owner:
 - 1. Drawings showing system design/configuration.
 - 2. Description of system components.
 - 3. Copy of ANSI/NSF 61 classification for all system components located within the tank.
 - 4. Design calculations for required voltage, amperage & life expectancy.
 - 5. Owner's maintenance manual.
 - 6. System "as-built" drawings

1.04 REFERENCES

- A. AWWA D106 - Sacrificial Anode Cathodic Protection Systems for the Interior Submerged Surfaces of Steel Water Storage Tanks
- B. NSF International
 - 1. NSF/ANSI 61—Drinking Water System Components

PART 2 - MATERIALS

2.01 GENERAL

- A. All materials in contact with the water or exposed to the interior of the tank shall be certified in accordance with ANSI/NSF 61 drinking water system components. Contractor shall submit copies of company registration and materials certificate to the owner verifying ANSI/NSF 61 system components classification.
- B. The anode materials shall be selected in accordance with the design criteria specified herein and AWWA D106 and shall consist of one of the following:
 - 1. Extruded galvorod magnesium alloys with a steel core.
 - 2. Extruded galvomag magnesium alloys with a steel core.
 - 3. Cast magnesium alloys with a steel core.
- C. The anode suspension system shall be vertically suspended from the roof of the tank. The anode lead wire shall be a minimum #8 AWG HMW-PE and will be used to secure the anode to a galvanized steel clevis insulator bracket bolted to the interior tank roof. Handhole cover assemblies used for the installation of vertical anode suspension systems from the roof of the tank shall consist of a cadmium plated 6" diameter cover, rubber gasket, clamping bar and stainless steel bolt assembly.
- D. The permanent reference electrode shall consist of a copper-copper sulfate electrode which is manufactured to remain stable (plus or minus 10mV) for minimum of twenty (20) years. The reference electrode to lead wire connection shall be encapsulated to prevent water migration. The reference electrode shall be positioned within the tank to provide the most representative measurements for the submerged surface areas.

2.02 TEST BOX

- A. The test box shall include:
 - 1. Calibrated type "SW" 2 amp, 200mV Holloway shunt for current verification.
 - 2. Variable 100 ohm, 100 watt rheostat to adjust current output
 - 3. High resistance 3.5 digital LCD display and push to read selector switch to monitor tank-to-water voltage potential and anode current.
 - 4. 9 volt DC battery.
 - 5. Reference electrode selector switch for primary and test cells.
 - 6. Screw type wire terminals.
 - 7. NEMA 4X rated fiberglass enclosure w/ SS hinge and latch suitable for padlock.

2.03 WIRING

- A. All wiring within the tank shall be insulated to prevent copper conductor to water contact. All wiring on the exterior of the tank shall be insulated and run in rigid conduit.

2.04 HARDWARE

- A. All hardware used in conjunction with the system shall be protected against corrosion.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Components of the cathodic protection system shall be installed in the manner and at the locations as shown on the design drawings prepared by the corrosion specialist.
- B. Pressure entrance fitting shall be installed in accordance with AWWA D100.
- C. Welding, cutting, and coating shall be in accordance w/ AWWA Standards D100, D102 & D652.
- D. The cutting of 5 inch diameter access openings for vertical anode suspension shall be performed by the tank contractor prior to tank coating. The cathodic protection contractor shall furnish drawings and materials to the tank contractor prior to coating. Access opening edges shall be completely coated as specified in the project specifications.
- E. Materials and equipment shall be inspected prior to installation. Any defective component shall be repaired or replaced.
- F. Electrical work shall be in accordance with the national electrical code.
- G. Lead wires shall be installed to prevent damage from abrasion.
- H. Electrical connections within the tank shall be sealed to prevent water migration.
- I. The test station shall be mounted at a location and height approved by the Owner.
- J. Work provided by the constructor shall be completed in a clean and safe manner.

3.02 SYSTEM START-UP

- A. After the system is installed and the tank is filled following the first-anniversary inspection of the tank coating, the cathodic protection contractor shall provide start-up service which includes energizing, testing, and adjusting the system for optimum performance of the cathodic protection system. This start-up service shall be in performed in accordance with AWWA D106 Section 5.2 testing. Start-up service shall be coordinated with the owner.
- B. All tank-to-water potential measurements shall be conducted with a calibrated portable copper-copper sulfate reference electrode and a portable high impedance voltmeter. A minimum of five (5) locations shall be measured. All test data shall be reviewed and evaluated by the corrosion specialist and the Owner's corrosion contractor. Cathodic protection contractor shall coordinate with the Owner's corrosion contractor. The final test and adjustment of the system shall be conducted approximately twelve (12) months after the start-up service.
- C. Coordinate the final test schedule with the one-year coating inspection.

3.03 WARRANTY AND MONITORING

- A. All workmanship, equipment, and materials furnished by the cathodic protection contractor shall be guaranteed for a one (1) year warranty period following the first-anniversary inspection of the tank coating. The cathodic protection contractor shall furnish report cards to be completed by the owner during the warranty period. Report cards received by the cathodic protection contractor shall be evaluated for system performance with the evaluation furnished to the owner.
- B. At the conclusion of the warranty period, the cathodic protection contractor shall update the owner's maintenance manual with any recommendations for optimizing corrosion control.

END OF SECTION

SECTION 28 21 00

CCTV SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. A Security System Supplier (SSS) shall furnish all materials, equipment, labor and services required to achieve a fully integrated and operational Closed Circuit Television (CCTV) surveillance camera system specified in these Specifications.
- B. The SSS shall provide new security surveillance cameras at Reservoir A1/A2 site for monitoring and review at the District's headquarters as shown on the Drawings. The SSS shall be responsible for programming, configuration, and integration of the equipment specified in these Specifications including interfaces, storage, recording, and management system.
- C. The Drawings and Specifications are not intended to be a complete listing of all components required for the system. Location and type of devices required as shown on Drawings are approximate only. The SSS shall locate and provide the applicable CCTV devices as required for suitable visual coverage at each location.
- D. All auxiliary and accessory equipment necessary for system performance in compliance with the applicable codes shall be provided even if not specifically detailed on the Drawings or in these Specifications.
- E. Preparation and submittal of detailed, project specific installation drawings (including but not necessarily limited to mounting, interconnection, wiring type details, supportive calculations, etc.) shall be included as a part of this work. This includes preparation of drawings and information, submittal, discussions, testing, repairs and retests, and coordination needed to secure approvals from the District.
- F. The SSS shall ensure that all equipment of the system is furnished, installed and connected in accordance with the manufacturer's instructions.

1.02 RELATED SECTIONS

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 05 19 – Low Voltage Conductors and Cables
- C. Section 26 05 33 – Raceways and Boxes
- D. Section 40 62 00 – SCADA System Hardware and Software
- E. Section 40 67 00 – Control Panel Hardware

1.03 SUBMITTALS

- A. All submittals shall be in accordance with the Section 01 30 00.

- B. Shop Drawings: Shop Drawings shall be numbered consecutively and shall accurately and distinctly present the following information:
1. Title Sheet
 2. Plans: Showing all devices, pull boxes, cabinets, conduits and conductors in their proposed locations
 3. Riser Diagram: Showing all conduit relationships between devices shown on the Plans. Show all power sources including panel identification and circuit number.
 4. Single-Line/Block Diagrams: Show system architecture and signal relationships of controls, processors and head-end devices within the system.
 5. Necessary details, including complete information for making connections between work under this Section and work completed under other related Sections under this Contract.
- C. Equipment Submittals
1. Submit parts list, for proposed equipment, materials, components and devices, listing the following information for each line item:
 - a. The system type,
 - b. Model number,
 - c. Project quantity,
 - d. Specification sheet page reference
 2. Organize the data sheets in the same order as they are listed in this Section.
 3. Submit manufacturer's specification sheet with descriptive information for equipment, materials, components and devices. Number each page, to correspond with the Parts List.
 4. Clearly delineate (with highlighter, arrow, or underline) on each specification sheet, which model numbers, options and configurations are being proposed for this Project.
 5. Include materials and finishes for all equipment.
- D. Software Submittal
1. Submit details for access and system management software. Submit cut sheets and descriptive literature clearly indicating all features and options to be provided under this Contract.
 2. Submit software licensing documentation indicating that the District shall be the holder of the software license for all software provided under this Contract.
 3. Submit programming and configuration details for the surveillance system. Submit programming for both local interfaces and central workstation located at the District's headquarters.
- E. Acceptance Testing Plan:
1. Submit a written document detailing the test procedures to be followed by the SSS in evaluating and proving the installed systems are properly wired and functional.
 2. Provide a sample of the test forms to be used for each system and for each component of each system. Test forms shall include signoff areas for each test procedure and include the SSS lead technician, Contractor's Representative, and the District.
 3. Include all tests recommended by the equipment manufacturer and as specified in this Section.

1.04 REFERENCE STANDARDS

- A. Work under this Section shall conform to:
 - 1. NFPA 70 – National Electrical Code.

1.05 SYSTEM DESCRIPTION

- A. Security Surveillance: Provide new video surveillance cameras as shown on plan Drawings to integrate into the central video system server (VSS). Cameras shall communicate with the local digital video recorder and remotely to the central video management system via Internet protocol (TCP/IP) Ethernet communication or Modbus TCP over District radio based broadband network.
 - 1. The integration with the VSS shall include, but not be limited to, remote operation of Pan/Tilt/Zoom (PTZ) camera and automatic camera positioning upon motion detection or other trigger events
 - 2. Remote or automatic initiation of digital recording.
 - 3. Provide all programming and configuration of the system software.
 - 4. All video cameras shall include the use of PTZ color cameras.
- B. Provide all ancillary equipment necessary to provide a complete and operating system, and meet the full intent of this design and other specifications within these construction documents whether specifically specified or not. Any equipment such as consumables, terminators, jumpers, interposing relays, hardware fittings, or any other materials or equipment needed to install this system shall be considered ancillary and be provided as a part of this project. The SSS shall provide cable for all security systems and integration of the sub-systems. Cable shall be provided in accordance with manufacturer specifications for the equipment it is terminating to.

1.06 FINAL DOCUMENTATION

- A. In accordance with Section 01 30 00
- B. Provide final documentation, operations, and maintenance manuals for all equipment furnished.
- C. Provide as-built site, riser, and panel drawings for the final installed system.
- D. Provide complete electronic backup of the final, configured digital video recorder and VSS workstation on suitable mass storage device.

1.07 PROJECT/SITE REQUIREMENTS

- A. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 100 feet above mean sea level.
- B. Temperature:
 - 1. Outdoor area equipment shall be suitable for operation at temperatures from 32° to +100° F degrees ambient.
 - 2. Interior area equipment shall be suitable for operation in conditioned spaces from +50° to +100° F degrees ambient

3. Storage temperatures shall range from -0° to 120° F degrees ambient minimum.
 4. Additional cooling or heating shall be furnished by the SSS under the Contract Price if required to conform to the indicated operating or storage temperatures as specified in these Specifications.
- C. Relative Humidity: Equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
 - D. Power Supply: 120 volts AC sources of electrical power supply shall be from control panel UPS power source provided under Section 40 62 00.
 - E. Cable installation, identification and termination shall be performed in accordance with manufacturer's installation manuals in addition to applicable codes. In the absence of manufacturer's recommendations on conductor applications, the Contractor shall provide cable in accordance with Section 26 05 19 and ensure that the cable selected meets all technical requirements of the location of its installation, and of the equipment to be installed.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All cameras shall be IP camera technology with final connection to the District network switches at the Reservoir A1/A2 site.
- B. All CCTV cameras shall be capable of being powered by power over Ethernet (PoE) technology. PoE power for surveillance cameras shall originate from the SSS provided equipment or network switches as required.
- C. All cameras shall use unshielded twisted pair (UTP) cable for signal transport. Camera video signals and power shall be via the same cable. Cameras that require greater power than can be provided by the standard 802.33af PoE shall be powered by high power PoE power injectors. In the event that a specific camera cannot be powered by PoE, a separate design proposal shall be submitted to the District for approval prior to installation.
- D. Category 6A cables shall be utilized to connect each camera to the digital video recorder and control engine installed in the Main Control Panel located at B/C Booster Pump Station Building or as specified herein.
- E. All required remote site video related equipment shall be connected to Main Control Panel UPS circuits.
- F. Conduit, Wire and Cable
 1. Provide required cabling, connectors, patch cords, resister packs, terminators, and all other miscellaneous items required for a fully functional System.
 2. The SSS shall be responsible for specifying the exact type, quantity, size, and location of all conduit, cable and wire for the surveillance system.
 3. Conduit shall be in conformance with Section 26 05 33.
 4. All wire and cable shall be underground rated.

5. Wiring Practices: provide consistently identified and numbered terminal strips for all external connections. Provide separate terminal strips for each different by voltage and function. Voltage and function designations shall be shown on drawings prepared and submitted by the SSS.
- G. The SSS shall be responsible for programming, configuration, and integration of the cameras into the VSS monitoring software as specified.
- H. The CCTV shall be fully tested and accepted, with test results recorded individual test reports for the District's review and acceptance. All CCTV devices and equipment shall be tested. Test and acceptance report shall include but not limited to integration of the cameras with the monitoring software as specified.

2.02 POWER SUPPLIES:

- A. All CCTV cameras shall be capable of being powered by power over Ethernet (PoE) technology. PoE power for cameras shall originate from the respective network switches or other SSS provided equipment.

2.03 CCTV CAMERAS

- A. PTZ Dome Cameras, Exterior:
 1. Mounting: As shown on Drawings or as recommended by the manufacturer.
 2. Day/Night Functionality: Provide automatic Day/Night functionality.
 3. Video resolutions: 1920 x 1080 minimum
 4. Pan Movement: 360° continuous rotation; 300° per second, minimum.
 5. Tilt Movement:-15° to 90° tilt angle minimum; Image shall auto-flip 180° at the bottom of the tilt travel
 6. Zoom Capability: 30x optical zoom minimum.
 7. Dome: Dome color shall be "smoked" and shall induce maximum light attenuation of 0.5 f-stop light loss.
 8. Environmental Housing: Environmental housing shall be suitable for outdoor weather exposed conditions (IP66 minimum).
 9. Camera shall be Industrial Video & Control, PTZ-HD30-15, Axis model Q6074-E, or approved equal.

2.04 SECURITY MONITORING HARDWARE AND SOFTWARE

- A. Provide VSS workstation installed at the District's headquarters. Workstation platform shall be configured with all; required operating system, networking software, ancillary/maintenance software and video applications.
- B. All software provided shall be licensed to the District without exception.
- C. VSS Workstation
 1. Provide mini-tower style Windows 10 Professional based computer system configured with accessories as required by the video surveillance system supplier and as specified in the Contract Documents.

2. The VSS workstation shall meet all requirements of the video application software and the following minimum specifications.
 - a. 10th Generation Intel Core i7 processor (8-core, 16M Cache, 4.8 GHz clock speed)
 - b. Windows 10 Professional 64-bit with latest service packs
 - c. 16 GB DDR4 Random Access Memory
 - d. 1 TB PCIe Solid State Hard Drive
 - e. UHD Graphics card with HDMI interface
 - f. Network card with dual-port 10Gb/s Ethernet interface
 - g. 802.11 Wireless Network Interface
 - h. Tray-load Optical Read/Write DVD drive
 - i. Minimum of six USB Ports
 - j. Wireless keyboard and mouse

- D. Computer system shall be Dell OptiPlex series, Lenovo, HP, or approved equal.

- E. Provide fully installed and configured Longwatch Video Surveillance software; Industrial Video & Control Video Management Software; Honeywell MaxPro Standard edition software; or equal.

2.05 REMOTE VIDEO MONITOR

- A. General
 1. Provide the collection, analysis, and storage of video images at a remote location. Unit shall operate independently at the remote location and not require a high-speed network interface for monitoring and operation.
 2. Support the transfer of video, event, access control, and configuration information between the VSS workstation and the remote site using the communications network as shown on the Drawings.

- B. Operating Modes: Provide 3 modes of video image collection:
 1. DVR Mode – local streaming video storage with features specified
 2. Event Mode – Event clip generation around the detection of a trigger event.
 3. Live Mode – On demand video streaming from the remote monitor to the VSS workstation or directly from a local CCTV camera or video server to the ActiveX control via TCP/IP network.

- C. Features:
 1. Configurable resolution, frame rates, and video quality parameters.
 2. Time stamping embedded within the video stream.
 3. Configurable auto file deletion time period (e.g., # days to keep).
 4. Support either IP or Analog cameras. Support compatible IP camera requiring either JPEG, MJPEG, MPEG-4, or H.264 streaming.

- D. Provide DVR with event detection based on SCADA system commands, hardwired inputs, or video analytics. Event detection shall be automatically uploaded to the VSS workstation via the SCADA Broadband radio link as shown on the Drawings. Video uploads shall be configured to allow transmission of video without impacting operation of the SCADA

system data. System latency of SCADA status or control during video uploads shall not be acceptable.

1. Provide the following event detection methods at a minimum:
 - a. External Trigger - digital events triggered and collected external to the camera.
 - b. Digital Input trigger - wired to the monitor integral I/O module, Modbus TCP Ethernet I/O module or suitable CCTV camera.
 - c. Audio Event trigger from a suitable CCTV camera; provide audio filter levels for trigger control.
 - d. Motion detection trigger from a suitable CCTV camera with adjustable monitoring zones.
 - e. Loss of video or disconnected cable trigger.
 - f. Tamper event trigger from a suitable CCTV camera that supports this feature.
 - g. Provide video analytics to create a security trigger.
 - h. Provide latching of event or trigger status
 2. Trigger Responses
 - a. Security Conditions: Triggered by any of the 12 digital inputs, software video analytics motion detection, or video analytics of objects in the video streams. Upon detection of a security event, provide configuration capability to trigger digital outputs and create video event clips.
 - b. Maintenance Conditions: Support the generation of maintenance events upon loss of power, restart of the remote video monitor, communications loss, or other hardware health event.
 3. Provide means to arm and disarm the system via a hardwired input.
- E. Configuration and Interface
1. Provide a local configuration and diagnostics web user interface accessible via a portable laptop with a direct Ethernet or wireless Ethernet connection.
 2. Provide remote configuration and management support for modifying all parameters from the VSS workstation
 3. Provide transfer of collected video files from the remote video monitor to a USB storage device.
 4. Provide transmission of events, event clips, and on-demand live feed to the VSS workstation for remote analysis and long-term event storage over any of the supported network protocols. Video transmission to the VSS shall be compatible with the Ethernet network topology shown on the Drawings.
- F. Provide windows based industrial computer for local storage of digital video. DVR shall be compatible with the VSS workstation for uploading video for archiving or review. Provide system with user configurable resolution and frame rates.
- G. Provide video recording system that remains active should network connections be lost. Unit shall dynamically upload events or video as required upon restoration of the network.
- H. Video recorder shall support a minimum of twelve (12) cameras and pan, tilt, zoom controls from the VSS workstation. Recorder shall include a minimum of 500 GB of internal storage.
- I. Provide Remote Video Engine by Longwatch with Longwatch Video Engine (LVE) Software; Industrial Video & Control; Honeywell; or equal.

2.06 MISCELLANEOUS COMPONENTS

- A. CCTV components shall be installed within the Main Control Panel located in the B/C Booster Pump Station. VSS shall coordinate component installation in the Main Control Panel with the PCSI as specified in Section 40 61 00. As an alternative, the VSS may provide a standalone security enclosure for housing the surveillance system components. If a standalone enclosure is provided, VSS shall provide enclosure and fabrication per the requirements of Section 40 67 00 and provide all necessary interconnecting conduit and wire for the standalone enclosure under the Contract Bid Price.
- B. Panel Mounted (Industrial Grade) Ethernet Switches
 - 1. As specified in Section 40 62 00.
- C. Provide panel mounted power injectors or other PoE components as required to meet power requirements of the provided cameras and equipment.
 - 1. Provide 802.3af compliance, Power-over-Ethernet (PoE) switch with port configurations as required to support cameras provided plus 25% spare capacity. Provide minimum 30 watts per port over two pairs. The switch shall be PoE 802.af backwards compatible. The switch shall be N-Tron or approved equal.
 - 2. 802.3at PoE Power Injector: For cameras requiring 802.3at PoE power,
 - 3. Provide with port configurations to support required cameras plus 25% spare capacity.
 - 4. Shall provide 36 watts per port over two pairs.
 - 5. PoE 802.3af backwards compatible.
 - 6. Axis PoE Midspan, or equal.
- D. Mounting Hardware
 - 1. Provide all hardware for camera mounting at the locations shown on the drawing. Mounting hardware shall be stainless steel, suitable for installation in a corrosive marine environment. Provide standard mounting hardware as furnished by the camera manufacturer to the greatest extent possible. Where manufacturer standard mounting hardware is not available in stainless steel, provide stainless steel mounting hardware.
 - 2. Boxes: Provide surface mount boxes for all devices. Boxes shall be surface mount and conform to Section 28 05 33.
- E. Conduit, Wire and Cable
 - 1. The SSS shall be responsible for the type, quantity, size, and routing of all conduit, cable and wire for the CCTV system. Provide CCTV cables and wire compatible with the CCTV equipment provided.
 - 2. Conduit shall be in conformance with Section 28 05 33.
 - 3. Wire and cable runs shall be continuous from source to destination; splices are not permitted.
 - 4. Wire and cable shall be Belden, West Penn, or equal.

PART 3 - EXECUTION

3.01 SYSTEM CONFIGURATION

- A. General
 - 1. Provide all system programming, configuration, and integration for equipment provided under this Contract.
 - 2. The primary locations for security access monitoring shall be at the B/C Booster Pump Station and the at the District Headquarters.
- B. Programming and configuration of the software shall be provided by the SSS. Camera recording and display configurations shall be arranged as a set of screens and displays dedicated to the new facilities provided under this Contract only. Displays shall be developed on the video central workstation and coordinated with the digital video recorder, and LAN/WAN network.
- C. Incorporate security cameras onto the new video monitoring system during initial setup, configuration, and commissioning.

3.02 EQUIPMENT, RACK AND WORKSTATION INSTALLATION

- A. CCTV components shall be installed within the Main Control Panel located in the B/C Booster Pump Station. VSS shall coordinate component installation in the Main Control Panel with the PCSI as specified in Section 40 61 00. As an alternative, the VSS may provide a standalone security enclosure for housing the surveillance system components. If a standalone enclosure is provided, VSS shall provide enclosure and fabrication per the requirements of Section 40 67 00 and provide all necessary interconnecting conduit and wire for the standalone enclosure under the Contract Bid Price.
- B. VSS workstation and other communication equipment required at the District Headquarters shall be installed near the District's existing SCADA system computers as directed by the District during construction.

3.03 GROUNDING PROCEDURES

- A. Provide grounding of all systems and equipment in accordance with the manufacturer's requirements and the National Electrical Code.

3.04 WIRE AND CABLE INSTALLATION PRACTICES

- A. Provide wire and cable installation as required by the manufacturer and in accordance with Section 26 05 19.

3.05 IDENTIFICATION AND TAGGING

- A. Cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags or other permanent markings. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. The wire-marking format contained in the shop drawings shall be utilized for all conductors installed under this Specification. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers. Hand written tags are not acceptable.

- B. All terminal points shall be appropriately identified and labeled as shown on shop drawings.

3.06 SYSTEM PREPARATION, CHECKING, AND ACTIVATION

- A. Provide preparation, checking and activation for CCTV systems and equipment. Provide comprehensive system testing and configuration including control of all cameras, selectable video uploads from each camera, confirmation of bandwidth compatibility of transmitted SCADA data, and remote review of station video clips.

3.07 START-UP RESPONSIBILITY

- A. Perform inspection and testing to determine the operating status of components and systems. Provide start-up services for all systems and equipment specified in these Specifications.
- B. Coordination: Coordinate testing of components of the system in cooperation with other trades.
- C. Verification: Perform inspection and/or testing procedures to ensure the following:
 - 1. Safe and proper operation of all components, devices or equipment, and the absence of extraneous or interfering signals.
 - 2. Proper grounding of devices and equipment.
 - 3. Integrity of signal and electrical system ground connections.
 - 4. Proper powering of devices and equipment.
 - 5. Integrity of all insulation, shield terminations and connections.
 - 6. Integrity of soldered connections and absence of solder splatter, solder bridges, and debris of any kind.
 - 7. Proper dressing of wire and cable.
 - 8. "Wire-checking" of all circuitry, including phase and continuity.
 - 9. Sequencing: determine and record the sequence of energizing systems to minimize the risk of damage from improper startup.
 - 10. Operation of all systems in accordance with specified performance requirements.

3.08 SYSTEM PERFORMANCE TESTING AND ADJUSTING PROCEDURES

- A. Provide performance testing and adjusting of all systems and equipment.
- B. VSS CCTV Performance Testing
 - 1. Demonstrate acceptable picture quality and camera views for each camera.
 - 2. Demonstrate acceptable picture quality on each video monitoring workstation, and display devices accessible over the LAN.
 - 3. Demonstrate camera switching for the monitoring video server.
 - 4. Demonstrate camera switching, recording and playback functions for the VSS video server, network video recorders, and digital video recorders.
 - 5. Demonstrate camera-positioning functionality, on pan/tilt/zoom cameras, throughout the entire range of possible camera positions.
 - 6. Ensure primary views are acceptable. Demonstrate the view obtained by each pre-programmed camera position.

7. Demonstrate automatic event-initiated recording sequences, including camera pre-positioning, where applicable.
8. Demonstrate video guard tour functions.
9. Demonstrate retrieval and playback of recorded video from each site.
10. Confirm SCADA data latency is not impacted during video uploading by testing SCADA latency with and without video uploading. SCADA data latency shall not be impacted by more than 10% during a video upload.

3.09 MANUFACTURER'S SERVICES: TRAINING

- A. Instruction: Provide instruction of plant personnel in the operation and maintenance of all equipment of the system.
- B. The manufacturer's qualified representative shall conduct the training.
- C. The training program shall consist of the following:
 1. Instructions on the operation of the equipment
 2. Instructions on the storing and retrieving historical video images
 3. Instructions on the maintenance of the equipment
 4. Instructions on diagnostics and troubleshooting

END OF SECTION

SECTION 31 05 19.13

GEOTEXTILE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes: Geotextile, also called filter fabric, in applications such as soil material separation and subgrade stabilization.

1.02 REFERENCES

- A. AASHTO M 288 - Standard Specification for Geotextiles.
- B. ASTM
 1. D 4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 2. D 4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 3. D 4632 – Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).
 4. D 4751 – Test Method for Determining Apparent Opening Size of a Geotextile.
 5. D 6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
- C. Corps of Engineers, COE CW - 02215 - Geotextiles Used As Filters.

1.03 SUBMITTALS

- A. Follow Section 01 30 00 – Contractor Submittals.
- B. Submit the standard manufacturer's catalog sheets and other pertinent information.

PART 2 - PRODUCTS

2.01 GEOTEXTILE

- A. Provide a geotextile (filter fabric) designed for use in geotechnical applications. The filter fabric shall provide a permeable layer or media while retaining the soil matrix.
- B. Use fabric which meets the physical requirements for Separation, High Survivability Level installation conditions as defined in AASHTO M 288.

2.02 WOVEN GEOTEXTILE FOR USE AS STABILIZATION FABRIC

- A. Geotextile for use as stabilization fabric shall be TenCate Mirafi 600X or approved equal.
- B. Properties:

1. Material: Woven, nonbiodegradable, fabric consisting only of continuous chain polymer filaments or yarns, at least 85 percent by weight polyolefins, polyesters or polyamide, formed into a dimensionally stable network.
2. Chemical Resistance: Inert to commonly encountered chemicals and hydrocarbons over a pH range of 3 to 12.
3. Physical Resistance: Resistant to mildew and rot, ultraviolet light exposure, insects and rodents.
4. Minimum Test Values:

Property	Value (Min.)	Test Method
Grab Tensile Strength	315 lbs.	ASTM D 4632
Grab Tensile Elongation	15%	ASTM D 4633
Trapezoidal Tear Strength	113 lbs.	ASTM D 4533
CBR Puncture Strength	900 lbs.	ASTM D 6241
Apparent Opening Size	40 sieve (0.43 mm)	ASTM D 4751
Permittivity (sec-1)	0.05	ASTM D 4491
Flow Rate	4.0 gpm/sq-ft	ASTM D 4491

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install geotextiles as shown on the Drawings and as per manufacturer's instructions.

END OF SECTION

SECTION 31 10 00

CLEARING AND DEMOLITION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, facilities, transportation and services to complete all clearing and demolition and related work as shown on the plans and/or specified herein.
- B. Work Included: All work necessary to move or remove and legally dispose of all interfering or objectionable material from the project site, including but not necessarily limited to trees, tree branches, tree stumps, brush, shrubs, weeds, debris, roots, rocks, but only as required.

1.02 REFERENCE STANDARDS

- A. Clearing and grubbing shall be in accordance with the provisions of Section 17 of the State Standard (Caltrans) Specifications, except as modified herein.

1.03 DEFINITIONS

- A. Clearing: Clearing shall consist of cutting, removing, and disposing of trees, shrubs, brush, limbs, and other vegetative growth. Clearing shall also include the removal and disposal of trash piles, rubbish and fencing, and the preservation of trees, shrubs, and vegetative growth which are not designated for removal.
- B. Grubbing: Grubbing is the removal and disposal of wood or root matter below the ground surface remaining after clearing.
- C. Stripping: Stripping refers to the removal and disposal of all organic sod, topsoil, grass, and grass roots; all evidence of surface improvements and other objectionable material remaining after clearing and grubbing.
- D. Demolition: The removal of existing structures, portions of existing structures, equipment, utilities, concrete curbs, sidewalks, and driveways, pipelines and other appurtenances.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EQUIPMENT

- A. Equipment shall be suitable for the work to be done and shall be in good operating condition. Equipment operators and workmen are to be skilled in such operations and shall be competently supervised.

3.02 CLEARING, GRUBBING AND STRIPPING

- A. Clear, grub and strip areas to be excavated or surfaced.

3.03 DEMOLITION

- A. Remove existing structures, portions of existing structures, and equipment called for on the plans and as directed by the Engineer.
- B. Contractor shall not demolish existing facilities beyond the limits designated on the drawings unless specifically directed to do so by the Engineer.

3.04 PRESERVATION OF PROPERTY

- A. The project area shall be cleared and grubbed only to the extent necessary to accommodate the work in conformance with the notes and details shown on the plans. Trees or growth shall not be trimmed back unnecessarily.
- B. Contractor shall take extreme care not to damage shrubs, trees, fences, irrigation systems and other improvements of adjacent property owners.
- C. All existing improvements not specifically designated on the plans to be removed or relocated shall remain in their original condition and location undisturbed. However, upon written permission by the Owner, existing improvements may, for the convenience of the Contractor, and at his expense, be removed and temporarily relocated during construction and shall be replaced in their original location in as good or better condition as when the Contractor entered upon the work site.

3.05 DEMOLITION OF UNDERGROUND PIPE AND CONDUIT

- A. Demolition of underground pipe and conduit shall be only as shown on the Drawings or necessary as determined in the field by the Engineer.
- B. Pipe to be abandoned shall be abandoned per Section 02 22 20.

3.06 STUMP AND ROOT REMOVAL

- A. The stumps and roots of all removed trees encountered during the course of Work, either trees removed previously on site or trees removed as part of the Work shall be removed to a depth of at least 24 inches below the natural grade.
- B. All exposed surface roots beyond the stump area shall be removed to a depth of at least 12 inches below the natural grade.
- C. Holes and depressions remaining after stump and root removal shall be filled per the Drawings.

3.07 REMOVAL OF DEBRIS

- A. All demolished and cleared material shall become the property of the Contractor and shall be legally disposed of by the Contractor.
- B. Removed concrete and asphalt concrete shall be legally disposed of off the project site at a location provided by the Contractor. Demolished concrete shall not be buried in structure backfill areas.

END OF SECTION

SECTION 31 23 00

TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation for trench excavation, backfilling, and compacting.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1.03 TESTING FOR COMPACTION

- A. Determine the density of soil in place by the use of a sand cone, drive tube, or nuclear tester.
- B. Determine laboratory moisture-density relations of existing soils by ASTM D 1557.
- C. Determine the relative density of cohesionless soils by ASTM D 2049.
- D. Sample backfill materials by ASTM D 75.
- E. Express "relative compaction" as the ratio, expressed as a percentage of the in place dry density to the laboratory maximum dry density.
- F. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction.
- G. The Owner will secure the service of a soils tester and pay the cost of initial testing. The Contractor will be responsible for the cost of all retests in failed areas. Test results will be furnished by the Owner's tester.

1.04 DEFINITIONS

- A. Pavement Zone. The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.
- B. Street Zone. The street zone is the top 18 inches of the trench or depth determined by the jurisdictional agency immediately below the pavement zone in paved areas.

- C. Trench Zone. The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.
- D. Pipe Zone. The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level 12 inches above the top of the highest or topmost pipe.
- E. Pipe Bedding. The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be as shown on the drawings or as described in these specifications for the particular type of pipe installed.

1.05 EXCESS EXCAVATED MATERIAL

- A. The Contractor shall make the necessary arrangements for and shall remove and dispose of all excess excavated material unless indicated differently in the special provisions for any job.
- B. It is the intent of these specifications that all surplus material not required for backfill or fill shall be properly disposed of by the Contractor at his expense at a proper disposal site.
- C. No excavated material shall be deposited on private property unless written permission from the owner thereof is secured by the Contractor. Before the Owner will accept the work, the Contractor shall file a written release signed by all property owners with whom he has entered into agreements for disposing excess excavated material, absolving the Owner from any liability connected therewith.
- D. The Contractor shall obtain a haul route permit from the city or agency having jurisdiction.

1.06 SAFETY

- A. All excavations shall be performed, protected, and supported as required for safety and in the manner set forth in the operation rules, orders, and regulations prescribed by the Division of Industrial Safety of the State of California.
- B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrians and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.
- C. No trench or excavation shall remain open during non-working hours. The trench or excavation shall be covered with steel plates, spiked in place, or secured with temporary A.C. pavement around the edges, or backfilled. A security fence shall be installed around the work area during non-working hours.

- D. The Contractor shall notify the Owner of all work-related accidents which may occur to persons or property at or near the project site, and shall provide the Owner with a copy of all accident reports. All accident reports shall be signed by the Contractor or its authorized representative and submitted to the Owner's authorized representative within twenty-four (24) hours of the accident's occurrence.

1.07 ACCESS

- A. Unobstructed access must be provided to all driveways, water valves, hydrants, or other property or facilities that require routine use.

1.08 PERMITS

- A. All work shall conform to the specifications and requirements of the State of California Department of Transportation, the city having jurisdiction, and/or other agencies involved. The Contractor shall keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits.

1.09 SLOPE PROTECTION

- A. Slope protection shall be installed where shown on the plans. The installation of the slope protection shall be considered a part of the work, and the Contractor shall include the expense in his cost.

PART 2 - PRODUCTS

2.01 NATIVE EARTH BACKFILL

- A. Native earth, segregated from topsoil, shall be used for trench zone backfill.

2.02 IMPORTED BACKFILL MATERIAL

- A. Whenever the excavated material is not suitable for backfill, the Contractor shall arrange for and furnish suitable imported backfill material that is capable of attaining the required relative density.
- B. The Contractor shall dispose of the excess trench excavation as specified in the preceding section. Backfilling with imported material shall be done in accordance with the methods described herein.

2.03 GRANULAR MATERIAL

- A. Granular material shall be defined as soil having a minimum sand equivalent of 30 as determined in accordance with State of California, Division of Highways, Test "California 217," with not more than 20% passing a 200-mesh sieve.

2.04 IMPORTED SAND

- A. Imported sand shall have a minimum sand equivalent of 30 per State of California, Division of Highways, Test "California 217" with 100% passing a 3/8 inch sieve and not

more than 20% passing a 200-mesh sieve. Certification that the sand meets this requirement shall be provided.

2.05 CRUSHED ROCK AND GRAVEL

- A. Crushed rock shall be the product of crushing rock or gravel. Fifty percent of the particles retained on a 3/8 inch sieve shall have their entire surface area composed of faces resulting from fracture due to mechanical crushing. Not over 5% shall be particles that show no faces resulting from crushing. Less than 10% of the particles that pass the 3/8 inch sieve and are retained on the No. 4 sieve shall be weatherworn particles. Gravel shall not be added to crushed rock.
- B. Gravel shall be defined as particles that show no evidence of mechanical crushing, are fully weatherworn, and are rounded. For pipe bedding, where gravel is specified, crushed rock may be substituted or added.
- C. Where crushed rock or gravel is specified in the bedding details on the plans, the material shall have the following gradations:

Sieve Size	1-1/2 Inch Max % Passing	1-inch Max % Passing	3/4 Inch Max % Passing
2"	100		
1-1/2"	90 – 100	100	
1"	20 – 55	90 – 100	100
3/4"	0 – 15	60 – 80	90-100
1/2"	-	-	30 – 60
3/8"	0 – 5	0 – 15	0 – 20
No. 4	-	0 – 5	0 – 5
No. 8	-	-	-

2.06 SAND-CEMENT SLURRY

- A. Sand cement slurry shall consist of one sack (94 pounds) of Portland cement per cubic yard of sand and sufficient moisture for workability.

2.07 ASPHALT CONCRETE

- A. Asphalt concrete pavement shall be Type B as specified in Section 39 of the Standard Specifications, State of California, Department of Transportation, 2015 edition.

PART 3 - EXECUTION

3.01 COMPACTION REQUIREMENTS

- A. Compaction tests shall be performed at random depths and at 200-foot intervals and as directed by the Engineer.
- B. If the backfill fails to meet the specified relative compaction requirements, the Contractor shall rework the backfill until the requirements are met. The Contractor shall make all

necessary excavations for density tests as directed by the Engineer. The compaction requirements of the city having jurisdiction or Caltrans shall prevail in all public roads. The Contractor will be responsible for the cost of all additional compaction tests in the reworked areas.

- C. Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as described below:
 - 1. Pipe zone and pipe base: 95% relative compaction
 - 2. Trench zone not beneath paving: 95% relative compaction
 - 3. Trench zone to street zone in paved areas: 95% relative compaction
 - 4. Street zone in paved areas: per agency requirements or 95% relative compaction. The most stringent agency requirements shall prevail
 - 5. Rock refill material for foundation stabilization: 90% relative density
 - 6. Rock refill for over excavation: 90% relative density

3.02 MATERIAL REPLACEMENT

- A. Removal and replacement of any trench and backfill material which does not meet the specifications shall be the Contractor's responsibility.

3.03 CLEARING AND GRUBBING

- A. Areas where work is to be performed shall be cleared of all trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Organic material from clearing and grubbing operations will not be incorporated in the trench backfill.
- C. Organic material from clearing and grubbing operations will be disposed of at a proper waste disposal facility.

3.04 SIDEWALK, PAVEMENT, AND CURB REMOVAL

- A. Saw cut bituminous or concrete pavements regardless of their thickness, and curbs and sidewalks prior to excavation for the structure in accordance with the requirements of the city, or agency having jurisdiction. Curbs and sidewalks that are damaged in the course of construction are to be cut and removed from joint to joint.
- B. Haul removed pavement and concrete materials from the site to a proper disposal facility. These materials are not permitted for use as trench backfill. If the material to be removed exceeds 50 cubic yards, the Contractor shall obtain a haul route permit from the city(s) having jurisdiction.

3.05 TRENCHING AND TUNNELING

- A. Excavation for pipe, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the facilities as shown on the plans.

- B. Trench banks shall be kept as near to vertical as possible and shall be properly braced and sheeted.
- C. Horizontal directional drilling, where used, shall be per Section 33 05 23.
- D. Tunneling will not be permitted.
- E. The use of a jack and bore may be employed for crossings.

3.06 BRACING

- A. The Contractor's design and installation of bracing and shoring shall be consistent with the rules, orders, and regulations of the State of California Construction Safety Orders.
- B. Excavations shall be so braced, sheeted, and supported that they will be safe such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.
- C. The sheeting, shoring, and bracing shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.
- D. Care shall be exercised in the drawing or removal of sheeting, shoring, bracing, and timbering to prevent the caving or collapse of the excavation faces being supported.

3.07 TRENCH WIDTHS

- A. Excavation and trenching shall be true to line so that a clear space of not more than 8 inches or less than 6 inches in width is provided on each side of the largest outside diameter of the pipe in place measured at a point 12 inches above the top of the pipe. For the purpose of this article, the largest outside diameter shall be the outside diameter of the bell on bell and spigot pipe or the pipe collar.
- B. Where the sewer trench width, measured at a point 12 inches above the top of the bell of the pipe, is wider than the maximum set forth above, the trench area around the pipe shall be backfilled with crushed rock, Class B concrete, or slurry to form a cradle for the pipe at the discretion of the Engineer.

3.08 LENGTH OF OPEN TRENCH

- A. The maximum allowable length of open trench shall be 400 feet, or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is less. Within developed areas, the length of open trench may be restricted as determined by the encroachment permit from the city or the agency having jurisdiction.

3.09 GRADE

- A. Excavate the trench to the lines and grades shown on the drawings with allowance for pipe thickness and for pipe base or special bedding.
- B. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions and shall be at a reasonably uniform grade.

3.10 CORRECTION OF OVER EXCAVATION

- A. Where excavation is inadvertently carried below the design trench depth, suitable provision shall be made by the Contractor to adjust the excavation, as directed by the Engineer, to meet requirements incurred by the deeper excavation.
- B. Over excavations shall be corrected by backfilling with approved bedding material, graded crushed rock or gravel and shall be compacted to provide a firm and unyielding subgrade or foundation, as directed by the Engineer.

3.11 DEWATERING

- A. The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. De-watering shall be done by methods that will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Dewatering methods may include well points, sump points, suitable rock or gravel placed below the required bedding for drainage and pumping, temporary pipelines, and other means, all subject to the approval of the Engineer. Water shall be discharged in accordance with the requirements of the project's NPDES permit.
- B. In no event shall the sanitary sewer system be used as drains for dewatering the construction trenches.
- C. Dewatering shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise. No concrete shall be poured in water, nor shall water be allowed to rise around the concrete or mortar until it has set at least eight hours.

3.12 FOUNDATION STABILIZATION

- A. Whenever the trench bottom does not afford a sufficiently solid and stable base to support the pipe or appurtenances, the Contractor shall excavate to a depth below the design trench bottom, as directed by the Engineer, and the trench bottom shall be backfilled with 3/4-inch rock and compacted to provide uniform support and a firm foundation.
- B. Where rock is encountered, it shall be removed to a depth at least 6 inches below grade and the trench shall be backfilled with 3/4-inch crushed rock to provide a compacted foundation cushion.
- C. If excessively wet, soft, spongy, unstable, or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Engineer and replaced by crushed rock.

3.13 EXCAVATED MATERIAL

- A. All excavated material shall not be stockpiled in a manner that will create an unsafe work area or obstruct sidewalks or driveways. Gutters shall be kept clear or other satisfactory measures shall be taken to maintain street or other drainage.

- B. In confined work areas, the Contractor may be required to stockpile the excavated material off-site, as determined by the project permits.

3.14 PLACING PIPE BEDDING

- A. Place the thickness of pipe bedding material over the full width of trench necessary to produce the required bedding thickness when the material is compacted to the specified relative density. Grade the top of the pipe bedding ahead of the pipe to provide firm, uniform support along the full length of pipe.
- B. Excavate bell holes at each joint to permit assembly and inspection of the entire joint.

3.15 BACKFILLING WITHIN PIPE ZONE

- A. Backfill per the detailed piping specification for the particular type of pipe and per the following.
- B. After pipe has been installed in the trench, place pipe zone material simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
- C. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

3.16 BACKFILL WITHIN TRENCH ZONE

- A. Compact per the detailed piping specification for the particular type of pipe and per the following.
- B. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.
- C. The remaining portion of the trench to the street zone or ground surface, as the case may be, shall be backfilled, compacted and/or consolidated by approved methods to obtain the specified relative compaction.
 - 1. Compaction using vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers shall be done with the type and size of equipment necessary to accomplish the work. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened, and compacted to the specified relative density. The Contractor shall repair or replace any pipe, fittings, manholes, or structures damaged by the Contractor's operations as directed by the Engineer.
 - 2. Consolidation of backfill performed by flooding, poling, or jetting shall obtain a relative compaction of the backfill material at least equal to that specified. When flooding, poling, or jetting methods are used, material for use as backfill shall be

placed and consolidated in layers not exceeding 3-feet thick. Flooding, poling, or jetting methods shall be supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required relative compaction. Care shall be taken in all consolidating operations to prevent the movement or floating of the pipe. Consolidation methods shall not be used where the backfill material is not sufficiently granular to be self-draining during and after consolidation, or where foundation materials may be softened or otherwise damaged by the quantities of water applied. The Contractor shall rectify any misalignment of the pipe because of consolidation operations as directed by the Engineer.

- D. If the excavated native material is too wet to achieve the required compaction, provide imported backfill or sand-cement slurry within the trench zone.

3.17 BACKFILL WITHIN STREET ZONE

- A. The street zone within roadbed areas shall be compacted using approved hand, pneumatic, or mechanical type tampers to obtain the required relative compaction.
- B. All work shall be done in accordance with the requirements and to the satisfaction of the city or the agency having jurisdiction.
- C. Flooding and jetting will not be permitted in this Zone.

3.18 SIDEWALK, PAVEMENT, AND CURB REPLACEMENT

- A. Replace bituminous and concrete pavement, curbs, and sidewalks damaged or removed during construction in accordance with the requirements of the city or the agency having jurisdiction.

3.19 SLOPE PROTECTION

- A. Where cutoff walls or concrete anchors are required, they shall be in accordance with the plans, with a minimum thickness of 12 inches. The wall shall extend at least 12 inches to undisturbed material on each side of the trench as excavated. Cemented rubble and concrete surface slope protection shall be a minimum of 4-inches thick.
- B. Wall or anchors shall be placed with a minimum horizontal spacing of:
 - 1. Not over 36 feet center to center on grades 25% to 35%
 - 2. Not over 24 feet center to center on grades 35% to 50%
 - 3. Not over 16 feet center to center on grades 50% and over
- C. Material used for construction of cutoff walls or concrete anchors shall consist of cast-in-place reinforced concrete or reinforced hollow unit masonry. When reinforced hollow unit masonry is used, all cells in the block shall be filled solidly with grout. A No. 4 reinforcing bar shall be placed vertically in each row of cells and No. 9-gage wall mesh shall be placed in each horizontal joint. In addition, a bond beam shall be placed at the top with two No. 4 bars.
- D. Where cutoff walls or concrete anchors are constructed of reinforced concrete, they shall have No. 4 reinforcing bars placed at 6-inches on center each way in the center of the wall. The bars shall extend full length and height of the wall.

END OF SECTION

SECTION 32 11 00

CONTROLLED LOW-STRENGTH MATERIAL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section Includes: Controlled low-strength material used as structural backfill and foundation fill under structures where indicated on the Drawings or required by these Specifications.
- B. Perform all sampling and furnish all testing of materials and products by an independent testing laboratory acceptable to the ENGINEER but engaged by and at the expense of the OWNER.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 229 – Controlled Low-Strength Materials.
- B. ASTM International (ASTM)
 - 1. ASTM C33 – Standard Specification for Concrete Aggregates.
 - 2. ASTM C150 – Standard Specification for Portland Cement.
 - 3. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - 4. ASTM D4832 – Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 - 5. ASTM D5971 – Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material.
 - 6. ASTM D6023 – Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM).
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Division 1, submittals including the following:
 - 1. Submit the proposed supplier and mix design with mix characteristics and compressive strength results.
 - 2. Stable-air generator admixture – Submit product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 - 3. Submit field quality control reports of cylinder breaks and measured slumps.

B. Laboratory Test Reports:

1. Submit laboratory test data as required under Section, when requested by the ENGINEER.

C. Certifications:

1. Certify that the CONTRACTOR is not associated with the independent testing laboratory, nor does the CONTRACTOR or its officers have a beneficial interest in the laboratory.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements

1. Controlled low-density material shall have a 28 day compressive strength, when tested in accordance with ASTM D4832, between 100 pounds per square inch and 500 pounds per square inch. The wet unit weight shall be no greater than 120 pounds per cubic foot.
2. Consistency shall be flowable, self-leveling, with slump between 6 to 10 inches.
3. Controlled low-density material shall be mixed at an off-site concrete plant with adequate equipment to prepare consistent controlled low-density material.

1.05 QUALITY ASSURANCE

- A. Manufacturer – Controlled low-strength material shall be manufactured by a ready-mix concrete producer with a minimum of one year experience in the production of similar products.
- B. Materials – For each type of material required for the work of this Section, provide primary materials which are the products of one manufacturer. If not otherwise specified here, materials shall comply with recommendation of ACI 229.
- C. Pre-Installation Conference – A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Notify ENGINEER of the meeting at least 10 days prior to its scheduled date.
- D. Field Testing – The field testing of Controlled Low-Strength Material shall be as specified for concrete in Section 03 30 00.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

1.07 DEFINITIONS

- A. Controlled Low-Strength Material (CLSM) – A self-leveling and self-compacting, cementitious material, sometimes referred to as flowable fill, used as a backfill in place of compacted fill.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or Local requirements.
- B. Cement: per Section 03 30 00.
- C. Aggregate: per Section 03 30 00.
- D. Water: per Section 03 30 00.
- E. Stable-Air Generator admixture: admixture specifically formulated for controlled low-strength material to improve flowability, lower densities, eliminate segregation and control strength development. Admixture shall be free of chlorides and alkalis.
- F. Other Admixtures: per Section 03 30 00.
- G. Water:
 - 1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances. Use of recycled or reclaimed water is not permissible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions of substrates and other conditions under which work is to be performed and notify ENGINEER of circumstances detrimental to the proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install controlled low-strength material as a structural backfill or foundation fill material where indicated on the Drawings or required by these Specifications.
- B. Place controlled low-strength material in a manner so that minimal segregation of the material occurs during and after placement, and without voids. Spade and vibrate as required to consolidate. Monitor placement to prevent flotation of pipes, structures and other items.

- C. For each truck load provided documentation to the ENGINEER with the following clearly noted: design mix, date, truck number, quantity, and the supplier's name and address.

3.03 PROTECTION

- A. Protect controlled low-strength material from traffic until sufficient strength has been achieved for further construction operations.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING AND SEALS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
- B. Asphalt Paving
- C. Fog Seal
- D. Slurry Seal
- E. Related Sections:
 - 1. Section 31 23 00 – Trenching, Backfilling and Compacting

1.02 REFERENCES

- A. Standard Specifications, State of California, Department of Transportation (CalTrans), 2015 Edition (State Standard Specifications)

1.03 DESCRIPTION

- A. The Contractor shall pave or repave all road surfaces within public Right-of -Ways, private right-of-ways, driveways, drainage courses, and other surfaces as provided for in the Contract Documents. Except as provided for in the Contract Documents, all paving materials shall be constructed of asphalt concrete or an asphaltic emulsion, with or without aggregate.
- B. Paint binder (tack coat) shall be applied to the vertical surface of all structures to which new asphalt concrete will abut. Additionally, where the Contract Documents provide for the placement of new asphalt concrete over existing pavement surfaces, a tack coat shall be applied to the surface of the old pavement. Where called for in the Contract Documents, the surface of aggregate base shall receive a prime coat of liquid asphalt immediately prior to commencing paving operations.
- C. Miscellaneous areas shall be those areas or structures called for in the Contract Documents to be surfaced or constructed of asphalt concrete. Such areas shall include but not be limited to, drainage ditches, equipment pads, walkways, and asphalt dikes.
- D. Asphalt Dikes - Asphalt dikes shall be constructed to the line and grade provided for in the Contract Documents. Asphalt dikes whose continuous length exceeds 5 linear feet shall be constructed by the use of an extrusion machine.

1.04 FOG SEAL

- A. Where provided for in the Contract Documents, the Contractor shall apply a fog seal that covers the repaved trench section and the adjacent street pavement. The Engineer shall determine the limits of the fog seal application. Such fog seal shall be constructed in accordance with the provisions of Section 37, "Bituminous Seals" of the State Standard Specifications. The exact proportion of water to asphaltic emulsion shall be determined by the Contractor up to a maximum of one part water to one part asphaltic emulsion.

1.05 SLURRY SEAL COAT

- A. Where provided for in the Contract Documents, the Contractor shall construct a seal coat of asphaltic emulsion and screenings that covers the repaved trench section and the adjacent street pavement. The Engineer shall determine the limits of the seal coat application. Such seal coat shall be constructed in accordance with the provisions of Section 37, "Bituminous Seals" of the State Standard Specifications for a double seal coat. A Certificate of Compliance shall be submitted for all materials used in constructing the double seal coat.

1.06 SUBMITTALS

- A. Provide submittals in accordance with Section 01 30 00, Contractor Submittals.
- B. Submit certificates of compliance for materials provided under this section.

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE PAVEMENT

- A. Asphalt concrete pavement shall be in accordance with the provisions of Section 39, "Hot Mix Asphalt" of the State Standard Specifications and this Section. Except as provided for in the Contract Documents, a Certificate of Compliance shall be submitted in lieu of the testing and reporting requirements of the State Standard Specifications.
- B. Aggregate - Except as provided for in the Contract Documents, all asphalt concrete used in the construction of asphalt concrete pavements shall be Type "B" meeting the gradation requirements for ½-inch maximum, medium of Section 39-1.02E, "Aggregate" of the State Standard Specifications.
- C. Asphalt Binder - Asphalt binder for asphalt concrete shall be a steam refined asphalt, Grade PG 64-10, conforming with the requirements of Section 92, "Asphalts" of the State Standard Specifications. The percentage of asphalt binder in asphalt concrete pavement shall be between 5-½ percent and 6 percent by weight.
- D. Asphalt Concrete for Miscellaneous Areas - The gradation of aggregate for surfacing of miscellaneous areas shall be the same as for other areas. The percentage of asphalt binder shall be increased by 1-percent by weight over that percentage for asphalt concrete placed in roadways.

2.02 COLD-MIX ASPHALT CONCRETE

A. General - Cold-mix asphalt concrete used in temporary paving applications shall be a plant mixed product conforming with the requirements of this Section. Cold-mix may be supplied directly from the batch plant or stockpiled on the job-site.

B. Aggregate - Aggregate shall meet the following gradation requirements:

Sieve Size	Percentage Passing
½-inch	100
¼ - inch	95-100
No. 4	58-72
No. 8	34-48
No. 30	18-32
No. 50	13-23
No. 200	2-9

C. Asphalt Binder - Asphalt binder for cold-mix asphalt shall be Type SC-800 in accordance with the requirements of Section 93, "Liquid Asphalts" of the State Specifications. The percentage of asphalt binder shall be between 4.8 and 7.5 percent.

2.03 PAINT BINDER AND PRIME COAT

A. Paint Binder (Tack Coat) - Paint binder shall be Type RS-1 asphaltic emulsion conforming with the provisions of Section 94, "Asphaltic Emulsions" of the State Standard Specifications.

B. Prime Coat - Prime coat shall be Type SC-70 liquid asphalt conforming with the provisions of Section 93, "Liquid Asphalts" of the State Standard Specifications.

PART 3 - EXECUTION

3.01 ASPHALT PAVING

A. Upon completion of all underground construction, including but not limited to trench backfill and aggregate base, the Contractor shall construct the final asphalt concrete surface. Such asphalt concrete surface shall be of the same depth, or greater, as the existing surface material. In no case shall the new asphalt concrete be less than 2-inches in depth.

B. All valve boxes, manholes, monument boxes, and other adjustable structures shall be brought to grade prior to placing the final lift of asphalt concrete. Where the distance between the edge of the new pavement and the existing edge of pavement, existing curb or gutter lip, or asphalt dike is less than 2 linear feet, the existing pavement shall be removed and replaced to the edge of pavement, existing curb or gutter lip or asphalt dike.

C. All temporary paving material, loose aggregate base, and other deleterious material shall be removed from the trench of the underlying surface. The surface of the aggregate base or sand cement slurry backfill and all abutting surfaces shall be prepared by spraying with a paint binder at a rate of 0.25 gallons per square yard. The Contractor shall prevent overspray onto adjacent pavement surfaces and other surfaces not scheduled to be paved. Paint binder shall not be tracked out of the work area by vehicles or equipment.

- D. Hot asphalt concrete shall be placed in the area to be paved and compacted by the use of rollers or vibratory plate type compaction equipment. The use of vibratory plate compaction equipment shall be limited to projects whose area totals less than 100 square feet and/or those areas where insufficient space is available for the operation of vibratory rollers. All spreading and compacting operations shall be in accordance with the provisions of Section 39, "Hot Mix Asphalt" of the State Standard Specifications except that tolerances for trench repairs will be measured by the use of a straight edge of sufficient length to span the full width of the trench plus 2-feet on each side of the trench line.
- E. If the total depth of asphalt paving exceeds 2-½ inches, the asphalt shall be laid in a minimum of 2 lifts with the maximum lift equaling 2-½ inches. The minimum thickness of any lift of asphalt concrete shall be equal to twice the maximum size aggregate in the asphalt concrete mix. Each lift shall be fully compacted and finished prior to placing the next lift except that the grade tolerances shall apply for the final lift only.
- F. All new asphalt concrete surfaces shall be abutted to adjoining surfaces along a neat sawcut line. In no case shall new asphalt be feathered over existing surface material, placed against damaged surfaces, or over or against any material not adequately prepared as defined herein. The final surface of the asphalt concrete shall be no more than ¼-inches above the adjacent existing surface nor shall the final surface be below the level of the adjacent surface. In areas of paving other than trench repairs, the plane of the surface shall not vary more than ¼-inches above or below the average plane of the surface when measured with an 8-foot straight edge.
- G. Skin patching shall not be considered an acceptable method of achieving the tolerances herein. Skin patching is hereby defined as a mix of asphaltic concrete whose maximum aggregate size is less than or equal to the No. 4 sieve used to fill depressions in the pavement plane.
- H. The final lift of asphalt concrete shall be placed in one continuous operation as the final order of work for the project. Where trenches do not form an unbroken line throughout the project, asphalt concrete may be placed in one continuous operation for each continuous trench, subject to the prior approval of the Engineer.
- I. All paving not conforming with the provisions of these specifications, the Contract Documents, or any public agency having jurisdiction over the work shall be immediately removed and replaced in accordance with the provisions of these specifications, the Contract Documents, and the directions of such agencies having jurisdiction over the work.

3.02 FOG SEALING

- A. Fog seal shall be constructed in accordance with the provisions of Section 37, "Bituminous Seals" of the State Standard Specifications, to the limits shown on the Drawings, listed in the Encroachment Permit, or as indicated by the Engineer.

3.03 SLURRY SEALING

- A. Slurry seal coat shall be constructed in accordance with the provisions of Section 37, "Bituminous Seals" of the State Standard Specifications for a double seal coat, to the

limits shown on the Drawings, listed in the Encroachment Permit, or as indicated by the Engineer.

END OF SECTION

SECTION 32 31 11
GATE OPERATORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electric Gate Operators:
 - 1. Heavy-duty, industrial, gear-driven slide gate operators (LiftMaster Model SL585).
- B. Monitored Photo Eyes
 - 1. Monitored Retro-Reflective Photo Eyes (LiftMaster Model LMRRUL)

1.02 RELATED SECTIONS:

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 32 31 19 – Ornamental Steel Fences
- C. Division 26 – Electrical

1.03 REFERENCES

- A. National Electrical Manufacturers Association (NEMA): NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- B. Underwriters Laboratories (UL): UL 325 - Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- C. Underwriters Laboratories (UL): UL 991 - Standard for Tests for Safety-Related Controls Employing Solid-State Devices.
- D. International Organization for Standardization: ISO 9001 - Quality Management Systems.

1.04 SUBMITTALS

- A. Product Data: Equipment list, system description, electrical wiring diagrams for installation, and manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Electrical wiring diagrams, voltage and total load.
 - 3. Description and requirements for wireless controller. Include configuration details, software requirements, licensing details and any additional hardwired requirements. Any software required shall be licensed to the Owner.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation methods.

- B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge conditions, and accessories.
 - 1. Operation, installation, and maintenance manuals including wiring diagrams.
 - 2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials and products in strict compliance with manufacturer's instructions and industry standards.
- B. Store products indoors in manufacturer's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 Certified Manufacturer.
- B. Installer Qualifications: Installation performed by factory authorized contractor specifically trained in gate operation systems of the type found within this section.
- C. Provide documentation of maintenance and repair service availability for emergency conditions.
- D. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.07 WARRANTY

- A. Manufacturer's Standard Limited Warranty:
 - 1. Warranty Period: 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Design is based upon the products of: LiftMaster; 300 Windsor Drive; Oak Brook, IL 60523. ASD. Toll-Free: 800.282.6225. Email: specs@LiftMaster.com. Web: LiftMaster.com.
- B. Or equal products of other manufacturers may be submitted.

2.02 GATE OPERATORS

- A. Gate Operators: LiftMaster SL585 Industrial Gear-Driven Slide Gate Operator.
 - 1. Compliance: UL Listed. Compliant to the UL 325, UL 991 and CSA C22.2 No. 247 standards.
 - a. This model is intended for use in Class I, II, III and IV vehicular slide gate applications.

2. Monitored Safety Inputs: 3 inputs per board (main board and expansion board) totaling 6 inputs with any combination of up to:
 - a. Main Board:
 - 1) 1 Monitored Close Photo Eye input
 - 2) 1 Monitored Open Photo Eye input
 - 3) 1 Monitored Open Safety Edge or Open Photo Eye input
 - b. Expansion Board
 - 1) 2 Monitored Safety Edge or Photo Eye inputs (selectable for Open or Close).
 - 2) 1 Monitored Photo Eye input (selectable for Open or Close).
 - c. 8 Monitored edges available when Transceiver is added.
3. Operator Speed: 11 inches (279.4 mm) per second.
4. Electrical Power Requirements:
 - a. 460 V AC, three phase, 60 Hz.
5. Accessory Electrical Power Requirements: 24V AC.
 - a. Main Board: 12V AC, maximum 500mA.
 - b. Terminal Strip:
 - 1) 2.2A maximum for 460 V AC, three phase.
6. Gear Reduction: 20:1 wormgear reducer in synthetic oil bath.
7. Motor: Switchless ½ HP, continuous duty
 - a. Capacity: Supports gate lengths up to 45 feet (13 m) and gate weights up to 1,000 pounds(454 kg).
 - b. Recommended Cycles per Hour: 20.
8. Metal Frame: 7 gauge pre-galvanized steel.
9. Chassis: Powder-coated galvanized steel.
10. Enclosure: Weather-resistant, lockable, 16-gauge steel cover.
11. Chain: #50 nickel-plated, 25 feet (7620 mm) supplied with each unit.
12. Gearbox: All-weather.
13. Receiver:
 - a. Security+ 2.0 3-channel on-board radio receiver, holds up to 50 remote controls (unlimited with use of 811LM/813LM)
 - b. Transmits 310 MHz, 315MHz, 390 MHz
14. Inherent Reversing Sensor: Utilizes Current Sense and RPM Sensor to detect obstructions or increased loads. Reverses gate when closing or stops/reverses the gate when opening.
15. Lockout/Tagout: Prevents power from being switched on when servicing operator. Safeguards workers from high voltage power.
16. LED Diagnostic Display: Simplifies installation and troubleshooting.
17. Colored Terminal Blocks: Provides easy identification of safety and fire department inputs.
18. Programmable Auxiliary Relays: 2 programmable relays with 6 settings each.
 - a. Pre-warning or gate-in motion sounder
 - b. Switch on/off devices at open or Close Limits or while gate is in motion.
 - c. Tamper detection if gate is pushed off Close Limit
 - d. Cycle quantity feedback.
 - e. Red/Green Light to control gate traffic.

19. Quick Close, Anti-Tailgate: Quickly secures property, preventing unauthorized access.
 20. Sequenced Access Management: Capable of sequentially controlling the operator in tandem with a barrier gate.
 21. Surge/Lightning Protection: Industrial Surge Protection on high and low voltage inputs. Protects against lightning strikes at a 50-foot (15.2m) radius.
 22. Plug-in Loop Detector Inputs: Programmed inputs for shadow, interrupt and exit.
 23. External Alarm Reset Button: Allows for quick reset of the gate operator when the alarm has been activated.
 24. Warning Device: UL 325 compliant entrapment warning alarm has ability to be set for pre-operation warning; provides a 3-second warning prior to and during gate movement.
 25. Maximum Run Timer: Protects against damage to the gate and operator by limiting the unit's run time to 120 seconds.
 26. Lockable External Manual Disconnect: Allows gate to be opened in the event of a power loss without removing the operator cover.
 27. Mechanical Braking: the mechanical braking system adds substantial gate position control at all points in travel. The solenoid-actuated brake system also prevents the gate from being back-driven
 28. Friction Clutch: Adjustable friction clutch helps protect gate and operator from damage should the gate meet an obstruction.
 29. Limit Settings: Driven limit nut switches are fully adjustable to provide precision, accuracy and reliability.
 30. Universal Footprint: Easily adapts operator to common footprints. Simplifies retrofit applications by adapting to pre-existing pads for Link, Stanley or LiftMaster operators.
 31. Operating Temperature Range:
 - a. Without heater: -4 degrees F (-20 degrees C) to 140 degrees F (60 degrees C).
 32. Accessories: Safety Monitoring Devices:
 - a. Monitored Photo Eyes and Wireless Edge Kits.
 - 1) LiftMaster LMRRUL Reflective Photo Eyes.
 - 2) LiftMaster LMWEKITU Wireless Edge Kit with Transmitter and Receiver.
 - b. Wired Monitored Edges (all require use of LMWEKITU)
 - 1) LiftMaster WR6 Wrap-Around 6 foot (1829 mm) round monitored edge
 33. Accessories: Provide the optional accessories listed below.
 - a. LiftMaster LOOPDETLM Plug-in Loop Detector
 - b. LiftMaster KPW250 – Wireless Commercial Keypad
- B. Software: Provide all software required for configuration and functioning of the gate. All required software provided shall be licensed to the Owner.

2.03 KEYPAD MOUNT

- A. Steel gooseneck mount for wireless keypad, LiftMaster model PED64 In-Ground or similar
 1. 2" x 2" square steel post, minimum 64" tall, 13" throw
 2. 4" x 4" keypad mounting plate
 3. Black powder-coated weather-resistant finish

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Inspect and prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions.
- B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Test for proper operation and adjust until satisfactory results are obtained.

3.03 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 32 31 12

BARRIER GATE OPERATORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electric Gate Arm Operators:
 - 1. High-performance commercial DC barrier gate operators with built-in Battery Backup (LiftMaster MA series).
- B. Monitored Photo Eyes
 - 1. Monitored Retro-Reflective Photo Eyes (LiftMaster Model LMRRUL)

1.02 RELATED SECTIONS:

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 32 31 13 – Chain Link Fences
- C. Division 26 – Electrical

1.03 REFERENCES

- A. National Electrical Manufacturers Association (NEMA): NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- B. Underwriters Laboratories (UL): UL 325 - Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- C. Underwriters Laboratories (UL): UL 991 - Standard for Tests for Safety-Related Controls Employing Solid-State Devices.
- D. International Organization for Standardization: ISO 9001 - Quality Management Systems.

1.04 SUBMITTALS

- A. Product Data: Equipment list, system description, electrical wiring diagrams for installation, and manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Electrical wiring diagrams, voltage and total load.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge conditions, and accessories.

1. Operation, installation, and maintenance manuals including wiring diagrams.
2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials and products in strict compliance with manufacturer's instructions and industry standards.
- B. Store products indoors in manufacturer's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 Certified Manufacturer.
- B. Installer Qualifications: Installation performed by factory authorized contractor specifically trained in gate operation systems of the type found within this section.
- C. Provide documentation of maintenance and repair service availability for emergency conditions.
- D. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.07 WARRANTY

- A. Manufacturer's Standard Limited Warranty:
 1. Warranty Period: 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Design is based upon the products of: LiftMaster; 300 Windsor Drive; Oak Brook, IL 60523. ASD. Toll-Free: 800.282.6225. Email: specs@LiftMaster.com. Web: LiftMaster.com.
- B. Or equal products of other manufacturers may be submitted.

2.02 BARRIER GATE OPERATORS

- A. Gate Operators: MA Series High-Performance Commercial Barrier Gate Operators with Built-in Battery Backup.
- B. MAT Mega Arm Barrier Gate Operators with aluminum cover.
- C. Compliance: UL Listed. UL 325, UL 991 and CSA C22.2 No. 247 standards.
- D. Intended for use in Class I, II, III and IV vehicular barrier gate applications.

- E. Warranty: 2 years for operator, 10 years for operator frame.
- F. Operation:
 - 1. Soft start/stop.
 - 2. Universal Controller: 8 inputs right or left-handed operation safety-stop.
 - 3. Anti-tailgate, quick-close features.
 - 4. Selectable Auto Open: 15 seconds after power failure or upon battery depletion barrier arm can be set to automatically open. 15-second delay helps reduce nuisance callbacks due to short power interruptions or brownouts.
- G. Operator Speed: Open or close speed of 2.5 seconds.
- H. Gate Arm:
 - 1. Breakaway arm; held in place with breakaway retaining nuts. If arm is hit, it will break away and can be re-installed; can be set up for right or left-hand mount.
 - 2. Red/white retro-reflectorized DOT tape.
 - 3. Length: 17 feet.
- I. Motor: 1/2 HP, 24V DC, 800 RPM motor, 6,000 cycles per day.
- J. Electrical Power Requirements: 120/220V AC.
- K. Accessory Electrical Power Requirements: 24V DC 500 mA Battery Backup for accessory power.
- L. Gear Reduction: 60:1 reducer in synthetic oil bath.
- M. Chassis: Powder-coated 1/4-inch (6 mm) aluminum alloy.
- N. Drive System: No. 80 gearbox.
- O. Built-in Receiver: Single remote control solution for gate access and additional access points. Ability to add up to 50 remote control.
- P. Magnetic Limit Sensors: Designed for high-cycle applications, contain no moving parts to wear out, provide reliable operation.
- Q. Surge Protection: Built-in at point of incoming line voltage from power spikes, surges.
- R. Auxiliary Outlet: Powers accessories devices.
- S. Battery Backup: Provides operation during power outages to maintain traffic flow.
- T. Automatically resets to normal operation when power is restored; provides up to 900 full cycles with a 12 ft (3658 mm) arm.
- U. Accessories: Provide the optional accessories listed below.
 - 1. Clutch: Allows arm to be manually pushed open. Arm automatically resets to normal closed position upon receiving activation. Ideal for areas that are concerned with vandals damaging arm.

2. EL2000 Commercial and Gated Community Telephone Entry System.
3. 811LM 1-Button Encrypted DIP Remote Control.
4. LD7LP Low-Power Loop Detector.

2.03 MONITORED RETRO-REFLECTIVE PHOTO EYE

- A. LMRRUL Monitored Retro Reflective Photo Eye Assembly: 6 ft (1829 mm) cable, bracket, hood, square reflector, reflector hood, reflector bracket, mounting hardware.
- B. Compliance: UL 325 requirements for gates as secondary entrapment protection.
- C. Enclosure: NEMA 4X waterproof and corrosion-resistant enclosure.
- D. Installation Design: Single-sided, does not require trenching.
- E. Alignment: LED indicator with visible feedback and adjustable photo eye.
- F. Photo Eye Beam: Polarized beam technology sends and receives beam through 2 polarized filters to avoid interference from shiny objects.
- G. Sensing Distance: 50 feet (15 m).
- H. Operating Temperature Range: -40 to 149 degrees F (-40 to 65 degrees C).
- I. Power: 2-wire photo eye interface.
- J. Operating Current: Greater than or equal to 40 mA.
- K. Output Versions: Monitored 2-wire.
- L. Response time: 35 milliseconds.
- M. Wake-up Delay: 500 milliseconds.
- N. Connection: 6 ft (1829 mm) cable, fine stranded with crimp terminals. 18 ga wire.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Inspect and prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions.
- B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- C. If preparation is the responsibility of another installer, notify Owner in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Test for proper operation and adjust until satisfactory results are obtained.

3.03 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. New chain link fencing and gates as shown on the plans and specified herein.
2. The replacement of existing chain link fencing and/or gates disturbed during construction to equal or better condition.
3. The intent of this specification is to provide for a complete installation in a workmanlike and professional manner. Not all required materials, installation procedures or hardware may be specifically listed.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Concrete

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. A36 - Structural Steel.
2. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
3. A123 - Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
4. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. A392 - Zinc-Coated Steel Chain-Link Fence Fabric
6. A817 - Metal-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire.
7. F567 - Installation of Chain-Link Fence.
8. F626 - Fence Fittings.
9. F668 - Polyvinyl Chloride Coated Steel Chain-Link Fences.
10. F900 - Industrial and Commercial Swing Gates.
11. F1043 - Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework.
12. F1083 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

B. State of California Department of Transportation (Caltrans).

1.03 MANUFACTURER'S QUALIFICATIONS

- ###### A. Fence, gates, and accessories shall be products of manufacturers' regularly engaged in manufacturing items of type specified.

1.04 SUBMITTALS

- A. Furnish the following information:
 - 1. Manufacturer's Literature and Data for chain link fencing, gates and all accessories.
 - 2. Manufacturer's Certificates for zinc coatings.
 - 3. Manufacturer's installation instructions.
- B. Shop Drawings for swinging gates and fence terminations.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials shall conform to ASTM F1083 and ASTM A392 for ferrous metals, zinc coated; and detailed specifications forming the various parts thereto; and other requirements specified herein. Zinc coat metal members (including fabric, gates, posts, rails, hardware and other ferrous metal items) after fabrication shall be reasonably free of excessive roughness, blisters and sal-ammoniac spots.
- B. ASTM A392 knuckled top and bottom. Single width fabric to full height of fence. Nine (9) gauge finished wire size, 3.5-inch mesh. Class 1 chain link fence fabric with 1.2 ounces of zinc coating per square foot of uncoated wire surface shall be used.
- C. Top and bottom tension wire shall be ASTM A817 and ASTM F626, having the same coatings as the fence fabric.

2.02 POSTS AND RAILS

- A. ASTM F1083, Grade SK-40A, round, zinc coated steel.
 - 1. Dimensions and weights of posts shall conform to the tables in the ASTM Specification.
 - 2. Dimensions and weights of gate posts shall conform to CALTRANS Detail A85.
- B. Provide post braces and truss rods for each gate, corner, pull or end post.
 - 1. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.
 - 2. Fit with suitable expansion sleeves and means for securing rail to each gate, corner, and end posts.
- C. Where indicated on the Drawings, posts shall be provided with barbed wire support arms. Each extension arm shall be sized to carry three strands of barbed wire at an angle of 45 degrees, the upper strand 12 inches out from the fence line and 12 inches above the top of the fabric.
- D. Posts, rails, and barbed wire support arms shall be hot-dipped galvanized and covered with two coats of black metal paint applied over a metal primer.

2.03 ACCESSORIES

- A. Accessories as necessary shall include caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories conforming to ASTM F626.
- B. Barbed wire shall be of the four-point pattern, composed of two strands of No. 12-1/2 gauge steel wire, Class III with large hard temper barbs spaced a maximum of 5 inches apart, and shall be heavily galvanized by the hot-dip process.

2.04 SWING GATES

- A. ASTM F900, type as shown on the plans.
- B. Gate framing, bracing, latches, hardware and coatings shall be the same as the fabric.
- C. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods, or shall have tubular members as necessary to provide rigid construction, free from sag or twist.
- D. Attach gate fabric to the gate frame by a method standard with the manufacturer, except that welding will not be permitted.
- E. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement.

2.05 CANTILEVER SLIDE GATES

- A. Gate Frame: Shall be made in accordance with ASTM F 1184 Type II Class 2, and in compliance with UL-325, and ASTM 2200. (No substitution) Gate to be made of Aluminum Alloy 6005A-T61. All square members are 2" sq. weighing 0.94 lb/FT (139 kg/m). Complete frame welded to top (HI-STRENGTH) one piece track and top frame member and 4" x 2" bottom rail weighing 1.71 lbs./ft (2.54 kg/m) Supply 2 truck assemblies that are swivel type having lubricated and scaled ball bearing wheels that will align in the track during all normal operations of the gate.
- B. Gate Finish (Frame): Galvanized steel to match fence
- C. Chain Link Filler: As specified. Chain link fabric filler installed using hook bolts that are inserted through pre-drilled holes in the frame. To these hook bolts the fabric will be attached by means of a tension bar which is laced through the last link of the fabric. The hook bolts shall be 15" (381mm) on center and all four sides of the gate. This shall assure a drum like tightness to the fabric. This fabric shall give additional strength to the gate.
- D. Diagonal adjustable 1/4" (6 mm) stainless steel truss cables (2) shall be provided inside each panel of the gate. (One each direction).
- E. Track shall be an enclosed (HI-STRENGTH) combination track and top rail aluminum extrusion weighing 4.75 lb/ft (7.03 kg/m). It shall withstand a 2,000 lb (907.2 kg) reaction load.

- F. Truck assembly: Swivel type, zinc die cast, with 4 sealed lubricant ball bearing wheels 2" (50 mm) in diameter. The load bearing wheels shall have an extruded dynamic load rating of 4,500 pounds each, and 2 side rolling wheels to ensure truck alignment in track. Truck assemblies shall be held to post brackets using 5/8" (16 mm) diameter stainless steel bolts which shall have a load rating of 11,000 pounds. Truck assembly to withstand 2,000 lb (907.2 kg) reaction load.
- G. Bottom guide wheel assemblies: Each assembly shall consist of two 3" (75 mm) diameter wheels with covers Per UL-325 and ASTM F 2200, straddling bottom horizontal gate rail, allowing adjustment to maintain gate frame plumb and in proper alignment. Attach one assembly to each guide post.
- H. Gate post brackets, latch and keepers shall be galvanized steel.
- I. Gate posts shall be 4" O.D. (101.6 mm) schedule 40 weighing 9.11 lb/ft (13.6 kg/m) minimum. Single gates with single tracks shall have 3 gate posts (1 latch post and 2 support posts). Single gates with dual tracks shall have 5 gate posts (1 latch and 2 dual support posts). Double gates shall have twice the number of support posts but do not have a latch post.

2.06 GATE HARDWARE

- A. Manufacturer's standard products, installed complete. The type of hinges shall allow gates to swing through 180 degrees, from closed to open position. Hang and secure gates in such a manner that, when locked, they cannot be lifted off hinges.
- B. Provide stops and keepers for all gates. Latches shall have a plunger bar arranged to engage the center stop. Arrange latches for locking. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger bar. Keepers shall consist of a mechanical device for securing the free end of the gate when in full open position.
- C. Provide provision for locking gate with a padlock. Lock to be provided by Owner.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fence with a properly trained crew, on previously prepared surfaces, to lines and grades as shown.
- B. Install fence in accordance with ASTM F567 and with the manufacturer's printed installation instructions, except as modified herein or as shown.
- C. Maintain all equipment, tools, and machinery while on the project in sufficient quantities and capacities for proper installation of posts, chain links and accessories.
- D. Supply accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to accommodate the installation of a complete fence, with fabric that is taut and attached properly to posts, rails, and tension wire.

3.02 EXCAVATION

- A. Provide post holes to the depth and diameter shown on the manufacturer's printed installation instructions.
- B. Clear loose material from post holes.
- C. Grade area around finished concrete footings as shown on the grading plans and dispose of excess material in conformance with Section 31 23 16.

3.03 POST SETTING

- A. Install posts plumb and in alignment.
- B. Straight runs between braced posts shall not exceed 500 feet
- C. Set posts in concrete footings of dimensions recommended by the manufacturer.
- D. Thoroughly compact concrete so as it to be free of voids and finished in a slope or dome to divert water running down the post away from the footing.
- E. Cure concrete a minimum of 72 hours before any further work is done on the posts.
- F. Fit all exposed ends of post with caps.
- G. Provide caps that fit snugly and are weathertight.
- H. Where top rail is used, provide caps to accommodate the top rail.
- I. Install post caps as recommended by the manufacturer.

3.04 TOP AND BOTTOM RAILS

- A. Install rails before installing chain link fabric. Provide suitable means for securing rail ends to terminal and intermediate post.
- B. Top rails shall pass through intermediate post supporting arms or caps.
- C. The rails shall have expansion couplings (rail sleeves) spaced as recommended by the manufacturer.

3.05 FABRIC

- A. Install and pull taut tension wire before installing the chain link fabric.
- B. Pull fabric taut and secured with wire ties or clips to the top rail, bottom rail and tension wire close to both sides of each post and at intervals of not more than 24 inches on center.
 - 1. Secure fabric to posts using stretcher bars and ties or clips.

3.06 GATES

- A. Install gates plumb, level, and secure for full opening without interference.
- B. Set keepers, stops and other accessories into concrete as required by the manufacturer.
- C. Adjust hardware for smooth operation and lubricate where necessary.

3.07 REPAIR OF GALVANIZED SURFACES

- A. Use galvanized repair compound, stick form, or other method, where galvanized surfaces need field or shop repair. Repair surfaces in accordance with the manufacturer's printed directions.

3.08 FINAL CLEAN UP

- A. Remove all debris, rubbish and excess material from the construction site.

END OF SECTION

SECTION 32 31 19

ORNAMENTAL STEEL FENCE AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein.

1.02 RELATED SECTIONS:

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 32 31 11 – Gate Operators

1.03 SYSTEM DESCRIPTION

- A. Ornamental steel fence system, nominally 8-ft in height, including all required components (i.e., panels, posts, gates and hardware). Fence panels shall be rackable for installation on sloped areas.
- B. Cantilever gate system, nominally 8-ft in height, including all required components (i.e., tracks, uprights, bracing, pickets, hardware, fittings, and fasteners).

1.04 QUALITY ASSURANCE

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

1.05 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.06 SUBMITTALS

- A. Furnish the following information:
 - 1. Manufacturer's Literature and Data for fencing, gates and all accessories.
 - 2. Manufacturer's Certificates for coatings.
 - 3. Manufacturer's installation instructions.
- B. Shop Drawings for gates and fence terminations.

1.07 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 PRODUCT WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. The fence system shall conform to Montage II Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel, Invincible design, flush bottom rail treatment, 4-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.
- B. All industrial ornamental cantilever gates shall conform to the Ameristar TransPort II gate system, Invincible design, manufactured by Ameristar Perimeter Security USA Inc., in Tulsa, Oklahoma.

2.02 MATERIAL

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum

zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90. Material for gate support posts shall be 4" square x 11 Ga. tubing.

- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.
- C. The materials used for cantilever gate framing (uprights & diagonal bracing) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The TransPort™ enclosed tracks shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.
- D. Material for cantilever gate pickets shall be 1" square x 1/8" wall aluminum pickets on gate systems greater than 24' openings, gate systems less than 24' openings shall have 1" square x 16 ga. steel pickets. Picket on center spacing shall not exceed 5". Pickets shall be securely fastened to face of top and bottom enclosed track extrusions.
- E. Material for gate uprights and diagonal bracing shall be 2" square x 1/4" wall aluminum. The cross-sectional shape of the enclosed-track shall conform to the manufacturers Fast-Trak™ design with as a single extrusion consisting of a 2" x 5" channeled support with integrated 2" x 2" enclosed-track raceway. Gates less than 24' openings shall be constructed as a single track system, gates greater than 24' openings shall be constructed as a dual track system.
- F. Suspension Rollers for enclosed tracks shall be used at each support post to track connection. Each truck assembly shall be capable of being adjusted vertically via threaded rod for fine-tune adjustment. Truck assembly shall be constructed in a way so that the primary housing for the truck rollers shall pivot via ball-bearing connection to threaded rod.

2.03 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly.
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.

- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.
- G. Cantilever gate frame uprights and diagonal bracing shall be pre-fabricated and pre-punched to accept frame fasteners. Enclosed track shall be pre-punched to accept gate uprights. Pickets shall be pre-cut to specified length and pre-drilled to accept picket to track fasteners. Posts shall be pre-cut to specified lengths.
- H. Top and bottom enclosed track extrusions shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Diagonal bracing shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Pickets shall be mechanically fastened to top and bottom enclosed track, as required by assembly instructions.
- I. The manufactured cantilever gate components shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36". Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.03 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 SWING GATE INSTALLATION

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

3.05 CANTILEVER GATE INSTALLATION

- A. Cantilever support posts shall be set in concrete footers having a minimum depth of 48". Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.
- B. Gate to be installed per manufacturers gate installation instructions. Gate shall be installed in compliance with ASTM F2200 standards.

3.06 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Minimum Sizes for Montage II Posts			
<u>Fence Posts</u>		<u>Panel Height</u>	
2-1/2" x 12 Ga.		Up to & Including 6' Height	
3" x 12 Ga.		Over 6' Up to & Including 8' Height	
<u>Swing Gate Leaf</u>	<u>Swing Gate Height</u>		
	<u>Up to & Including 4'</u>	<u>Over 4' Up to & Including 6'</u>	<u>Over 6' Up to & Including 8'</u>
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type				
Span	For INVINCIBLE [®] 8' Nominal (91-1/2" Rail)			
Post Size	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"
*Note: When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.				

END OF SECTION

SECTION 33 05 05.31

HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes the requirements and procedures for pressure and leakage testing of pressure distribution mains.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1.03 CONNECTION TO EXISTING MAINS

- A. The test shall be made before connecting the new line with the existing District pipes and mains.

1.04 TESTER PROCEDURE PLAN

- A. Contractor shall submit to the District a Test Procedure Plan. All testing shall be performed by a District-approved testing company or the design engineer who will be required to provide the District representative with certified testing results. Tester will have a gage and meter, calibrated annually. No testing shall take place against closed valves.

1.05 REQUIREMENTS PRIOR TO TESTINGS

- A. Before testing, the pipe trench shall be backfilled and compacted to the ground surface per Section 31 23 00.
- B. All concrete anchor blocks shall be allowed to cure a sufficient time to develop a minimum strength of 2,000 psi, but not less than five (5) days, before testing, unless otherwise directed by the District representative.
- C. Steel pipelines shall not be tested before the mortar lining and coating on all of the pipe lengths in the line have attained an age of 14 days. Cement-mortar lined pipe shall not be filled with water until a minimum period of eight hours has elapsed after the last joint in any section has been made.
- D. All surrounding utilities shall be installed prior to testing.

1.06 TESTING BEFORE FINAL PAVEMENT

- A. All pipelines shall be satisfactorily pressure tested prior to the placement of final pavement.

PART 2 - MATERIALS

2.01 WATER

- A. The same water used for chlorination of the pipeline may be used to fill the line for pressure testing.
- B. Make up water for testing shall be domestic water. Contractor shall pay for all make up water.
- C. Temporary manual air release valves shall be utilized when requested by the District.
- D. Test bulkheads shall be utilized in testing. Testing against valves will not be permitted.

PART 3 - EXECUTION

3.01 GENERAL

- A. All labor, materials, tools, and equipment for testing shall be furnished by the contractor.
- B. The pipeline shall be subjected to a field hydrostatic pressure of 200 psi for pipe 12 inches or greater for a period of four hours. For pipelines 10 inches or smaller, the pipe shall be subjected to a field hydrostatic pressure of 50 psi in excess of the anticipated working pressure of the pipe for a period of four hours.
- C. The water necessary to maintain test pressure shall be measured through a meter. The leakage shall be considered as the amount of water entering the pipe during the test, less the measured leakage through valves and fittings. Leakage shall not exceed the rate specified. Any noticeable leaks shall be stopped, and any defective pipe shall be replaced with new sections.
- D. The test shall further be conducted with valves open, and the open ends of pipes, valves, and fittings suitably closed. Valves shall be operated during the test period.
- E. In hilly areas, it may be necessary to conduct the test in segments so that no pipe section is tested at less than the pipe pressure class plus 50 psi, nor more than 1½ times the pipe pressure class.

3.02 FIELD TEST PROCEDURE

- A. The pipeline shall be filled at a rate such that the average velocity of flow is less than 1 fps. At no time shall the maximum velocity of flow exceed 2 fps. The following table has been provided to relate the velocity filling rate to an equivalent volume flow rate.
 - 1. Filling Rate in gpm equivalent to filling velocities of 1 fps

Normal Size (inches)	Flow Rate Q (gpm)
4	38
6	88
8	158
12	353
16	624

- B. All air should be purged from the pipeline before checking for leaks or performing pressure or acceptance tests on the system. To accomplish this, if air valves or hydrants or other outlets are not available, taps shall be made at the high points to expel the air, and these taps shall be tightly plugged afterwards.
- C. After the pipeline has been filled and allowed to sit a minimum of 24 hours (48 hours for mortar-lined pipelines), the pressure in the pipeline shall then be pumped up to the specified test pressure. If a large quantity of water is required to increase the pressure during testing, entrapped air, leakage at joints, or a broken pipe can be suspected. TESTS SHOULD BE DISCONTINUED until the source of trouble is identified and corrected.
- D. When the test pressure has been reached, the pumping shall be discontinued until the pressure in the line has dropped 25 psi, at which time the pressure shall again be pumped up to the specified test pressure. For HDPE pipe, a resting period of a minimum of 30 hours shall be used. This procedure shall be repeated until four hours have elapsed from the time the specified test pressure was first applied. At the end of the four hour period, the pressure shall be pumped up to the test pressure for the last time.
- E. The leakage shall be considered as the total amount of water pumped into the pipeline during the four-hour period, including the amount required in reaching the test pressure for the final time. Leakage shall not exceed the rates in the tables below. If the size, pipe material, or pressure fall outside of the table listed below, the leakage amount will be determined by the engineer.

DIP LEAKAGE ALLOWANCE

Pipe Size (inches)	Test Pressure (psi)	Allowable Leakage Gallons per four hours per 1,000 feet of pipe
4	250	1.7
6	250	2.6
8	250	3.4
12	225	5.4
16	225	7.2
20	225	9.0
24	225	10.8

PVC LEAKAGE ALLOWANCE

Pipe Size (inches)	Test Pressure		Allowable Leakage Gallons per four hours per 1,000 feet of pipe	
	Class 150 (psi)	Class 200 (psi)	Class 150	Class 200
4	200	250	1.5	1.7
6	200	250	2.3	2.6
8	200	250	3.0	3.4
12	225	250	5.1	5.7

STEEL PIPE ALLOWANCE

For steel pipe, the allowable loss rate shall be determined by the following formula:

$$L = \frac{HND(P)^2}{7,400}$$

In which:

- L = Allowable loss (gallons)
- H = Specific test period (hours)
- N = Number of rubber-gasketed joints in the pipe tested *
- D = Diameter of the pipe in inches
- P = Specified test pressure (psig)

* Flanged, welded and grooved joints shall have zero leakage. The test period shall be four hours for 24-inches in diameter and smaller pipe. The test period shall be eight hours for pipes greater than 24-inches in diameter.

- F. Any noticeable leak shall be stopped and all defective pipe, fittings, valves, and other accessories discovered in consequence of the test shall be removed and replaced by the contractor with sound material, and the test shall be repeated until the total leakage during a test of four hours (4) duration does not exceed the rate specified above.

END OF SECTION

SECTION 33 05 05.33

LEAKAGE AND INFILTRATION TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes the requirements and procedures for leakage and infiltration testing of gravity sewer systems, in accordance with ANSI/ASTM C828, Low Pressure Air Test.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 33 31 11 PVC Gravity Sewer Pipe
- B. Section 33 05 05.31 Hydrostatic Testing of Pressure Pipelines
- C. Section 33 05 61 Precast Concrete Manholes
- D. Section 33 05 62 Polymer Concrete Wet Well

1.03 TESTING

- A. General: All tests shall be made in the presence of the Owner's inspector.
- B. Leakage: Each section of sewer between two successive manholes shall be tested for leakage and the leakage test shall be made on all manholes.
- C. Infiltration: The infiltration test shall be made where excessive groundwater is encountered in the trench.
- D. Retesting: Even though a section may have previously passed the leakage or infiltration test, each section of sewer shall be tested subsequent to the last backfill compacting operation if, in the opinion of the Engineer, heavy compaction equipment or any of the operations of the contractor or others may have damaged or affected the structural integrity or watertightness of the pipe, structure, and appurtenances.
- E. Other Utilities: Owner's official tests will not be made until after all the other utilities have been installed and their trench compaction verified.
- F. Excessive Leakage or Infiltration: If the leakage or infiltration rate is greater than the amount specified, the pipe joints shall be repaired or, if necessary, the pipe shall be removed and relaid by the contractor.
- G. Acceptance: The sewer will not be accepted until the leakage or infiltration rate, as determined by test, is less than the maximum allowable.
- H. House Laterals: House laterals are not to be connected until after the sewer main has been successfully tested.

PART 2 - MATERIALS

2.01 EQUIPMENT

- A. The contractor shall furnish all equipment and materials required for testing.

PART 3 - EXECUTION

3.01 AIR TEST FOR PVC GRAVITY SEWERS

- A. Test Section: Each section of sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs.
- B. Addition of Air: Air shall be slowly added until the internal pressure is raised to 4.0 pounds per square inch gage (psig). The compressor used to add air to the pipe shall have a blowoff valve set at 5 psig to ensure that at no time the internal pressure in the pipe exceeds 5 psig.
- C. Internal Pressure: The internal pressure of 4 psig shall be maintained for at least two minutes to allow the air temperature to stabilize, after which the air supply shall be disconnected and the pressure allowed to decrease to 3.5 psig.
- D. Minimum Duration for Allowable Pressure Drop: The time in minutes that is required for the internal air pressure to drop from 3.5 psig to 3.0 psig shall be measured. The results shall not be less than the minimum permissible duration for air test pressure drop shown below.

MINIMUM DURUATION FOR AIR TEST PRESSURE DROP	
Pipe Size (Inches)	Time (Minutes)
4	2-1/2
6	4
8	5
10	6-1/2
12	7-1/2
15	9-1/2

- E. Retest: If the pressure drop from 3.5 psig to 3.0 psig occurs in less time than the above-tabulated or calculated values, the pipe shall be overhauled and, if necessary, replaced and relaid until the joints and pipe shall hold satisfactorily under this test.

3.02 INFILTRATION TEST

- A. Preparation of Test Section: The end of the sewer at the upper structure shall be closed to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three days, after which the section shall be tested for infiltration.

- B. Allowable Infiltration Rate: The infiltration shall not exceed 0.025 gpm per inch of diameter per 1,000 feet of main line sewer being tested, not including the length of laterals entering that section.
- C. Excessive Infiltration: Where infiltration in excess of the allowable amount is discovered before completion and acceptance of the sewer, the sewer shall be immediately uncovered and the amount of the infiltration reduced to a quality within the specified amount of infiltration, before the sewer is accepted.
- D. Individual Leaks: Even if the infiltration is less than the allowable amount, any individual leaks that may be observed shall be stopped as ordered by the Owner's inspector.
- E. Completion of Tests: All tests must be completed before the street or trench is resurfaced, unless otherwise directed by the Owner's inspector.

3.03 DEFLECTION TEST

- A. General: All PVC main line pipe shall be tested for deflection, joint displacement, or other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing. The mandrel shall be a full circle, solid cylinder, or a cylinder, approved by the Engineer as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside pipe diameter of the pipe, as follows:

Pipe Material	Nominal Size Inches	Minimum Mandrel Diameter Inches
PVC-ASTM D 3033	6	5.169
(SDR 35)	8	7.309
	10	9.137
	12	10.963

3.04 MANHOLE LEAKAGE TEST

- A. General: Water tightness of manholes shall be tested in connection with tests of sanitary sewers, or at the time the manhole is completed and backfilled.
- B. Plugs: All manhole inlets and outlets shall be plugged with approved stoppers or plugs.
- C. Fill Level: The manhole shall be filled with water to 2-inches below the bottom of the tapered cone section, with a minimum depth of 4 feet and a maximum depth of 20 feet. The water shall stand in the manhole for a minimum of one hour to allow the manhole material to reach maximum absorption. Before the test is begun, the manhole shall be refilled to the original depth as needed.
- D. Test Requirements: The drop in water surface shall be recorded after a period of from 15 minutes to one hour. The time of the test shall be determined by the Owner's inspector and may be varied to fit the various field conditions. The maximum allowable drop in the water surface shall be 1/2 inch for each 15-minute period of testing.

- E. Visible Leaks: Even though the leakage is less than the specified amount, the contractor shall stop any leaks that may be observed, to the satisfaction of the Owner's inspector.

END OF SECTION

SECTION 33 05 09.43

HOT TAP CONNECTIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes materials, requirements and procedures for hot tap (system under pressure) connections to existing distribution systems.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Existing Facilities 02 01 00
- B. Chlorination of Domestic Water Mains for Disinfection 22 11 23
- C. Hydrostatic Testing of Pressure Pipelines 33 05 05.31
- D. Copper, Brass and Bronze Pipe, Fittings and Appurtenances 22 11 13
- E. Manual Valves 33 12 16

1.03 APPROVED MANUFACTURERS

- A. Service Saddles and Corporation Stops
 - 1. See Section 22 11 13
- B. Tapping Sleeves
 - 1. Mueller JCM 432
- C. Tapping Valves
 - 1. See Resilient Seated Wedge Gate Valves Section 33 12 16
- D. Direct Tap
 - 1. All taps into existing pipes will be made through a service saddle, tapping sleeve, welded nozzle or welded coupling. Taps of the same size as the pipe are not permitted. Size on size connections shall be tees. Saddles are required for all taps. Direct taps are not permitted.

PART 2 - MATERIALS

2.01 SERVICE SADDLES AND CORPORATION STOPS

- A. Service saddles and corporation stops shall comply with Section 22 11 13.

2.02 TAPPING SLEEVES

- A. Tapping sleeves onto pipelines 12-inch and smaller shall be full circle cast iron with mechanical joint end glands or fabricated stainless steel or as approved by District Engineer.
- B. Gaskets shall be Bunz-N rubber with a wide cross section.
- C. Tapping sleeves onto 14-inch and larger ACP shall be fabricated steel with mechanical joint ends. All fabricated parts shall be epoxy coated per Section 09 90 00. All bolts and trim hardware shall be Type 316 stainless steel.

2.03 TAPPING VALVES

- A. Tapping valves shall be flanged resilient seat wedge gate valves per Section 33 12 16.

PART 3 - EXECUTION

3.01 NOTIFICATION

- A. The contractor shall provide proper notification to the District inspector prior to making a hot tap connection.

3.02 VERIFICATION

- A. The contractor shall pothole the proposed connection to verify the outside diameter, location and type of pipe to be tapped.

3.03 SURFACE PREPARATION

- A. The pipe barrel to be tapped shall be thoroughly cleaned with a wire brush to provide a smooth, hard surface for the saddle, sleeve or nozzle.

3.04 SERVICE SADDLE AND CORPORATION STOP

- A. Service saddles and corporation stops will be installed onto ACP, DIP or PVC mains in accordance with the manufacturer's accordance and Section 22 11 13. The outlet shall be oriented to comply with the intended use of the service connection.

3.05 TAPPING SLEEVES

- A. The tapping sleeve shall be installed in accordance with the manufacturer's instructions and to the satisfaction of the District representative.
- B. The pipe barrel shall be thoroughly cleaned with a wire brush to provide a smooth, hard surface for the sleeve.
- C. The sleeve shall be supported independent of the pipe during the tapping operation.
- D. The sleeve shall be pressure tested in the presence of the District representative prior to tapping.
- E. Thrust blocks shall be provided at the tapping sleeve per Standard Plan W-17 03 30 00.

3.06 TAPPING VALVE

- A. The tapping valve shall be installed on the tapping sleeve or weld nozzle per Section 33 12 16. All flange bolts shall be Type 316 stainless steel.

3.07 HOT TAP

- A. The hot tap into the existing pipe shall be made using the appropriate type of cutting machine and shell cutting bit for the material being tapped.
- B. The company performing the hot tap must be approved by the District. The tapping machine shall be operated per the manufacturer's operating instructions.
- C. Proper care shall be taken to prevent cutting material from entering the pipeline. The tapping coupon must be extracted.

3.08 EXTERIOR COATING REPAIR

- A. The exterior bituminous or mortar coating on steel or iron pipe shall be repaired in accordance with the manufacturer's directions and/or Section 09 90 00.

3.09 DISINFECTION

- A. The interior of the tapping valve and connecting piping shall be sprayed with a sodium hypochlorite solution prior to connection.

END OF SECTION

SECTION 33 05 13

PRECAST CONCRETE MANHOLES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes the materials, manufacture, and installation of precast concrete manholes and manhole frames and covers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. 31 23 00 Trenching, Backfilling and Compacting
 - 2. 03 30 00 Cast-in-Place Concrete

1.03 APPROVED MANUFACTURERS

- A. Precast Manholes
 - 1. Jensen Precast
 - 2. Oldcastle Precast
 - 3. Or approved equal.
- B. Joint Sealing Compound
 - 1. Henry Company (Ramnek)
 - 2. Conseal
- C. Lids and Covers
 - 1. Christy
 - 2. Utility Vault
 - 3. Phoenix Iron Works

1.04 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00, Submittal Procedures.

1.05 FRAMES AND COVERS

- A. All precast sections shall be provided with fabricated aluminum or steel frames and covers as specified or shown on the drawings and shall be built up so that the cover is

flush with the surrounding surface unless otherwise specified on the drawings or by the Engineer in the field.

PART 2 - MATERIALS

2.01 PRECAST CONCRETE MANHOLES

- A. Precast reinforced concrete manholes shall comply with ASTM C 478.
- B. Manhole components shall be designed for H-20 highway loads and site soil conditions.
- C. Manholes shall be fabricated only from eccentric taper sections and standard cylinder units of the proper internal diameter.
- D. Unless noted otherwise, minimum diameter of manholes and manhole sections shall be 48-inches. Minimum depth shall be 7-feet. Depth shall be measured from proposed finish surface elevation to the lowest pipe invert.
- E. Manhole sections shall be furnished without steps.
- F. Drop manholes of greater than 1-ft difference between inlet and outlet inverts are not permitted without the Engineer's approval.

2.02 MANHOLE FRAMES AND COVERS.

- A. Manhole frames and covers shall be made of ductile iron conforming to ASTM A 536, Class 400, or cast iron conforming to ASTM A 48, Class 30. Casting shall be smooth, clean and free from blisters, blowholes and shrinkage. Frames and covers shall be of the traffic type, designed for H-20 loading.
- B. Each manhole cover shall be ground or otherwise finished so that it will fit in its frame without rocking. Frames and covers shall be match-marked in sets before shipping to the site.
- C. Cover shall have lettering cast thereon as shown in the plans. No other lettering on the top side shall be permitted.
 - 1. Sanitary sewer covers shall be labeled "MCWD SANITARY SEWER" per MCWD Standard Detail S-3.
 - 2. Storm drain lids shall be labeled "STORM" per City of Marina standard detail SD-4.
- D. Before leaving the foundry, castings shall be cleaned and subject to hammer inspection. Castings shall be dipped twice in a preparation of asphalt or coal tar and oil applied at a temperature of not less than 290°F, not more than 310°F, and in such a manner as to form a firm and tenacious coating.

2.03 MANHOLE BASES

- A. Concrete used in pouring the manhole base shall be Class A concrete per section 03 30 00, Cast-in-Place Concrete.

- B. Precast bases are acceptable in lieu of field-formed bases with the approval of the Engineer.

2.04 JOINT SEALING COMPOUND

- A. The joint sealing compound shall be a pre-formed, permanently flexible plastic material Ram-Nek by Henry Company or approved equal.

2.05 WATERPROOFING

- A. Waterproofing shall be formulated to comply with Federal Specification SS-A-701.

2.06 CEMENT-MORTAR GROUT

- A. Grout for watertight joints between precast sections shall be composed of one part Portland cement to two parts of clean, well-graded sand of such size that all passes a No. 8 sieve. Cement, aggregate and water for mortar shall conform to the applicable provisions of section 03 30 00.

2.07 EPOXY GROUT

- A. Epoxy grout shall be used in repairing manhole, vault and concrete base surfaces. Epoxy grout shall be made with epoxy and sand. The sand shall be clean, bagged, graded and kiln-dried silica sand. The prepared grout shall wet the concrete surface and provide proper adhesion, or a coat of epoxy shall be applied prior to placing epoxy grout. The epoxy bonding compound shall be as specified in Section 03 60 00.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Excavation and backfill for precast concrete vaults shall be in accordance with Section 31 23 00 and the requirements herein.
- B. The contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations.
- C. The bottom of the structure shall be placed on 12- inches of compacted, crushed rock sub-base, graded level and to the proper elevation as shown on the plans, unless otherwise indicated by the Engineer.

3.02 MANHOLE BASE

- A. General: Manhole bases shall be poured in place against undisturbed soil with Class A concrete having 3/4-inch-maximum size aggregate and a slump of not greater than 2-inches. The manhole base shall be poured as one monolithic pour. Limitations for site-mixed and ready-mixed concrete set forth in Section 03 30 00, Concrete, shall be observed. A 12-inch thick base of 3/4-inch crushed rock shall be placed prior to the placement of concrete for all installations.

- B. Manhole Stub Placement: The manhole stubs and sewer main shall be set before the concrete is placed and shall be rechecked for alignment and grade before the concrete has set. The various sized inlets and outlets to the manhole shall be located as indicated on the plans and as detailed in the detail drawings.
- C. Matching Pipe Crown Elevations: Invert elevations of connecting sewers may vary depending upon sizes. The crown elevation of all pipes shall be the same as the crown elevation of the largest pipe unless otherwise indicated on the plans.
- D. Channel Configuration: The invert of the manhole base shall be formed so as to provide smooth channels conforming in size and shape to the lower portions of the inlet and outlet pipes. The channel shall vary uniformly in size and shape from inlet to outlet, and a shelf shall be constructed higher than the pipe as indicated on the drawings. The manhole base shall extend 12-inches below the bottom of the lowest pipe.
- E. Transitions: All transitions shall be smooth and of the proper radius to give an uninterrupted transition of flow.
- F. Finishing: The concrete base shall be shaped with a wood float and shall receive a hard steel trowel finish before the concrete sets.
- G. Placement of Additional Mortar: In the event additional mortar is required after initial set has taken place, the surface to receive the mortar shall be primed, and the mortar mixed with "Willhold Concrete Adhesive" in the amounts and proportions recommended by the manufacturer and as directed by the Owner's representative in order to secure as chip-proof a result as possible.
- H. Curing Time Before Further Construction: Unless approved otherwise by the District Engineer, in advance, the bases shall set a minimum of 24 hours before the manhole construction is continued.
- I. Manhole Barrel Impression Ring shall be used to mold a groove into the base to match the manhole barrel.

3.03 PRE-CAST MANHOLE BASE

- A. General: Place 12-inch thick base of ¾-inch crushed rock on undisturbed soil below pre-cast manhole base. Backfill and compact per Section 31 23 00.

3.04 INSTALLING MANHOLES

- A. General: Manholes for sewers of diameter 12-inches or less shall be constructed as shown on MCWD Standard Plans S-1, S-2, and S-3. Manholes for larger diameter sewers shall be constructed as shown on the project construction plans.
- B. Joints: Precast concrete manhole units shall be set in a bed of grout to make a watertight joint at least 1/2 inch thick with the concrete base or with the preceding unit. Manhole sections shall be set perfectly plumb. Inside joints shall be pointed and the excess grout wiped off. Preformed, cold-applied, ready-to-use, plastic joint sealing compound may be substituted for grout between units and must be used when groundwater is encountered.

- C. **Finish Elevation of Manhole Covers:** Precast sections shall be assembled so that the cover conforms to the elevation determined by the manhole location as follows, but limited to a maximum of 18-inches from the top of the manhole cone to the top of the ring and cover, unless otherwise instructed by the District representative.
1. **In Paved Area:** Top of cover shall be flush with the paving surface.
 2. **In Shoulder Areas:** Top of cover shall be flush with existing surface where it is in traveled way or shoulder and 0.1 foot above existing surface where outside limits of traveled way but not in the existing roadside ditch.
 3. **In Roadside Ditch or Unpaved Open Areas:** Top of cover shall be a minimum of 6-inches above the ground surface and surrounded with a concrete collar, per MCWD Standard Plans S-1. In special instances, as designated by the District representative or as shown on the plans, the top of the cover shall be flush with the surrounding ground surface and within a square concrete pad 2 feet larger than the manhole frame. Guard posts or paddle boards may be required adjacent to manholes in open areas.
- D. **Manhole Frame and Cover:** The manhole frame shall be bolted to grade ring and secured with grout and cement mortar fillet. After the frames are securely set, the frames and the covers shall be cleaned and scraped free of foreign materials, and shall be ground or otherwise finished as needed so the cover fits in its frame without rocking.
- E. **Watertightness:** It is the intent of these specifications that manholes and appurtenances be watertight and free from infiltration. All manholes are to be banded both inside and outside with cement-mortar grout. Where called for in the plans or supplemental specifications, manholes that are to be given a protective lining or coating shall be free of any seeping or surface moisture. The adequacy of manholes and appurtenances as to watertightness shall be determined by the District representative and shall be tested in accordance with Section 15043, Leakage and Infiltration Testing.
- F. **Stubs:** Sewer pipe shall be furnished and installed in manholes at the locations shown and in conformance with the detail drawings and plans. All stubs shall be plugged with stoppers as shown on the plans for various sizes of pipe.
- G. **Sealing Before Completion:** In order to prevent accidental use of the new sewer before completion and acceptance, the inlet to existing tie-in manholes shall be sealed with broken brick and mortar. Installation of these plugs shall be approved by the District representative. Plugs shall be removed at the time of final inspection or as directed by District representative.
- H. **Bulkheads:** Brick and mortar bulkheads shall be installed at the downstream end of all unused stub channels over 5 feet long to prevent the creation of a septic condition resulting from ponding of sewage and debris in the unused channels, and until such time as the manhole stub is connected and normal sewage flow can occur. A plug shall be required for all downstream stubs.
- I. **New Connections to Existing Manholes:** New connections to existing manholes wherein stubs have not been provided shall be made by core drilling through the base, as directed by the District Engineer.

- J. Backfill: Backfill around the precast concrete manhole shall be imported sand, and shall be placed and compacted in accordance with Section 31 23 00, Trenching, Backfilling, and Compacting.
- K. Grade Rings: Class B concrete rings shall be cast around manhole frames that are flush with the surface. The ring shall be placed after final grading or paving together with final cleanup.

3.05 MANHOLE AND MANHOLE BASE REPAIRS

- A. Manhole sections and bases that exhibit defects in the concrete surface may be rejected. Defective concrete surfaces of manhole sections and bases not rejected shall be repaired by chipping away unsound or imperfect concrete. Edges shall be left sharp and square with the surface. Loose material and dust remaining after chipping shall be removed by means of an air jet. Epoxy grout shall be applied to the surface to be repaired in accordance with the manufacturer's instructions. The grout shall wet the contact surface and provide proper adhesion, or a coat of epoxy shall be applied prior to placing the epoxy grout.

3.06 MANHOLE INFILTRATION TESTING

- A. General: Water tightness of the manhole shall be tested in connection with tests of gravity pipelines, or at the time the wet well is completed and backfilled.
- B. Plugs: All manhole inlets and outlets shall be plugged with approved stoppers or plugs.
- C. Fill Level: The manhole shall be filled with water to 4-feet below the bottom of the lid, with a minimum depth of 4 feet and a maximum depth of 20 feet. The water shall stand in the wet well for a minimum of one hour to allow the concrete material to reach maximum absorption. Before the test is begun, the manhole shall be refilled to the original depth as needed.
- D. Test Requirements: The drop in water surface shall be recorded after a period of from 15 minutes to one hour. The time of the test shall be determined by the Owner's representative and may be varied to fit the various field conditions. The maximum allowable drop in the water surface shall be 1/2 inch for each 15-minute period of testing.
- E. Visible Leaks: Even though the leakage is less than the specified amount, the contractor shall stop any leaks that may be observed, to the satisfaction of the Owner's representative.

END OF SECTION

SECTION 33 05 16

PRECAST CONCRETE UTILITY VAULTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes the materials, manufacture, and installation of precast concrete utility vaults and hatches.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. 31 23 00 Trenching, Backfilling and Compacting
 - 2. 03 30 00 Cast-in-Place Concrete

1.03 APPROVED MANUFACTURERS

- A. Precast Vaults
 - 1. Jensen Precast
 - 2. Oldcastle Precast
 - 3. Or approved equal.
- B. Joint Sealing Compound
 - 1. Henry Company (Ramnek)
 - 2. Conseal
 - 3. Or approve equal.
- C. Waterproofing
 - 1. Grace Dehydratine 4
 - 2. Or approved equal
- D. Traffic Rated Hatches
 - 1. Bilco Company
 - 2. Safe-Hatch by Flygt
 - 3. Jensen MetalTech
 - 4. USF Fabrication
 - 5. Or approved equal

1.04 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00, Submittal Procedures.

1.05 FRAMES AND COVERS

- A. All precast sections shall be provided with fabricated aluminum or steel frames and covers as specified or shown on the drawings and shall be built up so that the cover is flush with the surrounding surface unless otherwise specified on the drawings or by the Engineer in the field.

PART 2 - MATERIALS

2.01 PRECAST CONCRETE VAULT

- A. Precast concrete structures shall comply with ASTM C913, except as modified herein.
- B. Precast concrete vaults and covers shall be manufactured in a plant especially designed for that purpose and shall conform to the shapes and dimensions indicated on the plans.
- C. Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table and any other loads which may be imposed upon the structure. Live loads shall be for H-20 per AASHTO standard specifications for highway bridges. Design wheel load shall be 16 kips. The live load shall be that which produces the maximum shears and bending moments in the structure.
- D. Concrete shall be Class A conforming to Section 03 30 00.
- E. Vault floor shall be treated such that a non-skid surface is provided.
- F. Vault floor shall contain grooved channels to convey drainage to a sump area.
- G. Wall openings shall be sized to permit sealing the annular space with a mechanical seal (Calpico Pipe Lynx, EnPro Corporation Link-Seal, or approved substitute).

2.02 VAULT BASES

- A. Concrete used in pouring the vault base shall be Class A concrete per section 03 30 00, Cast-in-Place Concrete.
- B. Precast bases are acceptable in lieu of field-formed bases with the approval of the Engineer.

2.03 VAULT FRAMES AND COVERS

- A. Vault frames and covers shall be fabricated aluminum with stainless steel hardware.
- B. Covers shall be fabricated with supports to resist deflection.
- C. All covers shall be hinged providing access to the entire vault. Covers shall have spring hydraulic assists.
- D. All covers shall be equipped with a hold-open mechanism with safety chains.

- E. All covers shall be equipped with a flush, locking device with locking eyes up.
- F. All frames and covers shall be equipped with a “ladder up” to provide access assistance.
- G. All covers must be H20 traffic rated for equipment or vehicle loading, unless specified otherwise by the Engineer.

2.04 GASKET SEALS

- A. Preformed plastic sealing gaskets conforming to Federal Specification SS-S-210A; Ram-Nek or equal.

2.05 JOINT SEALING COMPOUND

- A. Compound shall be Quik-Seal by Associated Concrete Products; Ram-Nek by Henry Company; or approved equal.

2.06 WATERPROOFING

- A. Waterproofing shall be formulated to comply with Federal Specification SS-A-701.

2.07 CEMENT-MORTAR GROUT

- A. Grout for watertight joints between precast sections shall be composed of one part Portland cement to two parts of clean, well-graded sand of such size that all passes a No. 8 sieve. Cement, aggregate and water for mortar shall conform to the applicable provisions of section 03 30 00.

2.08 EPOXY GROUT

- A. Epoxy grout shall be used in repairing manhole, vault and concrete base surfaces. Epoxy grout shall be made with epoxy and sand. The sand shall be clean, bagged, graded and kiln-dried silica sand. The prepared grout shall wet the concrete surface and provide proper adhesion, or a coat of epoxy shall be applied prior to placing epoxy grout. The epoxy bonding compound shall be as specified in Section 03 60 00.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Excavation and backfill for precast concrete vaults shall be in accordance with Section 31 23 00 and the requirements herein.
- B. The contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations.
- C. The bottom of the structure shall be placed on 12- inches of compacted, crushed rock sub-base, graded level and to the proper elevation as shown on the plans, unless otherwise indicated by the Engineer.

3.02 INSTALLATION

- A. Openings or "knockouts" in precast concrete vaults shall be located as shown on the drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or coupling flange. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with 3,000-psi concrete or mortar, using an approved epoxy for bonding concrete surfaces.
- B. After the structure and all appurtenances are in place and approved, backfill shall be placed such that finished grade is sloped away from vault (in unpaved areas) or such that vault is flush with finished grade (in paved areas) to the original ground line or to the limits designated on the plans, unless otherwise indicated by the Engineer.
- C. All joints between precast concrete vault sections shall be made watertight using preformed mastic material. The sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint which remains impermeable throughout the design life of the structure. All joints shall be filled with dry-pack non-shrink grout.
- D. Frames and covers shall be built up so that the cover is flush with the surrounding surface unless otherwise specified on the drawings or by the Owner's representative in the field. The contractor is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.
- E. Waterproofing shall be applied to the exterior walls of all buried vaults in accordance with the manufacturer's instructions. Protection shall be placed over the waterproofing to prevent damage.

END OF SECTION

SECTION 33 11 00

GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. General requirements for piping systems, including pipe, joints, fittings, and valves.
 - 2. Pressure testing
- B. Related Sections:
 - 1. Section 02 01 00 – Existing Facilities
 - 2. Section 09 90 00 – Painting and Coating
 - 3. Section 22 11 13 – Copper and Brass Pipe, Fittings and Appurtenances
 - 4. Section 31 23 00 – Trenching, Backfilling and Compacting
 - 5. Section 33 11 13.15 – Ductile Iron Pipe and Fittings
 - 6. Section 33 11 13.90 – Thrust Restraint
 - 7. Section 33 12 16 – Manual Valves
 - 8. Section 40 92 13 – Automatic Valves

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI A13.1 – Piping and Piping Systems
 - 2. ANSI A31.1 – Power Piping ASME
 - 3. NSF 61 – Listing of Certified Drinking Water System Components – Health Effects
- B. American Society of Mechanical Engineering (ASME) – Boiler and Pressure Vessel Code
- C. California Plumbing Code (CPC)
- D. American Waterworks Association (AWWA)
 - 1. AWWA C116 Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
 - 2. AWWA C210 – Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - 3. AWWA C600 Installation of Ductile Iron Water Mains and Their Appurtenances
 - 4. AWWA C605 Underground Installation of PVC and Molecularly Oriented PVC Pressure Pipe and Fittings
 - 5. AWWA C900 PVC Pressure Pipe and Fabricated Fittings

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 30 00.
- B. Catalog cuts and product information showing materials and dimensions.
- C. Hydrostatic testing plans
- D. Operation and Maintenance manuals

PART 2 - MATERIALS

2.01 PIPE AND FITTINGS

- A. Small diameter steel pipe (2-inch and below) shall be Schedule 40 galvanized threaded steel pipe unless noted otherwise on the drawings.
- B. Small diameter polyethylene tubing (2-inch and below) shall be copper tube size (CTS), DR 9, meeting ANSI/AWWA C901, Tubing shall be black with blue stripe.
- C. Ductile iron pipe and fittings shall be as specified in Section 33 11 13.15
- D. Welded steel pipe and fittings shall be as specified in Section 33 11 13.20
- E. Joint restraints shall be as specified in Section 33 11 13.90.

2.02 VALVES

- A. Valves shall be as specified in Section 33 12 16 and Section 40 92 13.
- B. Multiple brands for same type of valve will not be accepted.

2.03 COATINGS

- A. All above-ground pipe, valves and fittings shall be epoxy-coated, color coded for water service per Section 09 90 00.
- B. New equipment shall receive final finish coats at the factory in accordance to AWWA C116. Each coat of paint shall be of the consistency as specified by the paint manufacturer, or thinned as necessary, and applied in accordance with the manufacturer's written instructions. Work shall be free from "runs", "bridges", "shiners", or other imperfections. Care shall be taken to obtain a uniform, unbroken coating over welds, edges and corners. Weld splatter shall be removed and all welds neutralized with thinner. Blasted surfaces shall be coated within four hours of being sandblasted. All dust shall be removed from surfaces prior to coating.
- C. All surfaces to be coated or painted shall be in the specified condition to receive the material before any coating or painting is performed. Follow manufacturer's instructions. During and after final application of protective coatings, all metal surfaces shall be checked mechanically with an Elcometer, Mikrotest, or other approved dry film thickness gage to insure that the specified dry film thickness has been attained. Coating testing and repair of damages, flawed areas, holidays, or mishaps shall conform to applicable AWWA standards.

- D. Care shall be taken to prevent damage to coated surfaces during shipment. Any coatings damaged during shipment shall be refinished as the original at no extra cost to the Owner.
- E. Coatings shall be guaranteed for a period of one year following the date of final acceptance by the Owner.

2.04 BURIED PIPING WARNING TAPE

- A. Plastic warning tape shall be an inert plastic film specifically formulated for prolonged underground use. The minimum thickness shall be 4 mils and the minimum width of the tape shall be 6 inches. Printing shall be a minimum of 2-inch block letters.
- B. Warning tape for domestic water pipelines shall be blue with black printing having the words "CAUTION: DOMESTIC WATER-LINE BURIED BELOW."
- C. Warning tape for sanitary sewer pipes shall be green with black printing having the words "CAUTION: SANITARY SEWER BURIED BELOW."
- D. Warning tape for recycled water pipelines shall be purple with black printing having the words "CAUTION: RECYCLED WATER-LINE BURIED BELOW."

PART 3 - EXECUTION

3.01 GENERAL

- A. Location: Install piping to the line and grade as shown on the Drawings, except for adjustments to avoid existing features.
- B. Confirm dimensions at the Project Site prior to pipe fabrication.
- C. Contractor shall take all measures necessary to maintain the existing sewer mains and services in operation until completion of the pipeline construction.

3.02 PIPING INSTALLATION

- A. Trenching
 - 1. The Contractor shall bear full responsibility for safety related to his trenching operations.
 - 2. Trenching, bedding, and backfill operations including but not limited to, pavement cutting and restoration, excavation, shoring, and steel plates shall be in accordance with Section 31 23 00. Insofar as practicable and at all times on grades in excess of 1-foot horizontal to 10-foot vertical (10 percent), trenching and pipe-laying operations shall proceed uphill from the lowest point with the bell end leading.
- B. Daily Limits - The Contractor shall excavate only that length of trench in which he can safely and properly install pipe and backfill daily. No trenches may be left open when the Contractor is not actively prosecuting work related to that trench. To facilitate the prosecution of the work, the Contractor may request to use plates to cover open trenches. The use of steel plates shall be dependent upon the prior approval of the Engineer.

C. Handling and Placing

1. Handle pipe, fittings, and appurtenances in such a manner as to insure delivery to the Project Site in a sound, undamaged condition. Take particular care not to injure linings and coatings and to keep the pipe clean. Load and unload these items using hoists in a manner to avoid shock or damage. Under no circumstances shall they be dropped, skidded, or rolled against other pipe.
2. Repair damaged items to the satisfaction of the Engineer. Set aside damaged items that cannot be repaired and remove from Project site within 24 hours.
3. The Contractor shall employ such devices and equipment as will enable the pipe to be transported, stored, and installed in its final location or configuration, as provided for in the Contract Documents.
4. Pipe to be installed in trenches shall be lowered into the trench using lowering slings and other devices that will prevent an uncontrolled drop into the trench. Compacted bedding material conforming with Section 31 23 00 shall be installed in the bottom of the trench and compacted prior to placing pipe in the trench. Bell holes shall be excavated such that the pipe is fully supported by the pipe barrel. Pipe shall not be permitted to be supported solely by the bells. Where the Contract Documents call for or the Contractor elects to use sand/cement slurry backfill material, the pipe shall be supported on wooden blocks or other supports on each side of every joint. An additional block at mid-span shall be used for PVC pipe. Such blocks shall be of such dimension as to raise the pipe high enough to clear the bells and long enough to span at least 2/3 of the trench width. Wooden blocks shall be redwood or pressure treated timber.

- D. Locator Wire - A wire to be used for future subsurface location shall be installed concurrent with pipe laying operations. The wire shall be a minimum of 12 gauge THW or THWN solid copper wire and shall be continuous for the entire length of pipe laid. The wire shall be secured to the pipe by either tape, mastic, or looping at a maximum interval of 12 feet. Connections between lengths of wire shall be made either by crimp connectors, or wire nut connectors. Each connection shall be at least double-wrapped with PVC electrical tape with each turn lapping the previous turn by at least 50-percent. The wire shall be brought to the surface in each valve box with at least 2 feet of wire more than that required to reach the surface. The wire shall be protected during backfilling operations to prevent displacement or continuity breaks. Any damage to the locator wire shall be immediately repaired.

E. Installation of Pipe Warning Tape

1. Warning tapes shall be installed a minimum 1-foot above and centered on the pipe. The warning tape shall be installed continuously for the length of the pipe and shall be fastened to valve stem casings or other vertical appurtenances by plastic adhesive tape.
2. Warning tape is not required for pipes installed by trenchless methods.

F. Valves

1. Clean valves of foreign material and inspect in open and closed positions prior to installation
2. Unless otherwise indicate, install valves with operating stem vertical. Mount horizontal valves in such a manner that adequate clearance is provided for operation.

3. Clean flange faces prior to installing flanged valves. After cleaning, insert gasket and nuts, tighten progressively and uniformly. If flanges leak under pressure, loosen nuts, reseal or replace gasket, retighten nuts, and retest joints.
4. Test valves in same manner as specified for piping systems. Protect parts of valves that could be damaged during pipeline test. Joints shall be watertight at specified test pressures. Repair any damage to valves.

G. Bolting Procedures

1. Description - All fittings, joints, assemblies, valves, and miscellaneous special fittings shall be installed in accordance with this Section. The required torque shall be as specified in the Contract Documents, the referenced specifications, and the manufacturer's recommendations.
2. Contractor shall have a calibrated torque wrench on site at all times.
3. Procedure
 - a. The pipe and fitting (or fittings) shall be carefully aligned using slings, blocks, jacks, or other means necessary to establish and maintain the correct alignment. Under no circumstances shall the bolts be used to achieve the correct alignment. As the bolts are inserted through the flange the gasket shall be inserted between the mating faces of the fitting and pipe.
 - b. After taking up the free slack in the nuts, the Contractor shall tighten each bolt in opposing succession taking multiple passes to achieve the proper. Opposing succession is hereby defined as tightening the first nut then the nut diametrically opposed to the first and proceeding either clockwise or counterclockwise in this manner around the circumference of the joint until the required torque is achieved. In no case shall the Contractor tighten the nuts in direct sequence or over-tighten any nut with respect to its opposing mate.
 - c. During the tightening operation and again upon completion of the tightening operation, the space between the mating faces of the fitting and pipe shall be inspected for evidence of non-parallel assembly. The tolerance for parallel assembly shall be 1/16-inches for mechanical joint faces and 1/32-inches for flanged faces. Other fittings and faces shall be within the tolerance recommended by the manufacturer. If the space is non-parallel in excess of such tolerance, the joint shall be completely disassembled and the installation repeated. The gasket shall be inspected for damage prior to retightening the bolts. If the mating faces of the fitting and pipe cannot be brought into parallel alignment the joint shall be disassembled, the pipe removed, the gasket replaced, and the assembly repeated.
 - d. Upon completion of the bolting operation between elements of the fittings and joints, the Contractor shall tighten all thrust restraint gripping surfaces in the same manner of opposing succession. The thrust restraining follower gland shall be tightened to the recommended torque as recommended by the manufacturer. The twist-off nut shall be considered as a safety mechanism to prevent damage from excessive torsional forces. The shear capability shall not be used in lieu of proper tightening, including the use of limiting torque wrenches.
 - e. All bolts on the fittings or joint, including those of the thrust restraining devices, shall be subject to a torque test by the Engineer. If any bolts are found to be under- or over-torqued or in any way evidencing damage, the Engineer may direct their readjustment or replacement in accordance with the provisions of this Section.
 - f. Upon completion of the bolting operation, all buried fittings shall receive a liberal coating of bitumastic type material (Protecto Wrap 160/160H, Tapecoat Brush-

Applied Coating, Christy's HD-50 Coal Tar Coating, or approved substitute). This coating shall be thoroughly worked into the spaces between joint faces, under and around bolts and nuts, and on all surfaces that will be in soil contact. The coating shall be allowed to attain an initial set prior to commencing any backfill operations and in no case shall backfill operations commence less than 1-hour after coating is completed.

3.03 HYDROSTATIC PRESSURE TESTING

- A. Hydrostatic pressure testing is required for pressure pipeline segments only (force main and pump system piping).
- B. Upon completion of pipeline construction, the Contractor shall fill the pipeline with water from an approved source. All work involved in hydrostatic testing of pipelines shall conform to the requirements of AWWA C600, AWWA C605 and the provisions of the Contract Documents.
- C. The Contractor shall provide all pumps, fittings, labor, equipment, and materials and all assistance necessary, including but not limited to, temporary thrust restraint and connection to the supplying water source for the hydrostatic testing of all pipelines. Hydrostatic testing shall be performed in the presence of the Owner's Inspector. Test pressures shall be a minimum of 150 psi or 150-percent of the service pressure for the pipeline, whichever is the greater.
- D. Test pressures shall be held for a minimum of 2 hours or that period of time provided for in the Contract Documents. During the hydrostatic test the pressure shall not be allowed to vary more than 5 psi above or below the required test pressure. Pressure variances outside the allowable range shall be considered a failed test. Tests shall not be held against closed line valves without the prior approval of the Engineer and all hydrant valves shall be open. Where service lines have been installed prior to conducting the hydrostatic test, the service line to the meter stop shall be included in the test. An additional allowance of 0.0078 gph/inch of service line diameter may be included for each service line included in the hydrostatic test in the calculation of allowable leakage in such cases.
- E. Upon completion of pipeline construction all pressure pipelines shall be hydrostatically tested and observed for leaks. The Contractor shall schedule the hydrostatic test with the Engineer at least two (2) days in advance of the test. The pipelines or pump suction barrels shall be filled and carefully brought to the test pressure. Failure of any portion of the system shall be cause for rejection and the Contractor shall promptly identify and correct the deficiencies causing the failure. The hydrostatic test shall be repeated until a satisfactory test is achieved. All visible leaks shall be promptly repaired regardless of the actual leakage measured.
- F. This procedure shall be followed until an acceptable test is achieved. The Contractor may be charged for the Engineer's time for reinspection for all tests after the first retest in accordance with the General Conditions.
- G. Allowable Leakage - The allowable leakage will be calculated by the following formula:

$$L_a = (LD\sqrt{P})/148,000$$

where: L_a = Allowable leakage

L = Length of the pipe run

D = Nominal diameter of the pipe in inches

P = Test pressure

- H. Flanged above-grade pipe shall have no leakage allowance. Contractor shall correct all visible leakage.
- I. The allowable leakage for differing lengths of pipe runs and higher test pressures will be provided for in the Contract Documents or by direction of the Engineer. The allowable leakage for test sections of differing diameters will be calculated as the sum of the computed leakage for each size.
- J. Equipment - The Contractor shall provide a test pump capable of supplying 250 psi static pressure, a means of adding replacement water during the test, and gauges and meters to monitor the pressure and replacement water used.

END OF SECTION

SECTION 33 11 13.15

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation, and testing of ductile-iron pipe and fittings.
- B. Related sections:
 - 1. Section 01 57 80 – Control of Ground and Surface Water
 - 2. Section 31 23 00 – Trenching, Backfilling and Compaction
 - 3. Section 33 11 00 - General Piping Requirements
 - 4. Section 33 12 16 – Manual Valves

1.02 REFERENCED CODES AND STANDARDS

- A. American Water Works Association (AWWA), latest edition:
 - 1. C104 – Cement Mortar Lining for Ductile-Iron Pipe and Fittings
 - 2. C105 – Polyethylene Encasement for Ductile –Iron Pipe Systems
 - 3. C110 – Ductile-Iron and Gray-Iron Fittings
 - 4. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 5. C115 – Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
 - 6. C150 – Thickness Design of Ductile Iron Pipe
 - 7. C151 – Ductile-Iron Pipe, Centrifugally Cast
 - 8. C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 9. C606 – Grooved and Shouldered Joints
- B. NSF International
 - 1. 60 – Drinking Water Treatment Chemicals – Health Effects
 - 2. 61 – Drinking Water System Components – Health Effects

1.03 APPROVED MANUFACTURERS

- A. Fittings
 - 1. US Pipe
 - 2. Tyler
 - 3. Sigma
 - 4. Or equal
- B. Pipe
 - 1. U.S. Pipe
 - 2. Pacific States

3. American Pipe
 4. Or approved equal
- C. Gaskets
1. Tripac 2000
 2. US Pipe
 3. John Crane Co.
 4. Or equal

1.04 USE OF GRAY-IRON FITTINGS

- A. Gray-iron fittings may not be substituted for ductile-iron.

1.05 SUBMITTALS

- A. Contractor shall provide submittals for review and approval by the Engineer in accordance with Section 01 30 00.
- B. Provide shop drawings or catalog cuts for all work and materials included in this Section.

PART 2 - PRODUCTS

2.01 DUCTILE-IRON PIPE

- A. Pressure class or thickness class of DIP shall be determined by the design method detailed in AWWA C150 the "Thickness Design Method."
- B. Ductile-iron pipe shall be manufactured in accordance with AWWA C151.
- C. All ductile-iron pipe shall be pressure class 350 for bell and spigot pipe. Flanged pipe shall be thickness class 53 unless indicated otherwise.
- D. All ductile iron pipe and fittings in sewer applications shall be polyurethane or polyethylene lined and coated.
- E. All buried ductile iron pipe shall have a factory applied bituminous coating of not less than 1 mil. in thickness.
- F. All exposed above-grade ductile iron pipe shall be epoxy-coated per Section 09 90 00.
- G. Unless otherwise called out on the plans, a "push-on" type joint shall be used. The joint dimensions and gasket shall be as specified in AWWA C111.
- H. Where restrained joints are called, push-on joints shall be restrained with locking gasket rated for 250 psi operating pressure for DIP.
- I. Flanges for ductile-iron pipe shall be the "screwed-on" type in accordance with AWWA C115.
- J. Outlets for DIP shall be as follows:

- | | | |
|----|----------------------|------------------------------------|
| 1. | 2" or smaller: | bronze service saddle |
| 2. | 2-1/2": | tapped tee or service saddle |
| 3. | 4" to 8" and larger: | D.I. tee fitting or service saddle |
| 4. | 12" and larger | D.I. tee fitting |

2.02 DUCTILE-IRON FITTINGS FOR PVC AND DUCTILE IRON PIPE

- A. Except as otherwise indicated on the drawings, all fittings on pipelines and piping assemblies shall be manufactured of ductile iron in accordance with the provisions of AWWA C110 and C153. The interior of the fitting shall be lined with polyurethane or polyethylene rated for sanitary sewer service. The exterior shall be coated with 100% solids epoxy.
- B. The body of the fitting shall be free of blows, sand pits, abrasions deeper than 10 percent of the material thickness, cracks, and other defects that adversely affect the performance of the fitting under pressure in-situ or the corrosion potential of that fitting. Likewise the coatings shall be free of chips, holes, abrasions, and scratches that reduce the thickness of the coating below the tolerances specified herein.
- C. Evidence of such defects or damage shall be cause for rejection of the fitting and the Contractor shall replace such defective or damaged fittings at no cost to the Owner.
- D. Push-on to push-on fittings shall not be used unless restraints are provided as described below.
- E. Restrained fittings shall be used where a thrust block is not specified. Where restrained joints are called, push-on joints shall be restrained with locking gasket rated for 250 psi operating pressure for DIP. Push-on joints shall be restrained with a mechanical type bell restraint for C-900 PVC pipe. Mechanical joint restraints shall be EBBA IRON, INC., MEGALUG, UNIFLANGE Series 1400, or approved equal. Flanged fittings may be used.
- F. Unless otherwise indicated on the drawings, all fittings with flanged ends shall be ductile iron class 150. The gasket surface shall have a serrated finish of approximately 16 serrations per inch, approximately 1/32-inch deep, with serrations in either a concentric or spiral pattern. All flanges shall be flat faced. In addition, all flanges shall meet the following tolerances:

1.	Bolt circle drilling	$\pm 1/16$ inch
2.	Bolt hole spacing	$\pm 1/32$ inch
3.	Eccentricity of bolt circle and	$\pm 1/32$ inch
4.	Maximum facing with respect to bore	$\pm 1/32$ inch

2.03 JOINTS

- A. Joints on fittings used in subsurface installations of transmission and distribution pipelines shall be mechanical joint or flanged type, as provided for in the Contract Documents, conforming to the requirements of AWWA C111. In piping assemblies, both subsurface and above grade, the joints shall be either mechanical joint or flange type conforming with the requirements of AWWA C110, C111, and C153 as provided for in the Contract Documents.

- B. Mechanical Joints - Each mechanical joint shall be supplied with an SBR gasket. The retainer or follower gland shall be replaced with a thrust restraining follower gland in accordance with the provisions of Section 33 11 13.90, Thrust Restraint.

2.04 GASKETS

- A. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber. Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets, 1/8-inch thick vulcanized butadiene rubber (SBR) or neoprene rubber gasket conforming with the provisions of AWWA C110, extending to the inner edge of the bolts may be used where a raised face flange is present.
- B. Rubber gaskets for push-on and mechanical joints shall be vulcanized butadiene rubber (SBR) manufactured in accordance with AWWA C111.

2.05 BOLTS AND NUTS

- A. All bolts and nuts shall be:
 - 1. High-strength, low carbon steel conforming with ASTM A307, galvanized after fabrication, or
 - 2. Type 316 stainless steel conforming to ASTM F593 G or H for bolts, and ASTM F594 with Tripac 2000 Blue Coating for nuts.
- B. Mechanical joint bolts (tee bolts) shall be 3/4-inches in diameter and be furnished for each joint in accordance with AWWA C110, AWWA C111, and AWWA C153.
- C. The length of each bolt or stud shall be such that between 1/4 inch and 3/8 inch will project through the nut when drawn tight.
- D. All bolts and nuts which are not type 316 SS shall be coated with Christy HD-50 Bituminous Coal-Tar Coating after installation.

2.06 PLASTIC FILM WRAP

- A. All ductile-iron pipe and fittings buried underground shall be protected with plastic film wrap in accordance with AWWA C105, unless noted otherwise below. Wrap shall be a loose polyethylene tube, either 8-mil thickness of linear low-density PE or 4-mil thickness of high-density cross-laminated PE. All joints between plastic tubes shall be wrapped with 2-inch-wide polyethylene adhesive tape, Polyken 900, Scotch wrap 50, or approved equal.

2.07 LUBRICANTS

- A. Lubricant for pipe insertion shall be NSF food grade and biodegradable.

2.08 POLYETHYLENE LINING FOR SEWER APPLICATIONS

- A. Lining material for ductile iron pipe and fittings (sewer applications) shall be virgin polyethylene complying with ASTM D1248 and bonded to the interior of the pipe fittings by heat process. The lining material shall be compounded with inert filler and a compound which resists ultraviolet light.

- B. The lining shall cover the interior surface of the pipe/fitting from the lain or beveled end to the rear of the gasket socket. The lining thickness shall be not less than 20 mils. The lining may taper at the ends, starting at 4 inches from the edge of the pipe. The minimum thickness at the end of the taper shall be 10 mils.
- C. Each pipe shall be guaranteed against separation of the lining from the pipe. Random checks for operation will be made during construction and any indication of separation shall be cause for rejection. The test method shall be mutually agreed upon by the contractor and the Owner.

2.09 POLYURETHANE LINING SYSTEM

- A. The lining material shall consist of a liquid-applied polyurethane coating especially formulated for use as a protective lining of pipelines carrying sewage. The material shall be Corropipe II Wasteliner or approved equal. The dry film thickness (DFT) of the lining shall be 40 mils (0.040 inch) nominal.
- B. In order to minimize potential dimensional and assembly problems, the coating thickness on sealing areas in the bell socket interior and on the spigot end of the pipe exterior shall be 8 mils (0.008 inch) nominal with a maximum of 10 mils (0.010 inch). Thicker coatings in these areas are acceptable if it is demonstrated that joint dimensions are within allowable tolerances after coatings.
- C. The lining material shall be applied to the pipe and fittings by an applicator certified or approved by the coating manufacturer. The coating shall be holiday tested with a high voltage tester at 50 volts/mil of material thickness. The material shall be applied and repaired to the pipes and fittings in strict accordance with the manufacturer's requirements with no exceptions. Owner shall be notified five (5) days in advance of the coating installation for factory inspection during the application of the material.
- D. All field cut ends shall be repaired and sealed prior to installation per the manufacturer's recommendations.

2.10 EPOXY COATING SYSTEM

- A. Epoxy lining and coating of valves shall be per AWWA C550 and Section 33 12 16 Manual Valves. All valves shall be lined and coated by manufacturer.
- B. Surfaces to be epoxy coated shall follow the surface preparation requirements as recommended by the manufacturer.
- C. Surfaces shall be coated with organic zinc primer to a dry film thickness of 3 mils.
- D. Apply two coats of epoxy paint (4 mils each) to the primed surface. The manufacturer's recommended drying time between coats shall be followed.
- E. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix

additional components for reasons of color or otherwise, even within the same generic type of coating.

PART 3 - EXECUTION

3.01 GENERAL

- A. Ductile-iron pipe and ductile iron fittings shall be installed in accordance with the applicable Sections of AWWA C600 and as specified herein.

3.02 TRENCHING, BACKFILLING, AND COMPACTING

- A. Trenching, backfilling, and compacting shall be in accordance with Section 31 23 00 and as specified herein.
- B. Backfill within the pipe zone, including the pipe base, shall be imported sand placed and compacted in accordance with Section 31 23 00.
- C. Backfill within the trench zone shall be native earth backfill placed and compacted in accordance with Section 31 23 00.

3.03 PLACEMENT OF PIPE IN TRENCH

- A. Lay pipes uphill if the grade exceeds 10%.
- B. The radius of curvature of the trench shall determine the maximum length of pipe section that can be used without exceeding the allowable deflection at a joint. Combined deflections at rubber gasket, restrained joint, deflection coupling or flexible coupling joints shall not exceed 2 degrees or that recommended by the manufacturer, if smaller.
- C. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various length and the deflection couplings shall be followed if applicable.
- D. The pipe shall be laid true to the line and grade shown on the plans within acceptable tolerances. The tolerance on grade is 1 inch. The tolerance on line is 2 inches.
- E. Pipe shall not be stabbed past the pipe manufacturer's pipe insertion line. Contractor shall mark new insertion lines where original spigot end is cut off.
- F. Wrap ductile-iron pipe and fittings with plastic film wrap in accordance with AWWA C105.
- G. Fittings shall be supported independently of the pipe.
- H. Until thrust blocks and supports are poured, fittings shall be temporarily supported by placing wooden skids under the bells so that the pipe is not subjected to the weight of the fitting.

- I. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with a mastic, 3M, Minnesota Mining and Manufacturing EC 244, or an approved equal. Stainless steel bolts shall not be coated.
- J. Where locking gaskets are used to restrain push-on joints, the pipe bell shall be stenciled "Locking Gasket."

3.04 MECHANICAL JOINTS

- A. Mechanical joints shall be installed in accordance with the manufacturer's recommendation and Section 33 11 00. The fitting shall be thoroughly cleaned of all dirt, debris, or other deleterious material and inspected prior to incorporation into the work.
- B. The pipe end shall be beveled with a grinding tool or rasp file to facilitate the assembly of the joint. The restraining follower gland shall be slipped over the end of the pipe followed by the gasket. The Contractor shall take care that the restraining follower gland and gasket are installed in the correct alignment and that the gasket is not forced onto the pipe or otherwise damaged.
- C. The pipe end shall then be inserted into the joint to the tolerance required by AWWA C110, C111, and C153. The pipe shall be aligned as straight as field conditions permit but in no case shall the pipe be deflected in excess of 3 degrees (5/8-inch per foot) or that maximum deflection recommended by the manufacturer, whichever is the lesser. The gasket shall then be inserted into the gasket seat taking care not to force or otherwise damage the gasket. Once the gasket is fully and evenly seated in the gasket space, the follower gland shall be aligned with the mating face of the fitting and the bolts inserted and the nuts threaded onto the bolts.
- D. All bolting shall be performed in accordance with the provisions of Section 33 11 00, General Piping Requirements.

3.05 FLANGED JOINTS

- A. Flanged joints shall be installed in accordance with the manufacturer's recommendation and Section 33 11 00. The fitting shall be thoroughly cleaned of all dirt, debris, or other deleterious material and inspected prior to incorporation into the work.
- B. The pipe and fitting shall be carefully aligned using slings, blocks, jacks, or other means necessary to establish and maintain the correct alignment. Under no circumstances shall the bolts be used to achieve the correct alignment. As the bolts are inserted through the flange the gasket shall be inserted between the mating faces of the fitting and pipe.
- C. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe run.
- D. Clean flanges by wire brushing before installing gasket.
- E. Clean flange bolts and nuts by wire brushing, lubricate threads with anti-seize compound, and tighten nuts uniformly and progressively. Between 1/4 inch and 3/8 inch shall project through the nut when drawn tight.

- F. All bolting shall be performed in accordance with the provisions of Section 33 11 00, General Piping Requirements.
- G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.06 ANCHORS AND THRUST BLOCKS

- A. Concrete anchors and thrust blocks shall be poured against wetted undisturbed soil in accordance with Section 33 11 13.90 and as shown on the Drawings.

3.07 PIPE SUPPORT

- A. All exposed pipe shall be supported as detailed in the plans.

3.08 TESTING

- A. All pressure piping shall be hydrostatically pressure tested in accordance with Section 33 11 00.

3.09 TAPPING

- A. Direct tapping of DIP shall not be allowed. All taps shall include a saddle with two-straps.

END OF SECTION

SECTION 33 11 13.20

STEEL PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation, and testing of welded steel pipe and fittings.
- B. Related sections:
 - 1. Section 01 57 80 – Control of Ground and Surface Water
 - 2. Section 31 23 00 – Trenching, Backfilling and Compaction
 - 3. Section 33 11 00 - General Piping Requirements
 - 4. Section 33 12 16 – Manual Valves

1.02 REFERENCED CODES AND STANDARDS

- A. American Water Works Association (AWWA), latest edition:
 - 1. C200 - Steel Water Pipe--6 In. (150 mm) and Larger
 - 2. C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. (100 mm) and Larger--Shop Applied
 - 3. C206 - Field Welding of Steel Water Pipe
 - 4. C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In. (100 mm Through 3600 mm)
 - 5. C208 - Dimensions for Fabricated Steel Water Pipe
 - 6. C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
 - 7. C210 - Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
 - 8. C213 - Fusion-Bonded Epoxy Coatings and Linings For Steel Water Pipe and Fittings
 - 9. C214 - Tape Coatings for Steel Water Pipe
 - 10. C215 - Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
 - 11. C217 - Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings
 - 12. C218 - Liquid Coating for Aboveground Steel Water Pipelines and Fittings
 - 13. C602 - Cement - Mortar Lining of Water Pipelines in Place - 4 In. (100 mm) and Larger
 - 14. C604 - Installation of Steel Water Pipe - 4 In. (100 mm) and Larger
 - 15. C606 - Grooved and Shouldered Joints
 - 16. C620 - Spray-Applied In-Place Epoxy Lining of Water Pipelines, 3 In. (75 mm) and Larger
- B. NSF International
 - 1. 60 – Drinking Water Treatment Chemicals – Health Effects

2. 61 – Drinking Water System Components – Health Effects

1.03 SUBMITTALS

- A. Contractor shall provide submittals for review and approval by the Engineer in accordance with Section 01 30 00.
- B. Shop Drawings:
 - 1. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances.
 - 2. Pipe, fittings and joint fabrication details for welded steel pipe.
 - 3. Submit reinforcement calculations for welded steel pipe to demonstrate compliance with AWWA M11.
 - 4. Submit procedures for welding field joints of welded steel pipe and welder qualifications.
 - 5. Submit samples of gaskets and other materials where required by the detailed specifications.
 - 6. Submit certified test reports as required herein and by the referenced standard specifications.
 - 7. All items utilized on systems conveying potable water including, but not limited to, pipe and valve linings, solvent cements, welding materials, gaskets and gasket lubricants, and additives in concrete or cement mortar shall comply with the Safe Drinking Water Act and NSF requirements for use in water systems in accordance with Section 64591 of the California Water Works Standards. Submit proof of NSF certification for each item.
 - 8. Testing data for welded joints.
 - 9. Submit leak and pressure testing plan.
 - 10. Submit shop drawings for leak and pressure testing apparatus including, but not limited to, temporary bulkheads necessary for testing of new pipelines.

1.04 QUALITY ASSURANCE

- A. Materials furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years.
- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.
- C. Field Quality Control:
 - 1. The Owner will:
 - a. Inspect field welds and test the welds if it is deemed necessary.
 - 2. The Contractor shall:
 - a. Perform leakage tests.
 - b. Perform bacteriological analysis for pipelines to be disinfected.

- c. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

PART 2 - PRODUCTS

2.01 WELDED STEEL PIPE:

- A. Pipe: Cement mortar lined steel cylinder pipe, AWWA C200 except as modified herein. Pipe shall be cement mortar coated where buried, and if required elsewhere by the Drawings or Specifications. Steel shall be ASTM A36.
 1. Dimensions: Nominal inside diameter shall be the minimum net inside clear lined diameter.
 2. Steel Cylinder Thickness: The pipe manufacturer shall design steel cylinder for pipe and fittings for the cover shown on the Drawings, in accordance with AWWA M-11. The minimum cylinder thickness for pipe with welded joints shall be 12 gauge. Design criteria areas follow:
 - a. Superimposed external load: AASHTO H20
 - b. Internal pressure including surge allowance: 150 psi
 - c. Internal negative pressure: 15 psi
 - d. Maximum allowable stress: 50% of minimum yield point or 16,500 psi, whichever is less.
 - e. Maximum deflection permitted: 2%
 - f. For tapered sections, minimum cylinder and mortar lining thicknesses shall conform to the requirements for the larger pipe diameter.
 3. Minimum steel cylinder thickness for piping:
 - a. Nominal 6 to 8 inch pipe, minimum steel cylinder wall 0.135 inch
 - b. Nominal 10 to 16 inch pipe, minimum steel cylinder wall 0.188 inch
 - c. Nominal 18 to 48 inch pipe, minimum steel cylinder wall 0.250 inch
 4. Minimum lining thickness:
 - a. Nominal 4 to 10 inch pipe, minimum lining ¼ inch
 - b. Nominal 11 to 23 inch pipe, minimum lining 5/16 inch
 - c. Nominal 24 to 36 inch pipe, minimum lining 3/8 inch
 - d. Over 36 inch pipe, minimum lining ½ inch
- B. Joints: Use welded joints, except flanged or connected with couplings where shown on the Drawings.
 1. Welded joints shall be butt strap, split butt strap, or lap joint. Butt straps and lap joint details shall be submitted to the Engineer for favorable review. The joint shall be designed to withstand all loads associated with installation and operating conditions. Rolled lap joints are not acceptable. The radius of the bell bends shall be greater than 15 times the cylinder wall thickness. Joint configuration and welding shall conform to the requirements of AWWA M 11 and AWWA C206 except Section 6 2 testing, which are modified herein. The size of fillet welds shall be equal to the thickness of the smaller plate being joined. Butt welds shall be full penetration.
 2. For pipe less than 22-inch diameter, the proceeding described in AWWA C205, paragraph 4.7.2.2.2 utilizing a burlap-covered ball shall be used for applying cement mortar lining to the insides of the joints.
 3. Cement mortar lining shall be patched after joint testing and may be hand applied. Conform to AWWA C205, Appendix A.

4. Provide special closure lap joints at approximately 500-foot intervals in accordance with AWWA C206.
- C. Fittings: Fittings shall be made of hydrostatically tested cylinders of the same material and minimum thickness as the pipe, except that elbows shall have greater thickness if necessary to compensate for stress concentrations. They shall be as detailed on the Drawings or, if not detailed on the Drawings, shall be designed by the pipe manufacturer by the method stated in the AWWA Pipe Manual M11 as modified herein, subject to the favorable review of the Engineer. Unless otherwise noted or detailed on the Drawings, fitting dimensions shall conform to AWWA C208. Adding pipe to the fittings does not change the requirement that the fittings conform to AWWA C208 dimensionally, nor does it reclassify the pipe portion as part of the fitting. Use 150 psi for the design pressure P.
1. Provide reinforcement for fittings (outlets, tees and wyes, etc.) in the form of collars, wrappers or crotch plates, in accordance with the current revision of AWWA M11, Table 13 2. Coat buried fitting reinforcement with cement mortar.
 2. Crotch plates shall be designed in accordance with AWWA M11, using a minimum plate thickness of 1 inch.
 3. Elbow dimensions (unless otherwise noted or detailed on the Drawings):
 - a. Minimum number of pieces for mitered elbows:
 - 1) 68° to 90°: Five pieces
 - 2) 46° to 67°: Four pieces
 - 3) 23° to 45°: Three pieces
 - 4) Up to 22½°: Two pieces.
 - b. Radius, R, to pipe centerline: 1.25 pipe diameters
 - c. Wrought steel elbows complying with ANSI B16.9 and ASTM A234 may be substituted for mitered elbows as long as they meet, as a minimum, the radius, wall thickness and internal diameter requirements of this specification.
 4. Nozzles 3 inches and less shall be Schedule 40 weld fittings. Wheeling Pipe-O-Lets; Allied Branchlets; or equal. They may be unreinforced.
 5. Flares: Flare diameter shall be equal to the flange O.D. for the same size pipe. Fabricate flares from two sections of truncated cones, one angled 22 ½ degrees from pipe axis, the other 45 degrees. Grind all interior welds and edges perfectly smooth before lining.
- D. Lining: Cement mortar meeting AWWA C205 except as modified herein. Cement shall be Type II. On pipe 27 inch diameter and larger, the lining shall be reinforced using a plain 2 x 4 inch, 13 x 13 gauge welded wire mesh welded to the inside of the pipe, fitting, or steel plate special. If the cement mortar lining is applied by the centrifugal process, the reinforcement may be omitted. Wire reinforcement shall conform to ASTM A185. Paint interior edges and other unlined surfaces with 2-part epoxy per Section 09 90 00.
- E. Coating:
1. Cement mortar coating: ¾ inch thick over the reinforcement, AWWA C205. Cement shall be Type II containing 15% to 20% pozzolan. Reinforcement shall be in accordance with AWWA C205.
 2. Non-cement mortar coating: Pipe without cement mortar coating shall be epoxy coated in accordance with Section 09 90 00. Shop prime with products compatible with final

coats. Hold back coatings of concrete encased portions of pipes from a point 2 inches within face of concrete encasement.

3. On buried piping where the cement mortar coating is held back for flexible couplings or other similar connections, edges shall be ground smooth and the exposed pipe shall be painted in accordance with Section 09 90 00, and shall overlap the cement lining and mortar coating. Stripe coat edges between finish coats.

F. Flanges and Bolts:

1. Steel ring flanges conforming to AWWA C207, Class D with bolt holes drilled in conformance with ANSI B16.1, 125-pound class except as needed to match equipment or other pipeline items. Bolts shall be sized in accordance with ANSI B16.1. Welding shall conform to AWWA C207. The inside diameter of all flanges shall be no more than 3/16 inch greater than the outside diameter of the steel cylinder. Flanges shall be welded to the cylinder without warping and with flange face perpendicular to the longitudinal axis of the cylinder.
2. Where ductile pipe joins with steel cylinder pipe, the steel flange is to be modified to be compatible, in pressure rating and configuration, with the ductile iron pipe. Provide insulating flanges for buried ductile iron to steel connections.
3. Exposed metal on the flanges shall be coated in accordance with Section 09 90 00. In addition, buried flanges, couplings and other mechanical connections shall be double-wrapped with polyethylene encasement, AWWA C105 and extended to overlap the cement mortar coating with edges of the encasement taped with PVC tape.

G. Gaskets: SBR rubber, 1/8 inch thick.

H. Interior Bracing: Each section of pipe 24 inch and larger shall have adequate interior bracing to prevent the pipe from being deformed during handling, transportation, storage, and installation. Bracing shall not be removed until construction operations are complete.

I. Factory Testing: Perform hydrostatic pressure tests of pipe and tests of specials in accordance with Section 5.2 of AWWA C200. Test methods are subject to the favorable review of the Engineer and the tests will be witnessed by the Inspector.

J. Marking: Cylinders and completed pipe and fittings shall be marked in accordance with AWWA C200-97, Section 6.1.

K. Interior Moisture Control: Maintain interior moisture and provide plastic sheet end caps during storage and transportation.

L. Protective Coating: Exposed steel at joints, flanges and other locations shall be coated in accordance with Section 09 90 00.

PART 3 - EXECUTION

3.01 GENERAL

- A. Steel pipe and fittings shall be installed in accordance with the applicable Sections of AWWA C604 and as specified herein.

3.02 TRENCHING, BACKFILLING, AND COMPACTING

- A. Trenching, backfilling, and compacting shall be in accordance with Section 31 23 00 and as specified herein.
- B. Backfill within the pipe zone, including the pipe base, shall be clean native sand or imported sand placed and compacted in accordance with Section 31 23 00.
- C. Backfill within the trench zone shall be native earth backfill placed and compacted in accordance with Section 31 23 00.

3.03 PLACEMENT OF PIPE IN TRENCH

- A. Lay pipes uphill if the grade exceeds 10%.
- B. Fittings shall be supported independently of the pipe.
- C. All damaged coatings shall be recoated after assembly with cement mortar.

3.04 FLANGED JOINTS

- A. Flanged joints shall be installed in accordance with the manufacturer's recommendation and Section 33 11 00. The fitting shall be thoroughly cleaned of all dirt, debris, or other deleterious material and inspected prior to incorporation into the work.
- B. The pipe and fitting shall be carefully aligned using slings, blocks, jacks, or other means necessary to establish and maintain the correct alignment. Under no circumstances shall the bolts be used to achieve the correct alignment. As the bolts are inserted through the flange the gasket shall be inserted between the mating faces of the fitting and pipe.
- C. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe run.
- D. Clean flanges by wire brushing before installing gasket.
- E. Clean flange bolts and nuts by wire brushing, lubricate threads with anti-seize compound, and tighten nuts uniformly and progressively. Between 1/4 inch and 3/8 inch shall project through the nut when drawn tight.
- F. All bolting shall be performed in accordance with the provisions of Section 33 11 00, General Piping Requirements.
- G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.05 WELDED JOINTS:

- A. General: Unless specified otherwise, shop and field welding of pipe shall conform to ANSI B31.1 as amended by this paragraph.
- B. Field welding of joints shall be in accordance with AWWA C206. Acceptance of field welds will be based on visual inspection and nondestructive testing by the Engineer

while the welds are being made and after they are completed. Hand or power wire brush each weld not complying with AWS Code D1.1 Sections 6.9 and 6.10. Determine the cause of defects and take corrective measures to prevent a reoccurrence.

- C. All field and shop welding shall be done by the electric arc process unless otherwise specified. All field welding shall be done in passes not thicker than 1/4-inch. Size and type of electrodes, and current and voltages used, shall be subject to the favorable review of the Engineer. Give particular attention to the alignment of edges to be joined, so that complete fusion and penetration will be effected throughout the bottom of the weld. Welds shall contain no valleys or undercuts in the center or edges of the weld. Thoroughly clean each pass, except the final one, of dirt, slag, and flux before the succeeding bead is applied.
- D. Clean completed field welds of pipe joints of dirt, slag and flux, and then visually inspect. Completely chip out all defects in welds discovered during field inspection in a manner that will permit proper and complete repair by welding subject to the favorable review of the Engineer. Under no circumstances will caulking of defective welds be permitted.
- E. All welding shall be done by experienced, skilled operators familiar with the methods and materials to be used. Hand welding will be done only by welders qualified under the standard qualification procedure of Section IX of the ASME Boiler and Pressure Vessel Code. The Contractor shall conduct tests of his welders, when required by the Engineer, in accordance with that code and in the presence of the Engineer. An independent testing laboratory, favorably reviewed by the Engineer, shall supervise the testing and determine the quality of the test work. Weld specimens in the same positions as those in which the welder is to qualify his work. The Engineer may require test specimens at any time. Any welder whose work is found unsatisfactory shall not remain employed on this Contract, regardless of the quality of his earlier work. Each hand weld specimen shall be plainly marked with the welder's identifying symbol. The Contractor shall furnish all materials required and pay all costs for qualifying welders.
- F. Field welds shall follow as closely as possible to the laying operation. All field welds shall be complete before lining or coating of the joints in steel pipe is begun. Where pipe is fusion epoxy lined and/or coated, follow AWWA C-213 procedures for field welded joints.
- G. A single, continuous, watertight, full fillet weld shall be the minimum required at all field joints. Double welded joints are required on all piping specifically noted to be double welded.
- H. Following satisfactory testing of the weld, the interior of all joints shall be cement mortar lined. Pipe 22-inches and less shall be finished using the ball and burlap procedure described in AWWA C205, paragraph 4.7.2.2.2. The exterior of the joints of buried pipe shall be cement mortar coated in accordance with Appendix A of AWWA C205. Prior to coating the exterior, tack weld one layer of wire mesh to the pipe.
- I. Steel edges not encased in concrete or cement mortar shall receive a protective coating of 16 mils of high solids epoxy per Section 09 90 00.

3.06 ANCHORS AND THRUST BLOCKS

- A. Concrete anchors and thrust blocks shall be poured against wetted undisturbed soil in accordance with Section 33 11 13.90 and as shown on the Drawings.

3.07 PIPE SUPPORT

- A. All exposed pipe shall be supported as detailed in the plans.

3.08 TESTING

- A. All pressure piping shall be hydrostatically pressure tested in accordance with Section 33 11 00.

END OF SECTION

SECTION 33 11 13.25

CONCRETE CYLINDER PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Work includes connecting new valves and fittings to existing concrete cylinder pipe. This section includes materials, installation, and testing of steel-cylinder type concrete pressure pipe.
- B. Related sections:
 - 1. Section 01 57 80 – Control of Ground and Surface Water
 - 2. Section 31 23 00 – Trenching, Backfilling and Compaction
 - 3. Section 33 11 00 - General Piping Requirements
 - 4. Section 33 12 16 – Manual Valves

1.02 REFERENCED CODES AND STANDARDS

- A. American Water Works Association (AWWA), latest edition:
 - 1. C206 - Field Welding of Steel Water Pipe
 - 2. C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In. (100 mm Through 3600 mm)
 - 3. C208 - Dimensions for Fabricated Steel Water Pipe
 - 4. C301 – Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
 - 5. C303 – Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
 - 6. C304 – Design of Prestressed Concrete Cylinder Pipe
 - 7. C504 – Rubber Seated Butterfly Valves
 - 8. C604 – Installation of Steel Water Pipe - 4 In. (100 mm) and Larger
 - 9. C651 – Disinfection of Water Mains
 - 10. Manual M9 – Concrete Pressure Pipe
- B. NSF International
 - 1. 60 – Drinking Water Treatment Chemicals – Health Effects
 - 2. 61 – Drinking Water System Components – Health Effects

1.03 SUBMITTALS

- A. Contractor shall provide submittals for review and approval by the Engineer in accordance with Section 01 30 00.
- B. Shop Drawings:

1. Layouts and Schematics: Submit detailed installation drawings of all piping. The Drawings shall include: pipe support locations and types, fittings, valves, other appurtenances.
2. Pipe, fittings and joint fabrication details.
3. Submit reinforcement calculations for welded steel pipe to demonstrate compliance with AWWA M9.
4. Submit procedures for welding field joints of welded steel pipe and welder qualifications.
5. Submit information on gaskets and gasket lubricants.
6. Submit certified test reports as required herein and by the referenced standard specifications.
7. All items utilized on systems conveying potable water including, but not limited to, pipe and valve linings, welding materials, gaskets and gasket lubricants, and additives in concrete or cement mortar shall comply with the Safe Drinking Water Act and NSF requirements for use in water systems in accordance with Section 64591 of the California Water Works Standards. Submit proof of NSF certification for each item.
8. Testing data for welded joints.
9. Submit leak and pressure testing plan.
10. Submit shop drawings for leak and pressure testing apparatus including, but not limited to, temporary bulkheads necessary for testing of new pipelines.

1.04 QUALITY ASSURANCE

- A. Materials furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 10 years.
- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.
- C. Field Quality Control:
 1. The Contractor shall:
 - a. Perform leakage tests.
 - b. Perform bacteriological analysis for pipelines to be disinfected.
 - c. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

PART 2 - PRODUCTS

2.01 CONCRETE CYLINDER PIPE

- A. Pipe: Prestressed Concrete Cylinder Pipe meeting AWWA C301 and/or Bar-Wrapped Concrete Pressure Pipe meeting AWWA C303. Match existing pipelines.
 1. Sizes as shown on the drawings.
 2. Fluid conveyed: potable water.

3. Working pressure shall be 100 psi. Test pressure (working pressure plus transient pressure) shall be 150 psi. Fittings, specials and connections shall be same pressure class as the pipe.
 4. Pipe and fittings shall be clearly marked with pressure class and piece number to permit easy identification in the field.
 5. Cement shall be Type I or Type II and in accordance with ASTM C150.
 6. Mortar coatings shall consist of one part cement to a maximum of three parts fine aggregate, by weight.
 7. Bell and spigot joint rings shall be steel, self-centering type.
 8. Rubber gaskets shall be per AWWA C301 or C303, as applicable.
- B. Manufacturers:
1. Northwest Pipe Company (formerly Ameron)
 - a. Water Transmission Division, Southwest Region, (909) 839-3978
 2. Thompson Pipe Group (formerly Hanson)
 - a. Pipeline Services Division, (972) 262-3600
- C. Fittings: Flange to bell and flange to spigot transition fittings, custom fabricated:
1. Length as needed to position the new tees and valves per the Drawings. Minimum length shall be 12-inches.
 - a. If the fitting length exceeds 48-inches, the Contractor may elect to have restraint tabs included on the fitting to allow casting a concrete thrust restraint anchor around the concrete cylinder pipe instead of the ductile iron pipe indicated on the Drawings..
 2. Pipe barrel and end connection to match the existing pipe.
 3. Provide new gasket at each connection.
 4. Exposed steel on the interior of the bell/spigot that will not be covered after assembly shall be coated with zinc or epoxy per the manufacturer's standard method.
 5. Provide steel bonding clip for connection to existing pipe.
 6. Thrust restraint blocks shall be cast around the new pipe segments as shown on the Drawings.
- D. Flanges and Bolts:
1. Steel ring flanges conforming to AWWA C207, Class D with bolt holes drilled in conformance with ANSI B16.1, 125-pound class except as needed to match equipment or other pipeline items. Bolts shall be sized in accordance with ANSI B16.1. Welding shall conform to AWWA C207. The inside diameter of all flanges shall be no more than 3/16 inch greater than the outside diameter of the steel cylinder. Flanges shall be welded to the cylinder without warping and with flange face perpendicular to the longitudinal axis of the cylinder.
 2. Where ductile pipe joins with concrete cylinder pipe, the steel flange is to be modified to be compatible, in pressure rating and configuration, with the ductile iron pipe. Provide insulating flanges for buried ductile iron to steel connections.
 3. Exposed metal on the flanges shall be coated in accordance with Section 09 90 00. In addition, buried flanges, couplings and other mechanical connections shall be double-wrapped with polyethylene encasement, AWWA C105 and extended to overlap the cement mortar coating with edges of the encasement taped with PVC tape.

- E. Gaskets: SBR rubber, 1/8 inch thick.
- F. Interior Bracing: Each section of pipe 24 inch and larger shall have adequate interior bracing to prevent the pipe from being deformed during handling, transportation, storage, and installation. Bracing shall not be removed until construction operations are complete.
- G. Interior Moisture Control: Maintain interior moisture and provide plastic sheet end caps during storage and transportation.
- H. Bonding wire: #10 AWG, stranded copper cable

PART 3 - EXECUTION

3.01 FIELD VERIFICATION

- A. Prior to ordering pipe, pothole the tie-in locations and verify the size and type of concrete cylinder pipe at the point of connection.
- B. Locate the upstream and downstream bell and spigot joints of the pipe segments to be replaced.

3.02 DELIVERY, STORAGE AND HANDLING

- A. Handle and store pipe so as not to damage the lining or coating.
- B. Pipe shall be kept clean and the ends covered until assembled for installation.
- C. Carefully inspect each pipe, fitting and accessory before installation to insure there is no defective workmanship or obstructions. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replace to the satisfaction of the Engineer.
- D. Damage to cement coatings or lining in excess of 100 square-inches per pipe segment or fitting, or in excess of 12-inches in any dimension, shall be reason to reject an item.

3.03 PIPE JOINING

- A. Thoroughly clean the bell and spigot rings before laying each joint of pipe by brushing and wiping.
- B. If any damage to the protective coating on the metal has occurred, repair the damage before laying the pipe.
- C. Lubricate the gasket and the inside surface of the bell with an approved lubricant (flax soap) which will facilitate the telescoping of the joint. Tightly fit together sections of pipe and exercise care to secure true alignment and grade.
- D. When a joint of pipe is being laid, place the gasket on the spigot ring and enter the spigot end of the pipe into the bell of the adjoining pipe and force into position. The inside joint space between ends of the pipe sections shall have an opening within the tolerances as recommended by the pipe manufacturer. No "blocking up" of pipe or joints will be

permitted, and if the pipe is not uniformly supported or the joint not made up properly, remove the joint and properly prepare the trench.

E. After joining, check the position of the gasket with a feeler gauge. If the gasket is out of position, disassemble the joint and repeat the joint laying procedure.

F. Exterior Joints

1. Make the exterior joint by placing a joint wrapper around the pipe and secure in place with two (2) metal straps. The wrapper shall be fiberglass reinforced or burlap cloth, with lengths encircling the pipe, leaving enough opening between ends to allow the mortar to be poured inside the wrapper into the joint.
2. Fill the joint with mortar from one side in one (1) continuous operation until the grout has flowed entirely around the pipe. During the filling of the joint, pat or manipulate the sides of the wrapper to settle the mortar and expel any entrapped air.

G. Checking the Joints

1. A steel feeler gauge approximately ½" wide x 0.010" thick (12 mm wide x .25 mm) is inserted into the joint recess inside the pipe to determine, by feel, if the gasket is properly seated in the groove.

H. Patching

1. Wherever necessary to patch the pipe, make patch with cement mortar. Do not install patched pipe until the patch has been properly and adequately cured and approved for laying by the engineer. Promptly remove rejected pipe from the site
2. Excessive field patching of lining or coating shall not be permitted. Patching of lining or coating will be allowed where area to be repaired does not exceed 100 sq. inches (2,540 sq. mm) and has no dimensions greater than 12" (304 mm). In general, there shall not be more than one patch on either the lining or the coating of any one joint of pipe.

3.04 TRENCHING, BACKFILLING, AND COMPACTING

- A. Trenching, backfilling, and compacting shall be in accordance with Section 31 23 00 and as specified herein.
- B. Backfill within the pipe zone, including the pipe base, shall be clean native sand or imported sand placed and compacted in accordance with Section 31 23 00.
- C. Backfill within the trench zone shall be native earth backfill placed and compacted in accordance with Section 31 23 00.

3.05 CUT-IN OF NEW FITTINGS

- A. Sequence the work to minimize the shut-down duration for water transmission mains. Pre-assemble valves and fittings outside the trench to the extent practical.
- B. Disinfection of new work shall be by the swabbing and flushing method of AWWA C651.

- C. Test existing valves in advance of the shut down to verify they operate. Coordinate repairs with the Owner if needed.
- D. Shut down and depressurize the existing pipeline.
- E. Expose the existing pipe segment(s) in the trench from joint to joint.
- F. Remove the mortar seal at the existing joints.
- G. Cut out and remove the pipe segment to be replaced.
- H. Insert the new flanged fittings at the exposed bell and spigot ends.
- I. Install the other fittings, valves and closure couplings between the flanged ends. Line valves shall be installed in the open position. Branch valves shall be installed in the closed position.
- J. Where inserted pipe fittings are dissimilar to the existing pipe, a bonding wire shall be used to connect the existing pipe across the cut-in section. Solder the wire to the exposed steel spigot at each joint prior to filling the exterior joint with mortar.
- K. Provide a cement mortar seal at the bell and spigot connections per the manufacturer's directions.
- L. Form and cast the thrust blocks as shown on the Drawings.
- M. Backfill and close the trench before placing the transmission main back in service.

3.06 PLACEMENT OF PIPE IN TRENCH

- A. Fittings shall be supported independently of the pipe.
- B. Until thrust blocks and supports are poured, fittings shall be temporarily supported by placing wooden skids under the bells so that the pipe is not subjected to the weight of the fitting.
- C. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with a mastic, 3M, Minnesota Mining and Manufacturing EC 244, or an approved equal. Stainless steel bolts shall not be coated.

3.07 FLANGED JOINTS

- A. Flanged joints shall be installed in accordance with the manufacturer's recommendation and Section 33 11 00. The fitting shall be thoroughly cleaned of all dirt, debris, or other deleterious material and inspected prior to incorporation into the work.
- B. The pipe and fitting shall be carefully aligned using slings, blocks, jacks, or other means necessary to establish and maintain the correct alignment. Under no circumstances shall the bolts be used to achieve the correct alignment. As the bolts are inserted through the flange the gasket shall be inserted between the mating faces of the fitting and pipe.
- C. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe run.

- D. Clean flanges by wire brushing before installing gasket.
- E. Clean flange bolts and nuts by wire brushing, lubricate threads with anti-seize compound, and tighten nuts uniformly and progressively. Between 1/4 inch and 3/8 inch shall project through the nut when drawn tight.
- F. All bolting shall be performed in accordance with the provisions of Section 33 11 00, General Piping Requirements.
- G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.08 ANCHORS AND THRUST BLOCKS

- A. Concrete anchors and thrust blocks shall be poured against wetted undisturbed soil in accordance with Section 33 11 13.90 and as shown on the Drawings.

3.09 TESTING

- A. All pressure piping shall be hydrostatically pressure tested in accordance with Section 33 11 00.

END OF SECTION

SECTION 33 11 13.90

THRUST RESTRAINTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation, and testing of thrust restraints for ductile-iron pipe and fittings, concrete cylinder pipe and buried valves.
- B. Related sections:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 31 23 00 – Trenching, Backfilling and Compaction
 - 3. Section 33 11 00 - General Piping Requirements
 - 4. Section 33 11 13.15 – Ductile Iron Pipe and Fittings
 - 5. Section 33 11 13.20 – Concrete Cylinder Pipe
 - 6. Section 33 12 16 – Manual Valves

1.02 REFERENCED CODES AND STANDARDS

- A. American Water Works Association (AWWA), latest edition:
 - 1. C105 – Polyethylene Encasement for Ductile –Iron Pipe Systems
 - 2. C110 – Ductile-Iron and Gray-Iron Fittings
 - 3. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 4. C153 – Ductile-Iron Compact Fittings for Water Service
 - 5. C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 - 6. C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
 - 7. C213 – Fusion-Bonded Epoxy Coatings and Linings For Steel Water Pipe and Fittings
 - 8. C219 – Bolted, Sleeve-Type Couplings for Plain-End Pipe
 - 9. C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
- B. ASTM
 - 1. A536 – Standard Specification For Ductile Iron Castings
- C. NSF International
 - 1. 61 – Drinking Water System Components – Health Effects

1.03 REQUIREMENT

- A. All pressure pipe shall be restrained against joint separation by the following methods:
 - 1. Welded continuous pipe.
 - 2. Bolted flanged fittings.
 - 3. Bell and spigot joints with locking gaskets.

4. Bell and spigot joints with bell restraint harness.
 5. Bell and spigot joints with concrete thrust anchors/ thrust blocks at valves and fittings, as detailed on the Drawings.
 - a. If the required test pressure for the pipeline exceeds the design pressure listed in the thrust block detail on the Drawings, the Contractor bring the discrepancy to the attention of the Owner and the Engineer for clarification or revision.
 6. Mechanical joint restraints at valves and fittings.
 7. Concrete thrust blocks at valves and fittings where indicated on the Drawings.
- B. Concrete thrust blocks shall be provided where new valves and/or fittings are added to existing bell and spigot type pipelines.
- C. New ductile iron pipelines shall be fully restrained by using locking gaskets at every bell and spigot connection and mechanical restraints at every valve and/or fitting connection.

1.04 SUBMITTALS

- A. Contractor shall provide submittals for review and approval by the Engineer in accordance with Section 01 30 00.
- B. Provide shop drawings or catalog cuts for all materials to be included in the Work. Submittal shall include fittings, gaskets, bolts, coatings and associated hardware.
- C. Provide certificate of NSF-61 compliance for gasket materials and coatings coming into contact with potable water.

PART 2 - PRODUCTS

2.01 LOCKING GASKETS

- A. Rubber gaskets with embedded steel gripper teeth, rated to hold a minimum pressure of 250 psi, meeting the requirements of AWWA C111.
- B. Manufacturers:
 1. Field-Lok 350 Gasket as manufactured by U.S. Pipe
 2. Sure Stop 350 Gasket as manufactured by McWane Ductile
 3. Fast-Grip Gasket as manufactured by American Ductile Iron Pipe
 4. Or approved equal

2.02 MECHANICAL JOINT RESTRAINT

- A. Design
 1. Restraint devices for nominal pipe sizes 3 inch through 54 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110.
 2. The devices shall have a working pressure rating of 350 psi for 3-16 inch, 250 psi for 18-48 inch and 200 psi for the 54 inch size. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

3. An identification number tracing the date and location of manufacture shall be cast into each gland body.
4. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.

B. Material

1. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
2. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
3. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.
4. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.

C. Manufacturer

1. Megalug Series 1100 produced by EBAA Iron Inc. or approved equal.

2.03 MECHANICAL BELL RESTRAINT

A. Design

1. Ductile iron pipe bell restraint shall consist of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell.
 - a. The restraint ring shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The restraint ring and its wedging components shall be made of minimum grade 65-45-12 ductile iron conforming to ASTM A536.
 - b. The wedges shall be heat treated to a minimum hardness of 370 BHN.
 - c. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges.
 - d. The split ring shall be made of a minimum grade of 65-45-12 ductile iron conforming to ASTM A536.
 - e. The restraint devices shall be coated using thermosetting epoxy or polyester based powder coating.
 - f. The connecting tie rods that join the two rings shall be made of low alloy steel that conforms to ANSI/AWWA C111/A21.11.
2. Mechanical bell restraint shall require conventional tools and installation procedures per AWWA C600.
3. The assembly shall have a rated pressure with a minimum 2 to 1 safety factor of 350 PSI in the 16-inch size and below; 250 PSI in the 18 through 36-inch sizes.

B. Manufacturer

1. Megalug Series 1700 restraint harness, manufactured by EBAA Iron, Inc. or approved equal.

2.04 RESTRAINED FLANGE ADAPTOR

A. Design

1. Restrained flange adapters shall be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
2. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
3. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
4. For PVC pipe, the flange adapter will have a pressure rating equal to the pipe.
5. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
6. An identification number tracing the date and location of manufacture shall be cast into each gland body.
7. All wedge assemblies and related parts shall be coated with a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
8. All casting bodies shall have a polyester based powder coating or thermoset epoxy coating to provide corrosion, impact and UV resistance. Coatings for wetted parts shall meet NSF 61.

B. Manufacturer:

1. SERIES 2100 MEGAFLANGE adapter, as produced by EBAA Iron, Inc.
2. Restrained Flange Coupling Adaptor, as produced by ROMAC Industries.
3. Or approved equal.

2.05 SLEEVE COUPLING WITH RESTRAINT

A. Design

1. Joint Restraint to prevent axial separation shall be incorporated into the design of the sleeve or coupling used to connect two plain pipe ends.
2. Sleeve body shall be carbon steel or ductile iron.
3. The restraint mechanism shall consist of a plurality of individually actuated gripping surfaces to maximize restraint capability.
4. Torque limiting twist off nuts shall be used to insure proper actuating of the restraint devices.
5. The restraint devices shall have a polyester based powder coating or thermoset epoxy coating coated using thermosetting epoxy.
6. Ductile Iron components shall be of a minimum of 65-45-12 ductile iron meeting the requirements of ASTM A536 of the latest revision and shall be tested in accordance with the stated standard.
7. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111 and ASTM D2000.

B. Manufacturer.

1. Series 3800 restrained joining system by EBAA Iron, Inc.
2. Style 400 RG by ROMAC Industries
3. Or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install mechanical restraints per the manufacturer's directions, the requirements of Sections 33 11 00 and 33 11 13.15, and the requirements of AWWA C600.

3.02 THRUST BLOCKS AND THRUST ANCHORS

- A. Trenching, backfilling, and compacting shall be in accordance with Section 31 23 00.
- B. Excavate pipe trench and install pipeline and fittings. Tighten all fittings and connections. Brace or support pipe or fittings as needed to prevent displacement.
- C. Excavate the area to receive the thrust block. Concrete anchors and thrust blocks shall be poured against wetted undisturbed soil. Where it is not practical to place the thrust block against undisturbed earth, the fill material placed between the blocks bearing surface and undisturbed soil shall be moisture conditioned and compacted to 95% modified proctor.
- D. Install rebar and ties, where required on the Drawings.
- E. Wet the soil without causing erosion or sloughing and place the concrete thrust block.
- F. High early strength concrete may be used to allow early backfilling of the trench.
- G. Do not pressure test the pipeline until the thrust block has achieved the required strength listed on the Drawings.

END OF SECTION

SECTION 33 11 13.15

FORCE-BALANCED FLEXIBLE EXPANSION JOINT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes force-balanced double-ball type ductile iron flexible expansion joints.
- B. Related sections:
 - 1. Section 33 11 00 - General Piping Requirements
 - 2. Section 33 11 13.15 – Ductile Iron Pipe and Fittings

1.02 REFERENCED CODES AND STANDARDS

- A. American Water Works Association (AWWA), latest edition:
 - 1. C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
 - 2. C153 – Ductile-Iron Compact Fittings
 - 3. C213 – Fusion-Bonded Epoxy Coatings and Linings For Steel Water Pipe and Fittings
- B. NSF International
 - 1. 61 – Drinking Water System Components – Health Effects

1.03 SUBMITTALS

- A. Contractor shall provide submittals for review and approval in accordance with Section 01 30 00.
- B. Provide shop drawings and product data, including dimensions, materials and design pressure ratings.
- C. Source quality control testing reports:
 - 1. Holiday testing of lining.
 - 2. Pressure test.

PART 2 - PRODUCTS

2.01 FORCE-BALANCED FLEXIBLE EXPANSION JOINT

- A. Flexible expansion joints shall consist of two ball and socket joints with an expansion unit between them. Force-balanced units shall incorporate a water chamber piston that acts in the equal and opposite direction of the imparting thrust to neutralizes the thrust forces.

- B. Flexible expansion joints shall be installed in the locations indicated on the Drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
- C. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 150 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.
- D. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 25°, 4" - 8"; 20°, 10" - 12"; 15°, 14+" and 8-inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.
- E. Provide 150-lb flanged end connections.
- F. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
- G. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- H. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
- I. Manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. The purchaser (or owner) shall reserve the right to inspect the manufacturer's facility for compliance.
- J. Flexible expansion joints shall be FLEX-TEND as manufactured by EBAA Iron, INC.

2.02 SOURCE QUALITY CONTROL

- A. Pressure test to rated working pressure before shipment.
- B. Holiday test epoxy lining with a 1500-volt spark test in accordance with AWWA C213.

2.03 GASKETS

- A. Gaskets for flanged joints shall be per Section 33 11 13.15.

2.04 BOLTS AND NUTS

- A. Bolts and nuts shall be per Section 33 11 13.15.

PART 3 - EXECUTION

3.01 GENERAL

- A. Ductile-iron pipe and ductile iron fittings shall be installed in accordance with the applicable Sections of AWWA C600 and as specified in Section 33 11 13.15.

3.02 HANDLING

- A. Protect sliding and rotating surfaces against damage during handling and shipping.

3.03 INSTALLATION

- A. Install flexible expansion joints in accordance with manufacturer's published instructions to meet minimum expansion and contraction values as specified.

END OF SECTION

SECTION 33 12 16

MANUAL VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation of manually operated valves.
- B. Manual valves to be supplied and installed per AWWA C507 and C509, unless noted otherwise below.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Trenching, Backfilling, and Compacting: 31 23 00
 - 2. Cast-In-Place Concrete: 03 30 00
 - 3. Painting and Coating: 09 90 00
 - 4. Hydrostatic Testing of Pressure Pipelines: 33 05 05.31
 - 5. Ductile-Iron Pipe and Fittings: 33 11 13.15
 - 6. Underground Facilities Identification. 33 05 26

1.03 REFERENCE STANDARDS

- A. Valves shall conform, as applicable, with the latest editions of the following codes and standards.
 - 1. AWWA C504 Rubber-Seated Butterfly Valves
 - 2. AWWA C509 & C515 Resilient Seated Gate Valves
 - 3. AWWA C550 Protective Interior Coatings for Valves and Hydrants
 - 4. ASTM B62 Composition Brass or Ounce Metal Castings
 - a. Ductile Iron Castings for Valves
 - b. Ductile Iron Pipe Flanges
 - 5. ASTM D 429 Tests for Rubber Property – Adhesion to Rigid Substrates

1.04 SUBMITTALS

- A. Submit manufacturer's product data, shop drawings and installation instructions demonstrating compliance with the reference standards and this specification for the intended service.
- B. Certified test reports shall be provided with each delivery showing that the valve(s) delivered complies with this specification.

1.05 APPROVED MANUFACTURERS

- A. Gate Valves - Aboveground Smaller Than 2 Inch
 - 1. Red & White
 - 2. Milwaukee
 - 3. Or approved equal
- B. Ball Valves Smaller than 3-inch
 - 1. Nibco
 - 2. Or approved equal
- C. Resilient - Seated Gate Valves: 4 Inch through 12 Inch
 - 1. Clow
 - 2. Mueller
 - 3. American Flow Control (AFC)
 - 4. Or approved equal
- D. Butterfly Valves
 - 1. Henry Pratt Company
 - 2. Dezurik
 - 3. American Flow Control (AFC)
 - 4. Or approved equal
- E. Valve Boxes
 - 1. Christy G5 with cast iron cover
 - 2. Or approved equal

1.06 FLANGED END

- A. All valves connecting to fittings on a main shall be flanged on at least one side and bolted to the fitting on the main.

1.07 SINGLE TYPE OF VALVE

- A. The Contractor shall choose an approved valve and then use only that valve throughout the Work (i.e., only one manufacturer and model per type of valve).

1.08 BUTTERFLY VALVES

- A. Butterfly valves shall only be used on lines 14 inches and larger or as specifically shown on the plans.

1.09 RESILIENT WEDGE GATE VALVES

- A. Resilient gate wedge valves shall be used on all pressure class 150 lines 4 inch through 12 inch.

1.10 FIELD HYDROSTATIC TEST

- A. All valves 16-inch and larger shall be field hydrostatically tested to the valves working pressure in the presence of the Owner's inspector. Each side of the valve shall be pressurized and tested independently.

PART 2 - MATERIALS

2.01 GENERAL

- A. Valves shall be installed complete with operating handwheels or levers, extension stems, worm gear operators, operating nuts, and wrenches required for operation.
- B. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.
- C. Valve body and trim casting shall be of domestic origin.
- D. Bolts for all valves shall be 316 stainless steel. Bolts consisting of 304 stainless steel shall not be permitted.
- E. Suitable valves shall be provided to connect to adjoining piping as shown on the plans.

2.02 VALVE OPERATORS

- A. Butterfly Valve Operators
 - 1. Provide lever or wrench operators having adjustable, "position indicator" for exposed butterfly valves smaller than 6 inches.
 - 2. Provide gear operators on butterfly valves 6 inches and larger. Gear operators for valves 8-inches and larger shall be of the traveling nut type. For large valves, worm gears shall be used with the approval of the Engineer.
 - 3. Gear operators shall be enclosed with seals provided on shafts to prevent entry of dirt and water into the operator. Gear operators for valves located above ground or in vaults and structures shall have handwheels. Minimum handwheel diameter shall be 12 inches. The operator shall contain a dial indicating the position of the valve disc or plug.
 - 4. Gear operators for buried or submerged valves shall have 2-inch square AWWA operating nuts.
 - 5. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed operators designed for buried or submerged service.
 - 6. Traveling nut and worm gear operators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full operating head with a maximum pull of 80 pounds on the hand-wheel. Provide stop limiting devices in the operators in the open and closed positions. Operators shall be of the self-locking type to prevent the disc or plug from creeping. Design operator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel operators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.
 - 7. Operators on buried valves shall produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

- B. Gate Valve Operators
 - 1. Provide hand-wheel operators for above ground gate valves. Minimum handwheel diameter shall be 12 inches.
 - 2. Provide 2-inch AWWA operating nuts for buried and submerged valves.
- C. Valve operators, handwheels, or levers shall open by turning counterclockwise.

2.03 PAINTING AND COATING

- A. Coat metal valves (except bronze and stainless-steel valves) located above ground or in vaults and structures in accordance with Section 09 90 00. Apply the specified prime coat at the place of manufacture. Apply finish coat in field. Finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.
- B. Coat buried metal valves at the place of manufacture per Section 09 90 00
- C. Valves 4 inches and larger shall be coated on their interior metal surfaces excluding seating areas and bronze and stainless steel pieces in accordance with AWWA C550 and these specifications. Sandblast surfaces in accordance with SSPC SP-1. Remove all protuberances which may produce pinholes in the lining. Round all sharp edges to be coated. Remove any contaminants which may prevent bonding of the lining. Coat the interior ferrous surfaces using one of the following methods:
 - 1. Apply powdered thermosetting epoxy (3M Scotchkote 6251 Fusion Bonded Epoxy or equal) per the manufacturer's application recommendations to a thickness of 7 to 9 mils. All gaskets and seals must be removed prior to applying coating.
 - 2. Apply two coats of catalytically setting epoxy (Tnemec Series N140, or equal) to a dry-film thickness of 7 to 9 mils total. Follow the paint manufacturer's application recommendations including minimum and maximum drying time between the required coats.
- D. All valve coatings shall be factory applied or by the manufacturer's qualified distributor. Touch up and repair of valve coatings shall be only done by authorized factory distributors.

2.04 ABOVEGROUND BALL VALVES 2 INCHES AND SMALLER

- A. Aboveground threaded end ball valves, 1/4 inch through 3 inches, for water service shall be full bore port ball type having a minimum working pressure of 200 psi. Valves shall have plastic coated lever operators.
- B. Materials of construction shall be as described below:
 - 1. Body: Bronze per ASTM B 62
 - 2. Ball: Type 316 Stainless Steel
 - 3. Seat and Seals: Teflon
 - 4. Stem: Bronze or Copper Silicon, per ASTM B 62, B99 (Alloy 651), B 584 or B 371 (Alloy 694)
- C. Stem material shall have a minimum tensile strength of 60,000 psi and a minimum yield strength of 30,000 psi.

2.05 RESILIENT-SEATED WEDGE GATE VALVES

- A. Valves shall conform to AWWA C509 and C515 and the requirements listed herein.
- B. All valves shall be bubble tight at 200 psi working pressure.
- C. Valves shall have non-rising low-zinc stems, opening by turning counter-clockwise and provided with 2-inch-square operating nut. Outside stem and yolk valves shall be used on backflow device shutoff valves.
- D. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.
- E. Stuffing boxes shall be O-ring seal type with two rings located in stem.
- F. Low friction torque reduction thrust bearings shall be located both above and below the stem collar.
- G. Materials shall be as described below:
 - 1. Body, Operating Nut Bonnet and Seal Plate: Cast Iron or Ductile Iron per ASTM A 126 Class B
 - 2. Gate: Cast Iron or Ductile Iron per ASTM A 126 Class B
 - 3. Bonnet and Seal Bolts: Type 316 Stainless Steel
 - 4. O-Rings: Synthetic Rubber per ASTM D2000
- H. All internal working parts (excluding gate) shall be all bronze containing not more than 2 percent aluminum or more than 7 percent zinc. Valve stems shall be cast or forged from bronze having a tensile strength of not less than 60,000 psi, a yield point of not less than 30,000 psi, and an elongation of not less than 10 percent in 2 inches.
- I. All gates shall be encapsulated in Buna-N rubber or a nitrile elastomer.

2.06 TAPPING VALVES

- A. Tapping valves shall conform with all requirements for gate valves 2 inches and larger and the additional requirements listed herein.
- B. All valve ends shall be flanged. The flange on one end shall have slotted bolt holes to fit all standard tapping machines.
- C. Seat rings shall be oversized to permit the use of full-size cutters.
- D. Resilient wedge valves may be used as tapping valves, provided that the disk fully retracts to produce a full port opening.

2.07 BUTTERFLY VALVES

- A. Butterfly valves shall conform to AWWA C504, Class 250B. Minimum working differential pressure across the valve disc shall be 250 psi unless specified otherwise on the drawing.

- B. Butterfly valves shall be furnished and installed with the type of ends as shown on the plans and as herein specified. Wafer style valves will not be permitted. Valves connecting to buried fittings shall be flange by mechanical joint, where the valve is directly bolted to flanged fitting. If valve is not available with flange by mechanical joint end configurations, CONTRACTOR shall provide mechanical joint valves and fittings with mechanical restraints at no extra cost to District.
- C. Each valve body shall be tested under a test pressure equal to twice its design water working pressure.
- D. Valves shall be bubble tight at rated pressures and shall be satisfactory for throttling service and frequent operation after long periods of inactivity. Valve discs shall rotate 90 degrees from the full-open position to the tight-shut position.
- E. Valve ends shall be flanged or mechanical joint. Flanged ends shall be compatible with ANSI B16.1 Class 125. Mechanical Joint ends shall be per AWWA C111. Mechanical Joint ends shall be mechanically restrained per Section 33 11 13.15 for specific pipe/valve size.
- F. Valve shafts shall be per AWWA C504, Section 4.2.3.
- G. Materials of construction shall be as described below:
 - 1. Body: Cast Iron or Ductile Iron per ASTM A 126 Class B
 - 2. Exposed Body Cap Screws and Bolts and Nuts: Type 316 Stainless Steel
 - 3. Discs: Cast Iron or Ductile Iron per ASTM A 126 Class B
 - 4. Seat: Buna-N Rubber
- H. The rubber seat shall be an integral part of the valve body. Rubber seats fastened to the disc by any means shall not be permitted.

2.08 BOLTS AND NUTS FOR FLANGED VALVES

- A. Bolts and nuts for flanged valves shall be Type 316 stainless steel in accordance with Section 33 11 13.15.

2.09 GASKETS

- A. Gaskets for flanged end valves shall be as described in Section 33 11 13.15.

2.10 VALVE BOXES FOR BURIED VALVES

- A. Valve extension pipe material shall be 8-inch PVC SDR 35 pipe.
- B. Design cast iron cap to rest within a frame on a cast-in-place concrete ring surrounding the valve extension pipe; size the tapered skirt of the cap for a close fit inside the upper sleeve portion of the valve box. Caps for the domestic water system shall be circular with the word "WATER" cast on the cap. Caps for the recycled water system shall be circular with "RECYCLED" cast on the cap. Coat the cap and frame with asphalt or coat-tar paint.

2.11 EXTENSION STEMS FOR BURIED VALVE OPERATORS

- A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 24 to 30-inches below the surface of the ground and/or box cover.
- B. Extension stems shall be steel and shall be complete with 2-inch-square operating nut.
- C. Valve stem extensions shall be of a solid design (no pinned couplings permitted) with guides.
- D. Valve extensions shall conform with MCWD Standard Plan W-7

PART 3 - EXECUTION

3.01 JOINTS

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound OR Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Rubber ring grooves of valves shall be inspected before installation by the Contractor for ridges or holes that would interfere with the rubber ring. Interferences with the rubber ring shall be corrected to a satisfactory connection or the valves replaced, as required by the District. (All valves shall have the same rubber-ring groove profile as the groove of the pipe couplings furnished with the pipe.)

3.02 BUTTERFLY VALVE OPERATORS

- A. Butterfly valves shall be installed with the operators on the street centerline side of the pipeline.

3.03 EXTERIOR PROTECTION

- A. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with bituminous mastic per Section 09 90 00 Coating of stainless-steel flange bolts is not required.
- B. Wrap buried valves with 8-mil polyethylene wrap per AWWA C10

3.04 CONCRETE SUPPORTS

- A. Valves shall be anchored in concrete as shown on plans.
- B. Concrete supports will not be required under valves bolted to flanged fittings.

- C. Until supports are poured, valves shall be temporarily supported by placing wooden skids underneath the valve so that the pipe is not subjected to the weight of the valve.

3.05 VALVE BOXES

- A. Valve boxes shall be firmly supported and shall be kept centered and plumb over the operating nut of the valve.
- B. Beveled sections of pipe will not be allowed at the top of the valve extension pipe. The top cut shall be square, and machine made.
- C. The box cover shall be flush with the surface of the finished pavement unless otherwise indicated on the Drawings.

3.06 BACKFILL

- A. All backfill within 24 inches of a valve shall be clean, washed sand.
- B. Backfill is to be placed and compacted in accordance with Section 31 23 00

3.07 VALVE LEAKAGE TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 33 05 05.33 for pressure testing requirements.
- B. Valves shall have a pressure rating higher than or equal to the test pressure.

END OF SECTION

SECTION 33 12 19

FIRE HYDRANTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes the materials, installation and testing of fire hydrants.
- B. Hydrants shall be supplied and installed per MCWD Standard Plan W-5, AWWA C 503 and as described herein.

1.02 RELATED WORK DESCRIBED ELSEWHERE

- A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).
- B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Trenching, Backfilling, and Compacting: 31 23 00
 - 2. Concrete: 03 30 00
 - 3. Painting and Coating: 09 90 00
 - 4. Hydrostatic Testing of Pressure Pipelines: 33 05 05.31
 - 5. Ductile Iron Pipe and Fittings: 33 11 13.15
 - 6. Manual Valves: 33 12 16

1.03 APPROVED WET BARREL HYDRANTS

- A. Residential Use
 - 1. James Jones 3760 (Hydrant Head and Fluted Spool),
 - 2. Clow 2060
- B. Commercial and Industrial Use
 - 1. James Jones 3770 (Hydrant Head and Fluted Spool)
 - 2. Clow 2065

PART 2 - MATERIALS

2.01 WET BARREL HYDRANT

- A. Hydrant Top Section
 - 1. Fire hydrants shall have individual valves for each outlet opening counter clockwise. Fire hydrants for residential use shall have two 2-1/2 inch hose nozzle and one 4-1/2-

inch pumper nozzle. Fire hydrants for commercial or industrial developments shall have one 2-1/2 inch hose nozzle and two (2) 4-1/2-inch pumper nozzles.

2. All outlets shall have National Standard Hose Threads.
3. The hydrant top section shall be manufactured of bronze conforming to ASTM B 62.
4. All interior working parts, including stems, shall be of bronze containing no more than 7% zinc or 2% aluminum.
5. Hydrants are to be provided with:
 - a. 1-1/8-inch sized pentagon-shaped operating nut, and
 - b. 1-1/8-inch capnuts.
6. All fire hydrants shall have the name of the manufacturer cast onto the hydrant body or shown on a permanently attached plate.
7. Plastic outlet nozzle caps shall be provided for all outlets. Caps shall be securely chained to the barrel with non-kinking metal chain in a manner to permit free rotation of the cap.
8. All hydrant flanges shall be eight-hole regular, Class 125, American Standard cast iron flange drilling.

B. Bury Section

1. The bury section shall be 6-inch cast iron long radius bury elbow and shall be cement lined in conformance with Section 33 11 13.15. Bury inlet shall be 6-inch rubber-ring hub bell connection for C900 PVC pressure pipe.
2. A flanged ductile iron spool shall be installed to position the hydrant flange 4 inches above the concrete pad (finish grade).
3. All wet-barrel fire hydrant cast-iron buries are to be cement lined.
4. When using a riser spool, bolts shall be stainless steel 316, standard non-break-away.
5. Bury section outlet and riser spool flanges shall be eight-hole regular, Class 125, American Standard cast-iron flange drilling.

2.02 BREAK-OFF CHECK VALVE

- A. Break-off check valve shall be installed on hydrant riser with break-off segment above finished grade.
- B. Break-off check valve shall be Clow model LBI-400A or equal.

2.03 VALVE

- A. The shut-off valve shall be a resilient-seated gate valve per Section 33 12 16, including the valve box. Butterfly valves will not be permitted on fire hydrant laterals.

2.04 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be per Section 33 11 13.15.

2.05 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile-iron Pipe and fittings shall be in accordance with Section 33 11 13.15.

2.06 CONCRETE

- A. Concrete pads and supports shall be Class B concrete conforming with Section 03 30 00.

2.07 GASKETS

- A. Gaskets shall be of rubber composition per Section 33 11 13.15.

PART 3 - EXECUTION

3.01 GENERAL

- A. Fire hydrant assemblies shall be installed in accordance with the standard drawing and as specified herein, and shall include the connection to the main, the fire hydrant, hydrant bury, shutoff valve, valve well and valve box, connection piping, concrete thrust blocks, and appurtenances.
- B. Refer to MCWD Standard Plan W-5.

3.02 LOCATION

- A. Fire hydrant assemblies shall be located as shown on the plans or as approved by the District representative. The center of the fire hydrant shall be, except as otherwise approved by the District representative, located as described below:
 1. Where concrete curb or asphalt concrete (A.C.) berm exists or is to be constructed, and the sidewalk is next to the property line; 1 feet 6 inches back of the back edge of the curb.
 2. Where 6-foot-wide or narrower sidewalk is to be installed or exists next to the curb; 12 inches back of sidewalk edge. Where there is insufficient public right-of-way behind the sidewalk, an easement will be required. For sidewalks wider than 6 feet; 18 inches back of the curb face.
 3. Where there is no curb or berm, the location shall be designated by the District representative.
 4. The flange elevation at the base of the hydrant shall be set 4-inches above the curb or sidewalk, or the surrounding graded area, or as approved by the District representative. Spools additional will not be permitted when correcting the flange elevation.

3.03 TRENCHING, BACKFILLING, AND COMPACTING

- A. All trenching, backfilling, compaction and other excavation shall be in accordance with Section 31 23 00.

3.04 VALVE AND VALVE BOX

- A. The valve and valve box shall be installed in accordance with Section 33 12 16.

3.05 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be installed in conformance with Section 33 11 13.15.

3.06 CONCRETE

- A. The concrete pad shall be Class B concrete and thrust blocker shall be Class A concrete and shall be placed per Section 03 30 00.

3.07 PAINTING

- A. All public fire hydrants shall be painted with one prime coat and two finish coats of yellow paint at the place of manufacture. Before the fire hydrant has been installed in accordance with Section 09 90 00. A final touch-up coat shall be applied just prior to the final inspection.

3.08 TESTING

- A. Test hydrants at the same time that the connecting pipeline is pressure tested. See Section 33 05 05.31 for pressure testing requirements.

END OF SECTION

SECTION 33 16 00

WATER UTILITY STORAGE TANKS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals to design and construct a welded steel potable water reservoir, anchorage, and appurtenances, as shown on the Drawings and as specified. Work shall also include a one-year anniversary inspection and report.
- B. Reservoir design, fabrication, erection, inspection, and testing shall be in accordance with AWWA D100 except as noted herein.

1.02 REFERENCE STANDARDS

- A. American Water Works Association
 - 1. AWWA D100 Welded Carbon Steel Reservoirs for Water Storage
 - 2. AWWA C652 Disinfection of Water-Storage Facilities.
- B. California Building Code (CBC), 2019 Edition.
- C. Steel Structures Painting Council Standards.
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid shall apply.

1.03 SUBMITTALS

- A. Submit to the ENGINEER in accordance with Division 1, submittals including the following:
- B. Shop drawings for the complete reservoir structure including walls, floor, roof, anchorage, structural members, ladder, guardrails, inlet, outlet, overflows, drain, clean-out, hatches, vent, attached piping, manways, and all other appurtenances. Detailed fabrication, including dimensions, member sizes and locations, welding and connection details, and materials information shall be provided.
- C. Structural calculations for the complete reservoir, including ladder, guardrail and reservoir anchorage, shall be stamped and signed by a Professional Civil or Structural Engineer registered in the State of California.
- D. Product information on the entire inside and outside paint systems including label data, surface preparation requirements, mixing instructions, thinning instructions, application instructions, percent solids, pot life, spreading rate, weight, drying time, time between coats, handling and storage and Safety Data Sheets.

- E. Paint Color Samples for Initial Color Selections: Manufacturer's standard color charts and up to three custom colors designated by the DISTRICT.
- F. Paint film testing test report.
- G. Reservoir disinfection and initial filling procedures listing all materials to be used, manner of filling and flushing, and all actions to be taken.
- H. Product data for pipe fittings and purchased fabricated items.

1.04 QUALITY ASSURANCE

- A. The reservoir MANUFACTURER shall have a minimum of ten (10) year experience in the design, fabrication, and erection of AWWA D100 welded carbon steel reservoirs similar in size and character required for this Project, and a minimum of five year satisfactory operation.
- B. The reservoir CONTRACTOR shall be experienced in fabrication, erection and testing and shall be a certified installer of the MANUFACTURER's products.

1.05 GUARANTEES AND WARRANTY

- A. Provide written warranty from the MANUFACTURER for the reservoir and associated appurtenances specified in this Section.
- B. Warranty Period: Five (5) years from acceptance of reservoir.
- C. Coverage: Cover defects or failures of materials or workmanship, in the opinion of the DISTRICT, which occur as the result of normal operation and service.
- D. Furnish to the DISTRICT written guarantee in the form of Guarantee/Warranty Form found within *Warranties and Bonds* section of the Contract Documents.

1.06 GENERAL DESCRIPTION

- A. The welded carbon steel reservoir shall have a nominal capacity of 1,600,000 gallons. Its primary function will be to store and provide operational, fire and emergency water storage for Zone A in Ord Community and Central Marina.
- B. The reservoir shall have separate inlet and outlet piping and one overflow assembly.
- C. The roof shall be a steel cone or domed shaped roof supported on internal structural framing with one central column. Reservoir shall be provided with a rounded "knuckle" type transition from the sidewalls to the roof.
- D. The reservoir shall be provided with cathodic protection system as defined in Contract Documents.
- E. Detailed dimensions, elevation, and appurtenance requirements are shown on the Contract Drawings.

1.07 AWWA D100 INFORMATION

- A. The following information is provided for the design and construction of the reservoir in accordance with AWWA D100 Foreword Part III.
1. Capacity to overflow weir: 1,910,000 gallons (nominal).
 2. Maximum process fluid height: 25'-1"
 3. Inside diameter at base: 114'-0"
 4. Floor pitch: See Contract Drawings.
 5. Type of roof: Weatherproof carbon steel plate and frame, spanning the reservoir shell with one interior column.
 6. Roof pitch: See Contract Drawings.
 7. Roof projection at eaves: None.
 8. Roof thickness: Minimum carbon steel plate thickness of 3/16-inch.
 9. Site location: CSUMB Campus, adjacent to 6th. Avenue, south of 8th. Street cut-off; Marina, California; (Latitude 36.656129°N, Longitude 121.796399°W)
 10. Time for Completion: See specification, Division 0.
 11. Name and distance to nearest railroad siding: Unknown; contact local railroad companies in Monterey County.
 12. Access roads: Public roads to the reservoir site.
 13. Availability of electric power: See specification Division 1.
 14. Availability of compressed air: Not available from District.
 15. Details of all welded joints referenced on the reservoir Contractor's drawings to be submitted in accordance with Contract Documents: Yes.
 16. Copper bearing steel required: No.
 17. Type of pipe and fittings for fluid conductors: See applicable Contract Drawings and Project Specifications.
 18. Snow loading: Omit.
 19. Special wind loading requirements beyond AWWA D100: Wind Design in accordance with ASCE 7, Exposure D, 103 mph, and I = 1.5.
 20. Special seismic design criteria: See Paragraph 1.8-B herein.
 21. Corrosion allowance to be added to components in contact with process fluid: None.
 22. Corrosion allowance to be added to components not in contact with process fluid: None.
 23. Location of manholes, ladders, and accessories: See Contract Drawings.
 24. Number, type, size, and location of pipe connections: See Contract Drawings.
 25. Removable silt stop: Not required.
 26. Overflow type and size: See Contract Drawings.
 27. Overflow maximum discharge rate: 4,800 gallons per minute.
 28. Normal maximum water withdrawal rate: 2,200 gallons per minute.
 29. Method of roof access: Exterior ladder with Personal Fall Protection System, see Contract Drawings.
 30. Safety devices: See Contract Drawings and as specified herein.
 31. Special vent required: No (standard turbo vent, see Contract Drawings).

32. For butt-joint welds subject to secondary stress, whether complete joint penetration is to be provided at joints in materials of thicknesses greater than 3/8-inch with square groove or double groove welds: Provide complete joint penetration.
33. Mill or shop inspection; mill test reports required: No.
34. Written report required certifying that the work was inspected as set forth in AWWA D100 Section 11.2.1: Yes.
35. Type of inspection to be performed on complete joint penetration welded shell butt-joints: Radiographic method.
36. Method of cleaning steel of mill scale (blast cleaned, pickled, other): Blast cleaned.
37. Types of paint and protective coatings: See Contract Drawings and Documents.
38. Paints and protective coatings to be applied by reservoir CONTRACTOR: Yes.
39. Paint or protective coatings required on the underside of the floor plates: No.
40. Shell, bottom, and roof water testing before paints and protective coating application: Not Applicable; Optional by CONTRACTOR.
41. Special requirements of CONTRACTOR for disposal of water used for water testing of shell and bottom: Any chlorinated or chloraminated water used for testing or construction purposes shall be dechlorinated by the CONTRACTOR prior to discharge to storm drain; also comply with all local, state, and federal regulations on the quality and discharge of such water.
42. Soil investigation foundation design criteria: See Project Geotechnical Report.
43. Foundation design: See Contract Drawings.
44. All requirements of ACI 301 applicable to the concrete work.
45. Piping depth of cover requirements: See Contract Drawings.
46. Design basis: AWWA D100, Appendix C designs will not be acceptable.
47. Whenever there is a change in thickness greater than 1/8 inch in sidewall plates, the plates shall be joined so that the offset is on the inside and the outside face of the plates are flush.
48. Knuckle plates shall be curved in both directions to the form of a torus. Knuckle plates may be curved along the circumferential axis during reservoir erection. Knuckle plates which are curved in only one direction will not be acceptable.

B. SPECIAL SEISMIC DESIGN REQUIREMENTS

1. The reservoir structure, including anchorage, shall be designed in accordance with AWWA D100 using the following parameters:
 - a. Where inclusion of vertical loads results in a less conservative design, vertical effects shall be neglected.
 - b. The vertical stress in the reservoir shell due to self-weight of the shell shall include vertical seismic effects, and shell buckling shall be checked by combining horizontal and vertical effects. The effect of internal liquid pressure shall not be used to increase permissible buckling stresses on the shell. No increase in compression stress shall be allowed for seismic loads.
 - c. Frictional resistance shall not be used to reduce the unbraced distance in designing roof members.
2. Concrete Anchorage System (if required)
 - a. Concrete anchorage shall be designed in accordance with ACI 318, Chapter 17, with California Building Code amendments, as appropriate.

- b. Anchor bolts shall be spaced equally around the circumference of the reservoir. Anchor spacing shall not exceed 10-feet on-center.
- c. The anchor bolt embedment into the concrete foundation, the connection of the bolt anchor chair to the shell and the capacity of the reservoir shell to withstand concentrated loads imposed by bolt anchor chairs shall all be designed with strengths that exceed the ultimate tensile capacity of the bolts to ensure ductile yielding of the bolts.

1.08 RESERVOIR APPURTENANCES

- A. All reservoir appurtenances shall be designed and detailed by the CONTRACTOR in conformance to the dimensions and requirements shown on the Contract Drawings and specified herein.
- B. Exterior Reservoir Ladder: An outside reservoir ladder and safety cage, guardrails and handrails, conforming to State, OSHA and ANSI A14.3 requirements, shall be provided for access to the roof of the reservoir from the reservoir base elevation. Safety cage shall extend a minimum of 3'-6" above the top of the reservoir.
- C. Access Ports. One 36 inch circular mono-bolt manway shall be provided in the sidewall of the reservoir. Manway shall be gasketed and provide a watertight seal. Manway opening shall be structurally reinforced.
- D. Sidewall and Roof Piping Connections. Sidewall piping nozzles and other reservoir connections for instrumentation, and altitude valve sensing lines, shall be provided as shown on the Contract Drawings. Sidewall and roof penetrations shall be structurally reinforced where required.
- E. Reservoir Overflows. Each overflow shall be equipped with a steel weir box and the CONTRACTOR shall verify that the weir will be capable of discharging the specified overflow rate. Overflow piping shall be mounted on the inside of the reservoir as shown on the Contract Drawings. Each overflow weir box shall be watertight and shall be sloped to completely drain. Each weir box and overflow discharge pipe shall be structurally braced to the adjoining sidewall.
- F. Drains. One reservoir drain shall be provided as shown on the Contract Drawings.
- G. Cleanout is Required.
- H. Interior Observation Platform: See Contract Documents.
- I. Roof Access Hatches. Two access hatch shall be provided. The hatch cover shall be rainproof and hinged, and a hasp provided for a padlock. Provide brackets and appurtenances as required so that a switch which indicates when the hatch cover has been opened can be provided. A removable safety frame shall be provided as shown on the Contract Drawings. The roof access hatch shall be hot dipped galvanized after fabrication and painting is not required.
- J. Vent: A center turbo vent and circumferential roof vents shall be provided, see Contract Drawings.

- K. Roof Perimeter Guardrail. A steel guardrail shall be provided around the roof access hatches as shown on the Contract Drawings.
- L. Reservoir Fabricator's Nameplate. The CONTRACTOR shall provide a reservoir nameplate listing the reservoir fabricator, design standards, date of design and construction, reservoir volume, reservoir dimensions, and other relevant information. This nameplate shall be fabricated from stainless steel. If so shown on the Contract Drawings, the nameplate shall be mounted at the location shown, but not less than 48 inches above the reservoir floor elevation and shall be mounted on a stainless steel bracket.
- M. Aircraft Warning Lights: None Required.
- N. Interior and Exterior Painter's Rails: None Required.
- O. Electrical receptacles, conduit, wiring, light fixtures, and appurtenances shall be mounted to the reservoir in accordance with Contract Documents. Provide penetrations, brackets, supports, and appurtenances as required to allow electrical and instrumentation installation.

1.09 ACCESS TO WORK

- A. The CONTRACTOR shall provide access lighting, ventilation, safety material, etc., to allow the review of all aspects of the CONTRACTOR's work, including but not limited to welding and surface preparation. The CONTRACTOR shall provide adequate time for the review of the Work before proceeding with the next phase.

PART 2 - PRODUCTS

2.01 TREATED SAND

- A. Treated Sand: Treated sand for use under the reservoir shall consist of a mixture of clean, dry natural sand and slow-curing asphalt, combined in a mechanical mixer before delivery to the reservoir site. Approximately 15 gallons of liquid asphalt shall be added to each cubic yard of sand. The liquid asphalt shall be Type SC-70 conforming to Caltrans Standard Specifications Section 93. In-situ mixing of liquid asphalt and sand is not acceptable.

2.02 MISCELLANEOUS METALS

- A. Miscellaneous metals shall be provided in accordance with Contract Documents.

2.03 INSIDE PAINT

- A. The reservoir inside paint system shall be a two or three-coat epoxy-polyamide paint system. All paint system materials shall be suitable for potable water service and approved by the National Sanitation Foundation (NSF) for such use. They shall have been evaluated for long-term fresh water resistance, and the system shall have demonstrated satisfactory service in fresh water for at least 18 months. This paint system shall have been in use for a minimum of 5 years with demonstrated satisfactory results.

- B. Epoxy-polyamide paint shall be packaged in containers of suitable size so that full containers of each component are used in mixing the paint to the proper proportions. Each container shall be marked with the manufacturer's name, distinctive product name or number, color, and lot number. Successive coats shall be tinted so that they are readily distinguishable. The top coat shall be white, semi-gloss.
- C. The inside paint system shall be Tnemec Series 20 Pota-Pox or approved equal.

2.04 OUTSIDE PAINT

- A. The reservoir outside paint system shall be a two-coat polyamidoamine epoxy and polyester polyurethane paint system. This paint system shall have been in use for a minimum of 5 years with demonstrated satisfactory results.
- B. Both polyamidoamine epoxy and polyester polyurethane paint shall be packaged in containers of suitable size so that full containers of each component are used in mixing the paint to the proper proportions. Each container shall be marked with the manufacturer's name, distinctive product name or number, color, and lot number. The first coat shall be tinted to the color of the finish coat and shall be semi-gloss. The finish coat color shall be selected by the DISTRICT and shall be a custom color within the limitations of the paint system
- C. The outside paint system shall be Tnemec Series 69 Hi-Build Epoxoline II and Series P71 Endura-Shield or approved equal.

PART 3 - EXECUTION

3.01 PORTLAND CEMENT CONCRETE FOUNDATION

- A. The reservoir shall be supported on the Portland cement concrete foundation shown on the Drawings. A treated sand layer shall be spread, graded, and compacted to slope uniformly upwards to the center of the reservoir. The floor slope shall be 1/4 inch per foot radially. Minimum sand thickness shall be 3 inches except at the outer 12-inch perimeter of the reservoir.

3.02 PERIMETER SEAL

- A. A continuous perimeter seal of 1-inch thick general purpose nonshrink grout or 1/2 inch thick cane-fiber joint filler meeting the requirements of ASTM D1751 shall be provided between the top of the Portland cement concrete foundation and the underside of the reservoir perimeter steel plate in accordance with Section 12.6.1 of AWWA D100.

3.03 RESERVOIR TESTING

- A. The quality of field welding shall be determined in accordance with Section 11.2 of AWWA D100. Weld quality shall be determined by spot radiographs or test segments, or both, of the number and location set forth in Section 11. Tests of field welds shall be made without additional cost to the DISTRICT. At the option of the DISTRICT, the review of radiographs and additional spot radiographs may be taken by the ENGINEER. At the conclusion of field welding and radiographic testing, the CONTRACTOR shall

submit a written report in accordance with AWWA D100 Section 11.2.1. Radiographic film and any test segments shall become the property of the DISTRICT.

- B. After the reservoir floor has been completely welded and the bottom shell ring attached, all welded seams in the floor shall be tested by using a vacuum box and a strong soap or linseed oil solution. All leaks evident during this testing shall be repaired and retested.
- C. A watertightness test of the reservoir by filling and checking for leaks is not required after erection and prior to field painting. However, at the CONTRACTOR's option this test may be performed before field painting. Water used in this test must be dechlorinated prior to disposal. Further, any leaks discovered after the reservoir is filled shall be repaired by emptying the reservoir, cutting out the defective welds, rewelding, properly restoring and curing the coating system, repeating the entire reservoir disinfection and coating contaminant procedure, and refilling the reservoir at no additional cost to the DISTRICT.

3.04 SURFACE PREPARATION FOR PAINTING SYSTEMS

- A. All surfaces shall be dry when painted and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other detrimental substances. All steel surfaces shall be prepared for painting by blasting to clean the surface and develop the required surface profile. The specified wash or prime coat shall be applied to blasted surfaces immediately after cleaning. In every case, the prime coat shall be applied before visible rust appears. Surface preparation for painting shall conform to the following Steel Structures Painting Council Specifications:
 - 1. Interior surfaces: SSPC-SP10, Near White Blast Cleaning.
 - 2. Exterior surfaces: SSPC-SP6, Commercial Blast Cleaning.
- B. Surfaces of welds shall be scraped, chipped, and wire brushed as necessary to remove all slag and weld spatter. The use of chipping tools which produce cuts, burrs, or excessive roughness will not be acceptable. Paint which has been damaged by repair work or activities during construction shall be removed and the edges of undamaged paint feather-edged so that patches will not be noticeable. Repairs shall be conducted in accordance with the written instructions of the paint system manufacturer.
- C. All blasting operations, including the recovery, reuse, and disposal of blasting materials, shall be performed in accordance with local, state, and federal laws.
- D. Surface preparation shall meet the written requirements of the paint system manufacturer. A representative of the paint system manufacturer shall make a minimum of one site visit to inspect surface preparation prior to the first paint application. The Contract Administrator shall review the completed surface preparation prior to the first paint application.

3.05 INTERIOR AND EXTERIOR PAING SYSTEMS APPLICATION

- A. All painting shall be completed after reservoir erection with the following exception: Those surfaces of the interior roof framing, roof plates, and overflow discharge pipe interiors which will be inaccessible to painting once reservoir erection is complete shall be painted prior to erection.

- B. The inside of each overflow discharge pipe shall be given the same inside paint coating as the inside shell wall coating system.
- C. Painting shall be completed in accordance with the manufacturer's written instructions. Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn. Paint shall be factory mixed to proper consistency and viscosity for warm weather application without thinning unless approved by the Contract Administrator. Thinning will be permitted only as necessary to obtain the recommended coverage at lower application temperatures. The Contract Administrator shall be notified prior to all paint mixing and provided with the paint lot numbers, quantities, and thinners for recording batch numbers and characteristics. In no case shall the dry film thickness of applied paint be reduced, by the addition of thinner or otherwise, below the thickness recommended by the paint manufacturer.
- D. Paint materials shall be applied immediately after surface preparation, acceptance by Contract Administrator, and before any surface rusting occurs, or any dust or soil has accumulated. Priming shall be performed by brushing or spraying for the inside surfaces and by brushing, rolling, or spraying for the outside surfaces. Finish coats shall be painted by spraying on inside surfaces and by spraying and rolling on outside surfaces.
- E. Minimum dry film thicknesses:

Inside Paint System

Primer	5.0 dry film mils
Intermediate	5.0 dry film mils
<u>Finish</u>	<u>5.0 dry film mils</u>
Total	15.0 dry film mils

Outside Paint System

Primer	2.5 dry film mils
Intermediate	5.0 dry film mils
<u>Finish</u>	<u>2.5 dry film mils</u>
Total	10.0 dry film mils

- F. Reservoir landings shall be coated with a permanent non-slip material in conjunction with the exterior painting.
- G. Paint shall be applied in a neat manner, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be hard and dry through the entire film before the next coat is applied. Each coat shall be applied in a manner that will produce an even film of uniform and specified thickness. In no case shall paint be applied at a rate of coverage greater than the maximum rate recommended by the paint manufacturer. Paint showing sags, checks, blisters, teardrops, or fat edges will not be accepted and shall be entirely removed and the surface repainted.
- H. Paint shall not be applied, except when protected under shelter, during wet, damp, or foggy weather. Paint shall not be applied when windblown dust, dirt, debris, or insects will collect on freshly applied paint. Paint applied with spray equipment shall be protected, during application, from being deflected or carried away by wind. Paint shall not be applied at an air temperature below 40 degrees F; to surfaces of metals which have

a temperature below 40 degrees F, regardless of air temperature; or when metal temperature is less than 5 degrees F above the dewpoint or when atmospheric conditions cause condensation on the surface of the metal. Contract Administration shall verify temperature and humidity at the painting location.

- I. Care and work methods shall be instituted to prevent paint from being dropped, spilled, or windblown onto concrete, buildings, miscellaneous structures, cars, or other property. All surfaces so damaged shall be cleaned, repaired, replaced, or repainted to an undamaged condition.

3.06 PAINT FILM TESTING

- A. The Contract Administrator shall be allowed to verify the paint film thickness by measuring the wet film thickness of each coat as it is applied and the dry film thickness of each coat prior to application of the next coat. Additional coats shall be applied in order to obtain the minimum dry film thickness specified for the painting system.
- B. The CONTRACTOR shall be responsible for their own quality control which shall include measurement of wet film thickness using a gage that will measure the wet film thickness within an accuracy of plus or minus 0.5 mil. A wet film thickness measurement shall be made for each 100 square feet of surface painted.
- C. The dry film thickness shall be measured by the Contract Administrator in accordance with SSPC-PA2 with a magnetic gage that will measure the dry film thickness within an accuracy of ± 0.25 mil. Dry film thickness measurements shall be made so that there is approximately one measurement for each 100 square feet of surface painted. Complete re-rigging after the paint has dried for dry film thickness measurements is not required provided that 90 percent or more of the locations tested meet or exceed the minimum dry film thickness specified.
- D. The paint on all interior surfaces including the roof shall be tested by the CONTRACTOR with a wet sponge low voltage holiday detector after the paint has cured for at least 5 days. The sponge shall be kept saturated by an electrolyte (5 percent sodium chloride) and a surfactant (2 percent household detergent). During testing the wet sponge shall be kept in continuous contact with the painted surface. Locations where holidays are detected shall be marked for repair and retested after repairs are completed. The CONTRACTOR shall provide access or rigging for the Contract Administrator to verify holiday testing with independent equipment.
- E. A written test report shall be prepared by the CONTRACTOR and provide to the ENGINEER at the conclusion of the CONTRACTOR's dry film testing. This test report shall state the type of dry film testing gage used, the locations where tests were made, the dry film thickness at each location, and the name(s) of the person(s) making or witnessing the tests. This test report shall be certified by a representative of the Contractor who witnessed the testing.

3.07 RESERVOIR CLEANING AND DISINFECTION

- A. After all painting and appurtenance installation work is complete, the interior of the reservoir shall be cleaned and disinfected. A minimum of 4 weeks prior to the proposed start of reservoir disinfection work, the CONTRACTOR shall submit a detailed

disinfection plan. All procedures shall be acceptable to the ENGINEER. The inside coatings shall be completely cured before disinfection is initiated.

- B. The CONTRACTOR shall furnish all cleaning, filling, disinfection, dechlorination, and related labor, materials, equipment, and incidentals for the cleaning and disinfection operations.
- C. Disinfection shall be in accordance with Method 2 (Section 4.2) of AWWA C652. A water solution containing 200 milligrams per liter of chlorine shall be sprayed or brushed on all interior surfaces of the reservoir, including the inlet and outlet piping to the first valve. The disinfection solution shall be prepared by adding one ounce of calcium hypochlorite powder (70 percent available chlorine) or 4.5 liquid ounces of sodium hypochlorite solution (12.5 percent available chlorine) to each 26 gallons of disinfection solution water. The surfaces to be disinfected shall remain in contact with the disinfection solution for at least 30 minutes, after which time potable water shall be admitted to the reservoir. The reservoir shall then be filled to the primary overflow elevation. Filling may take several days depending upon the method of connection to the DISTRICT's water system.
- D. After the reservoir has been filled, water samples will be taken by the DISTRICT for bacteriological and aesthetic quality testing. At the CONTRACTOR's option, the CONTRACTOR may take samples of the water used to fill the reservoir and the water in the reservoir for bacteriological and aesthetic quality testing (for comparison with the DISTRICT's results). All testing shall be performed by a laboratory licensed by the State of California for the types of tests performed. Should any test prove the water to be of unacceptable bacteriological or aesthetic quality, the reservoir shall be completely drained and re-disinfected by the CONTRACTOR without additional cost to the DISTRICT

3.08 PAINT SYSTEM CONTAMINANT TEST

- A. Before the Reservoir is placed into service, the reservoir water shall be tested for organic chemical contaminants (e.g. TCE, PCE, etc.) that may leach from its interior paint system. Reservoir water sample test results shall show that the level of concentration of any organic contaminant shall not exceed the requirements of the California Department of Health Services before the reservoir is placed into service.
- B. The following testing procedure shall be followed:
 - 1. The disinfection process is completed after the inside coating is cured.
 - 2. The reservoir is filled to the primary overflow elevation and is allowed to soak for a minimum of 7 days.
 - 3. After a minimum of 7 days, a water sample shall be taken and sent to a laboratory for testing to determine the presence of any leached volatile organic chemicals. The laboratory shall be licensed by the State of California for such tests. This testing is part of the Work.
 - 4. A report of each test result shall be sent to the ENGINEER and the California Department of Health Services.
 - 5. The Department of Health Services and the DISTRICT must approve the test results before the Recycled Water Storage Reservoir can be placed into service.

- C. Should the test results show unacceptable levels of any volatile organic chemical, the reservoir shall be dechlorinated, drained, the source of contamination remedied, disinfected, filled, and retested by the CONTRACTOR at no additional cost to the DISTRICT.

3.09 FIRST ANNIVERSARY INSPECTION

- A. The inside and outside surfaces of the reservoir shall be inspected by representatives of the DISTRICT and Contractor during a period of 12-16 months (DISTRICT operating requirements permit) after the reservoir was placed into service. The purpose of this inspection is to determine the condition of the paint systems and to determine if any repair work is necessary.
- B. The DISTRICT shall establish the date for the inspection and shall notify the CONTRACTOR at least 30 days in advance. If an inspection date has not been established within 16 months of the date the reservoir was placed into service, the first anniversary inspection shall be considered to be waived by the DISTRICT.
- C. The DISTRICT shall drain the reservoir and shall provide the necessary personal equipment (for confined space entry) for DISTRICT personnel to enter the reservoir. The CONTRACTOR shall provide suitable interior inspection lighting and ventilation. The CONTRACTOR shall also provide personal equipment (for confined space entry) for Contractor's personnel.
- D. Any location where coats of paint have peeled off, bubbled, or cracked, and any location where rusting is evident shall be considered to be a failure of the paint system. The CONTRACTOR shall make repairs at all points where failures are observed by removing the deteriorated coating, cleaning the surface, and recoating with the same paint system in accordance with the manufacturer's instructions. If within any designated area, the combined area of the failures as defined above exceeds 25 percent of the designated area, then for that area, the entire paint system shall be removed and repainted. For purposes of determining the need for complete repainting, the inside roof, shell, and floor shall each be considered separately.
- E. The CONTRACTOR shall prepare and deliver to the DISTRICT a written inspection report covering the first anniversary inspection, setting forth the number and type of failures observed, the percentage of the surface area where failure has occurred, and the names of the persons making the inspection. Color photographs illustrating the type of each failure and their location within the reservoir shall be included in the report.

END OF SECTION

SECTION 33 31 11

PVC GRAVITY SEWER PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation of polyvinyl chloride (PVC) gravity sewer pipe and fittings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Trenching, Backfilling and Compacting 31 23 00
- B. Cast-in-Place Concrete: 03 30 00
- C. Precast Concrete Manholes: 33 05 13
- D. Leakage and Infiltration Testing 33 05 05.33

1.03 SUBMITTALS

- A. Provide materials list showing material of pipe and fittings with ASTM references and grade.
- B. Provide certificates of compliance with all standards referenced in this section.

1.04 APPLICATION

- A. PVC SDR 26 shall be used for gravity sewer mains up to and including 27-inch in diameter, except as specifically called out on the project plans.

PART 2 - MATERIALS

2.01 PIPE AND FITTINGS

- A. ASTM Requirements: Pipe, fittings, couplings, and joints shall be in conformance with the size, material and performance requirements of ASTM D 3034, for SDR 35 and SDR 26 pipes, for pipes up to 15-inch, and the requirements of ASTM F679 (PS115) for pipes 18-inch through 27-inch.
 - 1. Pipes shall have gasketed joints.
 - 2. Pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13364-B as defined in ASTM D 1784.
 - 3. Fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13343-C.
 - 4. All pipe shall be of solid wall construction with smooth interior and exterior surfaces.

- B. **Manufacturer's Testing Certification:** During production of the pipe, the manufacturer shall perform the specified tests for each pipe marking. A certification by the manufacturer indicating compliance with specification requirements shall be delivered with the pipe. The certification shall include the test result data.
- C. **Pipe Marking:** All pipe, fittings, and couplings shall be clearly marked at an interval not to exceed 5-feet as follows:
 - 1. Nominal pipe diameter
 - 2. PVC cell classification
 - 3. Company, plant, shift, ASTM, SDR, and date designation
 - 4. Service designation or legend
- D. For fittings and couplings, the SDR designation is not required. All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.
- E. **Pipe Retest:** Pipe which is not installed within 120 days of the latest test shall not be used without prior approval of the Engineer.
- F. **Fitting and Coupling End Configurations:** The socket and spigot configurations for fittings and couplings shall be compatible with those used for the pipe.
- G. **Approved Pipe Manufacturers:**
 - 1. J-M Manufacturing Ring-Tite,
 - 2. Vinyltech,
 - 3. P W Pipe,
 - 4. Diamond Plastics,
 - 5. Carlon,
 - 6. Or approved equal.
- H. **Approved fittings manufacturers:**
 - 1. J-M Manufacturing,
 - 2. GPK Products,
 - 3. Or approved equal.

2.02 GASKETS FOR PVC PIPE

- A. **General:** Unless otherwise specified, gaskets shall be manufactured from a synthetic elastomer, and shall be extruded or molded and cured in such a manner as to be dense, homogeneous and of smooth surface, free of pitting, blisters, porosity, and other imperfections. The compound shall contain not less than 50 percent by volume of first-grade synthetic rubber. The remainder of the compound shall consist of pulverized fillers free of rubber substitutes, reclaimed rubber, and deleterious substances. The tolerance for any diameter measured at any cross section shall be $\pm 1/32$ -inch (.8mm).
- B. **Gasket Material Requirements:** When required by the Engineer, the contractor shall furnish test samples of gaskets from each batch used in the work. Gasket material shall meet the following requirements:

Property	Value	ASTM Test Method
Tensile Strength (min. psi)	2,000	D 412
Elongation at break (% min.)	350	D 412
Shore durometer, Type A (Pipe manufacturer shall select value suitable for type of joint)	40 to 65*	D 2240
Compression set (constant deflection) max % of original deflection	16	D 395
Compression strength after oven aging (96 hours, 158°F {70°C}) % of tensile strength before aging	80	D 573
Increase in Shore durometer hardness after oven aging. Maximum increase over original Shore durometer	10	D 2240
Physical requirements after exposure to ozone concentration (150 pphm. 70 hours, 140°F {40°C}), 20% strain)	No Cracks	D 1149

*This applies only to the sealing component of the gasket.

- C. Splices: No more than one splice will be permitted in a gasket. A splice shall be made by applying a suitable cement to the ends and vulcanizing the splice in a full mold. The splice shall show no separation when subjected to the following tests:
1. Elongation Test: The part of the gasket which includes the splice shall withstand 100% elongation with no visible separation of the splice. While in the stretched position, the gasket shall be rotated in the spliced area minimum of 180 degrees in each direction in order to inspect for separation.
 2. Bend Test: The portion of the unstretched gasket containing the splice shall be wrapped a minimum of 180 degrees and a maximum of 270 degrees around a rod of a diameter equal to the cross section diameter of the gasket.

PART 3 - EXECUTION

3.01 DELIVERY AND TEMPORARY STORAGE OF PIPE AT SITE

- A. Onsite Storage Limitation: Onsite pipe storage shall be limited to a maximum of one week, unless an exception is approved by Owner.
- B. Care of Pipe: At times when the pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hours as well as overnight. In no event shall the sewers be used as drains for removing water which has infiltrated into the construction trenches.

3.02 HANDLING OF PIPE

- A. Moving Pipe: Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.

- B. Inspection Pipe: The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

3.03 PLACEMENT OF PIPE IN TRENCH

- A. General: All pipe shall be laid without a break, upgrade from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the line and grade given so as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line.
- B. Trench Excavation: Dewatering, excavation, shoring, sheeting, bracing, backfill material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with Section 31 23 00, Trenching, Backfilling, and Compacting.
- C. Pipe Bedding: Unless shown otherwise on the drawings, pipe bedding material shall be imported sand or 3/4-inch crushed rock specified in Section 31 23 00.
- D. Subgrade at Joints: At each joint in the pipe, the pipe subgrade shall be recessed in firm bedding material so as to relieve the bell of the pipe of all loads and to ensure continuous bearing along the pipe barrel.
- E. Cleaning: The interior of the sewer pipe shall be cleaned of all dirt and superfluous materials as the work progresses.
- F. Joints: The mating surfaces of the pipe to be joined shall be wiped clean of all dirt and foreign matter and a lubricant applied that is approved by the pipe manufacturer. Then, with the surfaces properly lubricated, the spigot end of the pipe shall be positioned inside the bell and the joint shoved home.
- G. For larger diameter pipe where a lever attachment is required, the necessary precautions shall be taken to insure an undamaged pipe installation.
- H. Pipe Alignment: Unless specified otherwise, pipeline line and grade shall be as shown on the plans. Grade shall be measured along the pipe invert.
- I. PVC Pipe Curvature: Construction of curved reaches of PVC pipe shall not be accomplished by deflecting joints or by beveling pipe ends. Bending of PVC pipe to achieve vertical or horizontal curves without using deflection fittings shall be limited as follows:

<u>Diameter (Inches)</u>	<u>Minimum Radius (Feet)</u>
6	210
8	280
10	350
12	420

- J. Laterals: PVC wyes and other types of branches shall be furnished and installed along with the PVC sewer. Wyes sized as specified on the plans shall be installed for all sewer

house connections and for future sewer house connections as shown on the plans. The longitudinal barrel of branch fittings, to be placed in line and grade with the sewer mains, shall be of the same diameter, quality, and type as specified herein for sewer installations. Earthwork and bedding for branches and shall conform to the applicable provisions set forth in the specification for each pipe material. The branch of wye fittings shall be inclined upward at an angle not greater than 45 degrees from a horizontal line for sewer lines up to ten feet deep, and no more than 60 degrees for sewers deeper than 10 feet. No wye for sewer house connection branch shall be placed closer than 5 feet downstream of the centerline of any structure. The contractor shall place a support of graded crushed rock or imported sand under every wye branch when installed. The support shall be placed in accordance with the detail on the plans or as specified in Section 31 23 00, Trenching, Backfilling, and Compacting.

- K. Backfill: Backfill shall be placed and compacted in accordance with the requirements of Section 31 23 00. Backfill within the pipe zone shall be imported sand or clean native sand.

3.04 SADDLE CONNECTIONS

- A. General: All saddle connections of new laterals into existing sewer lines shall be made with a wye saddle.
- B. Scoring and Tapping: The sewer line to be saddled shall be scored to the approximate shape of wye or tee and shall be cut with a hole cutter. The tap holes shall be cleanly machined and may be further worked by hand to provide a true and neat opening for the collar wye or tee saddle. Pipe damaged during this operation shall be repaired or replaced. The Engineer shall be the sole judge as to the method of repair or replacement.
- C. Securement: The collar wye shall be secured to the sewer main with a catalytic epoxy resin. The saddle shall be tied to the main with wire of sufficient strength that no movement will occur during the setting of the epoxy resin.
- D. Encasement: After the connection has set sufficiently long for the epoxy resin to cure, the Engineer will inspect the connection and, if satisfactory, the contractor shall encase the fitting with Class B Portland cement concrete.
- E. Cleaning: The saddling operation shall be carried out in a workmanlike manner. Chips, dirt, epoxy mortar, and concrete shall be kept out of the sewer line being saddled. If directed by the Engineer, the reach of sewer main saddled shall be flushed and cleaned using a hydrocleaner or vacuum truck.
- F. Alternative Connection: In lieu of a saddle connection, a wye connection may be made by cutting the sewer and installing a wye.

3.05 CONCRETE ENCASEMENT

- A. Unless shown otherwise, concrete for encasement shall be reinforced or unformed or rough formed, and of the class as designated on the plans. Concrete shall be in accordance with Section 03 30 00, Concrete. Concrete used for encasing, cradling, bedding, cover for pipe, or other objects shall be used as shown on the Plans.

3.06 CLEANING

- A. Before testing, each pipe shall be thoroughly cleaned from manhole to manhole with a sewer scrubbing ball, and all debris and trash shall be removed from each manhole.

3.07 MANDREL TEST FOR PVC GRAVITY SEWERS 10-INCH IN DIAMETER AND SMALLER

- A. Following placement and compaction of backfill for all utilities, and prior to the placement of permanent pavement, all sewer mains shall be cleaned and mandrelled to verify that the pipeline is free from obstructions (deflections, joint offsets, lateral pipe intrusions, etc.).
- B. The Contractor shall pull a mandrel through each segment of installed sewer main to test the amount of deflection incurred during installation. The Engineer shall observe mandrel testing. The Contractor shall give at least a five (5) working-day notice to the Engineer before commencing mandrel testing.
- C. Mandrels shall be full circle, solid or rigid odd numbered (nine leg minimum) steel cylinders with pulling rings at each end and approved by the Engineer. The circular cross section of the mandrel shall have a diameter no smaller than ninety-five percent (95%) of the average inside diameter of the pipeline being tested. The length of the mandrel shall be no less than two times the full cross section diameter. A separate pull line shall be attached to each pull ring to facilitate removal of the mandrel if an obstruction is encountered.
- D. Mandrels shall be pulled through the pipeline by hand without the aid of mechanical pulling devices. Any deficiencies found by mandrel testing shall be corrected by the Contractor, at the Contractor's expense. Deficiencies shall be repaired by excavating the pipe at least to the pipe spring line. Pipe bedding and backfill shall be re-compacted after the repair. Internal rounding or vibration to correct deflection shall not be permitted. After repair and re-compaction of the pipe bedding and trench backfill material, the pipe shall be retested using the mandrel. Any pipe failing two mandrel tests shall be replaced.

3.08 LEAKAGE AND INFILTRATION TEST

- A. The pipe, manholes, and other appurtenances shall be tested for leakage and infiltration per Section 33 05 05.33, Leakage and Infiltration Testing.

3.09 CLOSED-CIRCUIT TELEVISION INSPECTION

- A. General: In addition to the regular leakage and infiltration test, the entire length of all new sewer lines shall be inspected by the contractor using closed-circuit television equipment. The inspection shall be conducted after the line has been successfully tested and prior to paving. The inspection shall be conducted in the presence of the Owner's inspector. For pipe lengths designed to absolute minimum design slopes (See Section 500-2 of the Procedural Guidelines), video inspection shall provide a profile of the sewer line.
- B. Responsibility: All labor and equipment necessary to conduct this inspection shall be furnished by the contractor.

- C. Notification: Requests for sewer line inspection shall be made to the Engineer a minimum of two working days in advance of the requested inspection date.
- D. Flushing: Each sewer section shall be flushed with water being introduced at the upstream manhole of each section prior to video recording.
- E. Stationing: The video shall show stationing corresponding to sewer stationing shown on plans for each manholes and Wye location.
- F. Submittal: The video shall be DVD format and be submitted to the Owner with two (2) of the computer printouts showing manhole numbers and stationing, wye stationing and distance between manholes prior to occupancy release for the dwelling units being served by the sewer. The tape and printout shall be labeled with the project name, tract number, street names, and contractor's name and shall list the station of any defects, dirt, low spots, etc. in the pipe.
- G. Repair of Defects: Even though the sewer line may have successfully passed the leakage and infiltration tests, any defects or low spots in the line shall be repaired to the satisfaction of the Engineer.
- H. Acceptance: Sewer section having standing water or defects shall be repaired by the contractor prior to Owner acceptance and prior to occupancy release for the dwelling units or commercial site being served by the sewer. Standing water in the system will not be allowed.

3.10 FINAL INSPECTION

- A. After paving has been completed and all manholes raised to grade, a final visual inspection shall be made. The necessary labor shall be furnished to assist the Owner's inspector in making the final inspection. Additional balling may be required if the lines are dirty, even though lines were previously balled. The contractor shall furnish a responsible person or supervisor for the final inspection to remove manhole covers and to note any corrections required by the Engineer in order to obtain final approval. Final Owner inspection shall be requested through the Engineer by giving at least two days' notice.

END OF SECTION

SECTION 33 31 13

HDPE SANITARY SEWER PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation of high-density polyethylene (HDPE) gravity sewer pipe and fittings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Trenching, Backfilling and Compacting 31 23 00
- B. Precast Concrete Manholes: 33 05 13
- C. Leakage and Infiltration Testing 33 05 05.33

1.03 REFERENCED CODES AND STANDARDS

- A. American Water Works Association (AWWA), latest edition:
 - 1. C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 inches (100 mm) through 63 inches (1575 mm) for Water Distribution and Transmission
 - 2. M55 – Manual of Water Supply Practices, PE Pipe Design and Installation.
- B. American Society of Testing and Materials (ASTM), latest edition:
 - 1. D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing.
 - 2. D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Pipe.
 - 3. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings.
 - 4. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Material.
 - 5. D4976 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
 - 6. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - 7. F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
 - 8. F2206 – Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock.
 - 9. F2620 – Standard practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
- C. Plastics Pipe Institute (PPI):
 - 1. PPI Handbook of Polyethylene Pipe – 2009 (2nd Edition).
 - 2. TR-33 – Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe.

3. TN-42 – Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects.

1.04 SUBMITTALS

1. Submit manufacturers product data per the requirements of Section 01 30 00.
2. Submit certification and/or training records demonstrating that the pipe fusing personnel have been trained to install the product(s) provided.

1.05 QUALITY ASSURANCE

- A. Factory Testing: Conduct factory testing on HDPE pipe in accordance with the requirements of AWWA C906, with the frequency on production runs as stated therein.
 1. Deliver, with the pipe, a certificate by the manufacturer indicating compliance with the specification requirements.
- B. Perform polyethylene (PE) pipe jointing employing only personnel trained in the use of butt-fusion equipment, electrofusion equipment (if required to perform the Work) and recommended methods for new pipe connections. Ensure personnel directly involved with installing the new pipe receive training in the proper methods for handling and installing the PE pipe. Conduct training employing qualified representatives of the polyethylene pipe manufacturer.

1.06 WARRANTY

- A. Warrant that the equipment used in this Work, where covered by patents or license agreements, is furnished in accordance with such agreements and that all applicable royalties and fees applicable to such license agreements have been included in the bid price given for this Work. No additional payment shall be awarded for such costs submitted after receipt of the bids.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, and store pipe and fittings as recommended by the manufacturer. Handle pipe in accordance with PPI “Handbook of Polyethylene Pipe, Chapter 2” using approved strapping and equipment rated for the loads encountered. Do not use chains, wire rope, forklifts or other methods or equipment that may gouge or damage the pipe or endanger persons or property. Conduct field storage in compliance with AWWA Manual of Practice M55, Chapter 7.
- B. If new pipe and fittings become damaged before or during installation, make repairs as recommended by the manufacturer, or, where directed by the Owner, replace the damaged materials at no additional expense to the Owner before proceeding with the Work.
 1. If any gouges, scrapes, or other damage to the pipe results in loss of 10% of the pipe wall thickness at any point, cut out and remove that length containing the damage or do not use that that piece of pipe.
- C. Deliver, store and handle other materials as required to prevent damage.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. High-density polyethylene (HDPE) plastic pipe and fittings meeting the applicable requirements of AWWA C906, ASTM F714 PE plastic pipe (SDR-PR), ASTM D4976 and ASTM D3350.
 - 1. Provide polyethylene pipe made of HDPE material having a material designation of PE 4710.
 - 2. HDPE material shall have a minimum cell classification of PE445474C/E.
 - 3. The minimum wall thickness of the HDPE pipe and fittings to be used shall meet the requirements for DR 17, unless indicated otherwise on the Drawings.
 - 4. Pipes shall be Iron Pipe Size (IPS) unless indicated otherwise on the drawings.
- B. Provide pipe sizes as indicated on the Drawings.
- C. Provide only pipe and fittings made of virgin material. No rework, except that obtained from the manufacturer's own production of the same formulation, shall be permitted. Use only resin compounds in the manufacture of HDPE pipe in accordance with the requirements of ASTM D3350.
- D. Furnish pipe and fittings that are homogenous throughout and free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
- E. Material color shall be black with green stripe indicating sanitary sewer.
- F. Fittings: Provide fittings, where and if required, conforming to the requirements specified below and fabricated in the pipe manufacturer's factory or other approved manufacturer of high-density polyethylene fittings (elbows and laterals). Remove the interior joint beads in the finished fittings prior to shipment by grinding or cutting to produce a smooth interior surface (maximum 1/16-inch protrusion, with no rough or jagged edges or undercuts). Provide elbows, where required, of the long radius design. Lateral fittings may use fiberglass wrap to provide the necessary reinforcement.
 - 1. Butt Fusion Fittings: Make fittings from HDPE material having a minimum material designation code of PE 3608, with a minimum cell classification as noted in Paragraph 2.01A above. Provide butt fusion fittings meeting the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified or shown on the Drawings.
 - a. Provide markings on molded fittings in compliance with the requirements of ASTM D3261.
 - b. Mark fabricated fittings in accordance with ASTM F2206.
 - c. Socket fittings shall meet ASTM D2683.
 - 2. Electrofusion Fittings: Make fittings from HDPE material having a minimum material designation code of PE 3608, with a minimum cell classification as noted in Paragraph 2.01A above.
 - a. Electrofusion fittings shall have a manufacturing standard of ASTM F1055.
 - 3. Fittings shall have a pressure rating equal to the pipe unless otherwise specified or shown on the Drawings.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

- A. Install pipe and fittings in strict accordance with the manufacturer's recommendations and instructions, the requirements of ASTM D2321, the requirements as specified in Section 33 11 00, "General Piping Requirements" of these Technical specifications and as further specified below.
- B. Pipe Laying: Carefully inspect all pipes for defects before placing in the trench, or in the bore hole in the case of horizontal directional drilling. Avoid abrasion or scratching of the pipe exterior surface during installation. Unless otherwise required, lay all pipes straight between changes in grade.
- C. Cutting Pipe: Whenever a standard pipe length requires cutting to fit into the line, provide for a lateral connection or to bring it to the required location, perform work in accordance with the manufacturer's instructions so as to leave a smooth, square end. Where a plain end to plain end joint occurs as a result of cutting into the pipe, install an electrofusion coupling to join the pipe sections
- D. Joint Construction: Comply with the requirements in Paragraph 3.02 below.
- E. Service Laterals: All service laterals shall be tapped into the main using a wye saddle welded onto the pipe.

3.02 PIPE JOINING

- A. Assemble and join the polyethylene pipe at the site using the butt-fusion method to provide a leak-proof joint. Threaded or solvent-cement joints and connections are not permitted. Employ and operate equipment and follow procedures for joining pipe in strict compliance with the manufacturer's recommendations and in accordance with ASTM F2620 or PPI TR-33. Use only personnel certified as fusion technicians per PPI TN-42 by a manufacturer of polyethylene pipe and/or fusing equipment to make the joints.
- B. Make butt-fused joints that are in true alignment and have uniform interior and exterior rollback beads resulting from the use of proper temperature and pressure. Allow the joint adequate cooling time before removal of pressure from the fusion machine. Provide a completed fused joint that is watertight and has tensile strength equal to that of the pipe. Prior to making the subsequent joint, grind the interior joint beads smooth (maximum 1/16-inch protrusion, with no rough or jagged edges or installation of pipe).
- C. Cut out defective joints and replace at no additional cost to the Owner. Do not use any section of HDPE pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10 percent of the wall thickness. Remove defective pipe from the site. However, a defective area of the pipe may be cut out and the resulting section ends fusion jointed in accordance with the procedures stated above. In addition, discard and remove from the site any section of the pipe having other defects, such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing or handling as determined by the Owner.

- D. Where terminal sections of pipe are joined within the pipe trench, or at the ends of directionally drilled pipe, make the connection using electrofusion couplings or connectors as manufactured by Central Plastics Electrofusion, or equal and as specified below. Provide couplings or connectors having tensile strength equivalent to or greater than that of the pipe being joined.
- E. Where the new HDPE pipe is to be joined to buried pressure flow pipe, make the connection using a restrained end transition coupling. Verify the outside diameter of the existing or adjoining pipe prior to commencing work on the respective section.
- F. Where fittings, including laterals, are shown on the Drawings as a required part of the installed adjoining pipeline, field join the fittings to the already installed adjoining sections of HDPE pipe using an appropriate fusion machine designed for in-trench joining, or by means of electro fusion couplings as specified above. Prior to making the closing field joint on a fitting installation, grind or cut the interior beads resulting from preceding field made joints on the fitting to the standard specified above.
- G. Electrofusion: Perform electrofusion joining in accordance with the manufacturer's recommended procedure. Other acceptable electrofusion joining shall be as described in ASTM F1290 and PPI TN-34.
 - 1. The process of electrofusion requires an electric source, a transformer (commonly called an electrofusion box) that has wire leads, a method to read electronically by laser or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used.
 - 2. The electrofusion box shall be capable of reading and storing the input parameters and the fusion results for later download to a record file that is to be submitted to the owner for his records.
 - 3. Demonstrate qualification of the fusion technician by submitting documentation of his/her electrofusion training within the past year on the same equipment proposed to be utilized for this Work.

3.03 DAMAGED PIPE

- A. Reject and remove from the job site pipes having cracks, splits, pipe curvature exceeding the offset specified hereinabove or scratches which, in the judgment of the Owner, affect the pipe strength. Repair damaged HDPE pipe as described in Paragraph 3.02 above.

3.04 TRENCHING, BACKFILLING, AND COMPACTING

- A. Trenching, backfilling, and compacting shall be in accordance with Section 31 23 00 and as shown on the Drawings.
- B. Backfill within the pipe zone, including the pipe base, shall be imported or clean native sand placed and compacted in accordance with Section 31 23 00.
- C. Backfill within the trench zone shall be clean native material placed and compacted in accordance with Section 31 23 00.

3.05 PLACEMENT OF PIPE IN TRENCH

- A. Lay pipes uphill if the grade exceeds 10%.

- B. The radius of curvature of the trench shall determine the maximum length of pipe section that can be used without exceeding the allowable deflection at a joint. Combined deflections at rubber gasket, restrained joint, deflection coupling or flexible coupling joints shall not exceed 2 degrees or that recommended by the manufacturer, if smaller.
- C. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various length and the deflection couplings shall be followed if applicable.
- D. The pipe shall be laid true to the line and grade shown on the plans.

3.06 CLEANING

- A. Before testing, each pipe shall be thoroughly cleaned from manhole to manhole with a sewer scrubbing ball, and all debris and trash shall be removed from each manhole.

3.07 LEAKAGE AND INFILTRATION TEST

- A. The pipe, manholes, and other appurtenances shall be tested for leakage and infiltration per Section 33 05 05.33, Leakage and Infiltration Testing.

3.08 FINAL INSPECTION

- A. After paving has been completed and all manholes raised to grade, a final visual inspection shall be made. The necessary labor shall be furnished to assist the Owner's inspector in making the final inspection. Additional balling may be required if the lines are dirty, even though lines were previously balled. The Contractor shall furnish a responsible person or supervisor for the final inspection to remove manhole covers and to note any corrections required by the Engineer in order to obtain final approval. Final Owner inspection shall be requested through the Engineer by giving at least two days' notice.
- B. Correct, at the direction of the Owner, damaged pipe and all other conditions not conforming to the requirements of these Specifications found as a result of this inspection. Similarly, remove obstructions and foreign material found in pipe. Perform corrections and removals as required at no additional expense to the Owner. Where, in the opinion of the Owner, major corrective work or replacement is required, re-perform leakage test on the corrected or replaced section of pipe main.

END OF SECTION

SECTION 33 41 13

HDPE STORM DRAIN PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes materials, fabrication, installation, and testing of High Density Polyethylene Pipe (HDPE) drain piping for use in gravity-flow drainage applications, as shown on the contract drawings and contained in this specification.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials
 - 1. M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe
 - 2. M294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
- B. American Society for Testing and Materials (ASTM):
 - 1. D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 2. D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - 3. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - 4. F2306 - Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

1.03 PROJECT CONDITIONS

- A. Take field measurements to determine the exact lengths and dimensions of the materials needed.
- B. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
- C. Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.

1.04 SUBMITTALS

- A. Material List:
 - 1. Submit a complete material list prior to performing any work. The material list shall include the manufacturer, model number and description of all materials and equipment to be used.
 - 2. Equipment or materials installed or furnished without prior acceptance may be rejected and if so shall be removed from the site by the Contractor.

B. Record Drawings:

1. Dimension from two permanent points of reference, such as building corners, the location of the connection to the existing basin, and routing of the drain line.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping materials from sunlight, scoring and distortion.
- B. Do not allow surface temperatures on pipe and fittings to exceed 120 degrees Fahrenheit.
- C. Store and handle pipe and fittings as recommended by manufacturer in published instructions.

PART 2 - PRODUCTS

2.01 PIPE

- A. HDPE Storm Drain Pipe shall have a smooth interior and annular exterior corrugations.
 1. 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S or SP.
 2. 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or SP, or ASTM F2306.
 3. Manufacturer: ADS N-12 Watertight Pipe, or approved equal.

2.02 JOINT PERFORMANCE

- A. Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be soil-tight and gaskets for diameters 12- through 60-inch, shall meet the requirements of ASTM F477. For diameters 4- through 10-inch, the joint shall be soil-tight using an engaging dimple connection. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

2.03 FITTINGS

- A. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

2.04 MATERIAL PROPERTIES

- A. Material for pipe and fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively.

PART 3 - EXECUTION

3.01 GENERAL

- A. HDPE pipe shall be installed in conformance with all applicable local and state codes and ordinances. The methods employed in the handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fittings, or equipment, repairs satisfactory to the District shall be made at no additional cost to the District.
- B. Follow manufacturer's directions except as shown or specified.

3.02 INSPECTION

- A. Exercise extreme care in excavating and working near completed work. Contractor shall be responsible for damages to facilities which are caused by his operations or neglect.
- B. Coordinate installation of HDPE pipe, so there shall be no interference with utilities, structural slabs and walls, paving, etc.

3.03 PREPARATION

- A. Prior to installation, stake out the pipe routing.
- B. Coordinate pipe installation work with the installation of other improvements, including structural, electrical, and mechanical work.

3.04 PROTECTION

- A. The Contractor shall provide adequate protection for all work until completion and final acceptance. Contractor shall take particular precautions to protect: existing structures and equipment, and improvements made under this contract. All damaged, stained or disturbed items shall be replaced at the expense of the Contractor, prior to final acceptance.
- B. The Contractor shall be responsible for damages to the grounds, walks, roads, buildings, piping systems, electrical systems and their equipment and contents caused by leaks in the drain systems being installed or having been installed by him. He shall repair at his own expense all damage so caused, to match existing undamaged work. All repair work shall be done as approved by the Engineer.
- C. During loading, transportation and unloading of pipe, every precaution shall be taken to prevent pipeline damage. Any damaged pipe shall be replaced or repaired to the satisfaction of the District. Where pipe is placed in stockpiles, it shall be neatly piled and blocked with strips between tiers.

3.05 CONNECTIONS

- A. Thoroughly clean pipe and fittings of dirt, dust and moisture before installation. Installation and joining methods shall be as recommended by the pipe and fitting manufacturers.

3.06 TESTING

- A. Demonstrate leak free installations per Section 33 05 05.33.

END OF SECTION

SECTION 40 61 00

PROCESS INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. A single Process Control System Integrator (PCSI) shall furnish all equipment, installation, testing, and startup services for Project. Work shall include providing facility controls hardware, establishing local communication networks, establishing remote communication networks, and providing project field instrumentation as specified herein.
- B. The SCADA System Programmer (SSP) shall be responsible for all SCADA system programming required for the addition and integration of the new facilities into the District's existing SCADA control system including all programming of the Project remote and central SCADA components. Work shall include all system programming of local controllers, local Operator Interface Panels (OIT), wireless and wired network devices, and central SCADA Human Machine Interface (HMI). Work shall also include coordinating with the PCSI to establish local communication networks, establish remote communication networks, and testing, startup, and system configuration services as specified herein.
- C. The Contractor shall retain the services of Colcon Systems Inc for the implementation of all SCADA system programming to act as the SSP for this Project. SSP Programming shall include configuration of central station HMI, establishing communications links, all new and modified PAC, and OITs.

Calcon Systems Inc
12929 Alcosta Blvd, Suite 9
San Ramon, California 94583
(925)-277-0665
Attention: Ryan Smith
rsmith@calcon.com

- D. Work performed by the SSP shall be provided under a control system programming allowance line item as defined in the Project Bid Form, Section 00 41 00.
- E. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- F. PCSI shall provide field instrumentation, Process Automation Controller (PAC), OIT hardware, control panels, and communication and network equipment hardware and software fully installed, configured, tested, commissioned, and documented for a fully functional process control system as specified and shown on the Contract Documents.
- G. SSP shall provide programming for PAC platforms, HMI platforms, OIT devices, wired and wireless communication and network equipment fully configured, programmed,

tested, commissioned, and documented for a fully functional process control system as specified and shown on the Contract Documents.

- H. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with the Contract Documents, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the District.
- I. New panels shall be fabricated and tested at a suitable UL 508 facility or equivalent, shipped and installed at the site. Modified panels shall be modified in-place as shown on the Contract Documents. Installation and modifications shall be coordinated with District operations.

1.02 SCOPE OF WORK

- A. General: Includes but is not limited to providing labor, hardware, software, licenses, cabinet and panel assemblies, equipment supports, instrumentation, wiring and specialty cables, tools, documentation and testing as required to control and operate the following facilities:
 - 1. Reservoir A1/A2, Zones B/C Booster Pump Station (BPS)
 - a. Provide field instrumentation
 - b. Provide new PAC based control panel complete with PAC hardware, configured control logic, network equipment for wired local area network (LAN) and radio based Wide Area Network (WAN) communication
 - c. Provide local configuration of BPS OIT
 - d. Provide antenna and install on Reservoir
 - e. Provide radio communications between Reservoir A1/A2 and BPS to District central SCADA located at District Headquarters. Communication link shall be routed via existing store and forward site at Reservoir 2
 - f. Provide power over Ethernet switches or equipment in BPS control panel and integrate local CCTV monitoring as specified under Section 28 21 00
 - 2. F-Booster Pump Station/Chlorination Building/Intermediate Reservoir Modifications:
 - a. Provide field instrumentation
 - b. Provide new control panel in F-Booster Pump Station for monitoring and control of new dosing pumps (3) in Chlorination Building
 - c. Modify existing PAC at F-Booster PS to forward chlorination system status and alarms to SCADA central
 - d. Provide PAC programming modifications for new altitude valve control at the Intermediate Reservoir
 - 3. Reservoir 2/Marina Booster Pump Station
 - a. Provide new antenna and install on rail guard on Reservoir 2.
 - b. Modify site configuration to support Reservoir 2 as a store and forward site for communications between BPS, remote well sites, and central SCADA as shown on the Drawings.
 - 4. SCADA Central at District Headquarters
 - a. Provide new communication equipment and integrate data streams into the existing District Broadband radio communications link
 - b. Provide HMI programming and graphical development to integrate new and modified process facilities into the existing District's SCADA system HMI
 - c. Coordinate with CCTV remote monitoring workstation as specified under Section 28 21 00

- B. The work under the PCSI shall include the following:
1. All materials, equipment, labor, and services required to achieve a fully integrated and operational system. Design and coordinate the instrument and process control system for proper operation with related equipment and materials provided under this section of specification and related existing equipment.
 2. All field instrumentation, sensors, analyzers, and devices as shown and as specified for monitoring and control functions.
 3. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided by others under other Sections of these Specifications whether they are shown on the Drawings or not.
 4. Provide a PAC based control panel including PAC components, panel mount touchscreen thick client OIT, and wired and wireless network devices for control and monitoring of A1/A2 Reservoirs and BPS.
 5. All equipment field installation, testing, startup, and commissioning to verify and confirm operability of all components prior to final process control programming installation and system startup by the SSP.
 6. Establishing local \and remote site communications prior to final process control programming and system startup by the SSP.
- C. The work of the SSP shall include
1. Programming of PAC platforms and system network configurations for control and monitoring of A1/A2 Reservoirs and BPS pumping systems.
 2. Configuration and programming of BPS network interfaces to intelligent motor controllers, generators, power meters and other devices as specified under Division 26.
 3. Programming of PAC platforms and system network configurations for control and monitoring of the chlorination system at F Booster.
 4. Programming of the existing F Booster control panel touchscreen thick client OIT to incorporate control and monitoring of the chlorination system at F Booster.
 5. Reconfiguration of the existing equipment at Reservoir 2, Marina Booster to provide store and forward communication functions.
 6. Modifications to the existing central station HMI to incorporate monitoring of BPS shall be provided by the District and is not required under this Contract except where specifically noted otherwise.
 7. Witnessing and confirming all equipment field installation, testing, startup, and commissioning by the PCSI to verify and confirm operability of all components prior to final process control programming installation and system startup by the SSP.
 8. Witnessing and confirming all local \and remote site communications by the PCSI to verify and confirm all communication links prior to final process control programming and system startup by the SSP.
- D. The PCSI and SSP shall use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and process control descriptions in the development of the PCSI's and SSP's submittals. The PCSI and SSP shall not deviate from or modify said numbering scheme without the District's approval.

- E. All work shall be coordinated with its operating personnel to minimize impact on the system daily operations. The following is a list of existing facilities where work shall be performed or possibly impacted by work under this Contract.
 - 1. Well 12/Marina Booster Pump Station/Reservoir 2
 - 2. A1/A2 Reservoirs and B/C Pump Station
 - 3. F Booster Pump Station /Intermediate Reservoir (I.R.) and Chlorination Building
 - 4. MCWD SCADA Central (District Headquarters)

- F. All new PAC programming, HMI graphics, and OIT graphics prepared by the SSP shall be appended to and be compatible with existing programs and graphic systems. Programs, documentation, databases, and graphic systems shall match the existing programming and configuration approach to the greatest extent possible and as specified.

- G. PAC hardware provided by the PCSI under this project is an updated model from the hardware presently in use at the District. All logic provided by the SSP under this Contract shall be updated, revised, fully tested, documented, and verified to be functional and operating properly on the provided hardware.

- H. New HMI and OIT graphics provided by the SSP shall match the “look-and feel” of the District’s overall system control approach with respect to colors, tag and naming conventions, control sequences, operator functions, etc.

- I. Related Work:
 - 1. Sample loop wiring diagrams are included for reference in Appendix 40 61 00-A.
 - 2. Project PAC Input/Output (I/O) list is included in Appendix 40 61 00-B.
 - 3. Project Instrument Lists are included in Appendix 40 61 00-C.
 - 4. P&IDs and Control System Architecture Block Diagrams are included in the Drawings
 - 5. Section 26 05 00 – Common Work Results for Electrical
 - 6. Section 26 05 53 – Electrical Identification
 - 7. Section 26 24 19 – Motor Control Centers
 - 8. Section 26 32 13 – Diesel Engine-Driven Generator Set
 - 9. Section 28 21 00 – CCTV Surveillance Systems
 - 10. Section 40 61 96 – Process Control Descriptions
 - 11. Section 40 62 00 – SCADA System Hardware and Software
 - 12. Section 40 67 00 – Control Panel and Hardware

1.03 SUBMITTALS

- A. The PCSI and SSP shall jointly submit in accordance with Section 01 30 00 shop drawings, submittals, and information for the materials and equipment provided under this and related control system Sections. Shop drawings shall be submitted as detailed herein. They shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature will not be acceptable.
 - 1. Shop drawings shall fully demonstrate that the equipment and services to be furnished comply with the provisions of these Specifications and shall provide a true and complete record of the equipment as manufactured and delivered.

2. Submittals shall be submitted as electronic bookmarked “PDF” formatted files or submitted as hard-copy, bound documentation. Hard-copy submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch for inclusion within the binder.
 3. Submittal drawings’ title block shall include, as a minimum, the PCSI’s registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.
 4. Separate submittals shall be made as follows:
 - a. Project Plan, Deviation List, and Schedule (by PCSI)
 - b. Field Instrumentation (by PCSI)
 - c. Process Control System Hardware (by PCSI)
 - d. Process Control Software (by SSP)
 - e. Control Panels (by PCSI)
 - f. Testing Plan (by PCSI and SSP per their respective tasks)
 - g. Training Plan (by SSP)
 - h. Spares, Expendables, and Test Equipment (by PCSI)
- B. Project Plan, Deviation List, and Schedule
1. The PCSI Project Plan shall be submitted and favorably reviewed before any further submittals will be accepted. The Project Plan shall, as a minimum, contain the following:
 - a. Overview of the proposed control system in clear text format describing the PCSI understanding of the project work, system architecture drawing, interfaces to other systems, schedule, startup, and coordination.
 - b. Approach to work in clear text format describing how the PCSI intends to execute the work. A discussion of switchover, startup, replacement of existing equipment with new, etc. shall be included as applicable. Approach shall include a description of the type and nature of coordination required with the SSP.
 - c. Preliminary hardware submittal information solely to determine compliance with the requirements of the Contract Documents prior to the PCSI development of process control programs and system layouts. Favorable review of hardware systems as part of this Project Plan stage shall not relieve the PCSI of meeting all the functional and performance requirements of the system as specified herein.
 - d. Project personnel and organization including the PCSI project manager, project engineer, and lead project technicians. Include resumes of each key individual and specify in writing their commitment to this project.
 - e. Preliminary coordination meeting agendas as specified herein.
 - f. Preliminary testing plan defining the expected work to be performed by the PCSI and SSP.
 2. Exceptions to the Specifications or Drawings shall be clearly defined by the PCSI in a separate Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Division 40 Specifications indicating conformance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the District. The acceptability of any device or methodology submitted as an “or equal” or “exception” to the specifications shall be at the sole discretion of the District.
 3. Project schedule shall be prepared and submitted using Microsoft Project scheduling software. Schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. The project schedule shall illustrate all major project milestones including the following:

- a. Schedule for all subsequent project submittals. Include in the time allotment the time required for PCSI and SSP submittal preparation, District's review time, and a minimum of two complete review cycles.
- b. Anticipated dates for all project coordination meetings including linkages to necessary specified predecessors.
- c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
- d. Software configuration (following approval of related submittals) to be performed by the SSP.
- e. Shipment of all instrument and control system equipment.
- f. Installation of all instrument and control system equipment.
- g. Testing: Schedule for all testing including at a minimum the Witnessed Factory Test, Operational Readiness Test, Functional Acceptance Test, and 30 Day Acceptance Test. Testing schedule shall include submittal of test procedures a minimum of 30 days prior to commencement of testing. Schedule shall also include submittal of completed test procedure forms for review and approval by the Construction Manager prior to shipment, startup, or subsequent project work.
- h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and OIT provided under this Contract and modifications to the SCADA central HMI.

C. Field Instrumentation

1. Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment ordered by the loop numbering system as shown in the Contract Documents.
2. Submit separate data sheets for each instrument including:
 - a. Project equipment tag and ISA tag number.
 - b. Product (item) name as used on the Contract Documents.
 - c. Manufacturer's complete model number.
 - d. Location of the device.
 - e. Input - Output characteristics.
 - f. Range, size, and graduations in engineering units.
 - g. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with the requirements of the Contract Documents.
 - h. Materials of construction for enclosure and wetted parts.
 - i. Instrument or control device sizing calculations where applicable.
 - j. Certified calibration data for all flow metering devices.
 - k. Two-wire or four-wire device type as applicable.
 - l. Submit index and data sheets in electronic format. Electronic format shall be in PDF or Microsoft Excel or Word.

D. Process Control System Hardware Submittal

1. Catalog cuts for PAC, including central processing units, memory, input modules, output modules, network interface modules, mounting racks, and power supplies. Submit system bill of materials and descriptive literature for each hardware component that fully describes the units being provided.
2. Catalog cuts for OIT hardware and ancillary components. Submit bill of materials and descriptive literature which fully describes the units being provided.

3. Catalog cuts for communication devices including radio hardware, radio modems, network switches, cables, peripherals, patch panels, and power supplies. Submit system bill of materials and descriptive literature for each hardware component, which fully describes the units being provided.
 4. Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall include I/O name (or spare), type, physical location, point address, functional description (text that includes signal source, control function, etc.), range (engineering units) and equivalent analog to digital “count” conversion, alarm limits (low-low, low, high, high-high, etc.), relay normal status contact configuration. Both hard I/O and software (network delivered) I/O shall be included. The I/O list shall be sorted in order by:
 - a. Physical location: Panel, Rack, CPU Name, or Remote I/O Drop
 - b. Interface Type: Hardwired I/O, Software I/O (Ethernet I/P, Modbus TCP, wireless, etc.)
 - c. I/O Type: AI, AO, DI, DO, PI, PO, etc.
 - d. Loop Number
 - e. Device Tag
 - f. Calibration Range and Setpoint (Analog)
 5. Complete block diagram showing the inter-connections between major hardware components, media type between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.
 6. A list of all hardware electrical and environmental characteristics and requirements. All planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the PCSI to proceed with the detailed site preparation for all equipment.
- E. Process Control System Software Submittal
1. Contract shall be implemented using the SSP’s licensed version of the suitable software platform(s). Submittals shall clearly state what, if any additional licensed software shall be used for configuration and provide confirmation of compatibility between hardware and software used on the Project. Any such additional required software shall be provided under the Project Bid Price and licensed to the District.
 2. Submit software logic and documentation for ladder logic, flow chart/function block, high level language or other controller language used for the application engineering, process control logic development effort.
 - a. Software logic and documentation shall match existing District programming formats, structure, and look and feel.
 - b. Each program module, subroutine, or function block shall be fully described in a program overview that defines the scanned inputs, scanned outputs, definition of constants and variables, and function of the routine.
 - c. Program documentation shall include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Link between “coil” and “contact” shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc.

- d. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the Process Control Descriptions included in 40 61 96 and as shown on the Drawings.
 - e. The software submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
3. Submit software logic and documentation for OIT and HMI graphics used for the application engineering, graphical user interface development effort.
- a. Database development: Submit cross reference index of I/O allocation, controller memory address, HMI or OIT graphic systems address, and HMI or OIT graphic screen where the I/O point shall appear. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.
 - b. Standard graphic format: Submit final drafts of standard graphical screen layouts defining screen zones, navigation strategy, color standards, standard graphic modules, control pop-up scheme, and other generalized user interface approach to be used for system graphics.
 - c. Process graphical development: Submit final drafts of logs, reports, trends, and process graphic displays for OIT and HMI development. The specifics of what shall appear on each display and report and any calculations are required to support them shall be presented. Final drafts shall reflect the graphical system requirements as specified herein as well as the result of the specified coordination meetings.
- F. Control Panel Submittal: Submittals and drawings shall be provided for all panels, consoles, and equipment enclosures.
- 1. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the PCSI and included in the Project Bid Price.
 - 2. Coordinate panel design and layout with the CCTV system components as specified under 28 21 00. Provide sufficient space for all CCTV components as required by the Security System Supplier as specified.
 - 3. Panel drawings shall include the following at a minimum:
 - a. Interior and exterior panel elevation drawings to scale.
 - b. Panel total weight including all components.
 - c. Nameplate schedule.
 - d. Conduit access locations for top or bottom entry.
 - e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a comprehensive bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
 - f. Panel control schematics and interconnection diagrams detailing the electrical connections of all equipment in and on the panel. Diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.
 - g. Space allocated and identified for the CCTV surveillance camera components as specified under Section 28 21 00.

4. Submit construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
5. Submit control panel component catalog data and cut sheets for all control panel equipment provided.
6. Submit heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling that shall ensure maintaining the integrity of the NEMA panel rating.
7. Submit UPS and battery sizing calculations to verify compliance with the specified power usage and backup power duration requirements. UPS sizing shall include all panel resident devices as specified for each panel provided. UPS for BPS facility shall also include serving video surveillance equipment as specified in Section 28 21 00.
8. Submit anchorage details and calculations as specified in this Section and Section 01 33 00.
9. Electrical Schematic I/O Wiring Diagrams: Provide electrical schematic I/O wiring diagrams depicting wiring within the panel as well as connections to external devices rewired for parallel system operation as shown on the Drawings.
 - a. Layout, format, and labeling used on the electrical schematics shall match format and level of detail shown on the Drawings including completion of all project and panel and component specific name and number placeholders, protection devices, wire and cable identification labeling, power supply connections, specific circuit and panel specified requirements, etc.
 - b. Field device wiring shall include the device ISA tag and District loop number as shown on the Drawings along with a unique numeric identifier consisting of the originating control panel, terminal block and terminal number where the wire lands with an additional alpha suffix if required to ensure uniqueness. For example:
HS140:LCP-GA/TB3-122
 - c. Control panel to control panel wiring shall include the source control panel, terminal block, and terminal number followed by destination control panel, terminal block, and terminal number with an additional alpha suffix if required to ensure uniqueness. For example:
LCP-GA/TB1-35:LCP-D/TB1-56
 - d. Field wiring for analog points will label the two-wire cable.
 - e. All field wiring shall include conduit routing on the schematic.
 - f. Process controller I/O wiring shall be numbered with rack number, slot number, point number, and panel termination terminal block and terminal number.
 - g. Process controller interface boards for fieldbus, networking, or other special systems wiring shall be numbered with rack number, slot number, and termination number.
 - h. Electrical schematics shall include 120 VAC and 24 VDC power supply circuitry including line filters and surge protection devices, 24 VDC power supplies, and terminal block distribution for normal/utility AC, DC, and UPS powered loads.
 - i. Two-wire and four-wire equipment shall be clearly identified and power sources noted.
 - j. All panel and field wiring shall be tagged and indicated on the electrical schematic. Submit final wire numbering scheme for approval by the Engineer. Complete all terminal board identification and terminal board numbers.
 - k. Provide electrical schematics under this Contract for all new and existing field devices.

- l. Incorporate panel/module power wiring and power supplies. Include all fuse and protection devices including ratings.
 - m. Coordinate electrical schematics I/O wiring diagrams with internal panel wiring diagrams.
 - n. Submit final circuit and cable labeling scheme for review and approval by the Engineer prior to development of panel fabrication, connection, and schematic drawings.
10. Submit comprehensive network diagrams for Ethernet IP, Modbus TCP, and wireless systems. The network diagrams shall contain the physical wiring layout showing trunk lines, drop lines, junction boxes, terminals, scanning device, terminating resistors, and all network connections. Indicate media transitions from copper to fiber, fiber to copper, wireless to wired, etc. Identify all equipment and physical location of each (enclosure, panel, etc.)

G. Testing Plan

1. Test Procedure Submittals: The PCSI and SSP shall submit procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop (per the specifications) with sign-off areas for the PCSI, SSP, and District. Submit separate procedures for each specified test phase including:
 - a. Witnessed Factory Test
 - b. Operational Readiness Test (ORT)
 - c. Functional Acceptance Test (FAT)
 - d. 30-Day Acceptance Test.
2. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including “highlighted” wiring diagrams with field technician notes are not acceptable substitutes for the formal test documentation.

H. Training Plan

1. Training Plan Submittal: Upon receipt of the Construction Manager's comments on the preliminary training plan included in the Project Plan, submit a final training plan. Training method and coverage shall be in conformance with the system training as specified herein. The training plan shall include:
 - a. Definitions of each course.
 - b. Recommended personnel for course attendance.
 - c. Schedule of training courses including dates, duration and locations of each class.
 - d. Resumes of the instructors who will actually implement the plan.

I. Spares, Expendables, and Test Equipment Submittal

1. Submit for each Subsystem:
 - a. A list of, and descriptive literature for spares, expendables, and test equipment to be provided under this Contract.
 - b. A separate list of, and descriptive literature for, additional spares, expendables and test equipment recommended by the PCSI.
 - c. Storage instructions for all spare parts.

1.04 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. Instrumentation, Systems, and Automation Society (ISA)
 - 1. ISA S5.2 - Binary Logic Diagrams for Process Operations
 - 2. ISA S5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
 - 3. ISA S5.4 - Instrument Loop Diagrams
 - 4. ISA S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - 5. ISA RP60.3 - Human Engineering for Control Centers
 - 6. ISA RP60.6 - Nameplates, Labels, and Tags for Control Centers
- C. American National Standards Institute (ANSI)
 - 1. ANSI X3.5 - Flowchart Symbols and Their Usage in Information Processing
- D. National Fire Protection Agency (NFPA)
 - 1. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories, Inc. (UL)
 - 1. UL 508 – Industrial Control Equipment
- F. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE Standard 472 - Electrical Surge Protection
- G. Electronic Industries Alliance (EIA)
 - 1. EIA Standard RS-232-C - Interface between data terminal equipment and data communication equipment employing serial binary data interchange.
 - 2. EIA Standard RS-422-A - Electrical characteristics of balanced voltage digital interface circuits
- H. American Society for Testing and Materials (ASTM).
 - 1. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- I. National Electrical Manufacturers Associations (NEMA)
 - 1. NEMA ICS6 - Enclosures for Industrial Controls and Systems

1.05 SYSTEM DESCRIPTION

- A. All SCADA system hardware shall be provided by the PCSI to the SSP for their use in developing, programming, and testing the system.
- B. All SCADA system software tools shall be provided by the SSP as necessary for programming the system.

- C. Provide all SCADA system programming development required for the addition and integration of the new BPS controls into the District's existing facility SCADA control system. Programming shall include configuration of central station Human Machine Interfaces (HMI), establishing communications links, Programmable Automation Controller (PAC) programming, and configuration of OITs. Work shall also include testing, start up, and commissioning.
- D. The new SCADA system at the A1/A2 Reservoirs B/C Pump Station Control Panel shall monitor and control the pump station equipment, A1/A2 Reservoirs and remote sites in the District Water System as shown on the Drawings.
- E. The pump control panel PAC shall also gather data from motor starters, power meters, and standby generator and make this data available to the District's Water Master server/central SCADA and Historian Server. All equipment specific communications are to be Ethernet or Ethernet over radio as specified in Section 26 24 19 and Section 26 32 13.
- F. The existing radio based telemetry network system shall be modified to establish communication links between the BCP and remote sites as shown on the Drawings.
- G. Communications between MCWD Corporate Yard and remote sites in the District Water System is based wireless telemetry system consisting UHF licensed 450 MHz band and 5.8 GHz broadband radio channels. The A1/A2 Reservoirs B/C Pump Station Control Panel shall communicate to the Water Master SCADA Server through a 5.8 GHz broadband link. District communications between A1/A2 Reservoirs B/C Pump Station Control Panel to remote sites in the Water System shall be a combination of 450 MHz and Broadband, as shown on the Drawings.
- H. The A1 and A2 reservoirs at the B/C Booster Pump Station site shall be refilled by Ord Community Well Field wells 29, 30, 31, 34 and 35) and Marina Wells 10 and 11. Well pumps shall be controlled via a digital ultrasonic level monitoring system which shall output a 4-20mA signal to the PAC for pump operation and controls based on A1/A2 Reservoir level.
- I. Control of the B booster pumps at B/C Booster Pump Station is based on B Reservoir level. Control of the C booster pumps at B/C Booster Pump Station is based on C1/C2 Reservoir levels. Reservoir levels shall be routed to the BPS via the radio links as shown on the Drawings.
- J. The new panel-mount touchscreen OIT at A1/A2 Reservoir and B/C Pump station shall operate independently from the existing Sewer Master SCADA server and Water Master SCADA server.
- K. Three new chlorine dosing pumps shall be provided to replace the existing dosing pumps in the Chlorination Building located at the I.R/F-Booster Pump Station site. A suction flow meter shall be installed to monitor Zone A flow and shall be used to control the dosing pumps. Dosing pumps shall be controlled by variable frequency drives. New control panel for the dosing pump control shall be provided and installed in the F-Booster Pump Station.
- L. Provide PAC programming modifications for new altitude valve control at the Intermediate Reservoir.

1.06 STORAGE AND HANDLING

A. Shipping Precautions

1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
2. Special instructions for proper field handling, storage and installation required by the manufacturer for proper protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other acceptable means of protection.

B. Identification During Shipping and Storage

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

C. Storage

1. Refer to Section 01 55 00.
2. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment and shall be adequately protected against mechanical damage. Equipment stored in untreated spaces shall have condensation space heaters installed to prevent moisture condensing on or within the equipment. Provide suitable power source for space heaters as required.
3. If any apparatus has been damaged, such damage shall be repaired by the PCSI at his/her own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the District. All mitigation effort shall be at the cost and expense of the PCSI, or the apparatus shall be replaced by the PCSI at no additional cost to the District.

1.07 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Interior spaces require NEMA 12 ventilated enclosures as specified herein. Exterior areas require NEMA Type 4X stainless steel enclosures. Refer to Section 26 05 00 for specific environmental and hazardous area classifications.

B. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 200 feet above mean sea level.

C. Temperature:

1. Outdoor areas' equipment shall be suitable for 10 to 30 C degrees ambient.
2. Equipment located in indoor locations shall be suitable for 20 to 30 C degrees ambient minimum.
3. Storage temperatures shall range from 0 to 40 C degrees ambient minimum.
4. Additional cooling or heating shall be provided if required by the equipment as specified herein.

- D. Relative Humidity. All equipment shall be suitable for 20 to 100 percent relative, condensing humidity.
- E. Power Supply: 120 volts AC sources of electrical power supply shall be from unregulated industrial panel boards (either utility or standby generator) unless a UPS power source is indicated on the Drawings.

1.08 QUALITY ASSURANCE

- A. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- B. The PCSI shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.
- C. The equipment and components specified herein were current products at the time of the design. Should the specified equipment become unavailable during construction, due to obsolescence or loss of commercial availability, the PCSI shall provide the latest product within the product line for approval or equivalent that meets the technical requirements of the specification.
- D. The Process Control System Integrator (PCSI) shall be a "systems house" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria:
 - 1. Employs a professional Control Systems Engineer or Electrical Engineer registered in the State of California to supervise or perform the work required by this Specification Section.
 - 2. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific process controllers, computers, and software proposed for this project.
 - 3. Has performed work of similar or greater complexity on at least five previous projects.
 - 4. Has been actively engaged in the type of work specified in this Specification Section for a minimum of five years.
 - 5. The PCSI shall maintain a permanent, fully staffed and equipped service facility within 4 hours travel time of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSI shall be capable of responding to on-site problems within 12 hours of notice.
 - 6. Actual installation of the instrumentation system need not be performed by the PCSI's employees; however, the PCSI as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
 - 7. The PCSI shall be one of the following or equal as approved by the District (firms are listed alphabetically).

- a. Calcon System Inc, San Ramon, CA (925-277-0665)
 - b. KBL Associates Inc., Hayward, CA (510-887-1117)
 - c. Primex Controls, Vacaville, CA (707-449-0341)
 - d. Technical Systems, Inc., Dixon, CA (707-678-1111)
 - e. Telstar Controls, Concord, CA (925-671-2888)
 - f. Tesco Controls, Sacramento, CA (800-948-3726)
 - g. Wunderlich-Malec, Pleasanton, CA (925-460-9910)
8. Being listed in this specification does not relieve any potential PCSI from meeting the qualifications specified in this Section. However, listed suppliers will not be required to submit a qualifications proposal. Suppliers interested in being listed as an equal to the above listed suppliers shall submit three copies of a qualifications proposal to the District no later than two weeks before the bid opening date. Qualifications proposal shall include information addressing the qualification requirements included herein with sufficient detail to verify that the proposed firm meets the qualifications criteria as specified herein. A list of approved equals will be issued no later than four days before the bid opening date.

1.09 MAINTENANCE

A. Test Equipment – NOT USED

B. Spare Parts

- 1. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the District.
- 2. As a minimum, the PCSI shall furnish the following spare parts:
 - a. Timers - One of each type provided.
 - b. Relays - One of each type provided.
 - c. Fuses - 10% (minimum of 5) of each type and size provided.
 - d. Light bulbs - 10% (minimum of 5) of each type provided.
 - e. One power supplies of each type provided, including process controller power supplies
 - f. Two of each type cable connector provided.

1.10 COORDINATION MEETING

- A. The PCSI and SSP shall schedule and hold six (6) mandatory control system coordination meeting during the Project. The Coordination Workshops shall include as a minimum the District, the Contractor, the PCSI's Project engineer, the SSP's Project engineer, and electrical subcontractor. District staff shall include construction managers, technicians, operators, and maintenance staff as required. The District shall determine which staff members will attend each workshop. Workshops shall all be held at the District Headquarters, Marina California.
- B. Schedule the Coordination Workshops a minimum of two weeks prior to the workshop date and include a draft agenda at the time of the request for review. Within one week subsequent to each workshop, submit draft workshop minutes for review and comment;

submit final minutes incorporating any comments as necessary. The PCSI shall be responsible for facilitating the workshop and providing presentation material to all participants. The PCSI and Contractor shall document the proceedings of the Coordination Workshops and submit along with all materials used at the workshop.

C. Workshops

1. Overall System Workshop: Within 30 days of issuance of Notice-to-Proceed or as part of the Project construction kick-off meeting, the PCSI and SSP shall lead and facilitate a half a day workshop. The intent of this workshop is to review and discuss the main items of the project and highlight key issues including but not limited to:
 - a. Describe how the system is expected to operate. Provide copies of the control system architecture for use in describing the SCADA system elements, programs, and operational issues. Include discussion of the main processes, control strategies, flows, pressures, temperatures etc.
 - b. Describe strategy and protocol for coordination with the SSP's programming effort that shall be implemented in parallel with the PCSI's work.
 - c. Describe all major mechanical, electrical and I&C equipment for the system. Point out any anticipated long-lead time items.
 - d. Request District definition of non-process control equipment diagnostic data to be monitored as required per Section 26 24 19 and Section 26 32 13 and other locations where required in the Contract Documents..
2. Interim Project Update Workshop: Midway through the SSP programming effort and before scheduling of the Witness Test, PCSI and SSP shall conduct a 4-hour workshop. The intent of this workshop is for the PCSI and SSP to present project progress and highlight any significant changes in the approach. PCSI and SSP shall present:
 - a. A recap of how the system is expected to operate – include main flows, pressures, temperatures etc. using an updated process flow diagram.
 - b. Reviews of any changes to the Contract Documents of equipment, process, or services either in form or function.
 - c. Programming and graphical approach used by the SSP for implementing the process control requirements of the Project; communicate any questions related to the process control execution as specified.
 - d. Discussion of any outside/offsite influences that may affect completion of the PCSI and SSP scope of work.
3. Project On-Site Testing, Training, Startup & Commissioning Workshop: Following successful completion of the PCSI and SSP Factory Testing but prior to startup and commissioning of new or modified control panels, PCSI and SSP shall conduct a 4-hour workshop. The intent of this workshop is for the PCSI, SSP, and Contractor to provide a review of the project schedule and project execution regarding testing, startup, and training as follows:
 - a. On Site Testing: Summarize the schedule for each stage of field testing and identify the teams that shall be responsible for the testing. The PCSI, SSP, and Contractor shall prepare a summary of how all the testing shall be performed, documented, and submitted. Draft test forms as specified herein shall be presented at the workshop. Forms will include confirmation and signoff of loop by loop functionality incorporating system programming being performed by the SSP.
 - b. Training: The PCSI, SSP, and Contractor shall provide a listing of all the scheduled training that will take place with anticipated dates in accordance with these Specifications. The PCSI, SSP and Contractor shall also prepare a summary of personnel and qualifications of the individuals responsible for the training. Also

- indicate the target audience for the training. Any off-site training should be coordinated with the District staff at least 30 days prior to training.
- c. Startup: The PCSI, SSP and Contractor shall coordinate startup and integrate into the startup plan with installation, programming, and system integration. The PCSI, SSP, and Contractor shall provide the draft startup plan including schedule for the startup and the personnel responsible for the startup. The plan shall be reviewed by and coordinated with the District operations staff to accommodate District operational requirements. The PCSI, SSP, and Contractor shall be responsible for the preparation of all documentation that shall be used for the startup testing and verification as specified herein.
 - d. Commissioning: Contractor shall review the Commissioning plan and provide status of required deliverables including but not limited to:
 - 1) O & M's
 - 2) Spare Parts
 - 3) Warranties
 - 4) Service Agreements
 - 5) Special equipment and tools
4. As required workshops: Three additional workshops shall be included for this project over and above the five workshops defined above.
- a. Topics and scheduling of these additional workshops shall be solely at the discretion of the District to address additional project requirements that may arise during construction.
 - b. Attendance at the additional workshops shall include at a minimum the Contractor, electrical subcontractor, PCSI, SSP, and District representatives as determined by the District.
 - c. Duration of each workshop shall be determined by the topic and discussion points but assume each additional workshop shall be 8 hours in length.
 - d. Specific personnel required for the workshops shall be determined based on the workshop topics to be addressed.
 - e. District shall provide a minimum of 2 weeks' notice to the PCSI of the need for the workshop after which the PCSI shall prepare a workshop agenda, coordinate workshop schedule, and facilitate the workshop.

1.11 FINAL SYSTEM DOCUMENTATION

- A. Submit operation and maintenance manuals covering instruction and maintenance on each type of equipment in accordance with the Section 01 70 00.
- B. Submittals shall be submitted as electronic bookmarked "PDF" formatted files or submitted as hard-copy, bound documentation. Hard-copy submittals, if provided, shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch for inclusion within the binder. Provide at a minimum:
 1. A comprehensive table of contents
 2. A functional description of the entire system, with references to the systems schematic drawings and instructions.
 3. "As Built" set of the PCSI approved control schematics, panel fabrication, and other PCIS provided detailed shop drawings.
 4. Index and instrument data sheets of the field devices supplied, including serial numbers, ranges and pertinent data.

5. Index and product data sheets of non-instrumentation equipment supplied, including serial numbers, ranges and pertinent data.
 6. Detailed service, maintenance and operation instructions for each item supplied.
 7. Complete parts lists with stock numbers and name, address and telephone number of the local supplier.
- C. Final documentation shall be new documentation written specifically for this project but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such figures shall be formatted within the printing of the page to form a legible, durable, and permanent reference book.
- E. Submit original software on memory storage media for all software provided under this Contract. Submit original paper based or electronic documentation of all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, etc. All software provided under this Contract shall be licensed to the District.
- F. Documentation shall include information from submittals updated to reflect the as-built or as-left system. Incorporate any modifications to the system resulting from the acceptance testing process.
- G. The PCSI's Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. A manual shall be furnished for all delivered hardware including peripherals. Include at a minimum the following:
1. Operation Information: Detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 2. Preventative-Maintenance Instructions: All applicable visual examinations, hardware testing and diagnostic routines and the adjustments necessary for periodic preventive maintenance.
 3. Corrective-Maintenance Instructions: Methodology for locating malfunctions down to the component replacement level. Include adequate details for locating the cause of an equipment malfunction, probable source(s) of trouble, and instructions for remedying the malfunction.
 4. Parts Information: Identify each replaceable or field-repairable component. All parts shall be identified on a bill of materials list on a drawing. Provide component manufacturer's contact information including name, local representative, phone numbers, web sites, and e-mail.
- H. The SSP's Software Maintenance documentation shall be sufficient for software maintenance and modification of the provided software and programming. Include at a minimum the following:

1. Application/Custom Software Manuals - Each custom program developed specifically for the system shall include the following information as a minimum:
 - a. Table of Contents
 - b. Overview of the program in plain English text
 - c. Narrative describing specifically how the program works. Identify all calculations, references to process I/O points, and operator inputs with cross references to the logic diagrams or code.
2. Software Listings and Databases- Submit copies of well-annotated as-built program listings. Listings shall reflect the as-built condition of the logic development following successful completion of acceptance testing. Include the following at a minimum:
 - a. All listings associated with the system generation and software configuration (e.g., system parameterization tables, build maps, disk maps, etc.). Submittals shall be included for process controllers, HMI application software, OIT application software, database applications, and all other equipment where specific programs or scripts were developed for this Project.
 - b. Listings of all I/O and variable data bases configured for and associated with the system.
 - c. Listing of all custom or modified software developed specifically for the system. Listings shall reflect any changes made after the factory acceptance test.
3. Machine Readable Documentation - Provide as-built documentation on memory storage media or as downloadable files. Program files shall be submitted in machine readable format for all programs developed under this Contract. The machine readable documentation shall include all documentation files including logic, annotation, and configuration files. Any changes made during or after acceptance testing shall be incorporated.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. General

1. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted. In order to ensure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to ensure compatibility between all equipment, it shall be the responsibility of the PCSI to coordinate all interface requirements with mechanical and electrical systems and provide any signal isolation devices that might be required.
2. To facilitate the District's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.

B. Physical

1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals that are established standards for the water industry.
2. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of isolated 4 to 20 mA dc (milliamperes direct current). However,

signals between instruments within the same panel or cabinet may be 1-5V dc (volts direct current).

3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. Provide mounting hardware and floor stands, wall brackets, or instrument racks. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X. Provide and size anchors in accordance with the seismic calculations as required. Provide minimum size anchor of 3/8-inch.
5. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70 and California Code of Regulations, Title 8, Electrical and General Safety Orders.
6. All indicators shall be linear in engineering process units unless otherwise noted.
7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent or better.
8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture, and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
9. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
10. All electronic/digital equipment shall be provided with radio frequency interference protection.
11. Provide heating, cooling, dehumidifying, and filtering devices in control panel, enclosures, and cabinets as required to maintain internal ambient conditions within the most restrictive requirements of the equipment housed. Submit calculations as part of the panel fabrication submittal process verifying these requirements.

C. Electrical

1. Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. Where possible, all field instruments shall be 24 VDC loop fieldbus powered as specified. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop or fieldbus link. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
3. Equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored unless otherwise noted.

4. All transmitter output signals shall include signal and power source isolation.
- D. Nameplates
1. All panels and field instruments shall be supplied with suitable nameplates that identify the panel and individual devices as required.
 2. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights and meters. Nameplates shall be a 3/32-inch thick, black and white, laminated Bakelite or Limacoid with engraved inscriptions. The letters shall be white against a black background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
 3. Each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the Drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start). Orient nameplates to facilitate reading the device identifier from a cursory inspection. Do not mount nameplates behind or under equipment.
 4. Provide nameplate fasteners and mounting as follows:
 - a. Stainless steel wire, 0.048-inch diameter with stainless steel crimped clamps for hanging nameplates.
 - b. Epoxy adhesive for cabinet mounted nameplates.

2.02 LIGHTNING/SURGE PROTECTION

- A. General – Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the internal plant electrical distribution system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring.
- B. Control Panel Power Supply – Provide protection of all 120 VAC instrument power supply lines. Source voltage to cabinets/panels regardless of location (indoor or outdoor), shall be protected by isolation transformers and surge suppressors. Provide gas tube surge suppressors or metal oxide varistors (MOVs) located at the point where the 120V source supplies enters the enclosure. Install the surge device to in strict compliance with the manufacturer’s recommendation for maximum allowable circuit length between protective device and incoming circuit. Provide signal surge suppression devices as manufactured by Phoenix Contact or equal.
- C. Instrument 120 V Power Supply – Provide protection for 120 VAC power to all 4-wire field instruments (indoor or outdoor). Provide individual gas tube surge suppressors or metal oxide varistors (MOVs) located at the instrument end of the circuit. Provide signal surge suppression devices as manufactured by Phoenix Contact or equal.
- D. 4-20 mA Signal Lines and Non-Fiber Based Data Highway Circuits – Provide protection on all signal and data highway circuits that leave a building or are routed external to a building. Provide gas tube surge arrestors, and Zener diode protectors. Circuit protection shall be provided at both ends of the signal or data highway lines within the control panel

at one end and as close to the instruments or termination device as possible. Provide signal surge suppression devices as manufactured by Phoenix Contact or equal.

- E. Inductive Loads – At a minimum, provide surge protection or interposing relays on all process controller outputs or switches rated 100 VA or less that drive solenoid, coil, or motor loads. Provide interposing relays or signal surge suppression devices as manufactured by Phoenix Contact or equal.

2.03 TUBING AND FITTINGS

- A. All instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of OD scratches having the following dimensional characteristics or as required to fit the specific installation:
 - 1. 1/4-inches to 1/2-inches O.D. by 0.035 wall thickness.
- B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. Fittings shall be Swagelok 316 stainless steel or equal and valves shall be Whitey 316 stainless steel or equal.
- C. All tubetrack shall be supported by stainless steel hardware and installed as per manufacturer's installation instructions.

2.04 UL LABEL

- A. All panel components shall be UL Listed for use in an industrial control panel assembly, and used for the specific purpose for which they are designed.
- B. All components that penetrate the panel shall be UL Listed to maintain the UL Type rating of the panel (Type 12, Type 4, Type 4X, etc.). If a NEMA 1 rated device is installed in the door of a NEMA 4X panel, the panel shall be de-rated to Type 1.
- C. Exhaust fans and louvers shall not be mounted on a control panel door containing operator devices.
- D. Non UL-Listed components may be used in a 120VAC circuit only if fed from an isolation transformer and a GFCI receptacle.

2.05 MAGNETIC FLOWMETER

- A. Flow Element
 - 1. Type:
 - a. Pulsed DC type.
 - 2. Function/Performance:
 - a. Operating Temperature: Process liquid temperatures of -10° to 70° C and an ambient of -10° to 60° C.
 - b. RFI protection: RFI protection to be provided.
 - c. Pressure rating: Equal to piping system where meter is installed.
 - d. Additional: Meter shall be capable of running empty indefinitely without damage to any component.
 - e. Additional: Meter shall be capable of registering flow in either direction

3. Physical:
 - a. Metering Tube: 304 stainless steel or equivalent.
 - b. Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as required by the piping system, unless otherwise indicated.
 - c. Liner: Polyurethane unless otherwise indicated on the Drawings or in the Instrument Device Schedule.
 - d. Electrodes: 316 stainless steel, bullet nosed or elliptical self-cleaning type unless otherwise noted.
 - e. Housing: Meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65).
 - f. Finish: All external surfaces shall have a chemical and corrosion resistant finish.
 4. Accessories/Documentation Required:
 - a. Factory calibration: All meters shall be factory calibrated. A copy of the report shall be included in the O&M manual.
 - b. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured.
 - c. Signal cable for installation between the flowtube and the transmitter. Length shall be as required by installation indicated on the Drawings.
 5. Manufacturer(s):
 - a. Krohne Enviromag 2300C no equal to match existing District equipment.
- B. Flow Converter/Transmitter**
1. Type:
 - a. Microprocessor based, intelligent transmitter compatible with flowtube provided.
 - b. The transmitter shall be mounted integrally on the flow tube, or remotely mounted on an instrument stand, wall, or control panel as shown on the Drawings.
 2. Functional/Performance:
 - a. Accuracy (including flowtube): Plus/minus 0.5 percent of flowrate.
 - b. Operating Temperature: -10 to 50° C.
 - c. Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument.
 - d. Diagnostics: Self diagnostics with on screen display of faults.
 - e. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
 - f. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
 - g. Empty Tube Zero: The transmitter shall include a feature that shall lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
 3. Physical:
 - a. Transmitter shall be suitable for surface or instrument stand mounting.
 - b. Enclosure shall be NEMA 4X (IP65).
 - c. 120VAC input power or as shown on the Instrument List.
 4. Accessories/ Required:
 - a. Keypad where required for transmitter configuration.
 - b. If hand-held programmers, special tools, software or cables are required for configuration and setup, the PCSI shall provide one set of configuration equipment,

plus and additional set of configuration equipment for every five flow meters provided on this project..

5. Manufacturer(s):
 - a. Krohne IFC 100 no equal to match existing District equipment.

2.06 ULTRASONIC LEVEL METER

A. Transducer

1. Type:
 - a. Non-contact, ultrasonic level transducer.
2. Function/Performance:
 - a. Measuring Range: Transducer range shall be suitable for the installation indicated on the Drawings, up to 50 ft (15m).
 - b. Temperature Range: -30 to 70° C.
 - c. Relative humidity: 0 to 100 percent.
 - d. Temperature Compensation: Transducers shall be provided with integral temperature sensors for temperature compensation.
3. Physical:
 - a. Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion resistant housing. Where indicated on the Drawings, transducers shall be approved for installation in Class I, Division 1, Groups C and D (Zone 0) environments.
 - b. The surface of transducers shall be Teflon coated where mounted on chemical tanks and exposed to vapors in the tanks that are not compatible with the transducer material.
 - c. Transducers shall be capable of being completely submersed without damage.
 - d. Transducers shall be suitable for surface, pipe, or flange mounting as indicated on the Drawings or Instrument Device Schedule. Appropriate mounting hardware shall be provided. Flanges shall be nominal 8-inch or as shown on the Drawings, resistant to attack by the medium being metered, or where required, shall be protected by corrosion resistant coatings and facings.
4. Options/Accessories Required:
 - a. Transducers located in areas where freezing condensation may occur shall be provided with special heaters or other type of transducer protection designed to prevent sensor icing.
 - b. Signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1000 feet (300 m), shall be as required by installation indicated on the Drawings.
5. Manufacturer(s):
 - a. Siemens Model XPS
 - b. Approved equal.

B. Transmitter/Converter

1. Type:
 - a. Microprocessor based compatible with the transducer(s) provided.
2. Functional/Performance:
 - a. Resolution (including transducer): Plus/minus 0.1% of range or 0.08 inches (2 mm), whichever is greater.

- b. Accuracy (including transducer): Plus/minus 0.25% of range or 0.24 inches (6 mm).
 - c. Range: As required by the installation indicated on the drawings.
 - d. Temperature Range: -20 to 50° C.
 - e. Output: One isolated 4-20 mA output with HART communication and 4 alarm contacts adjustable to trip at any point in the instrument range. Output contacts shall be rated 5 A at 230 VAC.
 - f. Temperature Compensation: Compensation over the temperature range of the sensor.
 - g. Display: Digital indicator displaying level/differential level or volume in engineering units or percent as indicated on the Drawings or in the Instrument Device Schedule.
 - h. Diagnostics: On screen instructions and display of self-diagnostics.
 - i. Loss of Signal: Transmitter shall ignore momentary loss-of-echo signals and shall indicate loss of echo on the transmitter unit.
 - j. Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable
3. Physical:
- a. Transmitter shall be suitable for surface or pipe stand mounting.
 - b. Enclosure shall be NEMA 4X (IP65).
 - c. 120VAC input power or as shown on the Instrument List.
4. Accessories Required:
- a. Handheld programmer for configuration and calibration of the instrument.
5. Manufacturer(s):
- a. Siemens Model HydroRanger 200.
 - b. Approved equal.

2.07 GAUGE PRESSURE TRANSMITTER

- A. Microprocessor based, intelligent type.
- B. Function/Performance:
- 1. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
 - 2. Accuracy: 0.05 percent of span.
 - 3. Operating Temperature: -20 to 80° C.
 - 4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28° C temperature change.
 - 5. Output: 4-20 mA DC linear with pressure or level, with HART protocol.
 - 6. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.
 - 7. Stability: 0.2 percent of upper range limit for 1 year.
 - 8. Display: Digital indicator displaying pressure or level in the engineering units indicated in the Instrument Device Schedule.
 - 9. Diagnostics: Self diagnostics with transmitter failure driving output to above or below out of range limits.
 - 10. Over Range Protection: Provide positive over range protection to 150% of the maximum pressure of the system being monitored by the instrument.

11. If required to meet the range or suppression/elevation requirements, a differential pressure transmitter shall be provided.

C. Physical:

1. Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be 316L stainless steel, unless otherwise indicated in the device schedule. Gaskets and O rings shall be Teflon.
3. NSF rated
4. Power Supply: 24 VDC loop power.
5. Sensor Fill Fluid: Silicone.

D. Accessories Required:

1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
2. For each transmitter provide a 316 stainless steel block and bleed valve. Valves may be mounted directly to the instrument or separately mounted. Valves shall be by the instrument manufacturer or by D/A Manufacturing or Anderson Greenwood.

E. Manufacturer(s):

1. ABB 621EG.
2. Rosemount 3051CG.
3. Foxboro by Schneider Electric IGP20
4. Approved equal.

2.08 PRESSURE SWITCH

A. Type:

1. Diaphragm actuated.

B. Function/Performance:

1. Repeatability: Better than 1 percent of full scale.
2. Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range.
3. Dead Band: Fixed unless adjustable dead band requirement is noted in the Instrument Device Schedule.
4. Reset: Unit shall be of the automatic reset type unless noted otherwise in the Instrument Device Schedule.
5. Over Range Protection: Over range protection to 150% of the maximum process line pressure.
6. Output: Single pole double throw (SPDT) unless requirement for double pole double throw (DPDT) switch is shown on the instrument device schedule. Switch rating shall be 10 A at 230 VAC.

C. Physical:

1. Housing: NEMA 4X (IP65) for nonhazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB).
 2. Switch Assemblies: Hermetically sealed switches.
 3. Wetted Parts: 316L stainless steel diaphragm, viton seals, 316 stainless steel connection port.
 4. NSF Rated
- D. Accessories/Options Required:
1. Shutoff Valve: Provide a 316 stainless steel shutoff valve. Valve shall be by D/A Manufacturing, Anderson Greenwood, or approved equal.
 2. Where indicate on the instrument device schedule, provide a 316 SS snubber for pulsation dampening.
- E. Manufacturer(s):
1. Static-O-Ring (SOR)
 2. Ashcroft
 3. Mercoid by Dwyer
 4. Approved equal

2.09 CHLORINE RESIDUAL ANALYZER

- A. Type:
1. Microprocessor based electronic transmitter/converter with a flow through sample cell.
 2. Measures free or total chlorine. Analyzer to be configured for free or total chlorine as indicated on the Drawings or the Instrument Device Schedule.
 3. Utilizes amperometric methods.
- B. Function/Performance:
1. Range: 0-10 ppm for either free or total Chlorine.
 2. Environmental Conditions: The instrument shall operate over an ambient temperature range of 5-45 °C.
 3. Output: Isolated 4-20 mA output and 3 alarm contacts rated 5 A at 230 VAC, adjustable to trip at any point in the instrument range.
 4. Display: Dot matrix or LCD type displaying chlorine residual in ppm.
 5. Temperature Compensation: Compensated for sample temperatures over the temperature range of the instrument.
 6. Diagnostics: On screen instructions and self-diagnostics.
 7. Total Chlorine:
 - a. Low Limit Of Detection (LOD): 0.03 ppm or better.
 - b. Repeatability/precision: 0.03 ppm or 3%, whichever is greater.
 - c. Response time: 90% of full scale within 100 seconds.
 8. Free Chlorine:
 - a. Low Limit Of Detection (LOD): 0.03 ppm or better.
 - b. Repeatability/precision: 0.03 ppm 3%, whichever is greater.
 - c. Response time: 90% of full scale within 140 seconds.

- C. Physical:
 - 1. Analyzers shall be suitable for surface mounting.
 - 2. A/C power shall be as specified herein.
 - 3. Electronics enclosure shall be NEMA 4X.
 - 4. Sensor shall have three electrodes and shall have an automatic cleaning mechanism.
- D. Accessories Required:
 - 1. Provide one year supply of consumables and one spare electrode.
- E. Manufacturer(s):
 - 1. ProMinent Fluid Controls, Dulcometer with DACb controller and Model 1003203 sensor. Provide Prominent halogen panel for housing components.
 - 2. Approved equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be as determined by the PCSI during development and fabrication of systems.
- B. The Drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Exact nature of the final equipment interconnections shall be as determined by the PCSI during development and fabrication of systems.
- C. The process control system software and hardware shall be configured as required to achieve the functional requirements per the Contract Documents.
- D. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as required by the device manufacturer. In no case shall more than one ground point be employed for each shield.
- E. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required on the Electrical Drawings for the locations.
- F. Unless specifically shown in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the Drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing and blowdown service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.
- G. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide

drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.

- H. Provide local electrical shutoffs and disconnects for all 4-wire field instruments requiring 120 VAC power. Electrical disconnects shall be suitably rated disconnect switches or manual motor starters as specified under Division 26.
- I. Provide all brackets, hangers, and miscellaneous metals required for mounting of equipment. Mounting hardware shall be installed in a workmanlike manner and not interfere with any other equipment.
- J. The PCSI shall provide on-site service to oversee installation. Certify that all field wiring for power and signal circuits are completed in accordance with manufacturer's requirements and best industry practice. Provide all necessary system grounding to insure a satisfactory functioning installation.

3.02 SCADA SYSTEM CONFIGURATION

- A. General: Refer to 40 61 96 for control and system monitoring requirements for new and existing sites. Develop the control system applications to implement the operational control descriptions for all systems. All process automation controller (PAC) programming, communication networks, and Human Machine Interface (HMI) graphics and programming shall be performed by SSP
- B. The SSP shall utilize their own development software necessary to perform the PAC, OIT, and HMI configuration work specified herein. All other software that may be necessary for a fully configured and operational system including radio configuration, alternative PAC configuration packages, and other software shall be provided under this Contract. All new software licenses and warranties shall be assigned to the District.
- C. Match the look and feel of the existing graphic screens, reports, database configuration, and PAC programming to the greatest extent possible. Examples of District addressing approach, screen graphics, and reports will be provided to the SSP following Notice to Proceed. The existing programming approach and look and feel shall be followed without exception.
- D. Provide real time and historical variable trending of all discrete and analog points provided or modified under this Contract to match existing trending screens.
- E. Modification of existing District reports is not required under this Contract.

3.03 TESTING

- A. General
 - 1. Provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section. PCSI and SSP shall provide factory testing prior to shipment of the equipment and also testing of the equipment once installed in the field. Once the system is in operation an additional 30-Day Acceptance Test is required.

2. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement shall have been satisfied.
3. All tests shall be conducted in accordance with approved procedures, forms, and checklist all as submitted by the PCSI and SSP. Each test to be performed shall be described and a space provided after it for signoff by the appropriate parties after its satisfactory completion. Include "punchlist" forms with the test procedure to document issues that arise during the testing. Punchlist forms shall include a resolution section that allows a description of the correction and signoff areas for PCSI, SSP, and District.
4. Copies of the sign off test procedures, forms and checklists shall constitute the required test documentation. The test result forms shall be submitted for review and approval at the completion of each test.
5. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.
6. The District reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the Contract Documents shall be performed at no additional cost to the District.

B. Witnessed Factory Test (WFT).

1. All panels provided under this Contract shall be inspected and tested as a system to verify that they meet the requirements of the Contract Documents. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.
2. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions and control devices/functions.
3. Tests to be performed shall include but not be limited to the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.
 - a. 100% wiring and database address verification of panel components and process controller I/O as applicable.
 - b. Demonstrate functionality of the process controls in conformance with the process control loop descriptions. Simulate operating conditions to verify the performance of the monitoring and control functions.
 - c. Demonstrate graphical user interfaces (hardware and software) for process controllers, OITs, and HMI.
 - d. Demonstrate the data communication network.
 - e. Demonstrate all system software functions specified.
 - f. Generate reports using test data.
 - g. Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, and processor failure
 - h. Other tests as necessary to verify complete functionality of the entire control system.

C. Operational Readiness Test (ORT)

1. General: Prior to startup and the Functional Acceptance Test, the entire system shall be certified (inspected, wired, calibrated, tested, and documented) by the PCSI and SSP that it is installed and ready for the ORT as defined below. The certification shall confirm that all testing procedures specified herein under the ORT have been successfully completed in their entirety by the PCSI and SSP prior to scheduling of the witnessed ORT.
 2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications. PID loop tuning shall be completed to achieve functional and stable control loop operation.
 3. The Loop/Component Inspections and Tests shall be implemented using forms and checklists developed by the PCSI and SSP and approved by the District. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the PCSI, SSP, and District:
 - a. Project Name, Test Date, PCSI Name, SSP Name, District Name, and Technician Name
 - b. Loop Number
 - c. Tag Number for each component.
 - d. Checkoffs/signoffs for each component.
 - 1) Tag/identification
 - 2) Installation
 - 3) Termination – wiring and tubing
 - 4) Scale, Range, and Setpoint as applicable
 - 5) Calibration/adjustment (4 point for analog, set point for switches) rising and falling
 - e. Checkoffs/signoffs for the loop
 - 1) Panel interface terminations
 - 2) I/O interface terminations
 - 3) I/O signal operation
 - 4) Inputs/outputs operational: received/sent, processed, adjusted
 - 5) System graphic response
 - 6) Total loop operation
 - 7) Process Controller Scaling and Adjustment
 - f. Space for comments
 4. The PCSI and SSP shall maintain the Loop Status Reports sheets at the job site and make them available at any time.
 5. These inspections, calibrations, and tests do not require witnessing. However, the District shall review Loop Status Sheets and spot-check the test process periodically. Any deficiencies found shall be corrected by the PCSI and SSP prior to commencement of the Functional Acceptance Test.
- D. Functional Acceptance Test (FAT).
1. General: Prior to startup, the entire installed instrument and control system shall be certified that it is ready for operation. A witnessed FAT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Test.

2. Each specified function and process control shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
3. PCSI and SSP shall perform radio system communication and network testing for each segment. Testing shall include performance and error tracking using standard network administration software.
4. Loop-specific and non-loop-specific tests shall be the same as specified under Factory Tests except that the entire installed system shall be tested from field device to the HMI and all functions demonstrated using live field based data to the greatest extent possible.
5. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available at the job site during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site during testing.
6. Following initial startup, the entire process control system shall operate for a continuous 100 hours without failure before this test will be started. Network testing and performance testing shall be on-line and monitoring network operation throughout the 100-hour period.
7. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the PCSI and SSP shall perform repairs, replacement, reprogramming, and/or retest within 10 days.

E. 30-Day Acceptance Test

1. After completion of the Operational Readiness and Functional Acceptance Tests, the PCVSI and SSP shall be responsible for operation of the entire system for a period of 30 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction. The 30-day control system acceptance test may occur concurrently with the FAT. Network performance monitoring shall continue throughout the 30-day test period.
2. During this test, District and PCSI and SSP personnel shall be present as required. The PCSI and SSP shall provide personnel for this test who have an intimate knowledge of the hardware and software of the system. Off-shift emergencies shall be fully supported by PCSI and SSP. Provide staff with cell phones or other mobile communication devices to ensure that support staff is available by phone and on-site within 4 hours following a reported problem from operations staff.
3. While this test is proceeding, the District shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. The plant operations shall remain the responsibility of District and the decision of plant operators regarding plant operations shall be final. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.
4. Any malfunction during the tests shall be analyzed and corrections made by the PCSI and SSP. The District will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
5. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, shall be considered as a non-field-repairable malfunction.
6. Upon completion of repairs the test shall be repeated as specified herein.
7. In the event of rejection of any part or function perform repairs or replacement within 10 days.

8. All computer equipment, network equipment, controllers, data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30 day test shall not be considered successful until all data base points and logic functions are tested and verified to be correct.
9. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:
$$\text{AVAILABILITY} = (\text{TOTAL TIME} - \text{DOWN TIME}) / \text{TOTAL TIME}$$
10. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided, shall not contribute to the availability test times above.
11. Upon successful completion of the 30-day operation test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete.

END OF SECTION

APPENDIX 40 61 00-A

REFERENCE DRAWINGS

SAMPLE ELECTRICAL SCHEMATICS AND LOOP DIAGRAM

Sample reference electrical schematics and loop diagrams are incorporated into the Drawing set. These sample drawings are included in the Contract Documents for reference and use by the PCSI in developing project specific electrical schematic diagrams as specified herein. These drawings are provided as an aid to the PCSI illustrating the level of detail and information required for the electrical schematic diagrams to be provided under this Contract.

INDEX OF SAMPLE ELECTRICAL LOOP DIAGRAMS

NO	DWG NO.	DESCRIPTION
1	AI	Instrumentation and Control Loop Diagrams Analog Input
2	AO	Instrumentation and Control Loop Diagrams Analog Output
3	DI	Instrumentation and Control Loop Diagrams Discrete Input
4	DO	Instrumentation and Control Loop Diagrams Discrete Output
5	PS	Instrumentation and Control Panel Internal Power Distribution

FIELD ①

CONTROL PANEL - BACK PANEL ①

GENERAL SHEET NOTES

SHEET KEYNOTES

1. TERMINAL BLOCK, WIRE NUMBERS, MEMORY ADDRESS, ETC TO BE COMPLETED BY THE CONTRACTOR PER THE REQUIREMENTS OF THE SPECIFICATIONS.
2. SAMPLE REFERENCE POINT-TO-POINT WIRING DIAGRAMS ARE INCLUDED FOR REFERENCE AND USE BY THE CONTRACTOR IN DEVELOPING SPECIFIC WIRING DIAGRAMS AS REQUIRED BY THE CONTRACT DOCUMENTS. THESE DRAWINGS ARE PROVIDED AS AN AID TO THE CONTRACTOR ILLUSTRATING THE LEVEL OF DETAIL AND INFORMATION REQUIRED FOR THE WIRING DIAGRAMS TO BE PROVIDED UNDER THIS CONTRACT. ALL EQUIPMENT REQUIRED PER THE CONTRACT DOCUMENTS INCLUDING OVER CURRENT PROTECTIVE DEVICES, AUXILIARY RELAYS, SURGE ARRESTORS, GROUNDING DETAILS, AND OTHER REQUIREMENTS SPECIFIED ARE NOT SHOWN BUT SHALL BE PROVIDED BY THE CONTRACTOR AND INCLUDED IN THE SUBMITTED DIAGRAMS DEVELOPED BY THE CONTRACTOR SPECIFICALLY FOR THIS PROJECT.
3. PLC MODULE CONFIGURATION VARIES DEPENDING ON MANUFACTURE. CONTRACTOR'S WIRING DIAGRAM SHALL INCLUDE ALL MODULE CONNECTION POINTS TO MATCH ACTUAL MODULE PROVIDED.
4. PANEL DETAILS INCLUDING TAGGING FORMATS, LOOP/DEVICE TAGS, LIGHT COLORS, ETC. ARE SHOWN AS EXAMPLES ONLY. CONTRACTOR SHALL PROVIDE SPECIFIC PANEL DETAILS AS SHOWN ON THE PLANS AND REQUIRED BY THE SPECIFICATIONS.

PLC MEMORY ADDRESS TO BE COMPLETED (TYP)
[XXXXXX]
LI-5003
RESERVOIR LEVEL

[XXXXXX]
FI-0171
PUMP NO. 1
DISCHARGE FLOW

[XXXXXX]
FI-0271
PUMP NO. 2
DISCHARGE FLOW

[XXXXXX]
PI-0112
PRESSURE

[XXXXXX]
SPARE

[XXXXXX]
SPARE

[XXXXXX]
SPARE

[XXXXXX]
SPARE

REFERENCE SAMPLE DRAWINGS - NOT TO BE USED FOR CONSTRUCTION

SHEET NO.

AI

OF

THIS BAR
SCALES EXACTLY
ONE INCH AT
FULL SCALE

INSTRUMENTATION AND CONTROLS
LOOP DIAGRAMS ANALOG INPUT

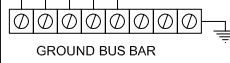
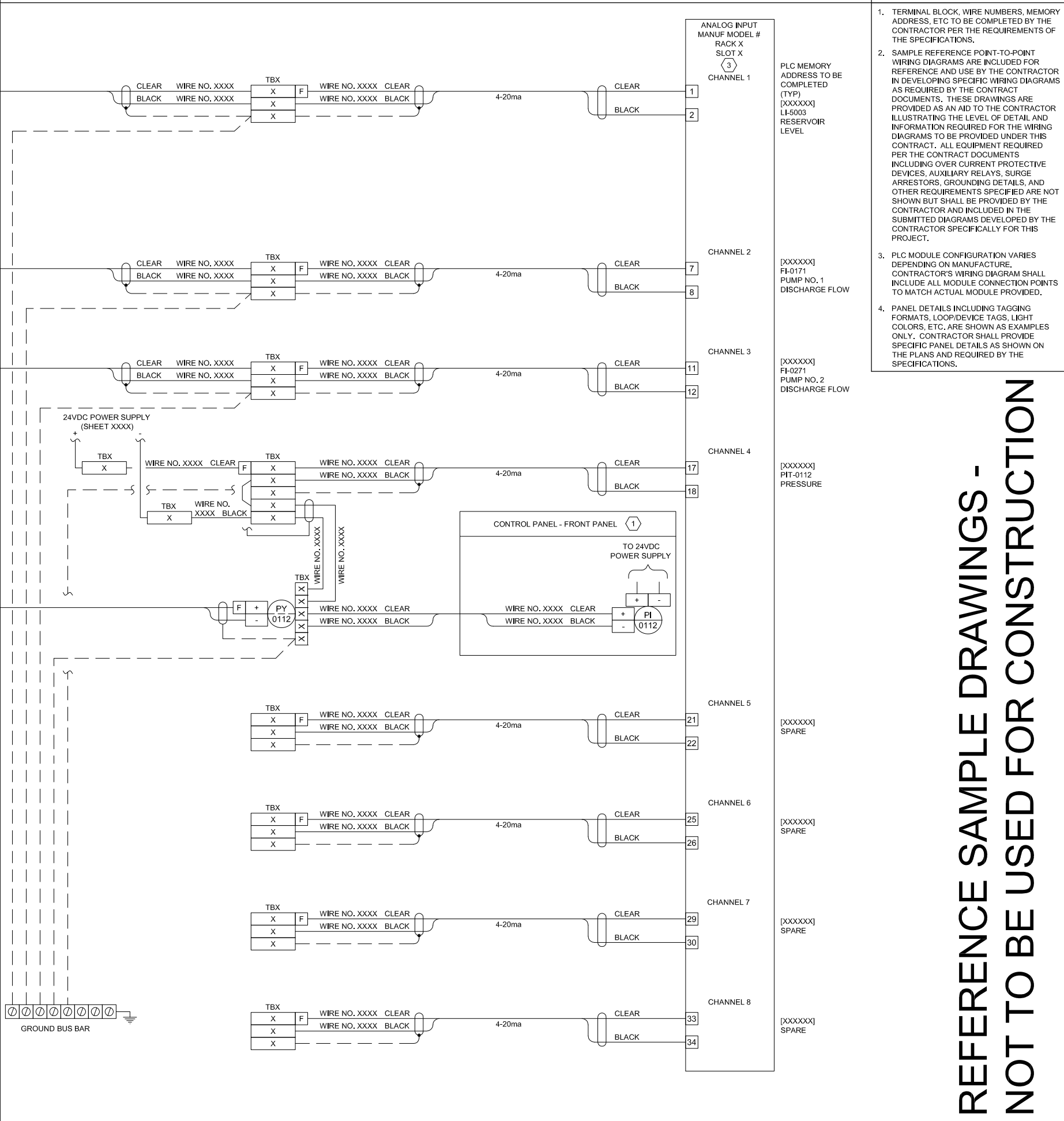
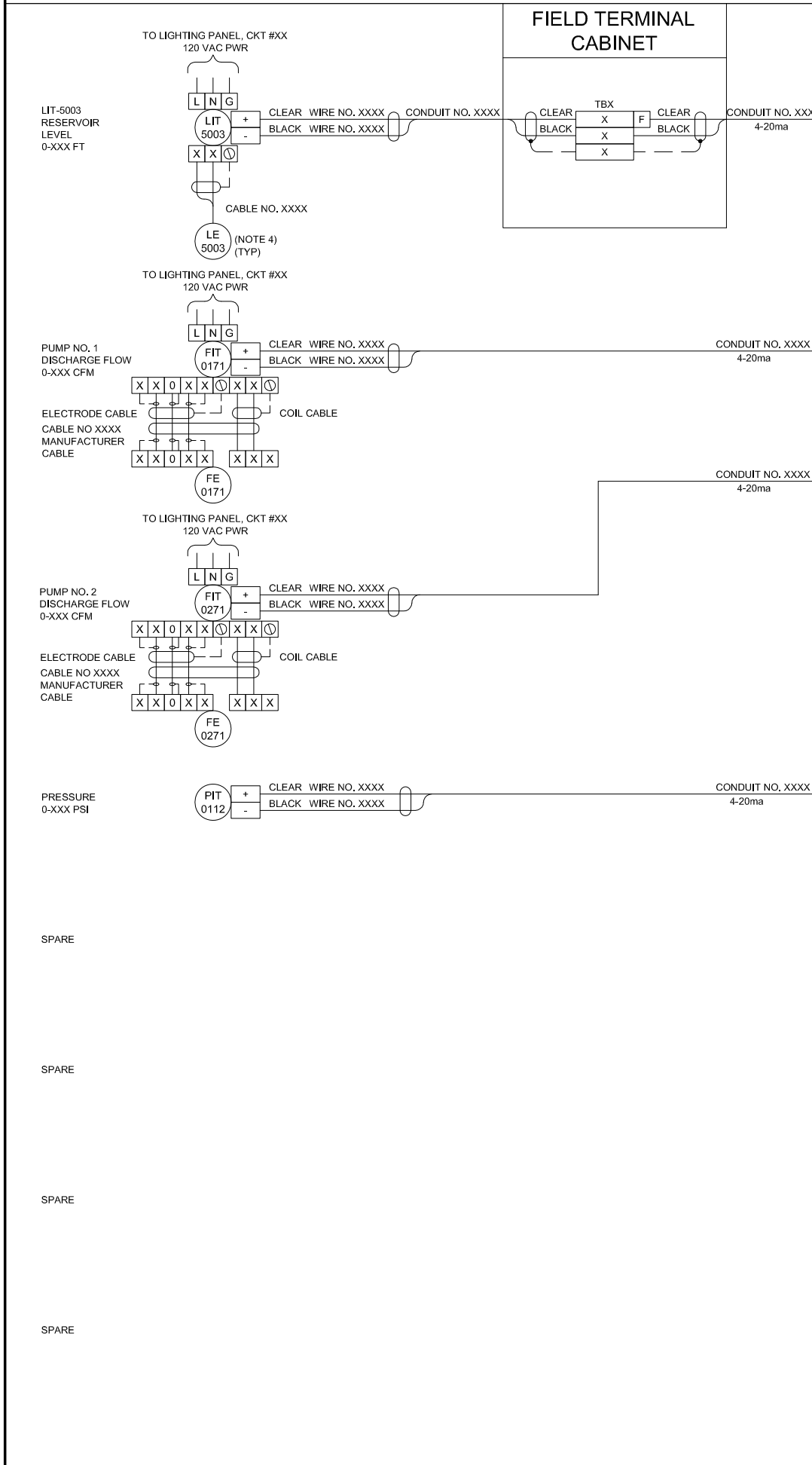
DESIGNED BY:

DRAWN BY:

CHECKED BY:

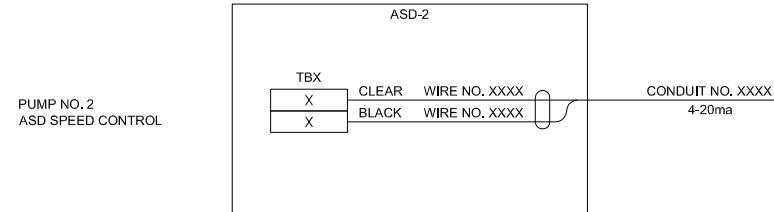
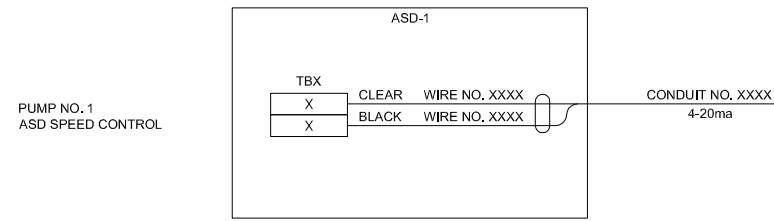
SCALE:

DATE:



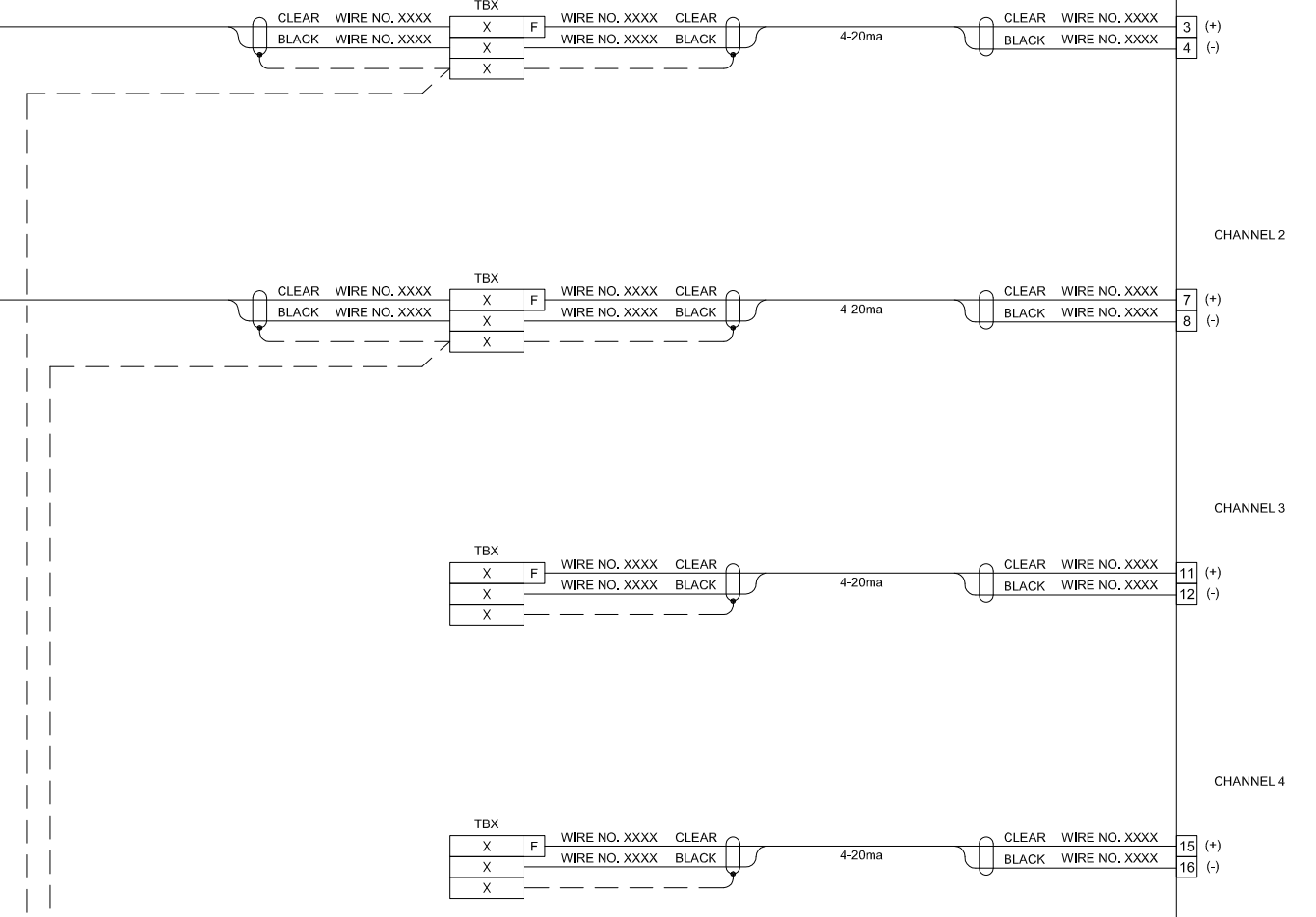
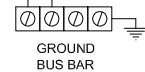
FIELD ①

CONTROL PANEL - BACK PANEL ①



SPARE

SPARE



ANALOG OUTPUT
MANUF. MODEL #
RACK X
SLOT X
③
CHANNEL 1

CHANNEL 2

CHANNEL 3

CHANNEL 4

PLC MEMORY
ADDRESS TO BE
COMPLETED
(TYP)
[XXXXXX]
SI-0184
PUMP NO. 1
ASD SPEED

[XXXXXX]
SI-0284
PUMP NO. 2
ASD SPEED

[XXXXXX]
SPARE

[XXXXXX]
SPARE

GENERAL SHEET NOTES

SHEET KEYNOTES

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REFERENCE SAMPLE DRAWINGS - NOT TO BE USED FOR CONSTRUCTION

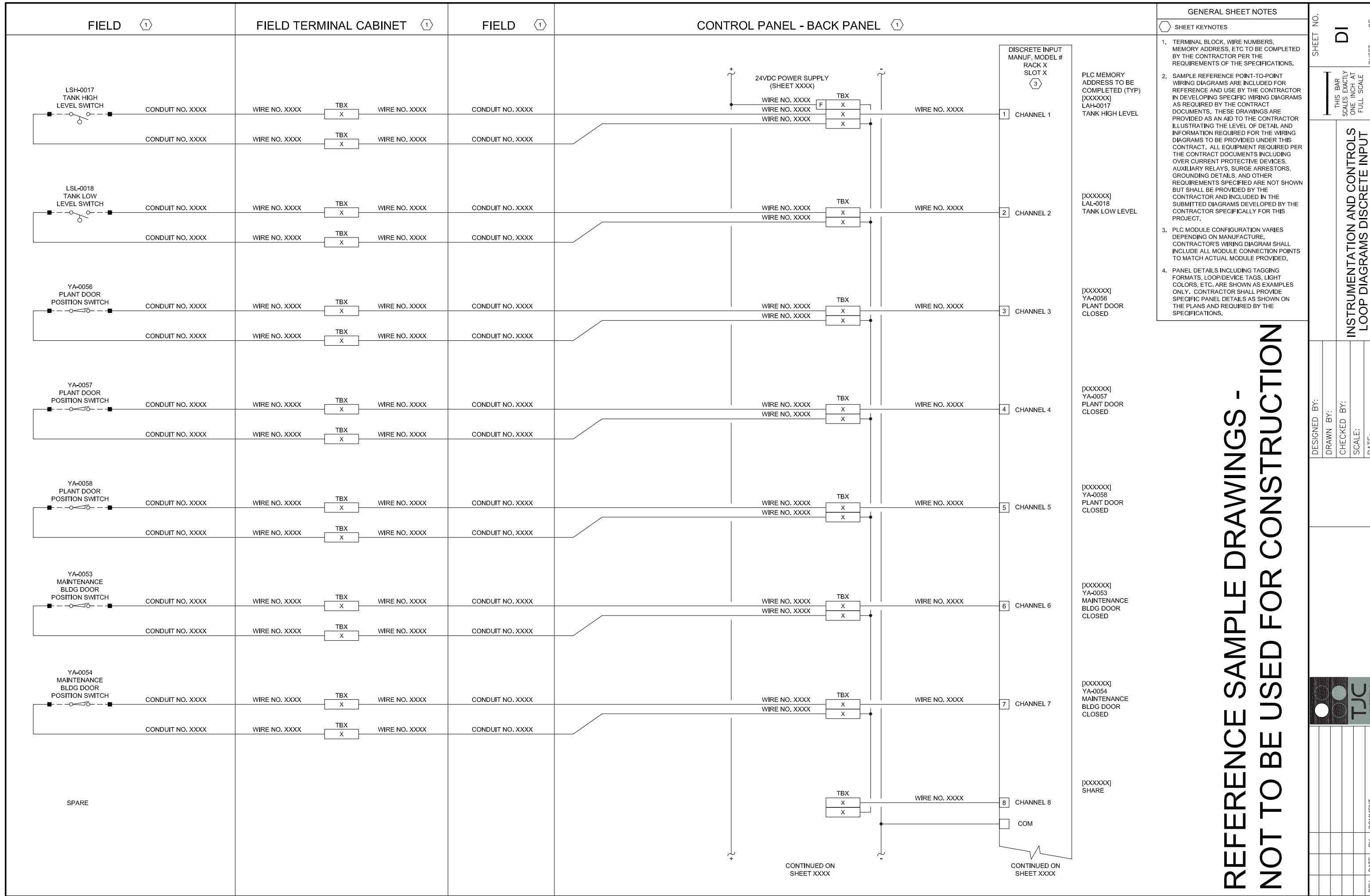
DESIGNED BY:	
DRAWN BY:	
CHECKED BY:	
SCALE:	
DATE:	

SHEET NO. **AO** OF
 THIS BAR
 SCALES EXACTLY
 ONE INCH AT
 FULL SCALE

**INSTRUMENTATION AND CONTROLS
LOOP DIAGRAMS ANALOG OUTPUT**

REV.	DATE	BY	COMMENT

W:\TJCA - CAD\TJCA - Standards\Inst\Sample Loop Drawings\AO_02/02/11_0941_ondrio_XRES:TJCA-bdr



SHEET NO. **DI** OF

THIS BAR SCALES EXACTLY ONE INCH AT FULL SCALE

INSTRUMENTATION AND CONTROLS LOOP DIAGRAMS DISCRETE INPUT

DESIGNED BY: _____

DRAWN BY: _____

CHECKED BY: _____

SCALE: _____

DATE: _____

REV. DATE BY COMMENT

W:\UGA - CADD\UGA - Standards\Inst\Sample Loop Drawings\DI_02/03/11_09:10_ondria_XREFS\UGA-bdr

TJC

FIELD ①

CONTROL PANEL - BACK PANEL ①

GENERAL SHEET NOTES

SHEET KEYNOTES

1. TERMINAL BLOCK, WIRE NUMBERS, MEMORY ADDRESS, ETC TO BE COMPLETED BY THE CONTRACTOR PER THE REQUIREMENTS OF THE SPECIFICATIONS.
2. SAMPLE REFERENCE POINT-TO-POINT WIRING DIAGRAMS ARE INCLUDED FOR REFERENCE AND USE BY THE CONTRACTOR IN DEVELOPING SPECIFIC WIRING DIAGRAMS AS REQUIRED BY THE CONTRACT DOCUMENTS. THESE DRAWINGS ARE PROVIDED AS AN AID TO THE CONTRACTOR ILLUSTRATING THE LEVEL OF DETAIL AND INFORMATION REQUIRED FOR THE WIRING DIAGRAMS TO BE PROVIDED UNDER THIS CONTRACT. ALL EQUIPMENT REQUIRED PER THE CONTRACT DOCUMENTS INCLUDING OVER CURRENT PROTECTIVE DEVICES, AUXILIARY RELAYS, SURGE ARRESTORS, GROUNDING DETAILS, AND OTHER REQUIREMENTS SPECIFIED ARE NOT SHOWN BUT SHALL BE PROVIDED BY THE CONTRACTOR AND INCLUDED IN THE SUBMITTED DIAGRAMS DEVELOPED BY THE CONTRACTOR SPECIFICALLY FOR THIS PROJECT.
3. PLC MODULE CONFIGURATION VARIES DEPENDING ON MANUFACTURE. CONTRACTOR'S WIRING DIAGRAM SHALL INCLUDE ALL MODULE CONNECTION POINTS TO MATCH ACTUAL MODULE PROVIDED.
4. PANEL DETAILS INCLUDING TAGGING FORMATS, LOOP/DEVICE TAGS, LIGHT COLORS, ETC. ARE SHOWN AS EXAMPLES ONLY. CONTRACTOR SHALL PROVIDE SPECIFIC PANEL DETAILS AS SHOWN ON THE PLANS AND REQUIRED BY THE SPECIFICATIONS.

SHEET NO. **DO** OF SHEET

THIS BAR SCALES EXACTLY ONE INCH AT FULL SCALE

INSTRUMENTATION AND CONTROLS LOOP DIAGRAMS DISCRETE OUTPUT

DESIGNED BY: _____
 DRAWN BY: _____
 CHECKED BY: _____
 SCALE: _____
 DATE: _____

REV. DATE BY COMMENT

COOLING WATER

DISCHARGE VALVE

MN-0104B

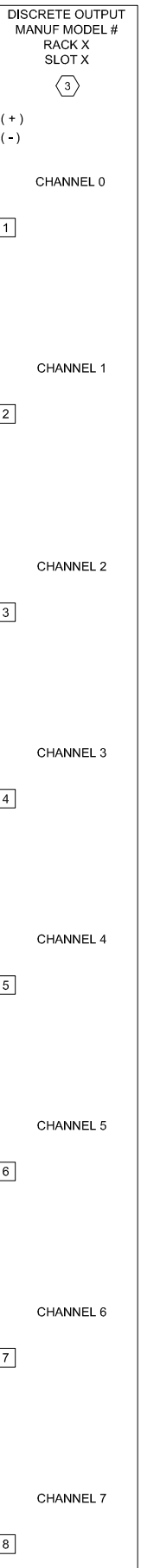
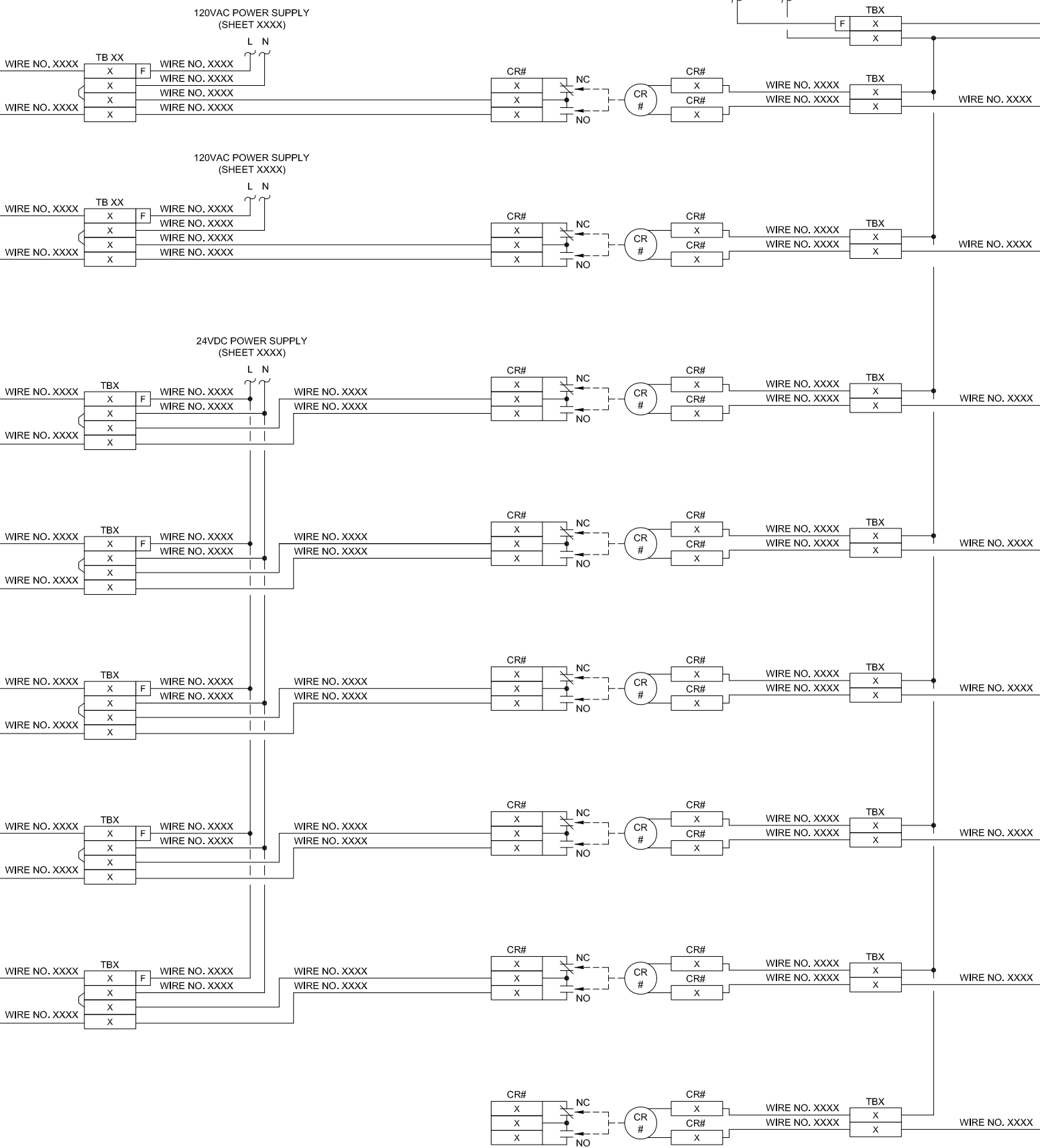
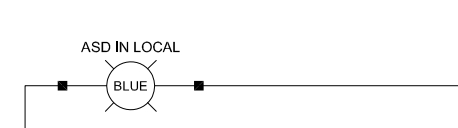
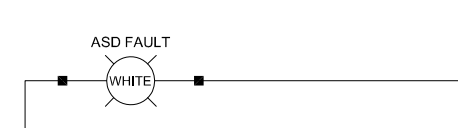
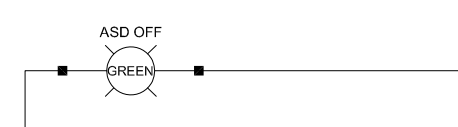
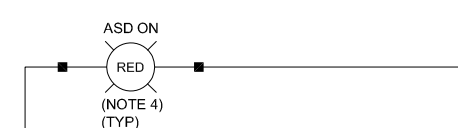
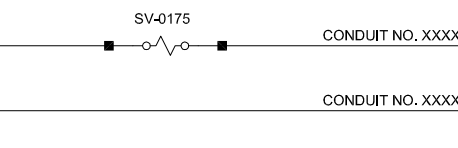
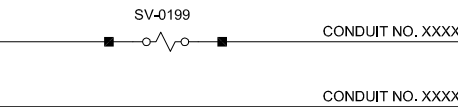
MN-0104C

MN-0120

MN-0107B

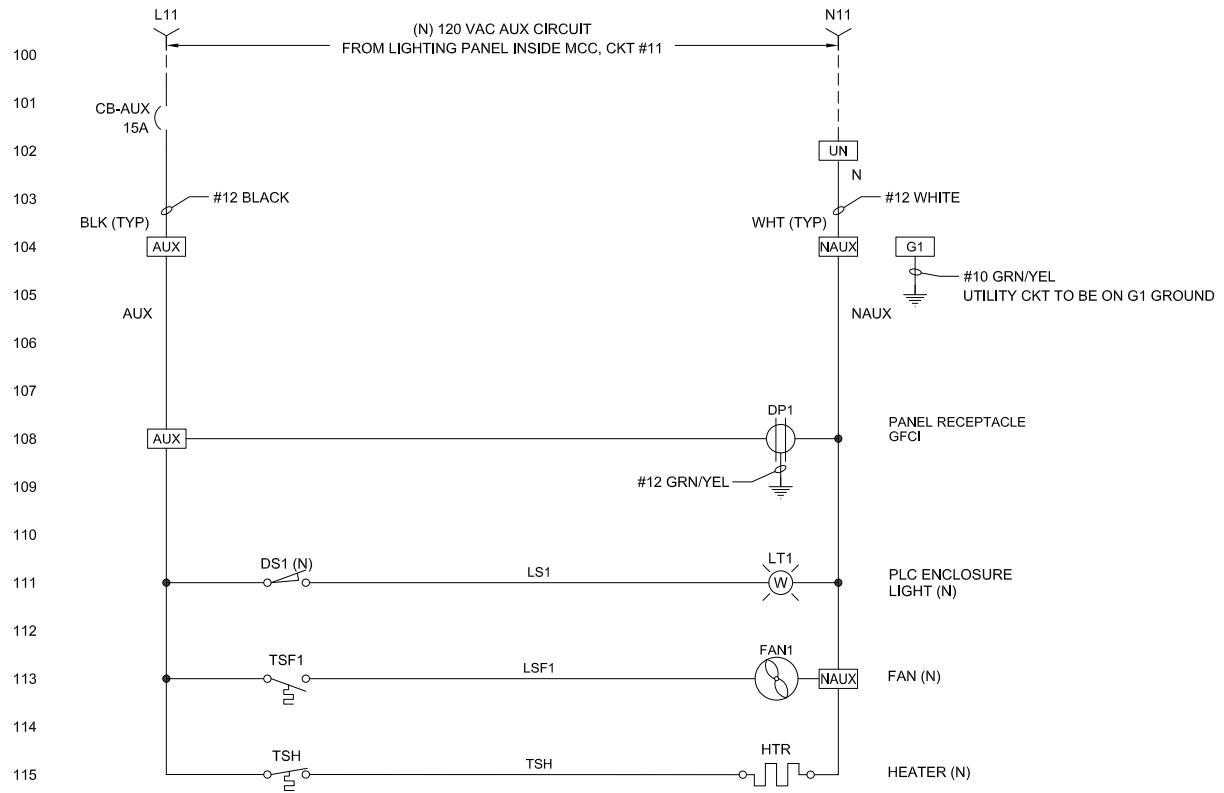
YN-0115

SPARE

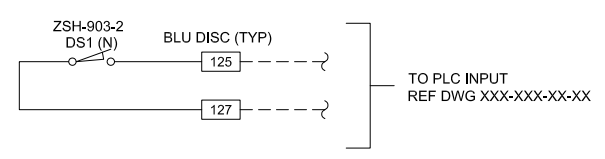


PLC MEMORY ADDRESS TO BE COMPLETED (TYP)
 [XXXXXX] SV-0199 COOLING WATER
 [XXXXXX] SV-0175 DISCHARGE VALVE
 [XXXXXX] MN-0104B ASD ON
 [XXXXXX] MN-0104C ASD OFF
 [XXXXXX] MN-0120 START REQUEST
 [XXXXXX] MN-0107B ASD FAULT
 [XXXXXX] YN-0115 ASD IN LOCAL
 [XXXXXX] SPARE

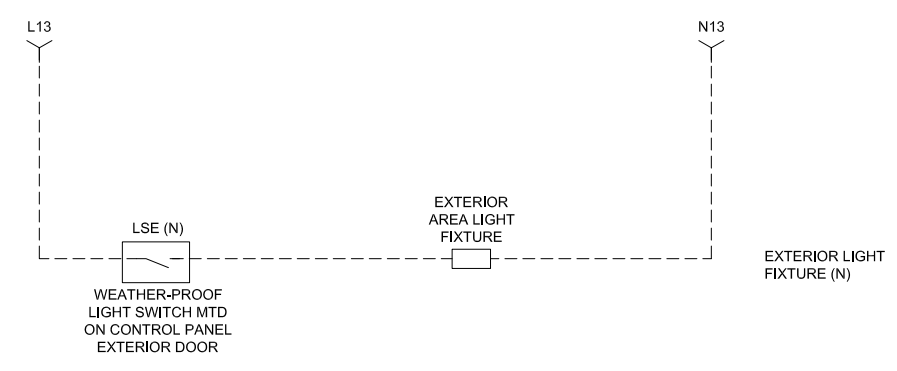
REFERENCE SAMPLE DRAWINGS - NOT TO BE USED FOR CONSTRUCTION



120VAC POWER DISTRIBUTION



INTRUSION SWITCH CIRCUIT



- NOTES:
- INTERNAL PANEL COMPONENTS AND WIRING ARE EXISTING UNLESS SHOWN AS NEW (N). FURNISH, INSTALL, AND TERMINATE NEW DEVICES AND NEW INTERCONNECTION WIRING TO EXTERNAL DEVICES.

REFERENCE SAMPLE DRAWINGS - NOT TO BE USED FOR CONSTRUCTION

SHEET NO. PD			
THIS BAR SCALES EXACTLY ONE INCH AT FULL SCALE			
TJC AND ASSOCIATES, INC.			
POWER DISTRIBUTION CONT			
DESIGNED BY:			
DRAWN BY:			
CHECKED BY:			
SCALE:			
DATE:			
REV.	DATE	BY	COMMENT

APPENDIX 40 61 00-B

PAC INPUT/OUTPUT (I/O) LIST

The I/O List is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSI based on the Process Control Loop Descriptions of Appendix 40 61 00-D, auxiliary device requirements, and spare requirements as shown on the Drawings and specified herein.



IO LIST

TOTAL WIRED I/O COUNT

	DI	DO	AI	AO		Area on Plan DWG	Comments
B/C Booster Pump Station	52	7	6	0		A1/A2 and B/C Booster Pump Station	
Chlorination Building	14	1	6	3		F-Booster Pump Station	
Totals	66	8	12	3			

TOTAL PROGRAMMED I/O COUNT (NOT SPARE)

	DI	DO	AI	AO	Radio	Area on Plan DWG	Comments
B/C Booster Pump Station	52	7	6	0		A1/A2 and B/C Booster Pump Station	
Chlorination Building	14	1	6	3	2	F-Booster Pump Station	
Totals	66	8	12	3			

IO LIST

Client: Marina Coast Water District
 Project: A1A2 Reservoir, B/C Booster Pump Station
 TJCAA Project #: 119038
 By: TJC & Associates
 Date: 1/4/2021

PAC Data

Location: A1A2 Reservoir, B/C Booster Pump Station
 Control Panel: MCP
 By: TJC & Associates
 Date: 1/4/2021

TAG NO.	DESCRIPTION	RANGE	I/O TYPE	COMMENTS
AIT-101	Chlorine Residual Analyzer	TBD	AI	
LIT-110	A1 Reservoir Level	0-30 Feet	AI	
LIT-120	A2 Reservoir Level	0-30 Feet	AI	
FIT-100	Zone A Flow	-10,000 to +10,000 gpm	AI	
FIT-200	Zone B Flow	-2,000 to +4,000 gpm	AI	
FIT-300	Zone C Flow	-2,000 to +6,500 gpm	AI	
TIT-400	Pump Station Building Temperature	TBD	AI	
MN-210	Zone B Booster Pump 1 Run Feedback	0=Off, 1=Running	DI	
YN-210	Zone B Booster Pump 1 Remote/Auto	0=Auto,1=Remote	DI	
UA-210	Zone B Booster Pump 1 Fault	0=Normal, 1=Alarm	DI	
PAHH-210	Zone B Booster Pump 1 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-210	Zone B Booster Pump 1 Over Temperature	0=Normal, 1=Alarm	DI	
MN-220	Zone B Booster Pump 2 Run Feedback	0=Off, 1=Running	DI	
YN-220	Zone B Booster Pump 2 Remote/Auto	0=Auto,1=Remote	DI	
UA-220	Zone B Booster Pump 2 Fault	0=Normal, 1=Alarm	DI	
PAHH-220	Zone B Booster Pump 2 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-220	Zone B Booster Pump 2 Over Temperature	0=Normal, 1=Alarm	DI	
MN-230	Zone B Booster Pump 3 Run Feedback	0=Off, 1=Running	DI	
YN-230	Zone B Booster Pump 3 Remote/Auto	0=Auto,1=Remote	DI	
UA-230	Zone B Booster Pump 3 Fault	0=Normal, 1=Alarm	DI	
PAHH-230	Zone B Booster Pump 3 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-230	Zone B Booster Pump 3 Over Temperature	0=Normal, 1=Alarm	DI	
MN-310	Zone C Booster Pump 1 Run Feedback	0=Off, 1=Running	DI	
YN-310	Zone C Booster Pump 1 Remote/Auto	0=Auto,1=Remote	DI	

IO LIST

TAG NO.	DESCRIPTION	RANGE	I/O TYPE	COMMENTS
UA-310	Zone C Booster Pump 1 Fault	0=Normal, 1=Alarm	DI	
PAHH-310	Zone C Booster Pump 1 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-310	Zone C Booster Pump 1 Over Temperature	0=Normal, 1=Alarm	DI	
MN-320	Zone C Booster Pump 2 Run Feedback	0=Off, 1=Running	DI	
YN-320	Zone C Booster Pump 2 Remote/Auto	0=Auto, 1=Remote	DI	
UA-320	Zone C Booster Pump 2 Fault	0=Normal, 1=Alarm	DI	
PAHH-320	Zone C Booster Pump 2 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-320	Zone C Booster Pump 2 Over Temperature	0=Normal, 1=Alarm	DI	
MN-330	Zone C Booster Pump 3 Run Feedback	0=Off, 1=Running	DI	
YN-330	Zone C Booster Pump 3 Remote/Auto	0=Auto, 1=Remote	DI	
UA-330	Zone C Booster Pump 3 Fault	0=Normal, 1=Alarm	DI	
PAHH-330	Zone C Booster Pump 3 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-330	Zone C Booster Pump 3 Over Temperature	0=Normal, 1=Alarm	DI	
MN-340	Zone C Booster Pump 4 Run Feedback	0=Off, 1=Running	DI	
YN-340	Zone C Booster Pump 4 Remote/Auto	0=Auto, 1=Remote	DI	
UA-340	Zone C Booster Pump 4 Fault	0=Normal, 1=Alarm	DI	
PAHH-340	Zone C Booster Pump 4 High High Discharge Pressure	0=Normal, 1=Alarm	DI	
TAH-340	Zone C Booster Pump 4 Over Temperature	0=Normal, 1=Alarm	DI	
PALL-010	Pump Station Low Low Suction Pressure	0=Alarm, 1=Normal	DI	
FUA-200	Zone B Flow Fault	0=Normal, 1=Alarm	DI	
FUA-300	Zone C Flow Fault	0=Normal, 1=Alarm	DI	
ZAH-001A	East Door Intrusion Alarm	0=Normal, 1=Alarm	DI	
ZAH-001B	West Door Intrusion Alarm	0=Normal, 1=Alarm	DI	
ZAH-001C	Roll-up Door Intrusion Alarm	0=Normal, 1=Alarm	DI	
ZAH-111	Reservoir A1 Hatch Intrusion	0=Normal, 1=Alarm	DI	
ZAH-112	Reservoir A1 Ladder Cage Intrusion	0=Normal, 1=Alarm	DI	
ZAH-121	Reservoir A2 Hatch Intrusion	0=Normal, 1=Alarm	DI	
ZAH-122	Reservoir A2 Ladder Cage Intrusion	0=Normal, 1=Alarm	DI	
FUA-100	Zone A Flowmeter Fail	0=Normal, 1=Alarm	DI	
LSL-160	Generator Fuel Tank Low	0=Normal, 1=Alarm	DI	From Generator Control Panel
YS-150A	Generator Over Crank	0=Normal, 1=Alarm	DI	From Generator Control Panel
YS-150B	Generator Overspeed	0=Normal, 1=Alarm	DI	From Generator Control Panel
TSH-150	Generator High Temp	0=Normal, 1=Alarm	DI	From Generator Control Panel
YS-150C	Generator Overload	0=Normal, 1=Alarm	DI	From Generator Control Panel
MN-150	Generator Running	0=Normal, 1=Alarm	DI	From Generator Control Panel

IO LIST

TAG NO.	DESCRIPTION	RANGE	I/O TYPE	COMMENTS
YC-210	Zone B Booster Pump 1 Call	0=Stop, 1=Run	DO	
YC-220	Zone B Booster Pump 2 Call	0=Stop, 1=Run	DO	
YC-230	Zone B Booster Pump 3 Call	0=Stop, 1=Run	DO	
YC-310	Zone C Booster Pump 1 Call	0=Stop, 1=Run	DO	
YC-320	Zone C Booster Pump 2 Call	0=Stop, 1=Run	DO	
YC-330	Zone C Booster Pump 3 Call	0=Stop, 1=Run	DO	
YC-340	Zone C Booster Pump 4 Call	0=Stop, 1=Run	DO	

TOTAL I/O COUNT - DI:	52
DO:	7
AI:	6
AO:	0

IO LIST

Client: Marina Coast Water District
 Project: Intermediate Reservoir, F Booster Pump Station
 TJCAA Project #: 119038
 By: TJC & Associates
 Date: 1/4/2021

PAC Data

Location: Chlorination Building
 Control Panel: LCP-7A
 By: TJC & Associates
 Date: 1/4/2021

TAG NO.	DESCRIPTION	RANGE	I/O TYPE	COMMENTS
SI-510	Chlorine Dosing Pump 1 Speed Feedback	TBD	AI	
SI-520	Chlorine Dosing Pump 2 Speed Feedback	TBD	AI	
SI-530	Chlorine Dosing Pump 3 Speed Feedback	TBD	AI	
FIT-500	Zone A Wellfield Flow	-2,000 to +13,200 gpm	AI	
LIT-500	Hypochlorite Tank Level	0-8 ft	AI	
FIT-501	Chlorine Flow	TBD	AI	
LI-110	A1 Reservoir Level		AI-Radio	Via Radio from B/C BPS
LI-120	A2 Reservoir Level		AI-Radio	Via Radio from B/C BPS
SIC-510	Chlorine Dosing Pump 1 Speed Command	TBD	AO	
SIC-520	Chlorine Dosing Pump 2 Speed Command	TBD	AO	
SIC-530	Chlorine Dosing Pump 3 Speed Command	TBD	AO	
YSC-502	Altitude Valve Operator SOV	1=Closed 0=Open	DO	
SV-502	Altitude Valve Operator SOV - Status	1=Closed 0=Open	DI	
FUA-500	Wellfield Flowmeter Fault	0=Normal, 1=Alarm	DI	
MN-510	Chlorine Dosing Pump 1 Run Feedback	0=Auto, 1=Remote	DI	
UA-510	Chlorine Dosing Pump 1 Fault	0=Normal, 1=Alarm	DI	
MN-520	Chlorine Dosing Pump 2 Run Feedback	0=Auto, 1=Remote	DI	
UA-520	Chlorine Dosing Pump 2 Fault	0=Normal, 1=Alarm	DI	
MN-530	Chlorine Dosing Pump 3 Run Feedback	0=Off, 1=Running	DI	
YN-530	Chlorine Dosing Pump 3 Fault	0=Normal, 1=Alarm	DI	
LSL-610	Generator Fuel Tank Low	0=Normal, 1=Alarm	DI	From Generator Control Panel
YS-600A	Generator Over Crank	0=Normal, 1=Alarm	DI	From Generator Control Panel

IO LIST

TAG NO.	DESCRIPTION	RANGE	I/O TYPE	COMMENTS
YS-600B	Generator Overspeed	0=Normal, 1=Alarm	DI	From Generator Control Panel
TSH-600	Generator High Temp	0=Normal, 1=Alarm	DI	From Generator Control Panel
YS-600C	Generator Overload	0=Normal, 1=Alarm	DI	From Generator Control Panel
MN-600	Generator Running	0=Normal, 1=Alarm	DI	From Generator Control Panel
			TOTAL I/O COUNT - DI:	14
			DO:	1
			AI:	6
			AO:	3
			Radio:	2

APPENDIX 40 61 00-C

FIELD INSTRUMENT LIST

Field Instrument List is included in Appendix 40 61 00-C. The Instrument List is included for reference only. Only major instruments are included in the Instrument List and miscellaneous switches, relays, and auxiliary devices are not included. Providing all instruments and devices necessary for a fully functioning system shall be the responsibility of the PCSI based on the Process Control Loop Descriptions per Appendix 40 61 00-D, auxiliary device requirements, and spare requirements as shown on the Drawings and specified herein.



**40 61 00 APPENDIX C
FIELD INSTRUMENT LIST**

TJC and Associates, Inc.

PROCESS AREA NO.	I TYPE	PROCESS LETTER	LOOP NO.	SUFFIX	INSTRUMENT TAG NO.	DESCRIPTIONS/LOCATION	RANGE	SETPOINT NOTE 5	UNITS	SPEC. REFERENCE		P&ID REF.	REMARK
										SECTION	PARAGRAPH		
	LE/LIT		110		LE/LIT-110	A1 Reservoir Level	0-30		ft	40 61 00		I-2	
	LE/LIT		120		LE/LIT-120	A2 Reservoir Level	0-30		ft	40 61 00		I-2	
					-								
	FE/FIT		100		FE/FIT-100	Zone A Flow	-10,000 to +10,000		gpm	40 61 00		I-2	
	FE/FIT		200		FE/FIT-200	Zone B Flow	-2,000 to +4,000		gpm	40 61 00		I-3	
	FE/FIT		300		FE/FIT-300	Zone C Flow	-2,000 to +6,500		gpm	40 61 00		I-4	
	TE/TIT		400		TE/TIT-400	Pump Station Building Temperature Transmitter	40 - 100		degrees F	40 61 00		I-5	
	PSL		010		PSL-010	Building Low Low Suction Pressure			psi	40 61 00		I-4	
					-								
	PSHH		210		PSHH-210	Zone B Booster Pump 1 High High Discharge Pressure Switch				40 61 00		I-3	Provided by Pump Motor Supplier
	TSH		210		TSH-210	Zone B Booster Pump 1 Over Temperature Switch				40 61 00		I-3	Provided by Pump Motor Supplier
	PSHH		220		PSHH-220	Zone B Booster Pump 2 High High Discharge Pressure Switch				40 61 00		I-3	Provided by Pump Motor Supplier
	TSH		220		TSH-220	Zone B Booster Pump 2 Over Temperature Switch				40 61 00		I-3	Provided by Pump Motor Supplier
	PSHH		230		PSHH-230	Zone B Booster Pump 3 High High Discharge Pressure Switch				40 61 00		I-3	Provided by Pump Motor Supplier
	TSH		230		TSH-230	Zone B Booster Pump 3 Over Temperature Switch				40 61 00		I-3	Provided by Pump Motor Supplier
					-								
	PSHH		310		PSHH-310	Zone C Booster Pump 1 High High Discharge Pressure Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	TSH		310		TSH-310	Zone C Booster Pump 1 Over Temperature Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	PSHH		320		PSHH-320	Zone C Booster Pump 2 High High Discharge Pressure Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	TSH		320		TSH-320	Zone C Booster Pump 2 Over Temperature Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	PSHH		330		PSHH-330	Zone C Booster Pump 3 High High Discharge Pressure Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	TSH		330		TSH-330	Zone C Booster Pump 3 Over Temperature Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	PSHH		340		PSHH-340	Zone C Booster Pump 4 High High Discharge Pressure Switch				40 61 00		I-4	Provided by Pump Motor Supplier
	TSH		340		TSH-340	Zone C Booster Pump 4 Over Temperature Switch				40 61 00		I-4	Provided by Pump Motor Supplier
					-								
	ZSH		001	A	ZSH-001-A	East Door Intrusion Alarm				40 61 00		I-5	
	ZSH		001	B	ZSH-001-B	West Door Intrusion Alarm				40 61 00		I-5	
	ZSH		001	C	ZSH-001-C	North Rollup Door Intrusion Alarm				40 61 00		I-5	
					-								
	ZSH		111		ZSH-111	Reservoir A1 Hatch Intrusion				40 61 00		I-5	
	ZSH		112		ZSH-112	Reservoir A1 Ladder Cage Intrusion				40 61 00		I-5	
	ZSH		121		ZSH-121	Reservoir A2 Hatch Intrusion				40 61 00		I-5	
	ZSH		122		ZSH-122	Reservoir A2 Ladder Cage Intrusion				40 61 00		I-5	
					-								
	AE/AIT		101		AE/AIT-101	Reservoir Chlorine Analyzer	0-110		ppm	40 61 00		I-4	
					-								
	YS		150	A	YS-150A	Generator Over Crank				EXISTING		I-5	Existing generator, relocated
	YS		150	B	YS-150B	Generator Overspeed				EXISTING		I-5	Existing generator, relocated
	TSH		150		TSH-150	Generator High Temperature				EXISTING		I-5	Existing generator, relocated
	YS		150	C	YS-150C	Generator Overload				EXISTING		I-5	Existing generator, relocated
	LSL		160		LSL-160	Fuel Tank Low Alarm				EXISTING		I-5	Existing generator, relocated
					-								
	LE/LIT		500		LE/LIT-500	Hypochlorite Storage Tank Level	0-8		ft	40 61 00		I-6	
	FE/FIT		501		FE/FIT-501	Chlorine metering pump dosage flow				EXISTING		I-6	Existing sensor reconnected
	AE/AIT		500		AE/AIT-500	Well field chlorine residual analyzer				EXISTING		I-6	Existing sensor reconnected
					-								

NOTES

1. NOT ALL DEVICES SHOWN ON THE P&ID ARE INCLUDED ON THIS LIST: HANDSWITCHES, INTERNAL PANEL DEVICES, PACKAGED EQUIPMENT, AND OTHER ITEMS ARE NOT SHOWN.
2. FINAL SETPOINTS AND SETTING RANGES TO BE PROVIDED BY THE INDICATED PACKAGED SYSTEM SUPPLIER.
3. MULTI-FUNCTION INSTRUMENTS MAY BE LISTED FOR EACH SEPARATE OUTPUT AND/OR SENSOR REQUIRED.
REFERENCE P&ID DRAWINGS FOR CLARIFICATION OF THE SIGNALS REQUIRED FROM EACH MULTI-FUNCTION INSTRUMENT.
4. ONLY ACTIVE POWERED DEVICES ARE LISTED IN THIS INDEX. GAGES, SITE GLASSES, THERMOMETERS, AND OTHER PASSIVE DEVICES SHALL BE PROVIDED AS SHOWN ON THE P&IDS
5. WHERE RANGES OR SETPOINTS ARE NOT PROVIDED, FIELD COORDINATE FINAL SETPOINTS WITH THE ENGINEER DURING COMMISSIONING
6. WORK IS INCLUDED AS PART OF SCHEDULES C, D AND E AND SHALL NOT BE PERFORMED IF THOSE SCHEDULES ARE NOT SELECTED.



40 61 00 APPENDIX C FIELD INSTRUMENT INDEX

TJC and Associates, Inc.

PROCESS AREA NO.	I TYPE	PROCESS LETTER	LOOP NO.	SUFFIX	INSTRUMENT TAG NO.	DESCRIPTIONS/LOCATION	RANGE	SETPOINT NOTE 5	UNITS	SPEC. REFERENCE		P&ID REF.	REMARK
										SECTION	PARAGRAPH		
	LSL		610		LSL-610	Fuel Tank Low Alarm				26 32 13		I-7	Provided by Generator Supplier
	TSH		600	A	TSH-600A	Generator Over Crank				26 32 13		I-7	Provided by Generator Supplier
	YS		600	B	YS-600B	Generator Overspeed				26 32 13		I-7	Provided by Generator Supplier
	TSH		600		TSH-600	Generator High Temperature				26 32 13		I-7	Provided by Generator Supplier
	YS		600	C	YS-600C	Generator Overload				26 32 13		I-7	Provided by Generator Supplier
					-								
	AE/AIT		500		AE/AIT-500	Chlorine Analyzer	0-110		ppm	40 61 00		I-6	EXISTING
	FE/FIT		500		FE/FIT-500	Wellfield Flow	-2,000 to +13,200		gpm	40 61 00		I-2, I-6	Provided By Others
	LE/LIT		500		LE/LIT-500	Hypochlorite Tank Level	TBD		ft	40 61 00		I-6	
	FE/FIT		501		FE/FIT-501	Chlorine Flowrate	TBD						EXISTING
					-								
	SV		502		SV-502	Solenoid Altitude Flow	0=Open, 1=Close					I-2, I-6	Provided by Others
					-								
					-								
					-								
					-								
					-								
					-								
					-								
					-								
					-								
					-								
					-								
					-								
					-								

NOTES

1. NOT ALL DEVICES SHOWN ON THE P&ID ARE INCLUDED ON THIS LIST: HANDSWITCHES, INTERNAL PANEL DEVICES, PACKAGED EQUIPMENT, AND OTHER ITEMS ARE NOT SHOWN.
2. FINAL SETPOINTS AND SETTING RANGES TO BE PROVIDED BY THE INDICATED PACKAGED SYSTEM SUPPLIER.
3. MULTI-FUNCTION INSTRUMENTS MAY BE LISTED FOR EACH SEPARATE OUTPUT AND/OR SENSOR REQUIRED.
REFERENCE P&ID DRAWINGS FOR CLARIFICATION OF THE SIGNALS REQUIRED FROM EACH MULTI-FUNCTION INSTRUMENT.
4. ONLY ACTIVE POWERED DEVICES ARE LISTED IN THIS INDEX. GAGES, SITE GLASSES, THERMOMETERS, AND OTHER PASSIVE DEVICES SHALL BE PROVIDED AS SHOWN ON THE P&IDS
5. WHERE RANGES OR SETPOINTS ARE NOT PROVIDED, FIELD COORDINATE FINAL SETPOINTS WITH THE ENGINEER DURING COMMISSIONING
6. WORK IS INCLUDED AS PART OF SCHEDULES C, D AND E AND SHALL NOT BE PERFORMED IF THOSE SCHEDULES ARE NOT SELECTED.

SECTION 40 61 96

PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Develop the control system applications to implement the operational control descriptions for all systems. All process automation controller (PAC) programming, communication networks, and Human Machine Interface (HMI) graphics and programming shall be performed by the SCADA System Programmer (SSP) designated in Section 40 61 00. This Section is provided to clarify control strategies to be used to program the system.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- C. All programming of PACs, OITs, HMIs, and other equipment shall be performed by the SSP as defined under Section 40 60 00.
- D. The SSP is cautioned to read this section in its entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section. The SSP shall implement these general strategies throughout the programming provided under this Contract unless specifically directed otherwise in the detailed Process Control Descriptions included in Appendix 40 61 00-A.
- E. Loop and device tagging criteria shown on the Drawings shall be followed without exception.

1.02 RELATED WORK

- A. Refer to Section 40 61 00 Process Instrumentation and Control - General Provisions
- B. Refer to Section 40 62 00 SCADA System Hardware and Software
- C. Refer to Section 40 61 00 Appendix A for Specific Process Control Descriptions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. The loop descriptions included in Appendix 40 61 00 -A are sorted by loop/device number.
- B. The loop descriptions are broken into a hierarchical layer concept:
 - 1. There may be one layer or multiple layers per loop, depending upon the specific requirements and characteristics of that loop.

2. An example of a multiple layered loop is as follows:
 - a. The lowest layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive.
 - b. The second layer of control is the Motor Control Center (MCC).
 - c. The third layer of control is at the Operator Interface Terminal (OIT) at the local area control panel.
 - d. The fourth layer of control is by the SCADA System with its associated operator workstations located at the treatment facility or via the operator's remote access.
3. HMI refers to the computer based control computers configured with a graphical interface to the SCADA System for implementing all operator-required tasks as described herein. Functions labeled under the HMI shall be able to be implemented at all the SCADA HMI's and associated local OITs.

3.02 GENERAL PROGRAMMING REQUIREMENTS

- A. The requirements specified herein represent general programming and control loop requirements to be followed by the PCSI for all programming efforts provided under this Contract. These general configuration and control requirements shall be used in conjunction with the detailed process control loop descriptions included in the following Appendix 406196-A to provide the complete process control loop functionality. The detailed process control loop descriptions do not describe the common configuration and programming requirements and conversely, these general requirements do not address process control specifics unique to a specific loop. However, if conflicts occur between these general requirements and the detailed process control descriptions, the detailed requirements shall be followed.
- B. Not all I/O signals are specifically defined in the Control Descriptions that are included in Appendix 40 61 00-A. Control programming, alarming handling, status displays, variable displays, and historical data collection, shall be implemented as specified herein, for all I/O points listed in Section 40 61 00.
- C. The Human Machine Interface (HMI) refers to the computer based graphical interface for implementing all operator required tasks as described in these Specifications. HMI for this project refers to both the SCADA workstation operator graphics, and the local Operator Interface Terminal (OIT) at each pump station facility. The HMI sends and receives data to and from the PAC based control system. The PACs control and monitor the process equipment (pumps, valves, flowmeters, field sensors, etc.) through the input and output of electrical signals. In general, only loops requiring PAC and/or HMI programmed logic are described in the following control loops. Hardwired, relay based control schemes, where required, are included on the schematic control diagrams included on the Drawings.
- D. Process controls and monitoring of the process equipment shall be implemented using a library of modular control objects that incorporate control logic, data structures, alarming, and graphics. All program control logic and alarming functions shall be performed in the PAC. The modular control objects shall be developed by the SSP specifically for this project using the SCADA programming environment as specified in Section 40 60 00. To the extent possible, common functions shall be implemented consistently using modular PAC and SCADA control objects and data structures for all of the process equipment.

- E. PAC programs shall be developed by the SSP to match existing District program standards, format, and structure. Programming shall use Function Block Diagram (FBD), and Ladder Logic (LD). Structured Text (ST) as necessary to match District standards.
- F. All processor programs shall be configured to allow modification of set points, timers, etc. readily by Owner personnel using the HMI as identified in the loop descriptions. Logic in the processor program shall be configured to allow modification using the programming devices and software either provided under this Contract and/or existing devices and software as described under Section 40 61 00. All plant control and alarm logic shall be resident in the processors. The system shall continue to operate properly in automatic mode upon failure of the HMI servers.
- G. All HMI “push button” inputs to the PAC shall be programmed to turn the associated memory bit in the PAC “ON” and upon completion of the required action, turn the associated memory bit “OFF”. The PAC internal logic shall sense the bit ON, and upon completion of the associated required action the PAC shall reset the bit to OFF. Reset of the bit shall occur within one PAC programming scan.
- H. Any operator entered setpoint change shall include verification logic within the HMI that requires a second, positive selection of the action by the operator (such as an OKAY button) prior to performing the command. Other operator-controlled operations (e.g., pump start/stop, open/close valve control) shall, in general, not require the second positive action. Selection of a control point shall also present the last valid set point or command sent to the device.
- I. Operator entered setpoints shall be limited to the reasonable operating range of the related process. Setpoints that are entered outside of the reasonable operating range shall be rejected and the setpoint shall return to its previous value. Reasonable operating ranges shall be determined based on Workshop discussions during the software development process.
- J. Incorporate failure of sequence logic to alarm upon incomplete or malfunction if the required operation does not occur within an adjustable time period, initially set at 5 seconds for electric motors, 30 seconds for diesel engines, and 90 seconds for gates and valves. Sequence failure alarm shall put the associated device(s) in FAIL mode if a control system command, either manual or automatic, is not verified by the appropriate action of the device. For example, if a valve is called to open and confirmation of the open valve is not received after the adjustable time period, issue a valve failure alarm; if a motor is called to run and confirmation of the running motor is not received after the adjustable time period, issue a motor fail to start malfunction alarm.
- K. Motors that have an H/O/A, L/O/R, or other control mode shown on the Drawings shall indicate at the HMI that the pump is being run in the respective active position (i.e. “Hand”, “Auto”, “Local”, or “Remote” positions). Incorporate a “Ready” state for each controlled device indicating the switch hierarchy is in the appropriate “Remote” and “Auto” positions with the equipment “Not Failed” so that control from the PAC is feasible.
- L. When a power failure occurs, the systems shall fail OFF, OPEN, CLOSE, or other Engineer determined safe position as identified in the loop descriptions. PAC controlled equipment shall be restarted automatically to re-establish the process when power is restored. Motor restart after power failure shall include user adjustable time delays (0-30

seconds) to allow stagger starting of motor loads to limit inrush currents. Motor restart time delays shall only be active following a power failure restart.

- M. All alarms shall display on a process control graphic and also tabulated on a common alarm screen. All alarms must be acknowledged by the plant staff before they can be cleared. No alarm shall clear from the alarm summary automatically until it has been acknowledged by the operator.
- N. Process alarms that are based on digital input signals shall include an operator-adjustable time delay and an HMI-selectable Enable/Disable selector switch. Process alarms that are currently disabled shall be clearly indicated on the HMI as disabled.
- O. Process alarms that are based on analog input signals shall be generated in PAC logic. The alarms required for each instrument are detailed in the specific Loop Descriptions below. Process alarm setpoints shall be adjustable at the HMI and shall be the same variable type as the process variable that they are associated with (e.g. REAL, INTEGER, etc.).
- P. All analog points brought into the process controller shall incorporate variable range alarms at the PAC with adjustable setpoints from the HMI. Set variable range alarms (low-low, low, high, and high-high) at 10%, 20%, 80%, and 90% of field instrument calibrated span unless specifically noted otherwise in the detailed loop descriptions or instrument list. All adjustable alarm set points shall be password protected.
- Q. All analog inputs shall be configured for presentation on trend screens of related variables and stored in the historical data system.
- R. All setpoints for controls, shutdown conditions, alarms, etc. derived from analog signals conditions shall be individually configured with adjustable deadbands (initially set at 3% deviation from set point) and time delays (initially set at 5 seconds) to avoid nuisance tripping and assist with system startup.
- S. Provide flow totalization as part of process controller logic for all flowmeter inputs to the process controller. Display the totalized flows along with the instantaneous flow rate for each flowmeter at the HMI.
- T. Provide PAC resident equipment runtime totalization for all new and existing equipment where Running status is monitored. Provide equipment start counter for all new and existing equipment where Running status is monitored. Provide individual HMI based reset commands for both run times and start counters for each piece of equipment.
- U. Historical Data Collection - All analog inputs, operator process control setpoints, and discrete equipment ON/OFF status shall be collected and stored in the Historian database and incorporated on fixed trend screens of related variables. Historical data collection shall be configured to match District standards
- V. Monitor PAC condition and CPU, power supplies, I/O points, and other components using integral PAC diagnostics. Develop PAC specific HMI monitoring graphics for PAC component conditions.
- W. Monitor communications and performance of the telemetry system between the SCADA servers and PACs, and between PACs. The system shall include the ability to remove sites

from polling from the HMI for maintenance purposes. Monitor and display current communications status, and communication statistics available from the network and telemetry equipment.

- X. Provide password protection at the HMI, PAC, and communication network interfaces and control access to the respective devices in conformance with District security requirements. Coordinate password selection and implementation with the District.

END OF SECTION

APPENDIX 40 61 96-A

SYSTEM OPERATIONAL DESCRIPTION

1.0 GENERAL

- A. System operation descriptions refer to operational and monitoring requirements of control elements.
- B. Detailed Loop Specific Control Descriptions should be used in conjunction with the project P&ID Drawings and electrical schematic diagrams. Abbreviations and conventions used throughout are shown on Drawings GI-1 through GI-3.

2.0 SYSTEM OVERVIEW

- A. The Booster Pump Station (BPS) shall monitor and control the B and C booster pumps, A1/A2 Reservoir, District well pumps and other system components. The electrical control panel shall include controls for pump on/off levels, pump rotations, system alarms, the automatic transfer switch and auxiliary controls.
- B. The A1/A2 Reservoirs provide operational and emergency water storage for Zone A and are the forebay to the B/C Zones Booster Pump Station. A1/A2 Reservoirs shall be refilled by District wells 10, 11, 29, 30, 31, 34 and 35. Wells 10, 11, 29, 30, 31, 34 and 35 shall be controlled based on A1/A2 Reservoir levels using a digital (on/off) ultrasonic level monitoring system which shall output a 4-20mA signal to the pump controller for the wells. B-booster pumps shall be controlled based on Reservoir B levels. C-booster pumps shall be controlled based on Reservoir C1 levels.
- C. The 3 variable speed dosing pumps for the chlorination system are located at the Intermediate Reservoir site. New PLC control panel located in the Chlorination Building shall monitor and control the dosing pumps. Dosing pumps shall be controlled by the Ord Wellfield main line flow upstream. A flow meter shall be installed upstream of the suction of the F-booster pump station and a chlorine analyzer shall be installed at the discharge to monitor the residual chlorine level. Remote site status shall be routed to the new PLC panel from the F Booster control panel.
- D. Communications between the Zone B/C Booster Pump Station and remote sites are through a wireless radio communication link.
- E. Indicated control level heights are preliminary. Provide final control level set points during startup and commissioning as directed by the District.

3.0 CONTROL LOOP INDEX

P&ID	Loop No.	Instrument/Equip ID	Description
I-2 (I-6)	100	FE/FIT-100	Zone A Flow to B/C BPS and Reservoir A1/A2
I-2	110	LE/LIT-110	A1 Reservoir Level A
I-2	120	LE/LIT-120	A2 Reservoir Level A
I-2	502	SOV-502	Altitude Solenoid Valve (SOV provided by Others)
I-3	200	FE/FIT-200	Zone B Flow
I-3	210	P-210	Zone B Pump 1
I-3	220	P-220	Zone B Pump 2
I-3	230	P-230	Zone B Pump 3
I-4	010	PSLL-010	Booster Pump Station Suction Pressure
I-4	101	AE/AIT-101	Chlorine Residual Analyzer
I-4	300	FE/FIT-300	Zone C Flow
I-4	310	P-310	Zone C Pump 1
I-4	320	P-320	Zone C Pump 2
I-4	330	P-330	Zone C Pump 3
I-4	340	P-340	Zone C Pump 4
I-5	001A	ZSH-001A	Pump Station East Door Intrusion
I-5	001B	ZSH-001B	Pump Station West Door Intrusion
I-5	001C	ZSH-001C	Pump Station Roll-up Door Intrusion
I-5	111	ZSH-111	Reservoir A1 Hatch Intrusion
I-5	112	ZSH-112	Reservoir A1 Ladder Cage Intrusion
I-5	121	ZSH-121	Reservoir A2 Hatch Intrusion
I-5	122	ZSH-122	Reservoir A2 Ladder Cage Intrusion
I-5	150	G-150	BPS B/C Generator
I-5	160	T-160	BPS B/C Generator Fuel Tank
I-5	400	TE/TIT-400	Pump Station Room Temperature
I-6	500	LE/LIT-500	Hypochlorite Tank Level
I-2,I-6	500	FE/FIT-500	Zone A Wellfield Main Flow Meter
I-6	500	AE/AIT-500	Chlorine Residual Analyzer

P&ID	Loop No.	Instrument/Equip ID	Description
I-6	510	P-510	Hypochlorite Dosing Pump 1
I-6	520	P-520	Hypochlorite Dosing Pump 2
I-6	530	P-530	Hypochlorite Dosing Pump 3
I-7	600	G-600	F Booster Generator
I-7	610	T-610	F Booster Generator Fuel Tank

4.0 DETAILED LOOP SPECIFIC CONTROL DESCRIPTIONS

A. Notes:

1. Use of the term N/A (Not Applicable) indicates existing field level controls or monitoring devices that are included in the description for completeness but not included in the work performed under this Contract except for new monitoring circuits to new control panels or HMI as indicated on the Contract Documents.
2. Descriptions refer to locations of alarm and control elements. Refer to I/O list for specific termination points of field sensors, switches, and panel lights.
3. Unless noted otherwise all panel mounted lights, control stations, indicators, and signal selectors shall be driven from resident PAC outputs and feed to resident PAC inputs.

LOOP 100: Zone A Flow to B/C BPS and A1/A2 Reservoir

PID: I-02

Equipment ID: FE/FIT-100, SOV 100

General: Monitors Zone A flow to/from B/C BPS and A1/A2 Reservoir

Control:

Field:

None.

Local:

None.

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

N/A

Alarms and Monitoring:

Field:

FIT-100

Local:

None.

Remote (MCP/OIT):

Zone A Flow (FIT-100)

Zone A Flow Fault (FUA-100)

Zone A Flow Totalizer (FIQ-100)

Remote (MCWD Corporate Yard):

Zone A Flow

Zone A Flow Fault (FUA-100)

Zone A Flow Totalizer (FIQ-100)

LOOP 110: A1 Reservoir Level

PID: I-02

Equipment ID: LIT-110

General: Monitors Reservoir A1 Level. Ord Well Field pumps (Wells 29, 30, 32, 34 and 35) and Marina well pumps (Wells 11 and 12) are controlled based off Reservoir A1/A2 levels.

Provide an HMI resident selector switch to allow operators to select tank level control variable as described below: use both LIT-110 and LIT 120 (average) when both are in service and operating within range (i.e. valid 4-20mA signal) or to manually select using LIT-110 or LIT-120 if transmitter fails or if a tank is out of service.

Control:

Field:

None

Local:

None.

Remote (MCP/OIT):

Ord wellfield pumps (Wells 29, 30, 32, 34 and 35) are controlled by the A1 and A2 reservoir levels. Strategy is as below:

- IF Level > High SP, alarm and stop all wells
- IF Level > Full SP, stop all wells
- IF Level > Low, maintain current wells
- IF Level < Low

IF no wells running, start lead well

IF wells running and level rising, maintain current wells

IF wells running and level falling, start next well

Remote (MCWD Corporate Yard):

Ord wellfield pumps (Wells 29, 30, 32, 34 and 35) are controlled by the A1 and A2 reservoir levels. Strategy is as below:

- IF Level > High SP, alarm and stop all wells
- IF Level > Full SP, stop all wells
- IF Level > Low, maintain current wells

- IF Level < Low
 - IF no wells running, start lead well
 - IF wells running and level rising, maintain current wells
 - IF wells running and level falling, start next well

Power Failure State

None.

Alarms and Monitoring:

Field:

LIT-110

Local:

None

Remote (MCP/OIT):

Level (LIT-110)
Level Fault (LUA-110)
Level High High Alarm (LAHH)
Level High Alarm (LAH)
Level Low Alarm (LAL)
Level Low Low Alarm (LALL)

Remote (MCWD Corporate Yard):

Level (LIT-110)
Level Fault (LUA-110)
Level High High Alarm (LAHH)
Level High Alarm (LAH)
Level Low Alarm (LAL)
Level Low Low Alarm (LALL)

Remote (Win 911):

Level Fault (LUA-110)
Level High High Alarm (LAHH)
Level High Alarm (LAH)
Level Low Alarm (LAL)
Level Low Low Alarm (LALL)

LOOP 120: A2 Reservoir Level

PID: I-02

Equipment ID: LIT-120

General: Functionally the same as Loop 110

LOOP 502: Intermediate Reservoir Altitude Valve Control Solenoid

PID: I-02

Equipment ID: SOV 502

General: Control reservoir flow via solenoid powered altitude valve.

Control:

Field:

None.

Local:

None.

Remote (MCP/OIT):

Solenoid controlled altitude valve shall be normally open, energize to close. Upon starting either of the F Booster Pumps, energize the solenoid to shut the valve from the existing F Booster control panel PAC. De-energize the valve (to open) once Intermediate Reservoir level drops 10 ft. Intent is to draw down tank level on start of the F-Booster then reopens at the lower water level.

Should valve command be issued without the expected change in the Intermediate Tank Level over an adjustable time period, issue a valve fault alarm.

Remote (MCWD Corporate Yard):

None.

Interlocks:

Valve position interlocked with F Booster Pump operation and Intermediate Tank level.

Power Failure State:

Valve fails to normally open position

Alarms and Monitoring:

Field:

None

Local:

None.

Remote (MCP/OIT):

Valve energized state (On/Off).

Remote (MCWD Corporate Yard):

Valve energized state (On/Off)

LOOP 200: Zone B Flow

PID: I-03

Equipment ID: FIT-200

General: Monitors Zone B Flow

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

N/A

Alarms and Monitoring:

Field:

FIT-200

Local (MCC):

None.

Remote (MCP/OIT):

Zone B Flow (FIT-200)

Zone B Flow Fault (FUA-200)

Zone B Flow Totalizer (FIQ-200)

Remote (MCWD Corporate Yard):

Zone B Flow (FIT-200)

Zone B Flow Fault (FUA-200)

Zone B Flow Totalizer (FIQ-200)

Remote (Win 911):

Zone B Flow Fault (FUA-200)

LOOP 210: Zone B Booster Pump 1

PID: I-03

Equipment ID: P-210, TSH-210, PSHH-210

General:

Zone B booster pumps operate in a Lead/Lag/Standby configuration to distribute water from Zone A to Zone B. Control of the B-Booster pumps is dependent on Reservoir B level and shall be interlocked when B/C BPS low suction pressure is detected. Pump rotation is pulsed each time the Lead pump is called in remote run.

Lead Pump is commanded to Run when Reservoir B level is greater than 3.2 feet and commanded Off when level reaches 14.5 feet.

Lag pump is commanded to run when Reservoir B level is greater than 5 feet and commanded Off when level reaches 12 feet.

Both Lead and Lag pumps are interlocked when Reservoir B level is greater than 15 feet, B/C BPS low suction pressure is detected or when A1/A2 Reservoir A1/A2 is less than 6 feet. There is an adjustable time delay between pump calls (initially set at 5 seconds).

Control:

Field:

None.

Local (MCC):

Hand/Off/Remote (HS-310A)

Reset (HS-210B)

Remote (MCP/OIT):

Auto/Manual – In Manual mode, pump is controlled at the motor starter. In Auto mode, pump is controlled by remote PAC call.

B-booster pumps are controlled based on B reservoir level in a Lead/Lag/Standby manner. Strategy is as below:

- IF B Reservoir Level < 3.2 feet, start Lead pump after 5 second delay and stop Lead pump when level rises above 14.5 after 5 second delay.
- IF Lead pump is running B Reservoir Level < 5 feet, start Lag pump after 5 second delay and stop Lag pump when level rises above 12 after 5 second delay second delay.
- IF B Reservoir Level > 15, stop all pumps
- IF A1/A2 Reservoir Level < 6, stop all pumps

Remote (MCWD Corporate Yard):

Manual On/Off – All automated control is resident at the MCC or MCP only

Interlocks:

Pump is interlocked from running if any of the below is true:

- Over Temperature HS-210A Alarm (TAH-210)
- High High Discharge Pressure Alarm (PAHH-210)
- Pump Fail Alarm (UA-210)
- HS-210A in “Off” position
- IF B Reservoir Level > 15, stop all pump
- IF A1/A2 Reservoir Level < 5, stop all pumps
- Pump Station Low Low Suction Pressure (PSL-010)

Power Failure State:

All Pumps Off.

Alarms and Monitoring:

Field:

None

Local (MCC):

Elapse Time Meter (KQ-210)

Over Temperature Light Indication (TLH-210)

High High Discharge Pressure Light Indication (PLHH-210)

Pump Fail Alarm (ULA-210)

Pump Running Light Indication (MLN-210)

Remote (MCP/OIT):

Elapsed Runtime Counter

Over Temperature Alarm (TAH-210)

High High Discharge Pressure Alarm (PAHH-210)

Pump Fail Alarm (UA-210)

Pump Running Status (MN-210)

Remote (MCWD Corporate Yard):

Elapsed Runtime Counter

Over Temperature Alarm (TAH-210)

High High Discharge Pressure Alarm (PAHH-210)

Pump Fail Alarm (UA-210)

Pump Running Status (MN-210)

Remote (Win 911):

Over Temperature Alarm (TAH-210)

High High Discharge Pressure Alarm (PAHH-210)
Pump Fail Alarm (UA-210)
Pump Running Status (MN-210)

LOOP 220: Zone B Booster Pump 2

PID: I-03

Equipment ID: P-220, TSH-220, PSHH-220

General: Functionally the same as Loop 210.

LOOP 230: Zone B Booster Pump 3

PID: I-03

Equipment ID: P-230, TSH-230, PSHH-230

General: Functionally the same as Loop 210.

LOOP 010: Pump Station Low Low Suction Pressure Switch

PID: I-4

Equipment ID3: PSL-010

General: Monitors pump station low low suction pressure.

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP/OIT):

Shutdown Zone B and Zone C booster pumps and interlock from running

Remote (MCWD Corporate Yard):

None.

Interlocks:

Zone B and Zone C booster pumps operational interlock

Power Failure State:

N/A.

Alarms and Monitoring:

Field:

None

Local (MCC):

None.

Remote (MCP/OIT):

Pump Station Low Low Suction Pressure Alarm (PALL-010)

Remote (MCWD Corporate Yard):

Pump Station Low Low Suction Pressure Alarm (PALL-010)

Remote (Win 911):

Pump Station Low Low Suction Pressure Alarm (PALL-010)

LOOP 101: Chlorine Analyzer

PID: I-04

Equipment ID: AE/AIT-101

General: Monitors Residual Chlorine Level. Should residual chlorine level drop below a user adjustable low level setpoint or exceed a user adjustable high level setpoint, issue an alarm (UA-101)

Control:

Field:

None.

Local:

None.

Remote (MCP):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

Off.

Alarms and Monitoring:

Field:

AIT-101

Local:

N/A

Remote (LCP7/OIT):

Residual Chlorine Level (AIT-101)

Residual Chlorine Level Alarm (UA-101)

Remote (MCWD Corporate Yard):

Residual Chlorine Level (AIT-101)

Residual Chlorine Level Alarm (UA-101)

Remote (Win 911):

Residual Chlorine Level Alarm (UA-101)

LOOP 300: Zone C Flow

PID: I-04

Equipment ID: FE/FIT-300

General: Monitors Zone B Flow

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

N/A.

Alarms and Monitoring:

Field:

FIT-300

Local (MCC):

None.

Remote (MCP/OIT):

Zone C Flow (FIT-300)

Zone C Flow Fault (FUA-300)

Zone C Flow Totalizer (FIQ-300)

Remote (MCWD Corporate Yard):

Zone C Flow (FIT-300)

Zone C Flow Fault (FUA-300)

Zone C Flow Totalizer (FIQ-300)

Remote (Win 911):

Zone C Flow Fault (FUA-300)

LOOP 310: Zone C Booster Pump 1

PID: I-04

Equipment ID: P-310, TS-310, PSHH-310

General: Zone C booster pumps consists of 4 pumps (1 future) that operate in a Lead/Lag 1/Lag 2/Standby configuration that distribute water from Zone A to Zone C. Pump rotation is pulsed each time the Lead pump is called in remote run.

Lead Pump is commanded to Run when average Reservoir C1 and C2 level is less than 6 feet and commanded Off when average Reservoir C1 and C2 level reaches 24 feet.

Lag 1 pump is commanded to run when Lead Pump is running and average reservoir level is less than 8 feet and commanded Off when level reaches 26 feet.

Lag 2 pump is commanded to run when Lead and Lag 1 pumps are both running and average Reservoir C1 and C2 level is less than 10 feet and commanded Off when average Reservoir C1 and C2 level reaches 28 feet.

Lead, Lag 1, and Lag 2 pumps are interlocked when Reservoir C1 or C2 level is greater than 29 feet, B/C BPS low suction pressure is detected or when Reservoir A1 or A2 is less than 6 feet. Provide an adjustable time delay between pump calls (initially set at 5 seconds).

Control:

Field:

None.

Local (MCC):

Hand/Off/Remote (HS-310A)

Reset (HS-310B)

Remote (MCP/OIT):

Auto/Manual – In Manual mode, pump is controlled at the motor starter. In Auto mode, pump is controlled by remote PAC call.

C-booster pumps are controlled based on Reservoir C1 and C2 level in a Lead/Lag1/Lag2/Standby manner. Strategy is as below:

- IF Reservoir C1/C2 Level < 6 feet, start Lead pump after 5 second delay and stop Lead pump when level rises above 24 after 5 second delay.
- IF Reservoir C1/C2 Level < 8 feet, start Lag1 pump after 5 second delay and stop Lag1 pump when level rises above 26 after 5 second delay.
- IF Reservoir C1/C2 Level < 10 feet, start Lag2 pump after 5 second delay and stop Lag2 pump when level rises above 28 after 5 second delay.
- IF Reservoir C1/C2 Level > 29, stop all pumps and interlock
- IF Reservoir A1/A2 Level < 6, stop all pumps and interlock

Remote (MCWD Corporate Yard):

Manual On/Off – All automated control is resident at the MCC or MCP only

Interlocks:

Pump is interlocked from running if any of the below are true:

- Over Temperature HS-310A Alarm (TAH-310)
- High High Discharge Pressure Alarm (PAHH-310)
- Pump Fail Alarm (UA-310)
- HS-310A in "Off" position
- IF Reservoir C1 or C2 Level > 29, stop all pumps and interlock
- IF Reservoir A1 or A2 Level < 6, stop all pumps and interlock
- Pump Station Low Low Suction Pressure (PSL-010)

Power Failure State:

Pump Off.

Alarms and Monitoring:

Field:

None,

Local (MCC):

Elapse Time Meter (KQ-310)

Over Temperature Light Indication (TLH-310)

High High Discharge Pressure Light Indication (PLHH-310)

Pump Fail Alarm (ULA-310)

Pump Running Light Indication (MLN-310)

Remote (MCP/OIT):

Elapsed Runtime Counter

Over Temperature Alarm (TAH-310)

High High Discharge Pressure Alarm (PAHH-310)

Pump Fail Alarm (UA-310)

Pump Running Status (MN-310)

Remote (MCWD Corporate Yard):

Elapsed Runtime Counter

Over Temperature Alarm (TAH-310)

High High Discharge Pressure Alarm (PAHH-310)

Pump Fail Alarm (UA-310)

Pump Running Status (MN-310)

Remote (Win 911):

Over Temperature Alarm (TAH-310)

High High Discharge Pressure Alarm (PAHH-310)

Pump Fail Alarm (UA-310)

LOOP 320: Zone C Booster Pump 2

PID: I-04

Equipment ID: P-320, TS-320, PSHH-320

General: Functionally the same as Loop 310.

LOOP 330: Zone C Booster Pump 3

PID: I-04

Equipment ID: P-330, TS-330, PSHH-330

General: Functionally the same as Loop 310.

LOOP 340: Zone C Booster Pump 4 (FUTURE)

PID: I-04

Equipment ID: P-340, TS-340, PSHH-340

General: Functionally the same as Loop 310. Provide all PAC logic for operating future pump under this Contract

LOOP 001A: Pump Station East Door Intrusion

PID: I-05

Equipment ID: ZSH-001A

General: Monitors east door pump station intrusion switch.

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

N/A.

Alarms and Monitoring:

Field:

None

Local (MCC):

None.

Remote (MCP/OIT):

Pump Station East Door Intrusion Alarm (ZAH-001A)

Remote (MCWD Corporate Yard):

Pump Station East Door Intrusion Alarm (ZAH-001A)

Remote (Win 911):

Pump Station East Door Intrusion Alarm (ZAH-001A)

LOOP 001B: Pump Station West Door Intrusion

PID: I-05

Equipment ID: ZSH-001B

General: Monitors West door PS intrusion switch. Functionally similar to Loop 001A

LOOP 001C: Pump Station Roll-up Door Intrusion

PID: I-05

Equipment ID: ZSH-001C

General: Monitors North roll-up door PS intrusion switch. Functionally similar to Loop 001C

LOOP 111: Reservoir A1 Hatch Intrusion

PID: I-05

Equipment ID: ZSH-111

General: Monitors Reservoir A1 Hatch intrusion switch.

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State

N/A.

Alarms and Monitoring:

Field:

None

Local (MCC):

None.

Remote (MCP/OIT):

Monitors Reservoir A1 Hatch intrusion Alarm (ZAH-111)

Remote (MCWD Corporate Yard):

Monitors Reservoir A1 Hatch intrusion Alarm (ZAH-111)

Remote (Win 911):

Monitors Reservoir A1 Hatch intrusion Alarm (ZAH-111)

LOOP 112: Reservoir A1 Ladder Cage Intrusion

PID: I-05

Equipment ID: ZSH-112

General: Monitors Reservoir A1 Ladder Cage Intrusion switch.

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State

N/A.

Alarms and Monitoring:

Field:

None

Local (MCC):

None.

Remote (MCP/OIT):

Monitors Reservoir A1 Ladder Cage Intrusion Alarm (ZAH-112)

Remote (MCWD Corporate Yard):

Monitors Reservoir A1 Ladder Cage Intrusion Alarm (ZAH-112)

Remote (Win 911):

Monitors Reservoir A1 Ladder Cage Intrusion Alarm (ZAH-112)

LOOP 121: Reservoir A2 Hatch Intrusion

PID: I-05

Equipment ID: ZSH-121

General: Monitors Reservoir A2 Hatch intrusion switch. Functionally similar to Loop 111

LOOP 122: Reservoir A2 Ladder Cage Intrusion

PID: I-05

Equipment ID: ZSH-122

General: Monitors Reservoir A2 Ladder Cage Intrusion switch. Functionally similar to Loop 121

LOOP 150: Generator G-150 Equipment

PID: I-05

Equipment ID: G-150

General: Monitors status and alarms for engine generator. Engine-generator set is existing, being relocated under this Contract.

Control:

Field:

None.

Local :

None

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

Call to run via ATS

Alarms and Monitoring:

Field:

None,

Local (Generator Control Panel)

Existing control panel relocated under this project

Remote (MCP/OIT):

Overcrank (YA-150A)

Overspeed (YA-150B)

High Temp (TAH-150)

Running (MN-150)

Overload (YA-150C)

Remote (MCWD Corporate Yard):

Overcrank (YA-150A)

Overspeed (YA-150B)

High Temp (TAH-150)

Running (MN-150)

Overload (YA-150C)

Remote (Win 911):

G-150 Composite Fault (UA-150)

LOOP 160: Generator Fuel Tank T-160

PID: I-05

Equipment ID: T-160

General: Monitors engine generator fuel tank level. Fuel tank is existing, being relocated under this Project.

Control:

Field:

None.

Local :

None

Remote (MCP/OIT):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

None.

Alarms and Monitoring:

Field:

None,
Local (Generator Control Panel)
Existing control panel relocated under this project
Remote (MCP/OIT):
Fuel Tank Low (LAL-160)
Remote (MCWD Corporate Yard):
Fuel Tank Low (LAL-160)
Remote (Win 911):
G-150 Fuel Tank Low (LAL-160)

LOOP 400: Pump Station Building Temperature

PID: I-05

Equipment ID: TE/TIT-400

General: Monitors Pump Station Building Temperature

Control:

Field:

None.

Local (MCC):

None.

Remote (MCP):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

None.

Alarms and Monitoring:

Field:

TIT-400

Local (MCC):

None.

Remote (MCP/OIT):

Pump Station Building Temperature (TIT-400)

Pump Station Building Temperature Transmitter Fault Alarm (TUA-400)

Remote (MCWD Corporate Yard):

Pump Station Building Temperature (TIT-400)

Pump Station Building Temperature Transmitter Fault Alarm (TUA-400)

Remote (Win 911):

Pump Station Building Temperature Transmitter Fault Alarm (TUA-400)

LOOP 500: Hypochlorite Tank Level

PID: I-06

Equipment ID: LIT-500

General: Monitors the hypochlorite tank level for the chlorination system located in the F-Booster pump station.

Control:

Field:

None.

Local:

None.

Remote (LCP-7A):

None.

Remote (MCWD Corporate Yard):

None.

Power Failure State

N/A

Alarms and Monitoring:

Field:

LIT-500

Local:

None

Remote (LCP-7/OIT):

Level (LIT)

Level High High Alarm (LAHH)

Level High Alarm (LAH)

Level Low Alarm (LAL)

Level Low Low Alarm (LALL)

Remote (MCWD Corporate Yard):

Level (LIT)

Level High High Alarm (LAHH)

Level High Alarm (LAH)

Level Low Alarm (LAL)

Level Low Low Alarm (LALL)

Remote (Win 911):

Level High High Alarm (LAHH)

Level High Alarm (LAH)

Level Low Alarm (LAL)

Level Low Low Alarm (LALL)

LOOP 500: Ord Wellfield Main Line Flow

PID: I-06

Equipment ID: FE/FIT-500

General: Monitors Ord Wellfield Main Line Flow

Control:

Field:

None.

Local:

None.

Remote (LCP-7A):

Cascaded PID loops based Residual Chlorine Level setpoint and Ord Main Line Flow SP is used to control the 3 metering pumps. Refer to Loop 510.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

Off.

Alarms and Monitoring:

Field:

FIT-500

Local:

None.

Remote (LCP-7/OIT):

Ord Wellfield Main Line Flow (FIT-500)

Ord Wellfield Main Line Flow Fault (FUA-500)

Ord Wellfield Main Line Flow Totalizer (FIQ-500)

Remote (MCWD Corporate Yard):

Ord Wellfield Main Line Flow (FIT-500)

Ord Wellfield Main Line Flow Fault (FUA-500)

Ord Wellfield Main Line Flow Totalizer (FIQ-500)

Remote (Win 911):

Ord Wellfield Main Line Flow Fault (FUA-500)

LOOP 500: Chlorine Analyzer

PID: I-06

Equipment ID: AE/AIT-500 (existing instrument)

General: Monitors Residual Chlorine Level. Should residual chlorine level drop below a user adjustable low level setpoint or exceed a user adjustable high level setpoint, issue an alarm (UA-500)

Control:

Field:

None.

Local:

None.

Remote (LCP-7A):

Used for trim control - Refer to Loop 510.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

Off.

Alarms and Monitoring:

Field:

AIT-500

Local:

N/A

Remote (LCP-7/OIT):

Residual Chlorine Level (AIT-500)

Residual Chlorine Residual Level Alarm (UA-500)

Remote (MCWD Corporate Yard):

Residual Chlorine Level (AIT-500)

Residual Chlorine Residual Level Alarm (UA-500)

Remote (Win 911):

Residual Chlorine Residual Level Fault (AUA-500)

LOOP 501: Hypochlorite Dosing Flowmeter

PID: I-06

Equipment ID: FE/FIT-501

General: Monitors total hypochlorite flowrate into well field main header at F-Booster/I.R. site. Should total hypochlorite flow measurement not match the summation of flow from the three hypochlorite metering pumps (P-510, P-520-, and P-530) within a user adjustable tolerance, issue a system alarm (UA-501B)

Control:

Field:

None.

Local:

None.

Remote (LCP-7A):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

N/A

Alarms and Monitoring:

Field:

FIT-501

Local:

None.

Remote (LCP-7/OIT):

Total Hypochlorite Flow (FIT-501)

Flowmeter Totalizer (FIQ-501)

Flowmeter Failure (UA-501A)

Flowmeter Calculated Flow Alarm (UA-501B)

Remote (MCWD Corporate Yard):

Total Hypochlorite Flow (FIT-501)
Flowmeter Totalizer (FIQ-501)
Flowmeter Failure (UA-501A)
Flowmeter Calculated Flow Alarm (UA-501B)

Remote (WIN-911):

Flowmeter Failure (UA-501A)
Flowmeter Calculated Flow Alarm (UA-501B)

LOOP 510: Hypochlorite Dosing Pump 1

PID: I-06

Equipment ID: P-510

General: The hypochlorite P510, P520, and P-530) system is located at the F-Booster/Intermediate Reservoir Site, which is downstream of the last Ord Well (the Marina wells have dosing at the wellhead). Pumps operate whenever a speed signal is received greater than 4 mA.

The three metering pumps located in the Chlorination Building are packaged systems with variable speed controls based on the FIT-500 Zone A Flow with/without residual trim. At each pump VFD LCD screen or the existing local OIT (LCP-7) the operator can select between three metering pump speed control modes: Manual, Dosage, or Dosage with Residual Trim.

In Manual Control mode the operator shall directly enter the speed at which the assigned pumps shall run.

In Dosage control mode, the operator enters the desired dosage setpoint and the calculated dosage is used as the Process Variable to a PAC based Dosage PID controller. The PID controller compares the calculated dosage to the operator entered dosage setpoint and adjusts the speed control output (SIC) to maintain the dosage setpoint (AIK-D).

In Dosage with Residual Trim control mode, a separate PAC based Residual Trip PID controller shall be used to trim the dosage required setpoint to maintain the measured free residual chlorine (AIT-500) at the operator entered Residual Setpoint (AIK-R). The Residual Trim PID controller shall be configured to execute on an adjustable periodic timer to allow control of the residual without excess windup caused by delays between control changes and measured residual changes. The output of the Residual Trim PID controller (AIC-R) shall be limited to +/-0.5 mg/L. The dosage required at the application point is:

Dosage Required, AIK = AIK-D+ AIC-R

Where,

AIK = The dosage required at the application point
AIK-D = The operator entered Dosage Setpoint
AIC-R = The output of the Residual Trim PID controller (in Mg/L)

The dosage required (AIK) is used as the setpoint, and the calculated actual dosage (AIC-D) is used as the Process Variable to the PAC based Dosage PID controller. The PID controller compares the calculated dosage to the dosage required setpoint and adjusts the speed control output (SIC) to maintain the dosage required setpoint.

The PAC will compare the speed signal sent to the pumps (SIC) against the speed feedback (SIT) received from the pumps and issue a failure alarm (UA) should the two speeds vary by more than an adjustable error band (initially set at 10%) after an adjustable time delay (initially set at 1 minutes). Final setpoints and error band shall be determined in the field following final tuning of the PID/trim loop. Upon determination of failure, the PAC will set the speed control signal to the failed pump to 0 (4 mA) until the PAC alarm is reset at the LCP 7 OIT.

Control:

Field:

None.

Local (at pump):

Hand/Off/Remote (HS-510A)

Reset (HS-510B)

Hand - speed control (SIC-510)

Remote (LCP-7/OIT):

Auto/Manual – In Manual mode, pump speed is controlled at the LCP-7/OIT. In Auto mode, pump is controlled by remote PAC (LCP-7A) speed control output (SIC-510) via an OIT resident selector switch for the three metering pump speed control modes: Manual, Dosage, or Dosage/Residual Trim.

Remote (MCWD Corporate Yard):

All control is resident at the LCP-7A only

Operator may select the speed control output (SIC-510) remotely via an HMI resident selector switch for the three metering pump speed control modes: Manual, Dosage, or Dosage/Residual Trim.

Interlocks:

Pump is interlocked from running if any of the below is true:

- Pump Fail Alarm (UA-510)

Power Failure State:

Off.

Alarms and Monitoring:

Field:

None,

Local (at pump):

Pump Fail Alarm (ULA-510)

Pump Running Light Indication (MLN-510)

Pump Speed Indication (SI)

Remote (LCP-7/OIT):

Pump Fail Alarm (UA-510)

Pump Running Status (MN-510)

Pump Speed Feedback (SIT-510)

Remote (MCWD Corporate Yard):

Pump Fail Alarm (UA-510)

Pump Running Status (MN-510)

Pump Speed Feedback (SIT-510)

Remote (WIN 911):

Pump Fail Alarm (UA-510)

LOOP 520: Hypochlorite Dosing Pump 2

PID: I-06

Equipment ID: P-520

General: Functionally the same as Loop 510.

LOOP 530: Hypochlorite Dosing Pump 3

PID: I-06

Equipment ID: P-530

General: Functionally the same as Loop 510.

LOOP 600: Generator G-600 Equipment

PID: I-07

Equipment ID: G-600

General: Monitors status and alarms for engine generator at the F Booster Pump Station.

Control:

Field:

None.

Local :

None

Remote (LCP-7A):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

Call to run via ATS

Alarms and Monitoring:

Field:

None,

Local (Generator Control Panel)

See control panel per Section 26 32 13

Remote (LCP-7/OIT):

Overcrank (YA-600A)

Overspeed (YA-600B)

High Temp (TA-600)

Running (MN-600)

Overload (YA-600C)

Remote (MCWD Corporate Yard):

Overcrank (YA-600A)

Overspeed (YA-600B)

High Temp (TA-600)

Running (MN-600)
Overload (YA-600C)

Remote (Win 911):

G-600 Composite Fault (UA-600)

LOOP 610: Generator Fuel Tank T-610

PID: I-07

Equipment ID: T-610

General: Monitors engine generator fuel tank level.

Control:

Field:

None.

Local :

None

Remote (LCP-7A):

None.

Remote (MCWD Corporate Yard):

None.

Interlocks:

None.

Power Failure State:

None.

Alarms and Monitoring:

Field:

None,

Local (Generator Control Panel)

See control panel per Section 26 32 13

Remote (LCP-7/OIT):

Fuel Tank Low (LAL-610)

Remote (MCWD Corporate Yard):

Fuel Tank Low (LAL-610)

Remote (Win 911):

G-600 Fuel Tank Low (LAL-610)

SECTION 40 62 00

SCADA SYSTEM HARDWARE AND SOFTWARE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide programmable automation controllers (PACs), Human Machine Interface (HMI) workstations, network equipment, and other SCADA ancillary equipment where shown on the Drawings and as specified herein.
- B. All hardware provided under this Contract shall be provided by the PCSI as defined in Section 40 61 00.
- C. All programming of equipment provided under this Contract shall be provided by the SSP as defined in Section 40 61 00.
- D. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- E. All software for PAC, OIT, or HMI programing shall be the SSP's licensed copies. Any ancillary software required for a fully functioning system shall be provided under the Contract Bid Price and licensed to the District.
- F. Provide communication and networking equipment network switches, firewalls, and other equipment as shown on the Drawings and specified herein. Provide communication and networking system configuration and establish reliable communication links between the A1/A2 Reservoirs B/C Booster Pump Station (BPS) and the District's central SCADA facility located at the MCWD (MCB) as well as to remote sites as shown on the Drawings and as specified herein.
- G. Provide remote alarm notifications to District personnel via cellular telephone link on a continuous basis.

1.02 RELATED WORK

- A. Section 28 21 00 – CCTV Surveillance Systems
- B. Section 40 61 00 – Process Instrumentation and Control - General Provisions (including Appendices)
- C. Section 40 61 96 – Process Control Descriptions
- D. Section 40 67 00 – Control Panels and Hardware

1.03 SUBMITTALS

- A. Refer to Section 40 61 00

1.04 REFERENCES

- A. Refer to Section 40 61 00.

1.05 MAINTENANCE

- A. As a minimum, provide the following:
 1. One spare PAC Central Processor Module.
 2. 10% spare I/O card module of each type provided under this Contract.
 3. One spare PAC dedicated rack mounted communication card of each type provided under this Contract.
 4. One spare Ethernet network switch of each type provided under this Contract.
 5. One spare communication modem and other communication interface devices provided under this Contract.
 6. One spare power supply of each type provided under this Contract.
 7. Ten percent (10%) (minimum of 2) of each type of miscellaneous components, switches, lights, cable connectors, and other field replaceable system components provided under this Contract.
- B. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by District.

PART 2 - PRODUCTS

2.01 SCADA EQUIPMENT - GENERAL

- A. Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- B. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
- C. The system shall be designed and constructed to withstand the demands of real time process management and control.
- D. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.
- E. All equipment furnished shall be designed and constructed so that in the event of power interruption, or temperatures outside the operational range, the systems specified hereunder

shall go through an orderly shutdown with no loss of memory and resume normal operation without manually resetting when power is restored.

- F. All software required to achieve the functionality described in the Specifications shall be provided. All software provided under this Contract shall be licensed to the Marina Coast Water District. Coordinate with the District for licensing details and points of contact.
- G. Only software platforms and releases approved by the District for use shall be installed.

2.02 PROGRAMMABLE AUTOMATION CONTROLLERS (PACS) GENERAL

- A. The PACs shall communicate between the operator workstation and field mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the HMI. The PAC shall be an intelligent microprocessor-based device that can collect data and process control functions. Communications with the operator workstation shall utilize the Ethernet 802.3 compliant data highway as shown in the Drawings. The PAC shall reside directly on the Ethernet data highway and communications shall be via a PAC chassis mounted Ethernet communications module as manufactured by the PAC manufacturer. Ancillary or third-party Ethernet equipment required to connect the PAC to the Ethernet data highway shall not be acceptable.
- B. All components of the PAC system shall be of commonly recognized industry standards and regularly sold for industrial installations. All components shall be assembled by the PAC manufacturer into standard structurally sound housings. All connecting cables, switches, and other operator-controlled devices shall be constructed so as to withstand, without damage, all normal use and handling. The PCSI as specified in Section 40 61 00 shall be responsible for installation of the equipment in control panel enclosures as specified in Section 40 67 00.
- C. The PAC system shall be of modular design with a plug-in processing unit, input/output cards, or assemblies. All components shall be marketed and supported by the one manufacturer. All necessary auxiliary cables, terminating components, connectors, and modules shall be included for a fully functioning PAC network system.
- D. Electrical supply voltage to the PAC shall be 24VDC. PAC system power supplies shall be fused for overload protection. Each PAC (including all I/O) shall be powered from the power supply and conditioning system as shown on the Drawings.
- E. The PAC shall be capable of stand-alone operation in the event of failure of the communication links.
- F. The PAC shall be a digital solid state logic system capable of performing the same functions as conventional relays, timers, counters, and math functions. The PAC shall consist of a central processor unit, memory, input/output cards and racks, power suppliers, interconnecting cables, communication lines and other optional items as necessary to meet the functional requirements.
- G. All products shall be designed, manufactured, and tested in accordance with recognized industrial standards. All products shall have corrosion protection. All products shall have UL, CSA and FM approval. The PAC subsystems shall be approved for and adhere to the following agency and environmental specifications:

1. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 \Hz, or 2G @ 10 ... 500Hz. The method of testing is to be based upon IEC 68-2-6standards for vibration. The system is to be operational during and after testing.
 2. Shock: 15G, 11 ms or operating rating of 30G for 11ms and storage rating of 50G for 11ms. The method of testing is to be based upon IEC 68-2-27standards for shock. The system is to be operational during and after testing.
 3. Temperature: All PAC hardware shall operate at an ambient temperature of 0 to 60 degrees C (32 to 140 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F).
 4. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation.
 5. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978
- H. Modules are defined herein as devices which plug into a chassis and are keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot.
- I. In a single chassis system all system and signal power to the CPU and support modules shall be distributed on a single motherboard or backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.
- J. All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.
- K. The programmable controller and all of the corresponding components within the family of controller products shall be by a company who regularly manufactures and services type of equipment. The manufacturer shall have a fully operational quality assurance and quality control program in place and shall comply with ISO9001 standards for "Quality Systems-Model for Quality Assurance in design/Development, Production, Installation, and Servicing".
- L. The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, local or headquarters technical assistance and a "1-800" phone line.
- M. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings, each of which indicates the manufacturer's catalog number and a product manufacturing date code.

2.03 PROGRAMMABLE AUTOMATION CONTROLLERS (PACS)

- A. PACs shall be Allen Bradley CompactLogix, no equal to match the District's existing SCADA system hardware.
- B. Major hardware components of the Main PAC platform shall include:
 1. Central Processing Unit (CPU)

2. Input/Output Modules
 3. Communications Modules
 4. Power Supply
- C. Central Processing Unit (CPU):
1. General
 - a. The CPU shall be at a minimum a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.
 - b. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers and service special function modules every scan. The CPU shall process the I/O with user program (s) stored in memory, and then control the outputs based on the results of the logic operation.
 - c. The CPU shall execute the user program by rapidly scanning the program stored in user memory. Both logic and data word functions shall be executed in the order they appear in the user program. As each section or rung of logic is solved, the results shall be available to any of the following logic elements.
 - d. The CPU shall support an instruction to allow a decrease in scan time by skipping over parts of the program when directed. The CPU shall allow the PAC program to be broken into logic subroutines that execute only when called. The PAC shall allow analog and discrete points to be updated immediately within the scan as the discrete or analog value is called in the configuration program.
 - e. The CPU shall be a single printed circuit board utilizing surface mount technology. The CPU shall plug directly into the I/O base and require no additional wiring to the base, power supply, or the I/O.
 - f. Provide program execution and support remote or local programming. The CPU shall provide I/O scanning and peer to peer inter-processor communication to other PACs in the system and to peripheral support devices.
 - g. Store programs in either battery backed RAM or non-volatile flash memory. Data registers shall be stored in battery backed RAM.
 - h. Provide a battery backed integral real-time clock that can be accessed from the control program. The clock shall include registers for the time of day (year, month, day, hour, minute, second, and day of the week). The real-time clock shall be easily synchronized with an external device such as a PC or another PAC as specified in Section 40 61 96. Permit changing program and data values while running without interrupting the process.
 - i. The PAC CPU family shall allow for user program transportability from one CPU model to another.
 2. Diagnostics
 - a. Read the inputs, perform all system logic, conduct on-line diagnostics, and control the outputs. Diagnostics shall include memory checks, communications monitoring, I/O bus monitoring, watchdog timing, and user program validation.
 - b. Monitor the health of every module in the local and Remote I/O backplanes. A single bit shall show the active or inactive state of each module. Information shall be accessible from the program, from programming software, or remotely from the HMI.

- c. The CPU shall perform on-line diagnostics that monitor the internal operation of the PAC. If a failure is detected, the CPU shall initiate system shutdown and fail-over if a failure occurs. The following at a minimum shall be monitored:
 - 1) Memory Failure
 - 2) Memory battery low
 - 3) CPU over temperature and general fault
 - 4) Communications port failure
 - 5) Scan time over run
 - 6) I/O failure
 - 7) Analog or special function I/O module failure
 - d. All diagnostic information shall be accessible at the programming terminal which attaches to the CPU. A diagnostic page on the PAC programming terminal shall provide information which identifies the nature of the fault, the absolute memory or I/O address of the fault, and the date and time of occurrence of the fault.
 - e. PAC diagnostic information shall be accessible to the host communications interfaces. Develop platform specific HMI PAC monitoring screens for presenting PAC diagnostics using the HMI configuration software specified herein to present the specific module failure to the operator.
 - f. The CPU shall have LED indicators to show status such as PAC GOOD, PROGRAM RUN, and BATTERY GOOD. If any of the above conditions occur, provide an internal PAC diagnostic fail alarm contact output. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.
3. Memory
- a. The CPU shall contain CMOS RAM program memory or compact flash storage memory. The Compact flash memory shall have the capability to backup RAM contents during power failures.
 - b. The program memory shall be sized as required to implement the functions specified plus 50% capacity for future use. The entire program memory shall be available for user program storage. Scratch pad and "housekeeping" programs shall be included in the calculation of the minimum memory size to ensure adequate spare memory is available to the District for future programming requirements.
 - c. The PAC CPU memory shall consist of the following functional types of memory:
 - 1) Logic program memory
 - 2) Constant data memory
 - 3) Variable data memory
 - 4) Input/Output memory
 - 5) CPU status data memory
 - 6) I/O word memory
 - 7) User memory for compiled programs
 - d. Memory allocation and combinations of logic and data storage up to the maximum limits shall be software configurable to match application requirements.
- D. Communication Ports and Remote I/O Communications
- 1. Provide a minimum of three (3) PAC CPU rack resident communication ports for local programming, operator interface, and remote I/O operations. Provide ports integral to the CPU or additional manufacturer's standard add-on communication port modules as required to implement the network communication schemes as shown on the Drawings and specified herein.

2. The CPU shall be capable of communicating with a minimum of 14 remote PAC base locations at a combined distance of 2500 feet. The CPU shall automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
3. The communication link between the CPU and any RIO chassis shall be via 20 AWG tinned copper communications grade cable as recommended by the PAC manufacturer. For racks located on a link of less than 2500 cable feet, the speed of the communications link shall be greater than 230K baud with RIO scan rate of less than 5 milliseconds per RIO.
4. Diagnostic and equipment status information shall be available from each RIO similar to that specified for the CPU.
5. It shall be possible to communicate with remote I/O racks or other PACs via fiber optic cable by using chassis mounted fiber optic modems as shown on the Contract Documents.
6. The remote I/O system shall have available a remote input/output arrangement capable of operation at locations physically separated from the PAC CPU by up to 5,000 feet and as detailed on the Drawings.
7. Communication with the remote I/O arrangement shall be through cable as recommended by the PAC manufacturer and provided by the PCSI under this Contract.

E. Input/Output Modules (I/O)

1. The I/O count and type shall be determined by the PCSI as required to implement the functions specified, as shown in Appendix 406200-B, and including the requirement for active spares as noted below.
2. I/O chassis shall be sized to accommodate two additional analog input modules for future addition.
3. Each I/O drop or I/O location shall include 20 percent (minimum of two) active input points (both DI and AI) and 20 percent (minimum of two) active outputs points (both DO and AO) for future use. The spares shall be the same type of I/O modules supplied for active process control functions. Spare output points that require the use of an external relay shall be supplied with the external relay. In addition to the indicated wired spares, provide additional 20% spare empty rack space (minimum of two slots) for installation of future I/O cards.
4. All installed unused points on all I/O modules shall be wired to terminal blocks and the termination cabinet in the sequential order that they occur on the I/O modules and in the order that the modules occur in the I/O rack. Termination of all spares at the end of the terminal strips or arbitrarily at random positions on the terminal strips shall not be acceptable. Spare analog input points shall each have their respective internal panel circuiting completed including a powered fuse and three terminal blocks reserved for future wiring and powering from panel powered loops. Refer also to Section 40 67 00.
5. I/O module usage shall comply with the following table unless noted otherwise:

a. I/O Type	Module Type
b. Analog input	4-20mA (individually isolated, remote power supply)
c. Analog output	4-20mA (individually isolated, remote power supply)
d. Discrete input	24VDC (individually isolated)
e. Discrete output	24 VDC (with interposing relays)
6. Minimum isolation between input/output and logic voltage shall be 1500V RMS per NEMA standards via opto-isolation for AC I/O modules and 500 VDC for DC and Analog I/O modules.
7. Each I/O module shall have field replaceable fuse protection and blown fuse indicators.

8. The 24 VDC power for analog instrument loops shall be provided by the PCSI as a part of the system. The 24 VDC power supply shall be derived from the input power circuit to the PAC. The field side of the 24 VDC power sources(s) shall have individual fusing and provided with a readily visible, labeled blown fuse indicator. Grouped fusing is not acceptable.
9. Each 24 VDC type discrete output shall have an associated independent interposing relay located in the same control panel. 120 VAC or 24 VDC power for relay outputs shall be provided from the associated equipment control circuit (as applicable) or independently sourced or protected 120 VAC or 24 VDC power source. Interposing relays shall be as specified in Section 40 67 00.
10. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single I/O module will not disable all mechanical components of the redundant system (i.e., inputs for Pump No. 1 on one input card, inputs for Pump No. 2 on another input card).
11. I/O modules shall contain a maximum of 16 points per card.

F. PAC Rack Power Supply

1. The power supplies shall provide sufficient regulation and ripple control to assure that the rack resident devices being operated can operate within their required tolerances. Output over voltage and over current protective devices shall be provided with the power supply to protect devices from damage due to power supply failure and to protect the power supply from damage due to external failure. Transformers shall have primary and secondary fuse protection.
2. Output over voltage and over current protective devices shall be provided.
3. The PAC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules. Provide 24 VDC power supply module selected to power the final load requirements necessary for meeting the functional requirements as specified in the Contract Documents. Provide power supply with total wattage ratings suitable for the devices and modules specified plus an additional 50% capacity.
4. Provide power supplies sized as required for the CPU and I/O module load requirements.
5. Refer to Section 40 67 00 for panel resident field instrument power supplies.

2.04 PAC SOFTWARE

- A. Providing PAC programming software is not required under this Contract.
- B. SSP shall perform new program development using Rockwell Automation RSLogix Micro or Studio5000, no equal, to match existing District programs.
- C. Develop all PLC programs for this Project using the SSP's fully licensed and legal version of the software.

2.05 COMMUNICATION NETWORKS

- A. The PCSI and SSP shall furnish and install complete IEEE 802.3 compliant Ethernet Local Area Networks (LANs) and Wide Area Networks (WANs) capable of supporting communications between all servers, operator workstations, PACs, wired or wireless as shown on the system architecture block diagram. The PCSI shall furnish all necessary

cables, face plates, connectors, modems, transceivers, repeaters, modules, splice kits, radios, etc. required for a complete and operational LAN and WAN.

- B. Alarms shall be provided on each computer to alert plant personnel of communication link cable break, stalled or malfunctioning communication director and security disconnect of malfunctioning remote systems units.
- C. Provide additional, spare network taps as part of each Ethernet network to connect a laptop computer to the networks. The taps must be easily accessible for connectivity.
- D. Industrial Managed Ethernet Switches: Where indicated on the Contract Documents, provide industry-standard ultra-wide IEEE 802.3u 100Base-TX and 100Base-FX autosensing Ethernet switches supporting Fast Ethernet communications. Power supply shall be 24VDC. FO port shall be suitable for type ST connectors. Switch shall be standard DIN rail mount type for industrial application having minimum operating temperature of 60 degrees C. Switch shall be Moxa, ADVANTECH, or approved equal.
- E. Ethernet 10/100BASE-T/TX Cable:
 - 1. The unshielded twisted pair cable shall be designed for use with a high speed (10/100/155/622 Mbps) Ethernet 10BASE-T, 100BASE-T/TX, and 1000BASE-T communications network. The twisted pair cable shall have a nominal impedance 100 ohms at a maximum attenuation of 32.8 dB per 100 meters at 250 MHz. The twisted pair cable shall be designed for 250MHz bandwidth operation. The twisted pair cable shall meet the ANSI/TIA-568-B.2-1 Category 6 specification. The twisted pair cable shall be plenum rated with FEP/FRPO insulation for moisture and flame protection and shall have a minimum of four 24 AWG solid copper conductor pairs. All 10/100/1000BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable. Provide Ethernet cable as manufactured by Belden or approved equal.

2.06 OPERATOR INTERFACE TERMINAL (OIT)

- A. General
 - 1. OIT shall be a panel-mount touchscreen operator interface terminal, minimum 15".
 - 2. Operator Interface Terminal shall be as manufactured by Automation Direct, C-more model EA9-T15CL-R, no equal, to match existing District equipment.
 - 3. Provide a configured operator interface terminal as shown on the drawings. Develop all OIT programs for this Project using the SSP's fully licensed and legal version of the software current version in use by the District.

2.07 HMI CONFIGURATION SOFTWARE

- A. Provide all HMI new and modified graphic screens, logs, reports, trends, and ancillary programs for this Project using the SSP's fully licensed and legal version of the HMI software, current version in use by the District.

2.08 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- A. Provide AC UPS for the BPS control panel. UPS sizing shall include all control panel powered equipment except auxiliary panel light and receptacle. Refer to Section 40 67 00. UPS for BPS site shall include additional site loads for surveillance camera, video storage equipment, and other components as specified in Section 28 21 00.
- B. Provide AC UPS for the LCP-7A control panel. UPS sizing shall include all control panel powered equipment except auxiliary panel light and receptacle. Refer to Section 40 67 00.
- C. The UPS shall sustain operation of the indicated equipment and shall provide power for an orderly shutdown to prevent the loss of the system during power failure prior to establishing standby power from the on site generator. The UPS system shall be sized to sustain a minimum of 1.5 times the connected full load for a minimum period of 30 minutes in an operating environment of 32°F to 104°. Exact sizing is the responsibility of the PCSI.
- D. The UPS shall be a true on-line double-conversion system that operates in the following modes:
 - 1. **Normal** – In normal operation incoming AC power shall be fed to the input power factor corrected (PFC) rectifier that converts the AC power to DC power for the inverter. In this mode, power shall also be derived from utility power for the battery charger. The inverter shall derive DC power from the PFC rectifier to regenerate filtered and regulated AC sine wave power for the connected load. The unit shall begin charging the battery once the UPS is connected to utility power, regardless of whether the UPS is ON or OFF. In the event of a utility outage or severe abnormality (sag or swell), the inverter shall support the connected load from battery power until the battery is discharged or the utility power returns, whichever occurs first.
 - 2. **Battery** – Upon failure of utility / mains AC power, the critical AC load shall be supplied by the inverter, which obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility / mains AC source.
 - 3. **Recharge** – Upon restoration of utility / mains AC power, after a utility / mains AC power outage, the input converter shall automatically restart and resume supplying power to the inverter and the battery charger to recharge the battery.
 - 4. **Automatic Restart** – Upon restoration of utility / mains AC power, after a utility / mains AC power outage and complete battery discharge, the UPS shall automatically restart and resume supplying power to the critical load and the battery charger automatically recharges the battery. This feature shall be capable of being disabled by the user.
 - 5. **Bypass** – The integral bypass shall perform an automatic transfer of the critical AC load from the inverter to the bypass source, in the event of an overload, PFC failure, internal over temperature, DC bus overvoltage or inverter failure conditions.
 - 6. **Economy** – The UPS shall allow the user to enable and place the UPS in Economy mode of operation to reduce electrical consumption. The Economy mode operation shall be an Active type, whereas the UPS will power the connected equipment through the bypass path and the UPS inverter shall be on and operating at no load in order to stay synchronized to the bypass to ensure rapid transfers to inverter power when input power falls outside of the user customizable parameters. The UPS shall also have a user customizable requalification time that input power must remain within the Economy mode parameters before transferring back to Economy operation. This is to minimize the number of transfers between bypass and inverter:
- E. The UPS system shall be lightning and surge tested per ANSI/IEEE C62.41 and shall be capable of reducing an input spike to less than 3 volts on the output for a 2000 to 1 spike

attenuation. The UPS system shall have 120 dB common mode and 60 dB Transverse mode noise attenuation.

- F. The UPS system shall provide a true separately derived power source as defined in the NEC article 250-5d with output neutral bonded to ground. There shall be no direct connection between input and output and less than 2 pf of effective input to output capacitance.
- G. The UPS system output shall be regulated to 120 VAC \pm 3%, 60 HZ \pm 0.5 HZ over the full dynamic range from no load to full load and low line VAC to high line VAC and low battery voltage to high battery voltage.
- H. The UPS system shall provide computer grade sine wave power with 5 percent or less total harmonic distortion.
- I. The UPS system capacity shall be rated in volt amperes (VA) while loaded with typical computer grade switch mode power supplies having a power factor of 0.6 to 0.7 and crest factor of 2.7 to 3.5. Efficiency shall be at least 90% when operated from AC line.
- J. The UPS system shall have built-in self-diagnostic monitoring capable of monitoring as a minimum AC volts in/out, AC current in/out, battery voltage, VA load, watts, power factor percent of full load, time of day, system hours, inverter hours and projected run time available. Provide relay interface feature for providing isolated dry contact interface to the PAC. The interface card shall have two normally open relay contacts for remote alarm (FAIL) condition and line/utility power (FAIL) condition for reporting to the PAC.
- K. The UPS system shall have a dual track redundant configuration that utilizes either line or inverter output for power and shall be designed to meet or exceed a MTBF of 100,000 hours.
- L. All cables and connectors for power distribution to the system components shall be furnished and installed under this contract.
- M. UPS systems shall be provided 120 VAC, 1 phase, 60 Hertz. The PCSI shall coordinate the input voltage and neutral requirements with the electrical contractor before ordering the UPS.
- N. The system batteries shall be sealed, no maintenance type rated for 100 amp hour at 12 VDC.
- O. The UPS system shall be Falcon UPS or approved equal.

2.09 MICROWAVE RADIO SYSTEM – 2.4 GHZ

- A. Provide 2.4 GHz microwave radio system based on Ubiquiti PowerBeam AC 2.4 GHz Series, no equal to match existing District equipment. Provide integrated radio and antenna system.
- B. Provide new point-to-point radio/antenna combinations at B/C BPS site to existing Reservoir 2.
- C. Provide radio equipment and configuration software. All software required for configuration of the radios shall be provided and licensed to the District.

- D. Radios shall be powered via passive Power over Ethernet (PoE). Provide PoE interface equipment in the MCP for the new radio at the B/C BPS. Use existing ports on existing PoE equipment at Reservoir 2 for powering the new radio at that location.
- E. Microwave Dish Antenna
 - 1. Provide integral microwave directional dish antenna compatible with radio system as specified. Provide all antenna-mounting hardware for mounting to the top of the support mast and include weather proof connectors for the cable connections. Coordinate weight of antenna with mast selection, mounting, and anchoring requirements and calculations as specified. Provide integral microwave dish antennae with the specified radio system , Ubiquiti no equal to match existing District equipment.
 - 2. Antenna mast shall be as shown on the Drawings with antenna mounted at center line at top. Size and diameter of mast shall be determined by PCSI based on lateral antenna load and a wind load of as required per Section 01 33 14. Height of mast shall be as shown on the Drawings.
 - 3. Communications cable shall enter through bottom of mast with access handhole entry at base. Provide all required grounding hardware, cables, and connections as recommended by the radio system manufacturer.
- F. Surge Protection
 - 1. Provide surge protection devices mounted in a NEMA 4X enclosure at the location recommended by the manufacturer. The enclosure shall house the grounded surge protector and include terminal block and fittings as required. The surge protector shall be grounded per NEC Art 810.
 - 2. The surge protector shall utilize silicon avalanche suppression diode (SASD) technology for protecting the radio equipment against lightning and power transients. The surge protection device shall be for CAT 6 cables and meet the requirements of IEEE/ANSI C62.41 with a response time of 5 nanoseconds. The surge protector device shall be Transtector ALPU-ORT or approved equal.
 - 3. At no time shall the surge protection device be mounted inside the same enclosure as the SCADA equipment.
 - 4. Provide industrial Ethernet cable (CAT 6) that is weather proof and UV resistant where shown on the Drawings. Connectors shall be weather proof and include sleeves that fit over the connector for weather protection. Cable shall be screened type (STP) or shielded to provide additional surge protection and shielding from high RF environments. Cable shall be per specification NEC/CEC: CMR (ETL) C (ETL) 75C SUN RES OIL RES II and be manufactured by CommScope or approved equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Refer to Section 40 61 00.

3.02 PAC COMPONENT INSTALLATION

- A. I/O Installation:

1. PCSI shall group I/O by equipment, and arrange like inputs in the same order. When there are two or more identical pieces of equipment, arrange the I/O on different I/O modules.
2. Arrange discrete I/O as follows:
 - a. Operator mode selections (Auto, Remote, Hand, Local, etc.)
 - b. Equipment status (Ready, Running, Open, Closed, etc.)
 - c. Alarm inputs (Failure, High Temperature, Overload, Overtorque, etc.)
 - d. Other

3.03 RADIO SYSTEM INSTALLATION AND CONFIGURATION

- A. Configure new radio to provide point-to-point connectivity between the B/C BOS site and the District's existing store and forward infrastructure located at Reservoir 2. PCSI and SSP shall provide installation, equipment configuration, and modification to existing PAC and store and forward hardware and software incorporate the new data streams from the B/C BPS for delivery to the District's SCADA Central located at District Headquarters over the existing 2.4 GHz broadband network.
- B. Provide data management for coordinating CCTV surveillance cameras video data as specified under Section 28 21 00. Provide broadband radio data stream management and configuration to ensure highest system priority to SCADA data. System configuration shall minimize latency impacts from video data on delivery of SCADA status and control data. Refer to CCTV installation, configuration requirements, and testing criteria as specified under Section 28 21 00.

3.04 SCADA SYSTEM INSTALLATION AND CONFIGURATION

- A. General:
 1. All system programming shall be performed by the SSP.
 2. SSP shall match the look, feel, and standards of the existing District SCADA system including graphic screens, reports, database configuration, security, communication, and PAC programming to the greatest extent possible. Examples of District addressing approach, screen graphics, and reports will be provided to the SSP after award of the Contract and further defined during the Coordination Workshops per Section 40 61 00. The configuration specified herein refers to general features and elements of the graphic, alarming, reporting, and other features of the SCADA system. However, all specific system elements shall conform to the District standards to the greatest extent possible.
 3. All other software that may be necessary for a fully configured and operational system including communication configuration shall be provided under this contract. All software licenses and warranties shall be assigned to the District by the PCSI.
 4. Refer to Section 40 61 96 for site specific control and system monitoring requirements.
 5. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers.
 6. The system shall allow the operator to control equipment such as pumps and valves as defined in the control loop drawings and control loop descriptions. All control actions shall require a two step action to assure positive verification of each control operation.
 7. Unless specifically noted otherwise, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

B. General Displays Requirements

1. Provide graphic, alarm summary, diagnostic, trends, and other displays in conformance with District standards as specified herein.
2. Provide graphic layouts and development conforming to existing District look and feel.
3. Graphic displays: The display shall depict basic the process diagrams with representative symbols for pumps, tanks, etc., combined with real time process variables or conditions. The displays shall be dynamic (i.e., symbols for a pump shall change color indicating run or stop or alarm, the volume of tanks shall be indicated by varying the height of the interior color of the tank symbol, etc.). All of the current data in the database shall be available for graphic displays. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.
4. Alarm summary display: The display shall consist of all points currently in alarm and shall include the tag number, description, time of occurrence, and present status (high, low, normal, etc.). The alarm summary shall identify alarm points by severity by utilizing distinct colors for each severity category.
5. System diagnostic displays: The displays shall summarize the error status of all system devices capable of reporting errors (i.e., PACs, computers, network equipment, printers, communication devices, etc.). The display shall indicate if an error is detected or a failure occurs. Status of primary and backup devices shall be indicated on display.
6. Trend displays: The trend display shall display the value of a maximum of eight assigned points versus time. Each point shall be trended in a different color. Each of the assigned points shall have a point identification number, point name, point description, current value, and instrument range displayed in the color used for its trend. Trending tags shall be either InTouch local tags or tags from existing District Wonderware InTouch Historian server. The time period shall be selected and be either current or historical. The time period selected and time and date of start shall be displayed. The values displayed on a historical trend shall consist of the stored values for each variable trended. Current trends shall be updated at the scan frequency of the variable. A trend display shall not be considered a graphic display.

C. Project Specific Graphics:

1. Process graphic displays, shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these contract documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
2. Screen formats, colors, and layout shall match existing District standards for all graphical screens. General graphical requirements shall be as specified herein at a minimum.
3. The BPS and other sites shall be fully integrated into the security, trending, system alarm log, and data historian systems presently in place within the District SCADA system. Coordinate local logic, alarming, and historian systems with existing District platforms.
4. BPS and other site control screens for pumps, gates, flow control valves, etc. shall be configured to be fully integrated into the District overall central SCADA graphical system menu structure. Coordinate with District staff to integrate the new sites into the system control hierarchy, screen navigation, security hierarchy, failsafe logic, positive operator verification of control commands, etc.

5. Development details of the graphic screen standards, formats, and development criteria shall be reviewed and finalized at the SCADA coordination workshops specified under Section 40 61 00.
 6. The HMI and OITs shall be fully integrated into the security, trending, system alarm log, and data historian systems presently in place within the District SCADA system. Coordinate local logic, alarming, and historian systems with existing District platforms.
 7. HMI and OIT control screens for pumps, gates, flow control valves, etc. shall be configured to be fully integrated into the District overall central SCADA graphical system menu structure. Integrate HMI and OITs into the system control hierarchy, screen navigation, security hierarchy, failsafe logic, positive operator verification of control commands, etc. New and revised HMI and OIT control screens shall match the general look-and-feel of the existing HMI control screens including color, general graphic symbols, control sequence, screen layouts, screen navigation, and other operational features.
 8. The PCSI shall be responsible for providing at a minimum the following graphic screens for the OIT and the HMI for new system provided under this Contract. The final completed and approved HMI screen graphics shall be incorporated into the SCADA central HMI platform server application and OITs
 9. The present SCADA central system at the facility utilizes various graphic screens for monitoring and control of the facility. The PCSI shall utilize these existing screens as templates for the new or modified SCADA graphics. Provide screen modifications including data addressing changes with 25% additional data on a minimum of five (5) existing graphical screens.
 10. Incorporate all SCADA software standard alarm summary screens, navigation screens, and other auxiliary graphics to provide a fully integrated and functional Menu Navigation Screen to include the new processes provided under this Contract.
 11. Provide an additional 15 new graphic screens as specified and directed by the District for display and control of new processes and packaged systems as shown on the Drawings. Specifics of the contents and layouts of the screens shall be developed and coordinated during the SCADA coordination workshops specified in Section 40 61 00. Where common screens are developed for identical process trains (e.g. a typical booster pump) the base screen shall count for only one of the specified additional screens.
- D. A graphic screen shall be defined as the process specific graphics, pump station overall performance parameters, individual pump operating parameters, etc. Secondary pop-up/pull-down screens used for control, alarm acknowledgement, etc. shall be counted as being part of an individual primary graphic screen. Screens shall comply with the control requirements as defined under Section 40 61 96.
- E. Historical Data Management
1. The following features shall be provided for processing and storage of system historical data:
 - a. Facility historical logging, archiving, and reporting shall be performed at the District's SCADA central at the MCWD. Local historical data shall be stored on a temporary basis only in a store and forward fashion. However, each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. Data Processing: The real time instantaneous values shall be stored in a historical log file on the hard disk at District defined sampling rates.

- b. Provide store and forward of system operational data. Provide for local storage of all historical facility operations data at each location as coordinated with District personnel at the SCADA Coordination Workshops. Data identified for store and forward processing shall be stored locally for a user adjustable time period and purged on the local system upon positive verification of successful delivery of data to Marina Coast Water District. Store and forward data shall conform to District standards for data addressing and storage standards. Refer also to Section 40 61 96.
- c. Store and forward of performance data acquired over the Ethernet link into motor starters (26 24 19), power meters (26 24 19) , and Standby Generators (26 32 13) shall be provided. Provide for local storage of all historical performance data as coordinated with District personnel at the SCADA Coordination Workshops. Performance data shall include but not be limited to equipment parameters as specified in the equipment technical specifications.
- d. Develop system trending functions that incorporate data fetches from remote District historical archives as required for local system troubleshooting and diagnostics. Coordinate historical data trending capability with the District at the system workshops to implement full local trending capability with the MCWD data archives. Access to off-site BPS operational data shall be transparent to the user.

F. Reports:

- 1. System reporting shall be performed at the District's SCADA central at the MCWD. Provide up to three (3) standard operational reports related to new systems provided under this Contract. Report shall consist of up to 50 points and shall summarize operational characteristics at the new facilities. Provide reports consisting of daily, weekly, monthly, and annual facility characteristics. Include one additional report with content to be coordinated with District staff during the system development. All automated report details, format, and final contents shall be developed during system workshops as specified in Section 40 61 00.

G. Remote Alarm Notification Configuration

- 1. SSP shall configure the existing WIN-911 remote alarming system where described in the Control Descriptions in Section 40 61 96 or where required under the District's standard notification scheme.

3.05 TESTING

- A. Perform system testing as specified under Section 40 61 00.

END OF SECTION

SECTION 40 67 00

CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The PCSI as defined under 40 61 00 shall furnish and install process control panels as shown on the Drawings and specified herein.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- C. Related Work
 - 1. Section 28 21 00 – CCTV Surveillance Systems
 - 2. Section 40 61 00 – Process Instrumentation and Controls General Provisions
 - 3. Section 40 62 00 – Process Control System Hardware and Software
- D. The following panels and consoles shall be furnished by the PCSI. Each panel shall be supplied with full sub-panels and side panels as required.

Panel Designation	Minimum Panel Size	Enclosure Rating & Type
A1/A2 Reservoir B/C Booster Pump Station Main Control Panel Enclosure (MCP)	As required	NEMA Type 12, steel construction Floor Mounted Front Access Only
Chlorination Building Control Panel (LCP-7A)	As required	NEMA Type 4X, stainless steel Wall-Mounted

- E. Provide Main Control Panel enclosure with sufficient space to accommodate CCTV Surveillance System components as specified under Section 28 21 00. Coordinate space requirements with the Security System Supplier specified in Section 28 21 00 to provide sufficient space, clearances, cooling, power supply capacity and voltage, and other requirements in conformance with the surveillance system manufacturer/supplier requirements.

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with Section 40 61 00.

1.03 QUALITY ASSURANCE

- A. Refer to Section 40 61 00.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Control panels shall be shipped directly to the site from the system integrator facility. Before the control panels are shipped, remove all case-mounted instruments from the face of the panels, and repack in their original shipping cartons for shipment to the site with the control panel
- B. Throughout this Contract, the Contractor shall provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoors in a dry location and follow all manufacturers' storage instructions. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the manufacturer's recommendations of the equipment being provided.

1.05 SPARES

- A. General:
 - 1. In addition to the items noted below and in the other specification sections, the Contractor shall provide suitable spare parts and expendable items in sufficient quantities to sustain the SCADA system for a period of 1 year after final acceptance. All spare parts shall be delivered to the site before testing begins.
 - 2. The following tabulation of spare parts and maintenance equipment is presented as a minimum of suitable types and quantities to be provided.
 - a. Provide the following spares:
 - 1) Fuses: 20 percent spares of each size and type used, but no less than 10 of each size and type.
 - 2) Indicating Light Bulb: 20 percent spares of each size and type used, but no less than 10 of each size and type.
 - 3) 24v Loop Dc Power Supplies: 20 percent spares of each size and type used, but no less than three of each size and type.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The dimensions on the attached detail drawings are for general reference only. The PCSI shall be responsible for ensuring final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.
- B. Control panels shall conform to the requirements of the NEC Article 409.
- C. Each control panel shall be manufactured and assembled per the requirements of UL 508A. The complete assembly shall bear the UL label as an Industrial Control Panel as defined by UL 508A. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment as necessary to achieve compliance with the UL standard. The Drawings do not detail all UL requirements.

- D. The UL label requirements shall apply to all panels except where enclosures contain instruments mounted through the enclosure walls or doors. In this case, panel construction shall meet all requirements of UL labeling as described above, but no UL label is required. This exception applies only if UL Recognized instruments or devices for the intended purpose are not made.
- E. Where two or more units of the same class of materials or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- F. Standard products: Unless otherwise indicated, provide material and equipment that is the standard product of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to the specifications.
- G. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- H. The instruments designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.
- I. The panels shall be completely fabricated, instruments installed and wired at the PCSI's facility.
- J. All panel components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Components mounting shall be oriented in accordance the functional requirements of the panel. Individual components shall be identified with suitable plastic or metal engraved tags mounted adjacent to (not on) each component; tags shall identify each component in accordance with the drawing, specifications, and PCSI's data.
- K. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- L. Nameplates
 - 1. All panels and panel devices shall be supplied with suitable nameplates which identify the panel and individual devices as required. Each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
 - 2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32 inch thick, black and white, Limacoid with engraved inscriptions. The letters shall be Black against a White background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable. Nameplates shall be affixed to the panels using 4-40 thread stainless steel button head hex screws or epoxy adhesive to maintain the integrity of the NEMA panel rating.

3. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights and meters.

M. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.
2. Centerline of indicators and controllers shall be located no lower than 48 inches or higher than 66 inches above the floor on a panel face.
3. Centerline of lights, selector switches and pushbuttons shall be located no lower than 32 inches or higher than 70 inches above the floor on a panel face.
4. Tops of annunciators or monitoring lights shall be located no higher than 86 inches above the floor on a panel face.
5. Installation of panel components shall conform to component manufacturers' guidelines.

2.02 TYPICAL EQUIPMENT

A. Structure and Enclosure

1. Panels shall be of continuous welded-steel construction. Provide steel angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural steel framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete. Plugs shall not compromise the overall NEMA rating of the panel.
2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and heavy duty stainless steel locking handle. Rear access doors shall be conveniently arranged and sized such that they extend no further than 24 inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.
3. The panels, including component parts, shall be constructed and assembled in a thoroughly workmanlike manner and shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
4. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments

shall be NEMA 4X unless otherwise noted. All panels located in a Hazardous location (e.g., Class 1, Division 1) shall be rated NEMA 7.

6. Freestanding vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of 316 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.
7. Free standing panels in NEMA 4X locations shall be provided with 316 stainless steel floor stands to allow for conduit entry in the bottom of the enclosure. Conduit penetrations shall be rated for the area in which they are installed in order to maintain the NEMA rating of the panel.
8. Each enclosure shall be provided with a print pocket 12" wide x 12" high x 2" deep located on the interior of the door.
9. Where shown on the Drawings, floor mounted enclosures shall have a nominal 12" x 12" folding shelf. Folding shelf shall have steel locking support arms. Panel arrangement shall allow full opening of the folding shelf without obstructions or relocating components, panel wiring, or equipment.
10. All wall mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.
11. Finish Requirements
 - a. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
 - b. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
 - c. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.
 - d. Apply a minimum of two (2) coats of flat white lacquer on the panel interior after priming.
 - e. Unless otherwise noted, the finish exterior colors shall be ANSI 49 gray with a textured finish.

2.03 ENVIRONMENTAL CONTROL

- A. All enclosures shall be provided with a thermostatically controlled strip heater to reduce condensation and maintain the minimum internal panel temperature.

- B. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.
- C. PCSI shall submit heat dissipation calculations for every control panel.
- D. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.
- E. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.
- F. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.
- G. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.

2.04 CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model A-HCI; or approved equal.

2.05 CONTROL PANEL – INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring
 - 1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
 - 2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 14 AWG minimum. Electronic analog circuits shall utilize 16 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
 - 3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. An exception to the 6-inches separation for different system wires routed in parallel requirement can be made if using wireways that have noise shield. Acceptable noise shielded wireway is Panduct PanelMax, or equal. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.
- B. Terminations

1. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components, or between panel components, is not acceptable. A maximum of two wires shall be installed in a single terminal point on both the internal and field wiring side of the terminal blocks.
2. Multi-level terminal blocks or strips are not acceptable.
3. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares. Provide unique color coded terminal blocks for different voltages, functions, and signal types.
4. Provide separate terminal block color and location for CCTV Surveillance System components as specified under 28 21 00.
5. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Drawings or specified elsewhere in Division 40.
6. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare points shall be wired to terminal blocks.
7. Analog inputs (AI) shall have five terminals per shielded pair connection with adjacent terminal assignments for each point. Terminals shall include a fused terminal block for powering loop powered devices, two terminals for connection of the analog input signal, and one terminal for DC common to be used for loop powered devices. The fifth terminal is for shielded ground connection for cable pairs. Note that additional terminals may be required for completion of a current loop of analog devices. Ground the shielded signal cable at the PAC cabinet. Provide additional fusing where required as specified under other sections of Division 40. Provide additional terminals to accommodate loops powering multiple devices such as isolators or indicators. All active and spare points shall be wired similarly with circuit wiring completed to the field terminal blocks including all protective devices, circuit tagging, and bundling specified.
8. Analog outputs (AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Note that additional terminals may be required for completion of a current loop of analog devices. Ground the shielded signal cable at the PAC cabinet. Provide additional fusing where required as specified under other Sections of Division 40. Provide additional terminals to accommodate loops powering multiple devices such as isolators or indicators. All active and spare points shall be wired similarly with circuit wiring completed to the field terminal blocks including all protective devices, circuit tagging, and bundling specified.
9. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
10. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
11. Terminal blocks shall be tubular clamp type rated 600 VAC/VDC minimum and as specified on drawings. If fuse terminal blocks are specified, they shall be with built-in puller and with fuse size as required. Provide 20% spare terminals for every terminal strip, space permitting. Terminals shall be clearly and permanently labeled with embossed numbers as shown on drawings. Provide raised and angled terminals for incoming field device circuits.

12. Terminal block jumpers: Where indicated on the drawings, terminal block jumpers shall be pre-made specifically designed for the application. Jumpers designed to screw in on top of terminal blocks are preferred.
 13. Provide all necessary accessories, partition plates, separating plates, end cover, group markers, etc., as required for proper installation of the terminal blocks.
 14. Control Wiring Terminal Blocks
 - a. Standard control terminal blocks shall be designed to accept No. 22 to No. 12 AWG wires. Terminal blocks shall be color coded for functionality as specified. Provide terminal blocks rated for 30 amperes, 600 VAC/VDC unless otherwise noted. Provide terminal blocks by the same manufacturer for all applications.
 - b. Provide Single Circuit Terminal Block unless otherwise specified. Provide Allen-Bradley 1492-J4; Phoenix Contact UT 4; or equal
 - c. Knife-Style Isolating Terminal Block: For analog 4-20mA or 1-5VDC applications. Provide fused terminal block/fuse insert plug with blown fuse LED indication. Provide Allen-Bradley 1492-JKD4; Phoenix Contact UDK 4-TG; or equal
 - d. Fused Terminal Block: Fused terminal blocks shall be designed to accept No. 22 to No. 12 AWG copper wires. Provide blown fuse LED indication, rated for 12A, 57VAC/VDC. Provide Allen-Bradley 1492-H5; Phoenix Contact UT4 HESILED; or equal
 - e. Grounding Terminal Block: Provide Allen-Bradley 1492-JG3; Phoenix Contact UT 2,5-PE; or equal
 - f. Provide plug in jumper modules by the same manufacturer as the terminal blocks. Provide side or center jumpers with number of poles as required for the application. Provide Allen-Bradley; Phoenix Contact; or equal
 - g. Provide end anchor and end barriers/covers by the same manufacturer as the terminal blocks. Provide Allen Bradley; Phoenix Contact; or equal.
 - h. Provide terminal block marking systems using snap-in marker cards or premarked blocks. Marking system shall be the standard system from the manufacturer of the terminal blocks. Provide marking system, by Allen-Bradley; phoenix Contact; or equal.
 15. Heavy Duty Terminal Block shall be designed to accept wires up to No. 10 AWG. Terminal blocks shall be gray colored and rated for 30 amperes, 600 VAC/VDC. Acceptable products: Allen Bradley 1492 W6, Phoenix Contact Universal "UK" Terminal Blocks, or approved equal.
- C. All wiring to circuits where foreign voltages are present (that is live circuits independent of the panel's normal circuit breaker protection) shall be clearly identified using yellow wiring insulation. The existence of foreign circuits shall also be indicated with yellow Phenolic nameplates with on the panel exterior with red engraved lettering reading "CAUTION FOREIGN VOLTAGES PRESENT".
- D. All wiring shall be clearly tagged on both ends of the wire and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and electrical schematic drawings prepared by the PCSI. All power wiring, control wiring, grounding and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:
1. Incoming 120 VAC Hot – Black
 2. 120 VAC Hot wiring downstream of panel circuit breaker – Red

3. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe
 4. 240, 208 or 480 VAC wiring – as specified in Division 16
 5. 120 VAC neutral – White
 6. Ground – Green
 7. DC power or control wiring – Blue
 8. DC analog signal wiring – Black (-), White or Red (+)
 9. Foreign voltage – Yellow
- E. Power supplies and backup power:
1. Provide circuits for all internal panel power distribution including 120VAC utility power, 120VAC UPS power, and 24VDC instrument power, as shown on the drawings and specified herein. Appendix 40 67 00-A includes sample sketches of a typical District control panel power supply distribution circuitry. The sample sketches are provided as a guide to the PCSI and present typical requirements for the internal control power distribution system to be provided under this Contract. The PCSI shall be responsible for developing and providing power supply circuitry that conforms to the Project specific requirements per the Contract Documents and incorporating the typical approaches presented on the attached sketches.
 2. PCSI shall be responsible for the final power supply design approach, equipment selection, equipment ratings, wiring, protective devices, and all other elements of the control panel power supplies as specified and shown on the Drawings.
 3. Provide power failure under-voltage relays for monitoring 24 VDC power supply and 120V AC power supply at each control panel provided under this Contract.
- F. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 40 90 00. Provide control, signal and communication line surge suppression in accordance with Section 40 90 00.
- G. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.
- H. All internal components in the control panels shall be fed from 24 VDC power supplies as required to power field instruments, panel devices, PAC's, switches, etc. 24 VDC power supplies shall be as specified. Internal panel components and control circuits shall have a separate power distribution circuits with a circuit breaker or fuse and blown fuse indication.
- I. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives. Provide one-inch minimum wire bending radius to prevent wires from being kinked or stressed at the wiring duct junctions. Wiring duct sizes shall not exceed 50%.
- J. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp. Light fixture shall be fed from 120V in the control panel.

- K. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall be powered from the panel 120V utility circuit.
- L. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
- M. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
- N. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 26.
- O. Relays not provided under Division 16 and required for properly completing the control function specified in Division 40, Division 26, or shown on the Drawings shall be provided under this Section.

2.06 COMPONENTS

- A. Control panels that contain motor controls, starters, drives, or circuits greater than 300VAC shall include a panel mounted molded case main circuit breaker for branch circuit overcurrent protection and disconnecting means of source power to the control panel. The panel mounted main circuit breaker shall include a flange type or rotary mechanism with through door handle for operation of the main breaker. The operating mechanism shall include a mechanical interlock that will allow the panel door to open only when the handle is in the OFF position. A bypass feature shall be included such that the panel door can be opened when the handle is on the ON position.
- B. Supplementary circuit breakers may be used for isolation and protection of control cable, coils, contacts and circuit elements within the control panel and tapped from the load side of branch circuit protective devices. Use of this type of breaker is in addition to the branch circuit overcurrent breaker.
- C. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to the motor.
- D. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements and as shown on the Drawings.
- E. Control panels that contain only low voltage control circuits shall include a din rail mounted UL-489 Listed main circuit breaker for branch circuit overcurrent protection and disconnecting means of source power to the control panel.
- F. All components shall be provided with finger safe terminals. Where finger safe terminals are not available for a specific component, the panel shall include insulated barriers to prevent accidental contact with energized components.

- G. All operating control devices and instruments shall be securely mounted on the exterior door for panels installed in interior location, inner dead-front doors for panels installed in outdoor locations, or as shown on the Drawings. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Drawings.
- H. Indicator lamps shall be heavy duty, industrial type, high-visibility LED, full voltage type pilot lights. Units shall have screw on plastic lenses and shall have factory engraved legend plates as required. Lens color shall be green for OFF, red for ON and amber for BYPASS or ALARM. Indicator lamps shall be by Allen-Bradley; Eaton Corporation or approved equal.
- I. Mode selector switches (e.g. HAND-OFF-AUTO, LOCAL-OFF-REMOTE, PUMP SELECTOR, LEAD-LAG, etc) shall be heavy-duty, industrial type with contacts rated for 120 VAC at 10 Amps continuous. Units shall have standard size, black field, and legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements, as required. Provide spring return style switches where shown on the Contract Documents. Units shall be single-hole mounting, accommodating panel thicknesses from 1/16-in minimum to 1/4-in maximum. Selector switches shall be by Allen-Bradley; Eaton Corporation or approved equal.
- J. Push-button, shall be heavy-duty, industrial type with momentary or maintained contacts as required, rated for 120 VAC at 10 Amps continuous. Units shall have standard size, black field, and legend plates with white markings, as indicated. Button color shall be red for EMERGENCY STOP or START and green for STOP. Contact arrangement shall be as required. Local emergency stop pushbuttons shall be red with mushroom head type, non-spring return (pull to reset type). Provide all emergency stop push-buttons with plastic finger guards to minimize risk of accidental pushbutton activation. Push-buttons shall be by Allen-Bradley; Eaton Corporation or approved equal.
- K. Interposing Relays
 - 1. Interposing relays shall be provided where external signal voltages or contact ratings are not suitable for direct interface to control panel components, or as shown on the Drawings. Interposing relays shall be DIN rail mounted, single pole type, with 6A, 120VAC rated contacts, and coils rated as required for the application. Interposing relays shall be Finder 38 Series, or approved equal.
- L. Control Panel Circuit Breakers
 - 1. Panel mounted main or branch circuit overcurrent protection breaker – Breaker shall be 120VAC, thermal magnetic type and be manufactured and tested per UL 489 standards. Short circuit rating shall be a minimum of 10kAIC. Breaker shall be suitable for panel mounting and include a through the door handle mechanism. Breaker shall be manufactured by Schneider Electric, Eaton, GE (ABB) or Equal.
 - 2. Din rail mounted main or branch circuit overcurrent protection breaker - Breaker shall be industrial, thermal magnetic type, 120VAC rated and be manufactured and tested per UL 489 standards. Short circuit rating shall be a minimum of 10kAIC. Breaker shall be manufactured by Eaton, Allen Bradley, Weidmuller or Equal,
 - 3. Supplementary breakers – Supplementary breakers shall be DIN rail mounted high density, energy limiting type rated for the circuit voltage in which it is installed. Breaker shall be used per the exceptions of the NEC and as tested per UL 1077. Breakers shall

be manufactured by Schneider Electric, Eaton, Allen Bradley, GE (ABB) or approved equal.

M. Instrument and Panel Power Supply (120VAC to 24VDC):

1. Single-phase DIN-rail mounted, switched-mode power supply with 120VAC input, 24VDC nominal output. Output shall be adjustable and regulated over the range 22.5 to 28.5 VDC. Power supplies shall be sized for their connected load plus 50% spare capacity unused for powering all the panel components provided under this Contract.
2. The power supply shall have an efficiency greater than 87% with maximum peak-to-peak voltage ripple of less than 100mV.
3. Where shown on the drawings, provide DC power supplies in a fully redundant configuration with a diode bridge redundancy module. The redundancy module shall be of the same manufacturer and series as the power supplies provided, and sized for the full capacity of each power supply. The redundancy module shall include a DC "OK" LED and an alarm contact output.
4. Power supply shall have the following status signals:
 - a. DC "OK" LED which remains lit during normal power supply operation, flashes when the output voltage has dropped by more than 10%, and is off when no input voltage is present.
 - b. An isolated DC "OK" relay contact rated 1A at 30V.
5. Acceptable products: Phoenix Contact, Sola Series, Allen Bradley, Weidmuller, or approved equal.

N. Ground Bar

1. Ground bars shall be UL listed and have suitable number and size of terminals necessary for terminating stranded copper ground wires.
2. Acceptable products: Square D Ground Bar Kits, or approved equal.

O. Uninterruptible Power Supply (24VDC):

1. Single-phase DIN-rail mounted, uninterruptible power supply with 24VDC input and 24VDC output. Rated for 10 amp minimum. Output shall be continuous even during a complete or partial interruption of incoming line power. UPS to include audio and visual alarms. UPS shall be UL 508 listed for installation in UL 508A Control Panels.
2. Industrial DIN rail mount uninterruptible power supply using sealed 24 VDC maintenance free hot swappable batteries. Batteries shall also be DIN rail mountable and hot swappable for ease of access and maintenance.
3. Nominal input voltage is 18VDV – 30VDC; nominal output voltage is 19.2 VDC – 27.6 VDC.
4. Rated for ambient temperatures of -13 degrees Fahrenheit up to 158 degrees Fahrenheit. At temperatures above 140 degrees Fahrenheit, derating of the power supply output occurs; power supply sizing calculations shall take this factor into account.
5. Provide USB port connection to monitor battery health, battery life, remaining battery runtime and alarms through a software interface. Provide UPS software to monitor parameters.
6. Provide service mode button on front for removal of batteries.
7. LED Status: Provide LED status lights for mains/battery mode, alarm, battery operation and bar graph for state of charge.

8. Alarms: Provide three signal outputs with two outputs configurable via the UPS software.
9. Acceptable products: Phoenix Contact QUINT UPS-DC-IQ, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment specified above as shown on the drawings. Follow all manufacturers' instructions when installing panel devices and accessories.
- B. Mount circuit breakers below 79-inches.
- C. Mount common switching power supplies on horizontal or vertical DIN rail per the equipment manufacturer's recommendation so that no de-rating is required.
- D. Mount terminal blocks on vertical wireways on the bottom of the panel, unless otherwise noted by the equipment manufacturer. Field and internal terminations shall be on opposite sides of the terminal block. Arrange terminals for segregation of field and internal wires, and segregation of 120VAC wires and signal wires.
- E. Mount PAC I/O modules near the terminal block area. Arrange the modules with 120VAC I/O and signal I/O on opposite sides.
- F. Unless noted otherwise by the manufacturer's layout recommendations, layout the backpanel in the following arrangement, from top to bottom, with wireway in between each:
 1. Network and communications equipment.
 2. CCTV Components
 3. 24VDC power supply and DC distribution.
 4. 120VAC power supply and AC distribution.
 5. Relays and timers.
 6. PAC racks.
 7. I/O racks.
 8. Terminal blocks.

3.02 FIELD QUALITY CONTROL

- A. All control panel and documentation testing shall be in accordance with Sections 40 90 00.

END OF SECTION

SECTION 40 91 13

AUTOMATIC VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes the materials and installation of self-contained automatic control valves.
- B. Items of equipment specified herein shall be the end products of a limited number of manufacturers in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.

1.02 RELATED WORK

- A. Painting and Coating: 09 90 00
- B. Ductile-Iron Pipe and Fittings: 33 11 13.15
- C. Copper, Brass and Bronze Pipe, Fittings and Appurtenances: 22 11 13
- D. General Piping Requirements: 33 11 00

1.03 SUBMITTALS

- A. Submit manufacturer's data indicating the type and size of valves to be provided, and compliance with this specification.

PART 2 - MATERIALS

2.01 COMPLETE ASSEMBLIES

- A. All valves shall be complete, with all necessary operating appurtenances included in the work under this section.

2.02 INTERIOR LINING AND EXTERIOR COATING

- A. An epoxy coating shall be applied to internal and external ferrous valve surfaces. Coating shall be per AWWA C550 unless specified otherwise, herein.
- B. Interior coating and exposed materials shall meet NSF 61.

2.03 GLOBE CHECK VALVE

- A. Silent Globe Check Valve shall be:
 - 1. Cla-Val Series 581

2. Val-Matic Series 1800
3. DeZurik-Apco Series CSC - 600
4. Or approved equal.

B. Materials:

1. Body: Cast iron per ASTM A126, Class B
2. Disc: Bronze per ASTM B584
3. Spring: Stainless steel T302 per ASTM A313.5
4. Seat: Bronze per ASTM B584

C. Valve disc shall be center guided at both ends and spring loaded for silent operation.

D. Flow area through the body shall equal or exceed the cross-sectional area of the equivalent pipe size.

E. Size as shown on the Drawings.

2.04 COMBINATION AIR RELEASE AND VACUUM RELIEF VALVE

A. Combination air release and vacuum relief valve for potable water service shall be:

1. Cla-Val Series 35
2. DeZurik Apco Series 140C
3. Or approved equal

B. Provide vent screen and cover

C. Size as shown on the Drawings

2.05 PRESSURE RELIEF/SURGE ANTICIPATOR VALVE

A. Pressure relief/surge anticipator valve shall be Cla-Val Model 52-03, size as shown on the Drawings.

B. Materials:

1. Body & Cover: Ductile Iron per ASTM A536
2. Main Valve Trim: Stainless Steel
3. Disc Retainer: Cast Iron
4. Diaphragm Washer Cast Iron
5. Seat: Stainless Steel
6. Stem, Nut and Spring: Stainless Steel
7. Seal Disc: Buna-N Rubber
8. Diaphragm: Nylon Reinforced Buna-N Rubber
9. Internal Trim Parts: Stainless Steel, Bronze; Brass
10. Any other wetted metallic parts: Stainless Steel; Bronze or Brass meeting NSF 61

C. Class 150 flanged ends.

2.06 PRESSURE REDUCING VALVE

- A. Pressure reducing valve shall be Cla-Val Model 90-01, size as shown on the Drawings.
- B. Materials:
 - 1. Body & Cover: Ductile Iron per ASTM A536
 - 2. Main Valve Trim: Stainless Steel
 - 3. Disc Retainer: Cast Iron
 - 4. Diaphragm Washer: Cast Iron
 - 5. Seat: Stainless Steel
 - 6. Stem, Nut and Spring: Stainless Steel
 - 7. Seal Disc: Buna-N Rubber
 - 8. Diaphragm: Nylon Reinforced Buna-N Rubber
 - 9. Any other wetted metallic parts: Stainless Steel; Bronze or Brass meeting NSF 61
- C. Class 150 flanged ends.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Automatic control valves shall be installed above ground or within a vault to provide for adjustment, maintenance and repair. Direct burial of a control valve will not be permitted under any circumstance.
- B. Automatic control valves are to be installed with ductile iron piping per Section 33 11 13.15, unless indicated differently on the Drawings.
- C. Prior to purchase of material, inspect valve to confirm valve size, manufacturer, and part number.

3.02 VALVE ADJUSTMENT AND TESTING

- A. All valves installed, replaced, refurbished, or adjusted shall be tested for normal operation.
- B. Initial adjustment shall be made by a trained manufacturer's representative before or during system start-up.
- C. Valves shall be readjusted if necessary, to operate at the design pressure.

END OF SECTION

SECTION 43 24 10

VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes: Vertical turbine canned-style pumps, complete with motors, baseplates, couplings, guard and pump cans as shown on the Drawings and as specified herein.
- B. Related sections:
 - 1. Section 09 90 00 – Painting and Coating
 - 2. Section 26 05 80 – Low Voltage Motors
 - 3. Section 26 24 19 – Motor Control Centers

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A743 – Casting, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Applications
 - 2. A108 – Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
 - 3. A48 – Gray Iron Castings
 - 4. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 5. ASTM A276 – Stainless and Heat-Resisting Steel Bars and Shapes
 - 6. ASTM B148 – Aluminum-Bronze Sand Castings
- B. American Water Works Association (AWWA):
 - 1. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service Sizes 4” through 144”
 - 2. AWWA E103 – Horizontal and Vertical Line Shaft Pumps
- C. Hydraulic Institute (HI):
 - 1. HI 2.1-2.6 – Vertical Pumps
 - 2. HI 9.1-9.5 – Pumps General Guidelines
 - 3. HI 9.6.1 – Centrifugal and Vertical Pumps for NPSH Margin
 - 4. HI 9.6.3 – Centrifugal/Vertical Pumps Allowable Operating Region
 - 5. HI 9.6.4 – Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values.
 - 6. HI 9.8 – Pump Intake Design.
- D. National Science Foundation (NSF):
 - 1. NSF 61 – Drinking Water System Components – Health Effects

- E. Underwriters Laboratories (UL) 1004 – Motors, Electric
- F. NEMA MG-1 – Motors and Generators

1.03 SUBMITTALS

- A. General: Submittal data provided shall be of sufficient depth to illustrate compliance with these specifications, the plans and other specifications that may influence the proper operation of this pump. No pump equipment shall be shipped until the required drawings and curves have been submitted to and acknowledged by the Engineer as being of general compliance and conformance with the information in the contract documents.
- B. Shop Drawings and Product Data: Submit the following accordance with Section 01 30 00:
 - 1. Product data to demonstrate that the equipment conforms to the Specifications.
 - 2. Motor data
 - 3. Seismic anchorage calculations produced by an employee or a contractor hired by the pump manufacturer.
 - 4. Pump layouts and dimensions.
 - 5. Pump performance curves.
 - 6. Critical speed calculations for bowl shaft and line shafts
 - 7. Bearing life calculations
 - 8. Evidence of compliance with NSF/ANSI 61
- C. Performance Testing: Submit certified non-witnessed factory performance test results in accordance with the Hydraulic Institute Standard 14.6 for each pump and meet Acceptance Grade 1U criteria including power and efficiency. Test complete pump including bowls, column, and discharge head. Receive favorable review of test results prior to shipping the equipment.
- D. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists. Provide all contact information for the manufacturer's local representative.
- E. Affidavits: Submit affidavit from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation.

1.04 QUALITY CONTROL

- A. General: Pumps shall be suitable for pumping municipal potable water and shall be designed and fully guaranteed for this use. Motors supplied with vertical turbine pumps under this specification shall be suitable for continuous operation under existing conditions. Motors shall be non-overloading throughout the full range of pump operation, as established by the pump model performance curve.
- B. Standards: Equipment furnished and installed by the contractor shall be in full conformity and harmony with the intent to secure the best standard of construction and equipment as a whole or in part. Pumps shall be installed in strict accordance with manufacturer's specifications, their standard drawings and their installation instructions.

C. Pump Analysis

1. In order to ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the following analysis shall be required:
 - a. Pump manufacturer shall perform a structural frequency analysis of the structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20% of the operating speed range.
 - b. The analysis shall also include all modes of interest and pictorially represent them in a fringe plot format. Modes of interest are defined as those structural frequencies that exist below 120% of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump structure's stresses and deflections shall also be reviewed.
 - c. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met. Analysis should be signed and stamped by the professionally licensed engineer who performed the analysis work.
2. Vibration
 - a. When measured in the direction of maximum amplitude on the pump, shall not exceed limits given in the latest ANSI/HI nomograph for the applicable pump type.

D. Testing

1. Pumps shall be factory tested to determine head versus capacity, efficiencies, and shaft brake horsepower required for the operating points specified. All tests shall be run in accordance with the latest editions of the American Hydraulic Institute Standards and ANSI 2.6-2000. Three (3) copies of the certified test results shall be furnished within three (3) days after completion of all specified tests.
2. The test shall be conducted after the impeller diameters have been trimmed to meet the duty head requirements. A calibrated test motor may be used as the pump test driver. Field conditions are to be simulated as far as possible and corrections for column pipe and other losses are to be calculated and included for comparison of results with the contract curves and field test curves.
3. The factory will verify the guaranteed hydraulic performance. Should the pump not meet contract conditions or perform satisfactorily in the judgment of the purchaser, the pump supplier/contractor shall proceed to correct the deficiencies.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The pump supplier shall provide operation and maintenance manuals for all equipment and accessories furnished. The manuals shall be original (no photocopies) and contain at least the following:
 1. Identification stating the general nature of the manual, which appears on or is readable through the front cover.
 2. Neatly typewritten index near the front of the manual, furnishing immediate information as to the location in the manual of all emergency data regarding the equipment.
 3. Complete and detailed instructions regarding operation and maintenance of all equipment involved.

4. Complete nomenclature of all replaceable parts, their part numbers, current cost, list of recommended spare parts to be kept on hand, and name address and telephone number of nearest vendor of parts.
5. Copies of all guaranties and warranties issued.
6. Copies of all favorably reviewed shop drawings with all data concerning changes made during construction.
7. Where content of manuals includes manufacturers' catalog pages, clearly indicate the precise items included in this installation.

1.06 WARRANTY

- A. Contractor shall provide a full warranty on all materials and installation, including parts and labor to make repairs, for a period of one (1) year from the date of Substantial Completion. Owner will test and notify Contractor of any noncompliance within one year after the date of startup.

PART 2 - MATERIALS

2.01 GENERAL

- A. The pumping units shall be supplied and installed by one manufacturer and shall be complete including pumps, motors, baseplates, columns, pump cans, couplings, guards and other accessories as specified herein.
- B. Design is based upon products of Flowserve. Approved manufacturers:
 1. Flowserve
 2. Weir Floway
 3. Or Equal.
- C. Pumps shall be designed to pump potable water.
- D. The pumps, motors, drives, couplings and base plates shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without damaging cavitation, and without excessive vibration or noise.
- E. Each major piece of equipment shall be furnished with a stainless-steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head and speed. Each pump shall have a specific nameplate denoting that the pumping unit is in compliance with NSF 61-G. As a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles, power and service factors.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Pump Schedule:

Item	B-Zone Booster Pumps	C-Zone Booster Pumps
Quantity of Pumps	3	3
Pump Manufacturer/Model (or equal)	Flowserve 15EMM	Flowserve 15EMM
Number of Stages	1	2
Design Point (Guaranteed Point)	1800 gpm @ 113.5 ft TDH	2000 gpm @ 211.6 ft TDH
Maximum Capacity	2750 gpm @ 75 ft TDH	2750 gpm @ 145 ft TDH
Minimum Capacity	750 gpm @ 130 ft TDH	750 gpm @ 255 ft TDH
Maximum Rotative Speed (rpm)	1775	1775
Impeller Diameter (in)	11.69	11.56
Motor Horsepower	75	150
Motor Voltage (3 phase)	460	460
Column Size (inches)	10	10
Discharge Size (inches)	10	10

- B. Pump total dynamic head (TDH) shall be measured as the pumping head required from the pump intake to the pump discharge.
- C. Pumps shall operate without excessive noise or vibration over the full operating range indicated in the pump schedule. Vibration shall meet Hydraulic Institute standards.
- D. Bowl shaft and line shaft shall have their first critical shaft speeds at least 125% of full operating speed.
- E. Actual tested horsepower of each pump, with final impellor trim, shall not exceed the motor nameplate horsepower at any point on the pump curve.

2.03 PUMP COMPONENTS

- A. Provide vertical turbine pumps including bowl assembly, column, line shaft and guides, discharge head and electric motor. Comply with construction features of ANSI/AWWA E103 except where indicated differently in this Specification. Materials of construction shall be as listed in Table 1 and Table 3 of E103 except where indicated differently in this Specification.
- B. Seismic: Entire pump and installation including motor, discharge head, anchors, column, drive shaft, pump bowls and impellers and fasteners shall comply with the seismic requirements in Section 01 33 12.
- C. Pump Construction: Pumps for potable water service or processes shall be constructed from NSF-61 and NSF-372 certified materials, or be NSF-61 certified.
- D. Lubrication: Open lineshaft pump shall be product lubricated.
- E. Pump Bowl Assembly

1. The pump bowls shall be made of ASTM A48 Class 30 Cast Iron, free of blow holes, sand holes, and other detrimental defects, and accurately machined. Bowls shall be of flanged-type construction.
2. Pump bowls shall have either fired porcelain or NSF 61 certified epoxy lining.
3. Provide wear rings on impellers and bowls made of type 316 stainless steel.
4. The pump shaft shall be of type 416 stainless steel. Bearings shall be bronze and/or neoprene. Bearings shall properly fit the housing without knurling the housings or bearings.
5. The impellers shall be of bronze, ASTM B584 grade C903. Impellers shall be of enclosed type and be statically and dynamically balanced. They shall be securely fastened to the shaft with taper bushings, lock nuts or keys. They shall be adjustable vertically by external means at the driver location.
6. Impeller skirt and series case throat area shall be thick enough to allow for machining wear ring at time of repair.

F. Lineshaft

1. The lineshafts shall be of pump shaft quality 416 stainless steel. The butting face shall be machined square to the axis of the shaft, with the maximum permissible misalignment of the thread axis with the shaft axis 0.002" in 6". The size of the shaft shall be as determined per AWWA E103 and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls.

G. Column Assembly

1. Pump column shall be butt welded A53, Grade B pipe with epoxy coating meeting NSF 61, or type 316 stainless steel.
2. Column thickness shall be

H. Discharge Head Assembly

1. Pumps shall have a fabricated discharge head assembly conforming to the mounting requirements of the pump can, drive unit and discharge piping. The top of the discharge head assembly shall have a registered fit for mounting the driving motor.
2. The discharge head shall be of fabricated steel, ASTM A53 Grade B, free of detrimental defects and shall be accurately machined. The discharge pipe flange shall be steel, faced and drilled to meet 150-pound ANSI connections. Provide direction of rotation arrow.
3. Provide a mechanical seal and an adjustable spacer type coupling for use with a solid shaft motor. All metallic parts of the mechanical seal shall be type 316 stainless steel. Top shaft shall be of the same material as the lineshaft. Provide a type 416 stainless steel shaft sleeve through the seal area.
4. Discharge head shall be epoxy lined and coated. Wetted parts shall have epoxy meeting NSF 61. Exterior coating shall be manufacturer's standard coating.
5. Pumps shall be provided with a stuffing box drain connection and a pressure gauge connection.
6. Stuffing box shall meet the requirements of AWWA E103.
7. Sole plate shall be fabricated steel, ASTM A53 Grade B, integral to the discharge head.

2.04 MOTOR

- A. Motors shall be constructed in accordance with the latest applicable NEMA, IEEE, and ASA standards and shall be designed and selected according to the specific purpose, application and load requirement needed.
- B. Motors shall be 3-phase, squirrel-cage induction type, high efficiency premium design having the efficiencies that meet or exceed 89% per NEMA MG-1-12.53a, to be clearly shown on nameplate with 1.15 Service Factor. The motor shall be filled with mineral oil complying with ANSI/NSF 61 and shall contain a balance tube from the bottom to the motor into the motor shaft coupling compartment above the motor.
- C. The connection between the motor and the pump shaft shall be through a coupling or clutch in the motor head complete with non-release protection to prevent the lineshaft from unscrewing in the event of phase reversal.
- D. The motor shall be equipped with a thrust bearing of ample capacity to carry all rotating parts plus the hydraulic thrust from the bowl assembly as designated in AWWA E103.
- E. Motor shall be supplied with factory installed thermal protection. Motor shall be equipped with three (3) normally closed thermostats (1 per phase) designed to open at high motor temperature, as determined by the pump manufacturer. Contact ratings for thermostats: 120-600 VAC, 720 VA. Leads for thermostats shall be located in the main outlet box.
- F. Motor shall be supplied with factory installed space heaters. Heaters shall be low-watt, density-type to prevent condensation within the motor during idle periods. Space heaters shall be silicone rubber “strip-type” wrapped around and bonded to the end turns. Heaters shall be 60Hz, 115 V_{rated}. Heater leads shall be located in the main conduit box.
- G. The supplier shall furnish two (2) copies of a parts list and a maintenance manual for each motor furnished.

2.05 COATINGS

- A. All wetted steel and cast-iron components shall be coated with an NSF 61 approved coating. Coating shall be Tnemec V140F or approved equal. Surface preparation and coating shall be shop-applied as recommended by the coating manufacturer.
- B. Non-wetted surfaces shall be coated with the manufacturer’s standard coating.
- C. Coatings shall be guaranteed for a period of one year following the date of final acceptance by the Owner.
- D. Care shall be taken to prevent damage to coated surfaces during shipment. Any coatings damaged during shipment shall be refinished as the original at no extra cost to the Owner.

PART 3 - EXECUTION

3.01 GENERAL

- A. During loading, transportation, and unloading, every precaution shall be taken to prevent damage to any well components. Any damaged items shall be replaced or repaired to the satisfaction of the District. Where well casing is placed in stockpiles, it shall be neatly piled and blocked with strips between tiers.
- B. Foreign material, scale and dirt, inside and outside, shall be removed from all components and materials before assembly.

3.02 INSTALLATION

- A. Install the pump units in strict conformance with manufacturer's installation instruction. Check pump and motor alignment according to the standards of the Hydraulic Institute after complete unit has been installed at the site.

3.03 TESTING

- A. Equipment shall be tested in the presence of the Engineer by an authorized pump manufacturer representative who shall certify in writing that the pump is operating in compliance with these specifications and is free from binding, scraping, overloading, vibration or other defects.
- B. The pumping unit shall be run and monitored for a minimum duration of four (4) hours during the test period. Motor running current reading shall be taken for each phase every 30 minutes.
- C. The Contractor shall furnish all necessary oil and grease as recommended by the pump manufacturer for initial operation.

3.04 FIELD SERVICE

- A. The equipment manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests.
- B. Operations and Maintenance Training: Provide on-the-job training of operators on pump operation, safety inspections and instructions and preventative maintenance procedures.

END OF SECTION

SECTION 46 33 00

LIQUID CHEMICAL FEED EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes requirements for providing and connecting liquid chemical feed equipment in an existing facility, and a new chlorine analyzer in the new pump station.

1.02 RELATED SECTIONS

- A. Section 02 01 00 – Existing Facilities
- B. Section 33 11 00 – General Piping Requirements
- C. Section 26 01 00 - Electrical General Requirements
- D. Section 34 42 16 - Wire and Cable
- E. Section 26 05 53 - Electrical Identification
- F. Section 40 61 96 – Process Control Descriptions

1.03 EXISTING FACILITY

- A. The existing well field disinfection system is located at the District's F Booster Pump Station. Coordinate access through the Engineer.
- B. The existing system consists of a sodium hypochlorite bulk storage tank with a dedicated chemical feed (dosing) pump for each well. The dosing rate for each pump is set to match the production rate and chlorination demand of the well it is matched to. The chemical feed pump runs concurrently with the well pump.

1.04 REQUIREMENTS

- A. The Contractor shall provide three (3) chemical feed pumps with packaged in-line housing, panels, and chlorine sensors.

1.05 SUBMITTALS

- A. Submit product data for materials and equipment per Section 01 30 00, Contractor Submittals.
- B. Submit drawings showing the proposed equipment locations.
- C. Submit a detailed description and schedule for the connection of the new equipment to the existing system. The system configuration is such that all wells must be shut off to

make certain connections and the District wishes to minimize this scheduled outage period.

1.06 WARRANTY

- A. The chemical metering pump manufacturer shall provide a two-year warranty on the metering pump mechanical drive and a one-year warranty on the liquid end and pump accessories.

PART 2 - MATERIALS

2.01 METERING PUMPS

- A. Manufacturers:
 - 1. ProMinent Fluid Controls, Inc.; model as scheduled, no substitutions.
- B. Solenoid Metering Pumps:
 - 1. Model: ProMinent Gamma/ XL Model 0730
 - a. Order Code: GXLaUS0730PVT7Q100UDC130EN
 - 2. Type: Solenoid diaphragm metering pump.
 - 3. Service: Sodium hypochlorite at 10 to 15 percent solution
 - 4. Number of units: 3
 - 5. Capacity: 7.26 gph at 102 psi backpressure.
 - 6. Power: 120V, single phase, 60 hz
 - 7. Connection Size: ½ x 3/8-inch
- C. Control Cable:
 - 1. Model: Universal control cable, 5-pin round plug; 5-wire, 15 ft.
 - a. Order Code: 1001301

2.02 CHLORINE ANALYZER

- A. Analyzer shall be Prominent DULCOMETER DACb controller, part number DACBW006AA000010010EN, in a DGMA in-line housing, part number DGMA401T010.
- B. Control panel shall be a Prominent halogen panel, part number 7744852.
- C. Chlorine Sensor shall be Prominent model 1003203

2.03 PIPE

- A. All hard piping shall be schedule 80 CPVC. Match existing size and color.
- B. Piping joints shall be schedule 80 CPVC, solvent weld.

2.04 BALL VALVES

- A. Ball valves shall be CPVC with compression fittings. Match existing for size and color.

2.05 TUBING

- A. All flexible tubing shall be polyethylene. Match existing for size and color.

2.06 INJECTION QUILL

- A. Retractable Injection Quill with integrated ball valve and check valve, rated for pressures up to 150 psi, suitable for use with sodium hypochlorite.
- B. Valve body: Stainless Steel
- C. Valve connection: 1-inch MNPT
- D. Inlet connection: ½-inch MNPT
- E. Solution tube: Alloy C276, nominal ½” diameter
- F. Insertion length: 12-inches
- G. Check valve: spring-loaded ball check with EPDM seal.
- H. Manufacturer: Saf-T-Flo model EB-146 or equal.

2.07 ELECTRICAL MATERIALS

- A. All electrical materials including conduits, wiring, cables, relays, boxes and panels shall be specified in Division 26.

2.08 JUCTION BOXES

- A. Provide control junction box for each metering pump to convert the incoming PAC based control wiring to the pin and sleeve arrangement required by the pumps for external control. Provide 6” x 6” NEMA 4X box at each pump with terminal blocks wired to the pump standard cable/pin arrangement. Contractor shall be responsible for ensuring that all required pin requirements are met for suitable operation of the pumps.
- B. Mount control junction box at a nominal 60-inches above finished floor and coordinate location with final pump installation to allow wiring with the provided cable.

2.09 EQUIPMENT PEDESTAL

- A. Wall-mounting shelf or pedestal for the chemical feed pump may be prefabricated or custom-fabricated, made of stainless steel or coated steel suitable for a corrosive environment.
- B. Shelf and wall anchors shall be designed to support the full weight of the chemical feed equipment.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate site access with the Engineer.
- B. Collect field measurements and prepare diagrams of new equipment to be added to the existing pump station.
- C. Coordinate with District's SCADA integrator to determine connection to existing telemetry and type of relay currently in use.
- D. Schedule outage for final connection a minimum of 7 days in advance of the Work.

3.02 INSTALLATION

- A. Contractor shall install wall-mounted equipment and materials (shelf, conduits, boxes, etc.) in advance of any scheduled shutdowns.
- B. Electrical installation shall be per the requirements of Division 26.
- C. Pull cables and wires through conduits prior to scheduled outages if possible.
- D. Contractor shall use drop cloths, plastic sheeting or other spill protections when making connections to the sodium hypochlorite system.
- E. Test all joints for leakage with clear water before refilling the header pipe with sodium hypochlorite solution.

3.03 TESTING

- A. Test operation of the pump by piping to temporary source and receiving tanks. Verify dosing rate by measuring volume transferred for a set time period. Clear water may be used for the test.

END OF SECTION