

California American Water Company
TECHNICAL SPECIFICATIONS
FOR
MONTEREY PENINSULA WATER SUPPLY PROJECT
SLANT WELL INTAKE SYSTEM
CIVIL CONSTRUCTION

The following Technical Specifications have been prepared under
the direct supervision of the following design professional:



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SECTION 01000

SUMMARY OF WORK

PART 1: GENERAL

1.01 WORK UNDER THIS CONTRACT

The CONTRACTOR shall furnish all labor, materials, equipment and means to construct the project entitled **MPWSP SLANT WELL INTAKE SYSTEM – CIVIL CONSTRUCTION**, as shown on the Drawings and described herein. The work includes, but is not limited to, the following:

Construction and installation of the Monterey Peninsula Water Supply Project (MPWSP) Slant Well Intake System within the CEMEX Sand Mining Site, which includes site grading, feed water pipeline (i.e. PVC or HDPE and DI pipe, DI fittings, valves, air/vacuum release valves with enclosure, blow-offs, and related appurtenances, concrete thrust blocks and thrust restraint joints, trench excavation and backfill, etc.), approx. 700 feet of 42-inch pipe installed using Horizontal Directional Drilling (HDD), mechanical piping vaults, mechanical piping (i.e. valves, meters, gauges, etc.), concrete electrical enclosures, electrical, instrumentation, and controls, pump to waste basins, site restoration, and existing utilities abandonment in accordance with the plans and specifications that are part of the contract and bid documents for this project and until satisfactory and final acceptance of the work by the OWNER.

The above general outline of principal features does not in any way limit the responsibility of the CONTRACTOR to perform all work and furnish the required materials, equipment, labor and means as shown or required by the Contract Documents as required to provide a complete and functional project.

Materials, equipment, labor, etc., obviously a part of the work and necessary for the proper operation and installation of same, although not specifically indicated in the Contract Documents, shall be provided as if called for in detail without additional cost to the OWNER.

1.02 LOCATION

All work is to be performed within the CEMEX Sand Mining Site, within the City of Marina, at locations shown in the project drawings and specifications for this project.

1.03 WORK BY OTHERS

Michael Baker International, Inc. is the OWNERS Agent (ENGINEER) and Civil Design Team for the MPWSP Slant Well Intake System (within the CEMEX Sand Mining Site). GEOSCIENCE Support Services Inc. is the Slant Well Designer and Boart Longyear is the Slant Well Drilling and Equipping Contractor.

1.04 OWNER FURNISHED PRODUCTS

GEOSCIENCE Support Services Inc. will purchase the pressure transducers for each slant well and with the assistance of Boart Longyear, install them. CAW will purchase the even (7) slant well intake pumps and they will be installed by Boart Longyear.

1.05 CONTRACTOR USE OF SITE

- A. Access to site: Limited to areas noted on project drawings.
- B. Emergency building exits during construction: Not Applicable
- C. Construction operations: Limited to areas noted on project drawings.
- D. Time restrictions for performing work: Working Hour Restrictions as specified in Supplemental General Conditions.
- E. Utility outages and shutdown: To be coordinated with OWNER, CEMEX, and Pacific Gas and Electric (PG&E) as needed and appropriate.

1.06 FUTURE WORK

Not Applicable

1.07 SEQUENCE OF WORK AND SPECIAL PROJECT REQUIREMENTS

- A. **Shutdowns.** Not Anticipated, pipeline does not connect to an active pipeline. A schedule, including time and duration of any anticipated shutdowns shall be submitted to the OWNER for approval prior to the start of construction.
- B. **Tapping.** Not Applicable
- C. **Schedule.** The CONTRACTOR shall allow for construction and schedule constraints in preparing the construction schedules required under Section 01300: Submittals. The schedule shall include the CONTRACTOR'S activities necessary to satisfy all constraints included and referenced in the contract documents.

- D. **Sequence.** The anticipated construction sequence is as follows:
1. The CONTRACTOR shall be required to coordinate his work plan and schedule with the offsite pipeline work which shall be ongoing during the duration of this project:
 - a. Feed Water Pipeline (from CEMEX Site to Desalination Plant Site).
 2. CONTRACTOR shall coordinate with OWNER and CEMEX to determine location and sequencing for horizontal directional drilling (HDD) pits and operation.
 3. CONTRACTOR shall install the feed water pipeline and medium voltage conduits from Main Switchgear to each medium voltage transformer simultaneously to reduce impact along access roads.
 4. CONTRACTOR shall construct the feed water pipeline with all gate and butterfly valves installed, so that the pipeline can be cleaned, and pressure tested before connecting to each well site conveyance pipeline.
- E. **Alternate Sequence.** The CONTRACTOR shall have the option of submitting an alternate sequence of construction to the OWNER prior to the commencement of work if he/she believes the work can be accomplished in a more efficient manner or logical sequence, and with less impact to CEMEX. The OWNER will review the alternate sequence and provide a final determination as to whether the proposed sequence meets the OWNER's sequencing requirements.
- F. **Traffic Control.** Not Applicable
- G. **Stormwater BMPs.** Contractor shall furnish, install and maintain Stormwater BMPs in accordance with the drawings prepared for this project and in accordance with local, county, and state requirements.

1.08 CHANGE PROCEDURES

- A. The Engineer may issue to CONTRACTOR a Proposal Request which includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Times for executing the change and the period of time during which the requested price will be considered valid. CONTRACTOR will prepare and submit an estimate within 15 working days. The estimate shall contain a detailed breakdown of the labor, equipment, material, subcontract, equipment rental, contingencies, overhead, and profit costs associated with the

requested change. The estimate shall also include any requested adjustments to Contract Times including the window of time the OWNER has to render a decision on the matter.

1.09 DEFINED TERMS

Terms used in these Specifications which are defined in the General Conditions of the Contract Documents shall have the meanings assigned to them in the General Conditions.

1.10 ABBREVIATIONS

Where any of the following abbreviations are used in the Contract Documents, they shall have the meaning set forth opposite each.

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
IEEE	Institute of Electrical and Electronics Engineers, Inc.
AISC	American Institute of Steel Construction
AMCA	Air Moving and Conditioning Association
ANS	American National Standard
ANSI	American National Standards Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers

ASTM	American Society for Testing and Materials
AWPA	American Wood-Preservers' Association
AWWA	American Water Works Association
CS	Commercial Standard
IBR	Institute of Boiler and Raditor Manufacturers
IPS	Iron Pipe Size
JIC	Joint Industry Conference Standards
NBS	National Bureau of Standards
NEC	National Electrical Code; Latest Edition
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
125lb ANS	American National Standard for Cast-Iron Pipe
250lb ANS	Flanges and Flanged Fittings, Designation B16.1-1975, for the appropriate class
AWG	American or Brown and Sharpe Wire Gage
NPT	National Pipe Thread
OS&Y	Outside Screw and Yoke
Stl.WG	U.S. Steel Wire, Washburn and Moen, American Steel and Wire or Roebling Gage
UL	Underwriters' Laboratories
USS Gage	United States Standard Gage
WOG	Water, Oil, Gas

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.01 FIELD SURVEY WORK

- A. Unless otherwise provided in the Supplementary Conditions the ENGINEER shall provide existing engineering control points to establish reference points for construction. Utilizing ENGINEERS's initial control base line, CONTRACTOR shall setup any new control bench marks to be utilized throughout the project. Base line shall be set in accordance with all lines, dimensions, reference points, and elevations given in the Contract Drawings.
- B. Should the CONTRACTOR detect a discrepancy between the information as presented in the Contract Drawings and any existing survey grid-work, bench marks, structures, etc., the CONTRACTOR shall notify the ENGINEER immediately. New construction shall not commence until accurate control base lines and bench marks have been established.
- C. The CONTRACTOR shall throughout the course of the project, set all additional stakes which are needed for offset stakes, reference points, slope stakes, pavement and curb line and grade stakes, stakes for structures, sewers, utilities, roadway drainage, pipe underdrains, paved gutter, fence, culverts, or other structures, supplementary bench marks, and any other horizontal or vertical controls necessary to secure a correct layout and construction of the work. Stakes for line and grade for pavements, curbs, storm drains, sewers, etc., shall be set at twenty-five (25) foot maximum intervals. Base lines shall be staked in such manner as to clearly define them for the project.
- D. It shall be the CONTRACTOR's responsibility that the finished work conform to the lines, grades, elevations and dimensions called for in the Contract Documents. The Work shall be subject to checking by the ENGINEER, but any inspection or checking of CONTRACTOR's layout by the ENGINEER and the acceptance of all or part of it shall not relieve the CONTRACTOR of his responsibility to secure the proper dimensions, grades, elevations and locations on the several parts of the Work. The CONTRACTOR shall exercise care in the preservation of stakes, monuments and bench marks and shall have them reset at his expense when they are lost or displaced.
- E. Prior to the commencement of any Work activity, the CONTRACTOR shall survey and layout the Work to be performed and advise the ENGINEER

of any conflicts, obstructions, concerns, etc. which will prevent completion of such work in accordance with the requirements of the Contract Documents. If the CONTRACTOR fails to conduct such survey and layout or if the survey and layout fails to identify a conflict, obstruction, etc., which it reasonably should have, and a conflict, obstruction, concern, etc., is discovered, the CONTRACTOR shall bear the cost of any standby time for labor and/or equipment which occurs pending the ENGINEER's direction and the cost of rework of any Work installed which is affected by the conflict, obstruction, etc.

- F. Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the Work, the CONTRACTOR shall verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

3.02 COORDINATION AND MEETINGS

- A. The CONTRACTOR will be required to coordinate his work, to phase the construction operations, and provide, install and maintain any temporary connections necessary to prevent interference to operation of OWNER's facilities. Any construction work requiring the shut-down of facilities must be scheduled and performed only at such times as shall be authorized by the ENGINEER and OWNER. Such work must be completed during the specific periods authorized by the OWNER. It may be necessary that work will be performed during several shut-down periods and/or during periods of premium time payment to accomplish the desired construction. All costs to perform the CONTRACTOR's work, including premium time payments, shall be borne by the CONTRACTOR and are included in the Contract price.
- B. In addition to the above, the CONTRACTOR shall:
 - 1. Coordinate scheduling, submittals, and work of the various sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
 - 2. Verify the utility requirement characteristics of operating equipment are compatible with the utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
 - 3. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on drawings. Follow routing shown for pipes, ducts, and conduit, as closely as

practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

4. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
5. Coordinate completion and clean up of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNERs partial occupancy.
6. After OWNER occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.

C. Job Progress Meetings

Progress meetings will generally be held monthly. CONTRACTOR's attendance shall be required.

1. Schedule - The ENGINEER will establish the meeting place, time and date, notify participants and administer the meeting. CONTRACTOR shall notify major subcontractors and suppliers, as appropriate.
2. Attendance
 - a. ENGINEER and/or resident project representative.
 - b. CONTRACTOR's project manager and project superintendent
 - c. OWNER's representative
 - d. Subcontractor, as appropriate to the agenda
 - e. Suppliers, as appropriate to the agenda
 - f. Other parties as determined by ENGINEER and/or OWNER
3. Agenda
 - a. Review minutes of previous meeting.
 - b. Review of work progress since previous meeting.
 - c. Review field observations, problems, conflicts.
 - d. Review problems which impede construction schedules.
 - f. Review of off-site fabrication, delivery schedules.
 - g. Review corrective measures and procedures to regain projected schedule.
 - h. Review revisions to construction schedules.

- i. Review plan progress, schedule, during succeeding work period.
 - j. Review coordination of schedules.
 - k. Review submittal schedules; expedite as required.
 - l. Review maintenance of quality standards.
 - m. Review proposed changes for:
 - effect on construction schedule and on completion date
 - effect on other contracts of the project
 - n. Other business
4. Minutes - ENGINEER will prepare and distribute copies to participants and OWNER for review at the next meeting.

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SECTION 01010

DRAWING INDEX

PART 1: GENERAL

1.01 DRAWINGS

The following drawings, dated September 2018, prepared by Michael Baker International, Inc. accompany this Specification and are part of the Contract Documents.

MPWSP SLANT WELL INTAKE SYSTEM- CIVIL CONSTRUCTION

<u>Sheet</u>		<u>Title/Description</u>
1 of 58	G1	Title Sheet, Location, and Vicinity
2 of 58	G2	General Notes, Sheet Index, and Legend
3 of 58	G3	Key Map
4 of 58	C1	Hydraulic Profile
5 of 58	C2	Access Road Grading Plan
6 of 58	C3	Site and Grading Plan Well Site #1
7 of 58	C4	Site and Grading Plan Well Site #2
8 of 58	C5	Site and Grading Plan Well Site #3
9 of 58	C6	Site and Grading Plan Well Site #4
10 of 58	C7	Site and Grading Plan Well Site #5
11 of 58	C8	Feed Water Pipeline Plan and Profile Sta 10+00 to 17+00
12 of 58	C9	Feed Water Pipeline Plan and Profile Sta 17+00 to 25+00
13 of 58	C10	Feed Water Pipeline Plan and Profile Sta 25+00 to 33+00
14 of 58	C11	Feed Water Pipeline Plan and Profile Sta 33+00 to 37+20.93 (HDD)
15 of 58	C12	3,000 Gallon Surge Tank #1 Site Plan
16 of 58	C13	8,000 Gallon Surge Tank #2 Site Plan
17 of 58	C14	Civil Details #1
18 of 58	C15	Civil Details #2
19 of 58	C16	Well Insertion Points (not used)
20 of 58	C17	Erosion Control Details
21 of 58	C18	Erosion Control Plan
22 of 58	S1	Structural Details
23 of 58	S2	Electrical Enclosure Details
24 of 58	M1	Mechanical Piping, Single Well Site
25 of 58	M2	Mechanical Piping, Two Well Site
26 of 58	M3	HVAC Notes, Legend, and Schedules
27 of 58	M4	HVAC Floor Plan
28 of 58	M5	3,000 Gallon Surge Tank #1 Details
29 of 58	M6	8,000 Gallon Surge Tank #2 Details
30 of 58	E1	Electrical Notes, Symbols, and Abbreviations
31 of 58	E2	Single Line Diagram 1

32 of 58	E3	Single Line Diagram 2
33 of 58	E4	Main Switchgear Elevation and Floor Plan
34 of 58	E5	Switchboard I Elevation and Floor Plan
35 of 58	E6	VFD Elevation and Floor Plan
36 of 58	E7	Overall Power Plan
37 of 58	E8	Well Site #1 Power, Instrumentation & Control Plan
38 of 58	E9	Well Site #2 Power, Instrumentation & Control Plan
39 of 58	E10	Well Site #3 Power, Instrumentation & Control Plan
40 of 58	E11	Well Site #4 Power, Instrumentation & Control Plan
41 of 58	E12	Well Site #5 Power, Instrumentation & Control Plan
42 of 58	E13	Conduit Schedule
43 of 58	E14	Panelboard and Lighting Schedules
44 of 58	E15	Electrical Details
45 of 58	E16	Control Diagram 1
46 of 58	E17	Control Diagram 2
47 of 58	E18	SCADA System Block Diagram
48 of 58	E19	Control Panel Elevation
49 of 58	E20	120 VAC and 24 VDC Power Distribution Schematic
50 of 58	I1	Symbols and Abbreviations
51 of 58	I2	P&ID Well Pump 101 (SW-1, Test Slant Well)
52 of 58	I3	P&ID Well Pump 201 (SW-2)
53 of 58	I4	P&ID Well Pump 202 (SW-3)
54 of 58	I5	P&ID Well Pump 301 (SW-4)
55 of 58	I6	P&ID Well Pump 401 (SW-5)
56 of 58	I7	P&ID Well Pump 501 (SW-6)
57 of 58	I8	P&ID Well Pump 502 (SW-7)
58 of 58	I9	P&ID Surge Tank #1 and #2

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

***** END OF SECTION *****

SECTION 01025

MEASUREMENT AND PAYMENT

SCOPE

This section covers methods of measurement and payment for items of Work under this Contract.

GENERAL

The Contract Price shall cover all Work required by the Contract Documents. All costs in connection with the proper and successful completion of the Work, including furnishing ALL materials, equipment, supplies, and appurtenances; providing all construction plant, equipment, and tools; and performing all necessary labor and supervision to fully complete the Work as indicated on the drawings or specified by these specifications and permit requirements, conduct start-up testing, conduct training, and provide operation and maintenance manuals and record drawings shall be included in the unit and lump sum prices bid. All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid. This requirement shall include all meetings and permit compliance requirements with affected utility companies and agencies with jurisdiction over the project.

ESTIMATED QUANTITIES

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

BASE BID ITEMS

BID ITEM #1: MOBILIZATION, DEMOLITION, BONDS AND INSURANCE

- A. Measurement and payment of construction of mobilization, limits of construction fencing (i.e. orange barrier fencing), demolition, set-up of office trailers, temporary utilities, sanitary facilities, employee and visitor parking, installation of project signs, bonds, and insurance will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form.
- B. Total amount of premiums, supported with documentation including certified invoices, paid by the Contractor to obtain performance and payment bonds, and

specified insurance shall be paid at one time together with the first progress payment.

- C. Total amount for this bid item will be paid at the lump sum price named in the bid form. The amount paid under this bid item shall not exceed five (5) percent of the Total Bid Price.

BID ITEM #2: MINE SAFETY AND HEALTH ADMIN (MSHA) TRAINING

- A. Measurement and payment of Mine Safety and Health Administration (MSHA) training will be based upon the component parts listed in the approved Schedule of Values. Total payment for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full training completion.
- B. This work includes having ALL contractor personnel who may be working onsite complete MSHA 8-hour new mining training (27 courses). Each personnel can complete training online or Contractor can hire a professional to come to their office and conduct a course. U.S. Dept. of Labor Certificate of Training (MSHA FORM 5000-23) must be provided to the CEMEX front office before personnel can enter the work site.

BID ITEM #3: ENVIRONMENTAL MITIGATION MEASURES

- A. Measurement and payment of environmental mitigation measures pursuant to the Supplemental General Conditions (Section 3), will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and functional erosion control system and all appurtenant work.
- B. Work included in this bid item includes but is not limited to all work related to developing and implementing environmental protection measures, permit compliance measures, associated reporting requirements as described in the Supplemental General Conditions - Section 3, at all times during construction.

BID ITEM #4: STORMWATER BMP INSTALLATION AND MAINTENANCE

- A. Measurement and payment of construction of all erosion control and storm water pollution prevention as it relates to this construction will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and functional erosion control system and all appurtenant work.
- B. Work included in this bid item includes but is not limited to all work related to developing, obtaining applicable permits, and maintaining sufficient erosion control and storm water pollution prevention plan at all times during construction.

BID ITEM #5: ONSITE GRADING

- A. Measurement and payment of onsite access roads and well site working pads will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable tunnel and pipeline and all appurtenant work.
- B. Work included in this bid item involves the grading of ingress/egress site access as shown on Sheet C2 and all site grading at all five (5) well sites. Work includes, but is not limited to, construction staking, site grading, excavation, backfill, compaction, dust control, all equipment, property owner coordination, connecting work to other bid items and all other appurtenant work and materials for a complete and functional access road and well working sites.

BID ITEM #6: 30" TO 42" FEED WATER PIPELINE

- A. Measurement and payment of construction of all work on the feedwater pipeline between Stations 10+00 and 33+00 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the feedwater pipeline between Stations 10+00 and 33+00, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, and compaction. Work also includes all connections to the well site pipelines, connecting work to other bid items, all pavement removal and road reconstruction, traffic control, structures, valves, labor, equipment, blow-offs, air release, and all other appurtenant work and materials for a complete and functional system as shown in design drawings.

BID ITEM #7: 42" FEED WATER PIPELINE – HORIZONTAL DIRECTIONAL DRILLING

- A. Measurement and payment of construction of work on the feed water pipeline between Stations 33+00 and 37+20, installed using horizontal directional drilling (HDD), will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the feed water pipeline between Stations 33+00 and 37+20, including but not limited to the excavation pits, shoring, pipe (fused 42" PVC (DR-25) or HDPE (DR-17) and appurtenances installation, backfilling, compaction, pressure and leakage testing,

flushing, and cleaning and disinfection of the 42-inch feed water pipeline. Work also includes connections to the feed water pipeline, connecting work to other bid items, all pavement removal and road reconstruction, traffic control, structures, valves, labor, equipment, blow-offs, and all other appurtenant work and materials for a complete and functional system.

BID ITEM #8: PIPELINE DISINFECTION AND TESTING

- A. Measurement and payment of pipeline disinfection and testing on the feedwater pipeline between Stations 10+00 and 37+20 and all other pipelines will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item, but not limited to, pressure and leakage testing, flushing, cleaning and disinfection of the feedwater pipeline and all other mechanical piping/valves between the well discharge head and the feedwater pipeline connection.

BID ITEM #9: WELL SITE #1 MECHANICAL PIPING (1 WELL)

- A. Measurement and payment of construction of all work on Well Site #1 (one well at site) mechanical piping and valving as shown in Sheet M1 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed concerning Well Site #1 mechanical piping, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction, pipe supports, and cathodic protection. Work also includes pump to waste piping, connecting work to other bid items, structures, labor, equipment, gauges, blow-offs, air release valves, meters, deep well solenoid control valve, and all other valves and appurtenant work and materials for a complete and functional system as shown in the construction drawings.

BID ITEM #10: WELL SITE #2 MECHANICAL PIPING (2 WELLS)

- A. Measurement and payment of construction of all work on Well Site #2 (two wells at the site) mechanical piping and valving as shown in Sheet M2 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.

- B. Work included in this bid item involves all work to be performed concerning Well Site #3 mechanical piping, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction, pipe supports, and cathodic protection. Work also includes pump to waste piping, connecting work to other bid items, structures, labor, equipment, gauges, blow-offs, air release valves, meters, deep well solenoid control valve, and all other valves and appurtenant work and materials for a complete and functional system as shown in the construction drawings.

BID ITEM #11: WELL SITE #3 MECHANICAL PIPING (1 WELL)

- A. Measurement and payment of construction of all work on Well Site #3 (one well at site) mechanical piping and valving as shown in Sheet M1 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed concerning Well Site #3 mechanical piping, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction, pipe supports, and cathodic protection. Work also includes pump to waste piping, connecting work to other bid items, structures, labor, equipment, gauges, blow-offs, air release valves, meters, deep well solenoid control valve, and all other valves and appurtenant work and materials for a complete and functional system as shown in the construction drawings.

BID ITEM #12: WELL SITE #4 MECHANICAL PIPING (1 WELL)

- A. Measurement and payment of construction of all work on Well Site #4 (one well at site) mechanical piping and valving as shown in Sheet M1 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed concerning Well Site #4 mechanical piping, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction, pipe supports, and cathodic protection. Work also includes pump to waste piping, connecting work to other bid items, structures, labor, equipment, gauges, blow-offs, air release valves, meters, deep well solenoid control valve, and all other valves and appurtenant work and materials for a complete and functional system as shown in the construction drawings.

BID ITEM #13: WELL SITE #5 MECHANICAL PIPING (2 WELLS)

- A. Measurement and payment of construction of all work on Well Site #5 (two wells at the site) mechanical piping and valving as shown in Sheet M2 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed concerning Well Site #5 mechanical piping, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction, pipe supports, and cathodic protection. Work also includes all connections to existing utilities, connecting work to other bid items, structures, labor, equipment, gauges, blow-offs, air release valves, meters, deep well solenoid control valve, and all other valves and appurtenant work and materials for a complete and functional system as shown in the drawings.

BID ITEM #14: PRECAST CONCRETE VAULTS WITH ACCESS HATCH

- A. Measurement and payment of construction of all work to procure and install seven (7) precast concrete vaults for each well, will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item to procure and install seven (7) precast concrete vaults that include an access Hatch, Fiberglass Ladder w/ Stainless Steel Hardware and Bilco Ladder up Safety Post, Link Seals for Pipe Openings. Work also includes but not limited to the excavation, trenching, shoring, link seals and appurtenances installation, geotextile fabric, crushed rock base, embedment, backfilling, compaction, connecting work to other bid items, labor, equipment, and all other appurtenant work and materials for a complete and functional system.

BID ITEM #15: PUMP TO WASTE BASINS

- A. Measurement and payment of construction of all work on five (5) pump to waste will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on each pump to waste basin, including but not limited to construction staking, excavation, rip rap rock class 2, geotextile fabric, and compaction. Work also includes connecting work to other bid items, labor, equipment, and all other appurtenant work and materials for a complete and functional system.

BID ITEM #16: 8' PVC COATED CHAIN-LINK FENCE WITH PRIVACY SLATS

- A. Measurement and payment of construction of all 8' Tall PVC Coated chain link fence and gates, including tan (sand) colored privacy slats will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at unit price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to install chain-link privacy fence, including but not limited to construction staking, excavation, PVC coated chain-link fence, privacy slats, and appurtenances installation, backfilling, compaction, labor, equipment, and all other appurtenant work and materials for a complete and functional system.

BID ITEM #17: 3,000 GALLON SURGE TANK #1

- A. Measurement and payment of construction of all work on the 3,000-gallon surge tank #1 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed for the 3,000-gallon surge tank #1, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction. Work also includes connecting work to other bid items, structures, valves, gauges, labor, equipment, and all other appurtenant work and materials for a complete and functional surge tank system.

BID ITEM #18: 8,000 GALLON SURGE TANK #2

- A. Measurement and payment of construction of all work on the 8,000-gallon surge tank #1 will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed for the 8,000-gallon surge tank #1, including but not limited to construction staking, excavation, trenching, shoring, pipe and appurtenances installation, pipe embedment, backfilling, compaction. Work also includes connecting work to other bid items, structures, valves, gauges, labor, equipment, and all other appurtenant work and materials for a complete and functional surge tank system.

BID ITEM #19: CONCRETE AND REINFORCING STEEL

- A. Measurement and payment of construction of all work related to concrete and reinforcing steel for electrical enclosure pads, surge tank pads, electrical cabinet pads, thrust blocks, valve anchors, etc. will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves but is not limited to all concrete and reinforcing steel for electrical enclosure pads, surge tank pads, electrical cabinet pads, thrust blocks, valve anchors, etc., including but not limited to the excavation, trenching, shoring, appurtenances installation, embedment, backfilling, and compaction. Work also includes connecting work to other bid items, labor, equipment, and all other appurtenant work and materials for a complete and functional system.

BID ITEM #20: WELL SITE #1 ENCLOSURE, ELECTRICAL, CONTROLS, AND HVAC

- A. Measurement and payment of construction of all work related to the electrical components at Well Site #1 based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the electrical components at Well Site #1, including but not limited to construction staking, Fibrebond concrete enclosure, switchboard, VFD, HVAC, excavation, trenching, conduit and appurtenances installation, labor, equipment, and all other appurtenant work and materials for a complete and functional electrical and controls system.

BID ITEM #21: WELL SITE #2 ENCLOSURE, ELECTRICAL, CONTROLS, AND HVAC

- A. Measurement and payment of construction of all work related to the electrical components at Well Site #2 based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the electrical components at Well Site #2, including but not limited to construction staking, Fibrebond concrete enclosure, switchboard, VFDs, HVACs, excavation, trenching, conduit and appurtenances installation, labor, equipment, and all other

appurtenant work and materials for a complete and functional electrical and controls system.

BID ITEM #22: WELL SITE #3 ENCLOSURE, ELECTRICAL, CONTROLS, AND HVAC

- A. Measurement and payment of construction of all work related to the electrical components at Well Site #3 based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the electrical components at Well Site #3, including but not limited to construction staking, Fibrebond concrete enclosure, switchboard, VFD, HVAC, excavation, trenching, conduit and appurtenances installation, labor, equipment, and all other appurtenant work and materials for a complete and functional electrical and controls system.

BID ITEM #23: WELL SITE #4 ENCLOSURE, ELECTRICAL, CONTROLS, AND HVAC

- A. Measurement and payment of construction of all work related to the electrical components at Well Site #4 based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the electrical components at Well Site #4, including but not limited to construction staking, Fibrebond concrete enclosure, switchboard, VFD, HVAC, excavation, trenching, conduit and appurtenances installation, labor, equipment, and all other appurtenant work and materials for a complete and functional electrical and controls system.

BID ITEM #24: WELL SITE #5 ELECTRICAL, CONTROLS, AND HVAC

- A. Measurement and payment of construction of all work related to the electrical components at Well Site #5 based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the electrical components at Well Site #5, including but not limited to construction staking, Fibrebond concrete enclosure, switchboard, VFDs, HVACs, excavation, trenching, conduit and appurtenances installation, labor, equipment, and all other

appurtenant work and materials for a complete and functional electrical and controls system.

BID ITEM #25: 1,500 KVA AND 1,000 KVA TRANSFORMERS

- A. Measurement and payment of construction of all work on 1,500 KVA and 1,000 KVA Transformers will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item involves all work to be performed on the 1,500 KVA and 1,000 KVA Transformers (stainless steel skin), including but not limited to construction staking, excavation, trenching, conduit and appurtenances installation, embedment, backfilling, compaction. Work also includes all connections to other bid items, tranfmier slab boxes, structures, labor, equipment, and all other appurtenant work and materials for a complete and functional system.

BID ITEM #26: ADDITIONAL ELECTRICAL EQUIPMENT AND INSTALLATION

- A. Measurement and payment of construction of all additional electrical equipment will be based upon the component parts listed in the approved Schedule of Values. Total payment for construction for this bid item and all appurtenant work will be made at the lump sum price named in the bid form. Except as otherwise provided under separate bid items, such price names shall constitute full compensation for the construction of a complete and operable systems and all appurtenant work.
- B. Work included in this bid item for additional electrical equipment includes all work for the main switchgear, PG&E slab Box and transformer, conduits, conductors (i.e. power, grounding, control), Pull Boxes, and Programming, including but not limited to construction staking, excavation, trenching, conduit and appurtenances installation, backfilling, compaction, connections to other bid items, labor, equipment, and all other appurtenant work and materials for a complete and functional electrical and controls system.

****END OF SECTION****

SECTION 01075

PRICE AND PAYMENT PROCEDURES

PART 1 : GENERAL

1.1 SECTION INCLUDES

- A. Applications for payment.
- B. Change procedures.
- C. Defect assessment.
- D. Unit prices.
- E. Alternates.

1.2 APPLICATIONS FOR PAYMENT

- A. Submit updated cost loaded construction schedule with each Application for Payment.
- B. Payment Period: Submit at one-month intervals, including work completed through the end of the month.
- C. Substantiating Data: When ENGINEER requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 - 1. Partial release of liens from major subcontractors and vendors.
 - 2. Construction progress schedules, revised and current.
 - 3. Estimate of future value of work completed, with projected total value of work completed by the end of each month through the end of the project.

1.3 CHANGE PROCEDURES

- A. Maintain detailed records of work done on a Cost of Work basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.
- B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.
- C. On request, provide additional data to support computations:
 - 1. Quantities of products, labor, and equipment.
 - 2. Taxes, insurance and bonds.
 - 3. Overhead and profit.

4. Justification for any change in Contract Time.
 5. Credit for deletions from Contract, similarly documented.
- D. Support each claim for additional costs, and for work done on a Cost of Work basis, with additional information:
1. Origin and date of claim.
 2. Dates and times work was performed, and by whom.
 3. Time records and wage rates paid.
 4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
- E. The ENGINEER will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on a Field Order
- F. The ENGINEER may issue a Proposal Request including a detailed description of proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. CONTRACTOR will prepare and submit estimate within 10 days.
- G. CONTRACTOR may propose changes by submitting a request for change to ENGINEER, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors.
- H. Stipulated Sum/Price Change Order: Based on Proposal Request and CONTRACTOR'S fixed price quotation or CONTRACTOR'S request for Change Order as approved by ENGINEER.
- I. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work which are not pre-determined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.
- J. Work Directive Change: ENGINEER may issue directive, on EJCDC 1910-8-F Work Directive Change signed by OWNER, instructing CONTRACTOR to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- K. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. ENGINEER will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

- L. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- M. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- N. Change Order Forms: EJCDC 1910-8-B Change Order.
- O. Execution of Change Orders: ENGINEER will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- P. Correlation Of CONTRACTOR Submittals:
 1. Promptly revise Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 3. Promptly enter changes in Project Record Documents.

1.4 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements in accordance with article 13 of the General Conditions.
- B. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
 1. Products wasted or disposed of in a manner that is not acceptable.
 2. Products determined as unacceptable before or after placement.
 3. Products not completely unloaded from transporting vehicle.
 4. Products placed beyond lines and levels of required Work.
 5. Products remaining on hand after completion of the Work.
 6. Loading, hauling, and disposing of rejected products.

1.5 UNIT PRICES

- A. Authority: Measurement methods are delineated in individual specification sections.
- B. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.
- C. Take measurements and compute quantities. ENGINEER will verify measurements and quantities.

- D. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Actual quantities provided shall determine payment.
1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.
 2. When actual Work requires 25 percent or greater change in quantity than those quantities indicated, OWNER or CONTRACTOR may claim for Contract Price adjustment.
- E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.
- F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by ENGINEER multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- G. All work specified in DIVISION 1 – GENERAL REQUIREMENTS shall be considered incidental to and included in the appropriate Unit Prices stated in the Bid Form.
- H. Measurement Of Quantities:
1. Weigh Scales: Inspected, tested and certified by applicable state Weights and Measures department within past year.
 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
 3. Metering Devices: Inspected, tested and certified by applicable State department within past year.
 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
 5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
 6. Measurement by Area: Measured by square dimension using mean length and width or radius.
 7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
 8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.6 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at OWNER'S option in accordance with article 9 of Instructions to Bidders. Accepted Alternates will be identified in OWNER-CONTRACTOR Agreement.
- B. Coordinate related work and modify surrounding work.

PART 2 : PRODUCTS

Not Used.

PART 3 : EXECUTION

Not Used.

***** END OF SECTION *****

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SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.01 BEFORE STARTING WORK

A. Preliminary Progress Schedule

In accordance with the General Conditions, the CONTRACTOR shall prepare and submit to the ENGINEER for approval, a preliminary construction progress schedule. This submittal is to be made within ten (10) days from the effective date of Agreement.

The work day to calendar date correlation of the construction schedule shall be based on a 40-hour work week with adequate allowance for holidays, adverse weather and all other special requirements of the work.

The schedule shall include, as a minimum, the following separate activities:

1. Physical construction (includes mobilization, demobilization, setup time, lags, etc.).
2. Issuance by CONTRACTOR of purchase orders for material and equipment and submittal of shop drawings and samples to the ENGINEER.
3. Review by ENGINEER for each submittal of samples and shop drawings. Unless otherwise approved by the ENGINEER, allow a minimum of fifteen (15) working days for ENGINEER to review each submittal.
4. Fabrication time for materials and equipment.
5. Delivery of materials and equipment.
6. Installation of materials and equipment.
7. Testing, start-up and training for individual pieces of equipment or entire systems as appropriate.
8. Winter affected activities.

9. Outages or interruptions of OWNER's facilities required to perform work.
10. Demolition or removal work under this Contract.

Activity durations shall represent the best estimate of elapsed time considering the scope of the Work involved in the activity and the resources planned for accomplishing the activity expressed in working days.

Activity descriptions shall clearly define the scope of work associated with each activity. If activity descriptions contained in the schedule are not sufficient to describe the work, a supplemental narrative description is to be provided.

The construction work shall be detailed to an extent that progress can be readily monitored on a daily basis. In general, the construction work shall be detailed such that no construction activity shall have a duration greater than fifteen (15) work days.

Each activity shall be coded by the CONTRACTOR as necessary for proper and efficient utilization of the schedule. As a minimum, each activity shall be coded by:

1. Activity type (ie., submittal, ENGINEER's review, delivery, construction, etc.).
2. Responsibility (ie., CONTRACTOR, subcontractor A, subcontractor B, OWNER, ENGINEER, etc.).
3. Area (ie., Building A, Building B, sitework, etc.).
4. Work order (ie., OWNER assigned number required for monthly invoicing requirements).

The above schedule development requirements are a minimum and the CONTRACTOR shall develop the schedule as necessary to properly control and manage the project.

The preliminary progress schedule shall be submitted in a graphic representation of all significant activities and events involved in the construction of the project, and a written statement explanatory thereof for a complete understanding of the diagram.

The schedule reports shall be bound in booklet form and tabbed.

B. Shop Drawings and Samples Submittal Schedule

The preliminary progress schedule shall contain activities in the network representing submittal and review of shop drawings and material samples.

C. Schedule of Values

In accordance with the General Conditions the CONTRACTOR shall submit to the ENGINEER a schedule of values representing a detailed subdivision of the lump sum Contract amount. This subdivision, when approved by the ENGINEER, will become the basis for computing the contractors monthly progress payments. If practical, the schedule of values shall be developed by assigning a cost value to the appropriate activities contained in the preliminary progress schedule. If activities, or other line items, in the schedule of values contain costs associated with material, labor or subcontracts these costs are to be identified separately by listing the activity multiple times and identifying material, labor and subcontract with a suffix M, L and S respectively. Cost values for activities representing materials/equipment only shall be assigned to the activity representing delivery of such material/equipment to the job site.

D. Cash Flow Schedule

Accompanying the Schedule required above, the CONTRACTOR shall also submit to the ENGINEER, for approval, a Cash Flow Schedule. The Cash Flow Schedule shall show the amounts of money by months which will be required to reimburse the CONTRACTOR for Work performed during each month of the Contract Times. The sum of all the monthly cash requirements shall equal the Contract Price.

The approved Cash Flow Schedule will be used by the OWNER to program funds for progress payments to the CONTRACTOR. Monthly payments will be made to the CONTRACTOR in accordance with the Contract Agreement, but at no time will the aggregate amount of payments exceed the accumulated amount of payments for the same period of the approved Cash Flow Schedule.

E. Preconstruction Video Taping

Prior to mobilization at the site, the CONTRACTOR shall furnish to the ENGINEER a digital recording of all planned construction areas, material storage areas, areas adjacent to these areas, including but not limited to, streets, driveways, sidewalks, curbs, ditches, fencing, railing, visible utilities, retaining structures and adjacent building structures. The purpose of the video taping is to document existing conditions and to provide a fair measure of required restoration. Care should be taken to

record all existing conditions which exhibit deterioration, imperfections, structural failures or situations that would be considered substandard.

Temporary lighting shall be provided as necessary to properly record areas where natural lighting is insufficient (indoors, shadows, etc.). The tapes shall include an audio soundtrack to provide the following information:

1. Detailed description of location being viewed referenced to Contract Drawings (ie. station no., building designation, pipeline route etc.)
2. Direction (N, S, E, W, looking up, looking down, etc.) of camera view
3. Date, time, temperature, environmental conditions at time of taping.

Any areas not readily visible by recording methods shall be described in detail. Unless otherwise approved by ENGINEER, recording shall not be performed during inclement weather or when the ground is covered partially or totally with snow, ice, leaves, etc.

The original recording shall be submitted to the ENGINEER accompanied by a detailed log of the contents of each recording. The log should include location descriptions with corresponding recording counter numbers to facilitate the quick location of information contained on the tapes. The tapes will be maintained by the ENGINEER during construction and may be viewed at any time by CONTRACTOR upon request. Upon final acceptance, the tapes will become the permanent property of the OWNER.

1.02 FINALIZING SCHEDULES

The CONTRACTOR shall be prepared to present and discuss at the preconstruction meeting, the schedules submitted in accordance with this specification. Unless additional information is required to be submitted by the CONTRACTOR, the ENGINEER will, within 15 working days of the preconstruction conference, provide comments to the CONTRACTOR. The CONTRACTOR shall then resubmit the affected schedules addressing the ENGINEER's comments.

Approval of the final schedules by the ENGINEER is advisory only and shall not relieve the CONTRACTOR of responsibility for accomplishing the work within the Contract Times. Omissions and errors in the approved schedule shall not excuse performance less than that required by the Contract. Approval by the ENGINEER in no way makes the ENGINEER an insurer of the success of those

schedules or liable for time or cost overruns flowing from shortcomings in such schedules.

1.03 REQUIREMENTS FOR CONFORMING WITH SCHEDULE

If, in the opinion of the ENGINEER, the CONTRACTOR falls behind the progress schedule, the CONTRACTOR shall take such steps as will be necessary to improve his progress, and ENGINEER may require CONTRACTOR to increase the number of shifts and/or overtime operations, days of work, and/or the amount of construction planned, and to submit for approval such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the OWNER. An updated cash flow schedule will be required in this occurrence and will be provided with the supplementary schedules referenced above.

1.04 UPDATING SCHEDULES

The CONTRACTOR shall submit to the ENGINEER quarterly updates of the schedules required per this specification section.

Progress and shop drawing schedule updates shall reflect the progress to date by providing actual start dates for activities started, actual finish dates for completed activities, and identifying out of sequence work, schedule logic changes and any circumstances or events impacting the current schedule. The updates shall also contain the CONTRACTOR's best estimate of the remaining duration for activities not complete as of the date of the update. All graphic presentations, reports and computer discs required per the initial submittal of these schedules shall be provided with each update.

The schedule of values and cash flow schedules shall be updated to reflect any changes.

1.05 ADJUSTMENT OF PROGRESS SCHEDULE AND CONTRACT TIMES

- A. If the CONTRACTOR desires to make changes in his method of operating which affect the approved progress schedule, he shall notify the ENGINEER in writing stating what changes are proposed and the reason for the change. If the ENGINEER approves these changes, the CONTRACTOR shall revise and submit for approval, without additional cost to the OWNER, all of the affected portions of the schedule.
- B. Shop drawings and samples which are not approved on the first submittal or within the schedule time shall be immediately rescheduled, as well as any work which fails to pass specified tests or has been rejected.

- C. The Contract Times will be adjusted only for causes specified in the General Conditions. In the event the CONTRACTOR requests an adjustment of the Contract times, he shall furnish such justification and supporting evidence as the ENGINEER may deem necessary for a determination as to whether the CONTRACTOR is entitled to an adjustment of Contract Times under the provisions of the General Conditions. The ENGINEER will, after receipt of such justification and supporting evidence, make findings of fact and will advise the CONTRACTOR in writing thereof. If the ENGINEER finds that the CONTRACTOR is entitled to any adjustment of the Contract Times the ENGINEER's determination as to the total number of days adjustment shall be based upon the currently approved progress schedule and on all data relevant to the adjustment. The CONTRACTOR acknowledges and agrees that actual delays in activities which, according to the progress schedule, do not affect the Contract completion date shown by the critical path in the network will not be the basis for an adjustment of Contract Times.
- D. From time to time it may be necessary for the progress schedule and/or Contract Times to be adjusted by the OWNER to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the OWNER, and other unforeseeable conditions which may indicate schedule and/or Contract Times adjustments. Under such conditions, the ENGINEER shall direct the CONTRACTOR to reschedule the work and/or Contract Time to reflect the changed conditions, and the CONTRACTOR shall revise his schedule accordingly. No additional compensation shall be made to the CONTRACTOR for such changes except as provided in the General Conditions. Unless otherwise directed, the CONTRACTOR shall take all possible actions to minimize any extension to the Contract Times and any additional cost to the OWNER.

1.06 SHOP DRAWINGS

The CONTRACTOR shall promptly supply to the ENGINEER for approval, shop drawings with details and schedules for all items contained in the list of required Shop Drawings included at the end of this Section, or for other items as may be required by the ENGINEER.

A sufficient number of copies to allow the OWNER to retain four (4) reviewed copies of all drawings, schedules and brochures shall be submitted for approval. Black line prints, blue line prints or reproducible transparencies are required. Blueprints (white lines on a blue background) are not acceptable. Each submittal shall have the job name on it and the appropriate specification section or contract drawing reference.

Shop drawings shall be numbered with the WATER COMPANY's file number ____-____-XX Rev. _____. Detailed procedures for numbering will be outlined at the pre-construction meeting.

Each copy of the submittals made to the WATER COMPANY for approval shall be prepared by the CONTRACTOR and shall have an identifying title stamp as follows:

California-American Water Company
Monterey District
MPWSP Slant Well Intake System
Shop Drawing No. ____-____-____ Rev. _____

As required by the General Conditions, each copy of the submittals shall also be stamped with the CONTRACTOR's approval indicating that the shop drawing has been reviewed for conformance to the Contract Documents and has been coordinated with all other work and/or trades. The CONTRACTOR shall identify and bring to the attention of the ENGINEER any deviations to the Contract Documents contained in the submittal. For shop drawings being resubmitted the CONTRACTOR shall identify and bring to the attention of the ENGINEER any revisions other than those originally requested by the ENGINEER.

Submittals smaller than 8½x11 inches shall be secured to paper 8½x11 inches.

Submittals will be returned, stamped with the following classifications:

- a) "Approved" - There are no notations or comments on the submittal and, in our opinion, the submittal meets the requirements of the Contract Documents and the CONTRACTOR may release the equipment for production.
- b) "Approved as Noted" - Notations have been made on the submittals to insure conformance with the Contract Documents. The CONTRACTOR may release the equipment for production in accordance with the notations.
- c) "Not Approved" - The submittal does not meet the requirements of the Contract Documents. The CONTRACTOR must submit the specified product.
- d) "Revise and Resubmit" - When the material submitted is incorrect or insufficient to review properly and it is necessary to see the complete package again.
- e) "Resubmit Record Copy" - Used with the review action "Approved As Noted". The resubmittal shall incorporate notations.

Where a submittal indicates a departure from the Contract which the ENGINEER deems to be a minor adjustment in the interest of the OWNER not involving a change in Contract Price or extension of Contract Times, the ENGINEER may approve the submittal but the approval will contain, in substance, the following notation:

"The modification indicated on the attached submittal is approved in the interest of the OWNER to effect an improvement for the Project and is accepted with the understanding that it does not involve any change in the Contract Price or Times; that it is subject generally to all Contract stipulations and covenants; and that it is without prejudice to any and all rights of the OWNER under the Contract Bonds."

It is emphasized that the ENGINEER's approval of CONTRACTOR's submitted data is for general conformance to the Contract Drawings and Specifications, but subject to the detailed requirements of Drawings and Specifications. Although the ENGINEER may check submitted data in more or less detail, such checking is an effort to discover errors and omissions in CONTRACTOR's drawings and to assist the CONTRACTOR in coordinating and expediting his work, and shall in no way relieve the CONTRACTOR of his responsibility to engineer the details of the Work in such manner that the purpose and intent of the Contract will be achieved, nor shall such detail check by the ENGINEER be construed as placing on the ENGINEER, any responsibility for the accuracy, and for proper fit, functioning and performance of any phase of the Work included under this Contract.

1.07 SAMPLES

When required by the ENGINEER or where noted in other Sections of these Specifications, samples or materials shall be submitted for approval.

Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

Submit samples of finishes from the full range of manufacturer's standard colors, textures, and patterns for ENGINEER's selection.

Include identification on each sample, with full project information.

Submit the number or samples specified in individual specification sections; one of which will be retained by ENGINEER.

Reviewed samples which may be used in the Work are indicated in individual specification sections.

1.08 PROGRESS PAYMENTS

The detailed arrangement for submittal of progress payments shall be discussed at the preconstruction meeting. In general, progress payments shall be submitted monthly in a format acceptable to the ENGINEER. The progress payment request shall be based on the approved schedule of values and should provide the percentage of completion, total dollar value completed, dollar value completed prior to the current payment, and the amount requested for this progress payment for each line item contained in the schedule of values. Progress payment requests for material and/or equipment suitably stored but not yet incorporated into the work shall be accompanied by a copy of the appropriate manufacturers invoice, shipping order, bill of lading, etc. and the progress payment amount shall be the direct cost to the CONTRACTOR, or subcontractor, for such material and/or equipment. Payment will not be made to the CONTRACTOR if, upon inspection by the ENGINEER, it is determined that the material and/or equipment does not conform to the requirements of the Contract Documents including proper storage, receipt of approved shop drawings, receipt of any special guarantees, Bonds, insurance coverage, any evidence of damage or imperfections, etc.

1.09 CONTRACTOR'S DAILY REPORTS

If requested by the ENGINEER or the Resident Project Representative, the CONTRACTOR shall prepare and submit daily reports containing the following information:

1. The number of craftsmen and hours worked of each subcontractor,
2. the number of hours worked by each trade,
3. the number of hours worked of each type of equipment,
4. a description of work activities performed,
5. a description of any material or equipment deliveries,
6. description of obstructions encountered,
7. temperature and weather conditions.

The daily reports shall be submitted on a daily basis, by the end of the next business day.

Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents. Notice shall be as required therein.

1.10 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

Prepare complete written maintenance and operating instructions covering the equipment provided under this Contract. Divide the operating instructions into basic sections according to type of equipment.

Instructions shall describe all equipment and controls, their purpose, and their operation and use. Include maintenance checklists for use by the OWNER's personnel and a complete listing of replacement parts with pertinent information relative to ordering such parts.

Submit instructions in duplicate draft form for review by the ENGINEER at least eight weeks prior to initial operation, and in final form within thirty days after return of one copy of the draft with the ENGINEER's notations.

Prior to release of Final Payments, revise and resubmit copies of the instructions to accord with any changes in procedures or equipment made during start-up or initial operation. Resubmittals are also required for changes made during the guarantee period.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

***** END OF SECTION *****

SECTION 01500

TEMPORARY FACILITIES

PART 1: GENERAL

1.01 WATER SUPPLY

If reasonably available, water for the purpose of this Contract will be supplied to the CONTRACTOR by the OWNER. The CONTRACTOR shall furnish and install all necessary meters, temporary piping and valves in connection with such water supply.

The OWNER reserves the right to impose limitations upon the CONTRACTOR'S use of water as the OWNER, in its sole discretion, determines may be necessary to assure it of its continued ability to meet the demands of its customers and the volumes and pressures required for fire protection. Any water required by the CONTRACTOR in excess of the quantities the OWNER provides to the CONTRACTOR must be furnished by the CONTRACTOR at his own cost.

1.02 TEMPORARY HEAT

If Applicable, the CONTRACTOR shall provide approved type heating apparatus with the necessary fuel in order to protect and/or dry out the work. The stored materials and finished work shall be protected at all times from damage by the weather elements.

1.03 ELECTRICAL SUPPLY

The CONTRACTOR shall pay all fees, obtain necessary permits and have meter installed for power and light as may be required for the prosecution of his work.

1.04 TEMPORARY LIGHTING

Provide and maintain lighting for construction operations and lighting to exterior staging and storage areas after dark for security purposes.

1.05 BARRIERS

CONTRACTOR to provide barriers to prevent unauthorized entry to construction areas and orange barrier guardian safety fencing to protect existing facilities and adjacent properties from damage from construction operations and demolition. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing buildings. Provide

protection for plant life designated to remain. Replace damaged plant life. Official Limits of Construction will be identified with flags laid out by a biologist.

1.06 FENCING

CONTRACTOR to install security fencing if needed to secure the site and materials. The CEMEX Site is a secure site with security personnel at night, but the public can access the site from the beach.

1.07 PARKING

Parking will be available in certain areas outlined during the Pre-Bid Meeting.

1.08 PROGRESS CLEANING

Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust. Remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.09 SANITARY FACILITIES

The CONTRACTOR shall provide suitable temporary facilities and enclosures for the use of workmen and shall maintain same in a sanitary condition.

The CONTRACTOR is advised that the OWNER is in the business of providing potable water and the CONTRACTOR'S sanitary arrangements shall not endanger the OWNER'S facilities.

1.10 FIELD OFFICES

CONTRACTOR shall provide a temporary field office if deemed necessary.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

***** END OF SECTION *****

SECTION 1545

PROTECTION OF WORK AND PROPERTY

PART 1: GENERAL

1.1 PUBLIC AND PRIVATE PROPERTY

- A. The Contractor shall protect and maintain all underground or aboveground utilities and structures affected by the work and all lawns, shrubs, trees, fences, rockeries, etc., and parking strips or private property crossed by or adjacent to his operation, and any damage shall be repaired and restored by the Contractor.
- B. The Contractor shall take adequate precautions to protect existing sidewalks, curbs, pavements, utilities, adjoining property, and structures, and to avoid damage thereto, and the Contractor shall at the Contractor's own expense completely repair any damage thereto caused by the operation
- C. The Contractor shall confine the construction activities to the Limits of Construction and Public Right of Way. Any work outside of the Limits of Construction on private property will require the specific written approval of the property owner.
- D. Completion of work across private property shall be carried out in one continuous operation of construction of the facilities with immediate restoration and cleanup of the construction area.
- E. Wherever it may be necessary for the Contractor to excavate in any lawn areas, the sod shall be carefully cut and rolled and replaced after excavations have been properly compacted. All work shall be done in a manner calculated to leave the lawn area clean of earth and debris and in a condition as near as possible to that which existed before work was started.
- F. Ornamental trees and shrubbery shall be carefully removed with the earth surrounding their roots, wrapped in burlap and replanted in their original positions within 48 hours. Ornamental trees or shrubbery destroyed, or damaged, by the Contractor, whether on public or private property shall be replaced by the Contractor with material of equal quality, and no additional compensation will be allowed for such replacement.
- G. It is expressly understood that the Contractor shall in particular restore all such easements and rights-of-way to a condition equal to its original condition and in a condition satisfactory to the property owners and the Owner.

*** END OF SECTION ***

SECTION 01600

PRODUCTS

PART 1: GENERAL

1.01 PROTECTION OF MATERIAL AND EQUIPMENT

All electrical and mechanical equipment shall be stored in a warm, dry shelter with proper ventilation. Under no circumstances shall motors, electrical control equipment or any other electrical or mechanical equipment be stored under polyethylene plastic covers or tarpaulins. When space is available inside existing structures, and the OWNER approves, the CONTRACTOR will be allowed to store equipment inside them. Should such space not be available, the CONTRACTOR shall construct a shelter with a source of heat and proper ventilation as approved by the ENGINEER for the storage of equipment.

The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

After valves and hydrants have been inspected, the CONTRACTOR shall properly store them prior to use. In order to prevent entry of foreign material that could cause damage to the seating surfaces, the valves and hydrants shall be stored in a fully closed position unless recommended otherwise by the manufacturer. Resilient seated valves shall be stored in accordance with the manufacturer's recommendations. This may include storage with protective covers for rubber seats and in marginally open condition. Valves and hydrants should be stored indoors.

If valves must be stored outdoors, the CONTRACTOR shall protect the operating mechanism, such as gears, motor, actuators and cylinders, from weather elements. Valve ports and flanges must be protected from the weather and foreign materials. If valves are subject to freezing temperatures, all water must be removed from the valve interior and the valve closed tightly before storage, unless specifically recommended otherwise by the manufacturer. Valves shall be stored on pallets with the discs in a vertical position to prevent rainwater from accumulating on top of the disc, seeping into the valve body cavity and freezing and cracking the casting.

1.02 SERVICING EQUIPMENT

The CONTRACTOR shall check all equipment upon acceptance to determine if oil reservoirs are full and areas to be greased are properly packed with grease. The CONTRACTOR will provide the proper grease or oil for use in lubricating the required areas in the equipment. Any service to equipment while in storage, or

installed pending acceptance, is the responsibility of the CONTRACTOR and shall be performed per manufacturer's requirements, industry standards or as stated specifically in the technical specifications.

1.03 MATERIAL/EQUIPMENT FURNISHED BY OWNER

If applicable, certain material and equipment may be furnished by the OWNER as noted in the Contract Documents. The CONTRACTOR's responsibility for material and/or equipment designated to be furnished by the OWNER shall begin upon the CONTRACTOR's acceptance of such material and/or equipment at the point of delivery to him. All material and equipment shall be examined and items found to be defective in manufacture and/or otherwise damaged shall be rejected by the CONTRACTOR at the time and place of delivery to him. The OWNER will thereupon repair or replace the damaged items.

After acceptance of material and/or equipment by CONTRACTOR at point of delivery to him, CONTRACTOR shall be responsible for the proper storage, handling, servicing and installation of such material and/or equipment in accordance with manufacturer's recommendations, industry standards or specific requirements of the Contract Documents. Any material and/or equipment found to be defective prior to acceptance by the ENGINEER shall be repaired or replaced by CONTRACTOR at no additional cost to OWNER unless CONTRACTOR submits proof that such defect was latent and could not have been detected by CONTRACTOR when performing his duties and responsibilities under these Contract Documents.

CONTRACTOR's vs. OWNER's responsibilities for providing guarantees or warranty and manufacturer's representatives for service, inspection, certification of installation, installation, field training, start-up, etc. for material and/or equipment furnished by OWNER shall be as follows unless otherwise specified: OWNER will provide the warranty and CONTRACTOR is responsible for providing manufacturer's representatives for all necessary field service, start-up service, installation certifications, installation, field training of OWNER's personnel, etc. for OWNER furnished material and/or equipment as required for acceptance of such material and/or equipment in the completed project.

PART 2: PRODUCTS

2.01 GENERAL

Unless otherwise specifically provided for in these Specifications, all equipment, materials and articles incorporated in the work shall be new, in current production and the best grade obtainable consistent with general construction usage.

2.02 COORDINATION OF DIMENSIONS

The CONTRACTOR shall verify and make necessary corrections to construction dimensions so that all specified and/or alternative equipment, which is approved by the ENGINEER, can be installed and will function within the intent of the Contract Drawings and Specifications. The CONTRACTOR will promptly notify the ENGINEER of all necessary corrections required.

2.03 SAFETY AND HEALTH REQUIREMENTS

All materials, equipment, fixtures and devices furnished shall comply with applicable Laws and Regulations.

All equipment furnished and installed under this Contract shall be equipped with suitable and approved safety guards and devices required for the safety of the public and operating personnel. Such guards and safety devices shall be in accord with the latest requirements of safety codes approved by the American National Standards Institute as well as the safety requirements of applicable Laws and Regulations. Where said safety codes of the ANSI are incompatible with applicable Laws and Regulations, said Laws and Regulations shall prevail.

PART 3: EXECUTION

3.01 INSTALLATION

Material and equipment shall be installed in accordance with the appropriate Sections of these Specifications.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

The CONTRACTOR shall arrange for a qualified service representative from each company, manufacturing or supplying certain equipment as required by the individual Specification Sections to perform the duties herein described.

After installation of the applicable equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include but shall not be limited to, the following points as applicable:

1. soundness (without cracked or otherwise damaged parts)
2. completeness in all details, as specified
3. correctness of setting, alignment, and relative arrangement of various parts
4. adequacy and correctness of packing, sealing and lubricants

The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.

On completion of his Work, the manufacturer's or supplier's representative shall submit to the ENGINEER a complete signed report of the result of his inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the Contract Documents and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

After the ENGINEER has reviewed the reports from the manufacturers' representatives, the CONTRACTOR shall make arrangements to have the manufacturers' representatives present when the mechanical performance tests are made.

***** END SECTION *****

SECTION 01650

TESTING

PART 1: GENERAL

1.01 DESCRIPTION

This Section covers testing in accordance with the Specifications, as shown on the Drawings, and as necessary for a complete and satisfactory installation.

1.02 PIPELINES

All pipelines, valves, appurtenances, etc. installed per these Contract Documents shall be tested in the manner described by the technical specifications. Unless otherwise stated, all pipelines shall be hydrostatically tested, with no leakage, at a pressure at least equal to the maximum operating pressure of the pipeline.

1.03 WATER CONTAINING VESSELS

Test operation of the surge tanks in accordance with the manufacturer's recommendations.

1.04 LIQUID CHEMICAL STORAGE TANKS

Not Applicable

1.05 DAMPPROOFING AND PAINTING

Not Applicable

1.06 MECHANICAL PERFORMANCE TESTS

Test operation of the air/vacuum release valves, check valves, deep well solenoid control valves, and magnetic meters in accordance with the manufacturer's recommendations.

PART 2: PRODUCTS

Not applicable to this section.

PART 3: EXECUTION

Not applicable to this section.

***** END OF SECTION *****

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SECTION 01700

PROJECT CLOSEOUT

PART 1: GENERAL

1.01 TESTING OF FACILITIES

The CONTRACTOR shall complete all Work in a manner consistent with these Contract Documents and other requirements as stipulated on the Drawings. The Work shall be tested under operating conditions and pressures and any leaks or malfunctions shall be repaired to the satisfaction of the ENGINEER at no additional expense to the OWNER.

1.02 CLOSEOUT PROCEDURES

Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for ENGINEER's inspection. Provide submittals to ENGINEER that are required by governing or other authorities. Submit Application for final payment identifying total adjusted Contract sum, previous payments, and sum remaining due.

1.03 FINAL CLEANING

Execute final cleaning prior to final inspection. Clean site; sweep paved areas, rake clean landscape surfaces. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.04 PROJECT RECORD DOCUMENTS

Maintain on site, one set of the following record documents; record actual revisions to the Work:

1. Contract Drawings
2. Specifications
3. Addenda
4. Change Orders and other modifications to the Contract
5. Reviewed shop drawings, product data, and samples

Store record documents separate from documents used for construction. Record information concurrent with construction progress.

Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number
2. Product substitutions or alternates utilized
3. Changes made by addenda and modifications

Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract Drawings.

Submit documents to ENGINEER with final Application for Payment.

1.05 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.
- B. Deliver to (**California-American Water Company, located at 511 Forest Lodge Road, Pacific Grove, CA 93950**) as directed by ENGINEER; obtain receipt prior for final payment.

1.06 GUARANTEES AND WARRANTIES

The CONTRACTOR expressly warrants that all workmanship and materials performed or furnished under this Contract will conform to the Specifications, Drawings, samples and other applicable descriptions furnished or adopted by the CONTRACTOR and with all applicable laws, provisions and requirements of the Contract Documents. The CONTRACTOR shall remedy any defects due to faulty materials or workmanship which shall appear within a period of one (1) year from the date of acceptance of the work hereunder and pay for any damage to other work resulting therefrom. The OWNER shall give notice of observed defects with reasonable promptness. The CONTRACTOR warranty hereunder is in addition to, and not in limitation of, any obligations found elsewhere in the Contract Documents, any special guarantees provided by the CONTRACTOR or his suppliers, and any obligations imposed by law.

In addition to the above requirements, the CONTRACTOR shall assign material and equipment guarantees and warranties from all manufacturers and suppliers to the OWNER and deliver copies of such guarantees and warranties and the assignments thereof to the OWNER in order to assure the OWNER of the full benefit of such guarantees and warranties.

1.07 RESTORATION

The CONTRACTOR shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces and structures in accordance with the Drawings and City of San Diego requirements for work performed within the City's right-of-way. In the absence of specific direction, standards, or details, restoration and/or replacement shall be performed such that the disturbed areas are returned to a condition equal to or better than that before the work began and to the satisfaction of the ENGINEER and applicable authorities, and shall furnish all labor and materials incidental thereto.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

***** END OF SECTION *****

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SECTION 02020

DEWATERING

PART 1 - GENERAL

1.1 GENERAL

- A. The dewatering of all areas where work must be performed under this Contract is the responsibility of the CONTRACTOR and no additional sum will be allowed for any dewatering operation, overtime, equipment rental or any other expense incurred due to the occurrence of ground water, surface water or water from possible leakage of existing buildings, structures and piping in the vicinity of the CONTRACTOR'S operations.
- B. Should water be encountered, the CONTRACTOR shall furnish and operate suitable pumping equipment of such capacity adequate to dewater the trench. The trench shall be sufficiently dewatered so that the laying and joining of the pipe is made in the dry. The CONTRACTOR shall convey all trench water to a natural drainage channel or storm sewer without causing any property damage and in strict accordance with state and/or local requirements.
- C. Disposal of silt and debris which accumulates during construction shall be performed in strict accordance with federal, state and local requirements.

1.2 PERMITS

- A. The CONTRACTOR shall be responsible for obtaining and paying for any permits required for dewatering and disposal.

***** END OF SECTION *****

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SECTION 02025

EXISTING UTILITIES AND STRUCTURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. General: Certain information regarding the reputed presence, size, character, and location of existing underground facilities such as pipes, drains, sewers, electrical lines, telephone lines, cable TV lines, gas lines, and water lines has been shown on the contract drawings and/or provided herein. This information with respect to underground facilities is provided by the OWNER in accordance with conditions described in paragraphs 4.3.1, 4.3.1.1, 4.3.1.2 and 4.3.2 of the General Conditions.
- B. Potholing: The CONTRACTOR shall furnish all labor, materials, tools, and equipment required to pothole all existing utilities to discover the actual location and size of existing underground utilities and improvements, prior to beginning any construction of proposed facilities.
- C. Railroad Tracks: The CONTRACTOR shall protect in place all railroad tracks within and around the project area since they are considered historic.

1.2 NOTIFICATION OF UTILITIES

- A. **UNDERGROUND SERVICE ALERT (USA) shall be notified by the CONTRACTOR 48 hours prior to any construction, 1-800-422-4133.**
- B. The CONTRACTOR shall notify the utility company contacts listed on the cover sheet of the drawings to inform each respective representative of the work under this Contract which will pass through the areas where their facilities exist.
- C. Notification to the utility representatives shall be made in a sufficient amount of time, (min. 72 hours) prior to start of any potholing in the affected areas.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All traffic control, labor, equipment and materials required to investigate, backfill, and restore existing improvements for all potholed utilities shall be furnish by the CONTRACTOR, in accordance with utility company and agency requirements and these specifications.

- B. Materials for temporary support, adequate protection, and maintenance for all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the CONTRACTOR at his own expense.

PART 3 - EXECUTION

3.1 POTHOLING & ALIGNMENT ADJUSTMENTS

- A. After USA marking is complete, the CONTRACTOR shall employ a licensed LAND SURVEYOR, to measure and record the location, elevations, and the dimension of all underground existing utilities which cross proposed water distribution facilities. Potholing shall occur 200 feet in advance, in each direction, of any trenching operation.
- B. The CONTRACTOR shall depict and provide the results of the field surveys, i.e., station, offset, elevation and size for each utility crossing on the plans on a daily basis.
- C. The CONTRACTOR shall adjust the alignment of the water line as directed by the ENGINEER. No deviation shall be made from the required line or depth except with the consent of the ENGINEER.
- D. **The cost of adjusting water mains and appurtenances up to an additional 2 feet in depth as directed by the ENGINEER shall be considered incidental to the contract price established by the unit prices shown on the bid schedule.**

3.2 REPAIRS

- A. Existing pipes or conduits crossing the trench, or otherwise exposed, shall be adequately braced and supported to prevent trench settlement from disrupting the line or grade of the pipe or conduit, all in accordance with the directions of the ENGINEER. Utility services broken or damaged shall be repaired at once to avoid inconvenience to customers. Storm sewers shall not be interrupted overnight. Temporary arrangements, as approved by the ENGINEER, may be used until any damaged items can be permanently repaired. All items damaged or destroyed by construction and subsequently repaired must be properly maintained by the CONTRACTOR.

3.3 RELOCATION

- A. Where it is necessary to relocate an existing utility or structure, the work shall be done in such a manner as is necessary to restore it to a condition equal to that of the original facility. No such relocation shall be done until approval is received from the owner of the utility or structure being changed.

***** END OF SECTION *****

SECTION 02210

TRENCHING, BACKFILLING AND COMPACTION

PART 1 - GENERAL

1.01 SUBMITTALS

- A. Trench Safety: Submit excavation protective system plans for all project trenches, a copy of the project OSHA permit under which excavations over 5 feet deep will be conducted, and the names of the competent persons assigned to supervise the project.
- B. Agreements for Disposal of Excavated Materials: Submit property owner agreements which allow the disposal of excavated materials generated by the project.
- C. Backfill Materials Reports: Submit backfill materials reports in conformance with paragraph.3.07.A.
- D. Backfill Materials Certifications: Submit manufacturer materials certifications in conformance with paragraph 3.07.B.
- E. Compaction Testing: Submit compaction testing and retesting results in conformance with paragraphs 3.06 and 3.07.C on a daily basis.

1.02 PROFILES AND TOPOGRAPHY

- A. Contours, topography and profiles of the ground shown on the Drawings are believed to be reasonably correct but are not guaranteed to be absolutely so and are presented only as an approximation. The CONTRACTOR shall accept the construction site with conditions the same as existed at the time of bidding.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The trench backfill and surface restoration requirements shall conform the requirements of California American Water as shown or noted on the Drawings or as specified herein.

2.02 BACKFILL MATERIALS

- A. Clean Sand: Clean sand shall be free from deleterious materials and conform to the following gradation and plastic index requirements:
 - 1. Gradation
 - a. U.S. Standard Sieve Sizes: No. 4, No. 200
 - b. Percent Passing: 100, 0-12
 - 2. Plastic Index: Shall not exceed 2 when measured in accordance with AASHTO Designation: T 90.
- B. Aggregate Base Material: Aggregate Base Material shall be Class 2, ¾ inch maximum aggregate base in accordance with the requirements of Section 26, "Aggregate Bases", of the State Specifications.

PART 3 - EXECUTION

3.01 CONSTRUCTION EQUIPMENT

- A. Where the work is located in or adjacent to pavements, all equipment shall have rubber tires. Crawler equipment shall be permitted when there is no danger of damaging pavement. It is the CONTRACTOR'S responsibility, to repair, at CONTRACTOR expense, any damages due to the use of any equipment to complete the work. **Blasting shall not be allowed**, rock excavation shall be accomplished with hydraulic hammers or rotary rock grinders only.

3.02 NOISE, DUST AND ODOR CONTROL

- A. The CONTRACTOR'S construction activities shall be conducted so as to eliminate all unnecessary noise, dust and odors.

3.03 PROTECTION OF TREES

- A. Special care shall be taken to avoid damage to trees and their root system. Machine excavation shall not be used when, in the opinion of the ENGINEER, it would endanger the tree. In general, where the line of trench falls within the limits of the limb spread, headers are required across the trench to protect the tree. The operation of all equipment, particularly when employing booms, the storage of materials, and the disposition of excavation shall be conducted in a manner which will not injure trees, trunks, branches or their roots unless such trees are designated for removal.

3.04 TRENCH SUPPORT

- A. Unsupported open cut excavation for mains will not be permitted where trenching may cause danger to life, unnecessary damage to street pavement, trees, structures, poles, utilities, or other private or public property. During the progress of the work, whenever and wherever it is necessary, the CONTRACTOR shall, at his expense, support the sides of the excavation by adequate and suitable sheeting, shoring, bracing or other approved means. Such trench support materials and equipment shall be maintained and remain in place until backfilling operations have progressed to the point where the supports may be withdrawn without endangering property. All work shall be performed in accordance with the State OSHA requirements.

3.05 TRENCH EXCAVATION

- A. General Excavation: General excavation shall consist of the satisfactory removal and disposal of all materials encountered, including rock, taken from within the limits of the Work contracted, meaning the material lying between the existing ground line and the bottom of the trench as shown on the Drawings and as required by the Specifications, regardless of whether the existing ground line is exposed to air or is covered by water. It is distinctly understood that any reference to earth, rock, silt, debris or other materials on the Drawings or in the Specifications is solely for the OWNER's information and shall not be taken as an indication of classified excavation or the quantity of earth, rock, silt, debris or other material encountered.
 - 1. All excavation shall be made to the lines and grades indicated on the Drawings and as required by the Specifications or established in the field by the ENGINEER.
 - 2. All excavated materials shall be properly disposed of by the CONTRACTOR clear of the site. The CONTRACTOR shall furnish to ENGINEER satisfactory evidence that an appropriate disposal site will be used.
- B. Trench Width: The width of trenches shall be held to a minimum to accommodate pipe and appurtenant installations. In no case shall the minimum trench width be less than two (2) feet, and the maximum trench width should not be greater than the outside diameter of the pipe, plus two (2) feet. It is distinctly understood that the CONTRACTOR accepts total responsibility for the means and methods to provide trench support to accomplish an appropriate trench width.
- C. Trench Width Outside of "Neat Lines": If, for any reason, the trench width exceeds the maximum trench width defined in paragraph 3.5.B, above, the

CONTRACTOR shall properly dispose of the additional excavated material, provide additional backfill materials as specified in paragraph 2.2 and backfill and compact the additional volume of trench, in conformance with paragraph 3.6, at no additional cost to the OWNER.

D. Trench Depth

1. General: All trenches shall provide for a minimum of 48-inches of cover from the top of the pipe to finished grade, unless otherwise authorized by the ENGINEER.
2. Soil: Where excavation is made in soil, the trench shall be excavated to a depth of: the cover shown on the Drawings, plus the outside diameter of the pipe, plus 6-inches (thickness of pipe bed) below the bottom of the pipe. The bottom of the trench shall be accurately prepared by means of hand tools, so as to provide a uniform and continuous bearing support to install the pipe bed. All loose material shall be removed from the trench bottom. After preparation of the trench bottom, a pipe bed shall be prepared in conformance with paragraph 3.6.A.
3. Rock: Where excavation is made in rock or boulders, the trench shall be excavated to a depth of: the cover shown on the Drawings, plus the outside diameter of the pipe, plus 8 or 12 inches (thickness of pipe bed) below the bottom of the pipe, determined as follows: an 8-inch bed for pipes with a nominal diameter of 12-inches or less, a 12-inch bed for pipes with a nominal diameter of 16-inches or greater. All loose material shall be removed from the trench bottom. After preparation of the trench bottom, a pipe bed shall be prepared in conformance with paragraph 3.6.A.
4. Unsuitable Bottom: When unsuitable material is found below subgrade, as determined by the ENGINEER, the CONTRACTOR shall remove the unsuitable material to a depth determined by the ENGINEER, and provide clean compacted sand as specified in paragraph 3.6.B, to backfill to the bottom of the trench in areas where unsuitable material has been excavated below the bottom of the trench.

3.06 TRENCH BACKFILLING AND COMPACTION

- A. Pipe Bed: Prior to pipe and appurtenant installation, fine grade and hand place a uniform density layer of clean sand in accordance with paragraph 2.2.A, to the thickness as specified in paragraph 3.5.D, for pipe and appurtenances. Trench shall be backfilled as described below immediately after pipe is laid.

- B. Bottom of Pipe to Springline: Clean sand, as described in paragraph 2.2.A, shall be used to backfill the trench from the bottom of the pipe to springline of the pipe, and shall be compacted to 90% of maximum dry density as measured by the Standard Proctor Method in accordance with ASTM 698 with placement of the material in uniform, not to exceed, 4-inch loose layers, and eliminating the possibility of settlement, pipe misalignment or damage of joints.
- C. Springline to 12-inches above the Top of Pipe: Clean sand, as described in paragraph 2.2.A, shall be used to backfill the trench from springline of the pipe to 12-inches above the top of pipe, and shall be compacted to 95% of maximum dry density as measured by the Standard Proctor Method in accordance with ASTM 698 with placement of the material in uniform, not to exceed, 6-inch loose layers and avoiding injury to or moving the pipe.
- D. Remaining Trench Backfill: Native Sand, shall be used to backfill the trench from 12-inches above the top of pipe to the subgrade of the finished surface courses, and shall be compacted to 90% of maximum dry density as measured by the Standard Proctor Method in accordance with ASTM 698.
- E. Surface Conditions: The trench surface shall be regularly attended to during the course of the Contract. The CONTRACTOR shall take prompt corrective measures to correct any settlement or wash-out. The trench surface shall be maintained in a safe condition and shall not interfere with natural drainage. **All trenches shall be completely backfilled or be steel plated at the end of each day.**
- F. Deficiency of Backfill: Any materials required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the CONTRACTOR at his expense.

3.07 QUALITY CONTROL AND ASSURANCE

- A. Backfill Materials Report: The CONTRACTOR is responsible for obtaining and paying all costs to employ an independent, materials testing laboratory to conduct and prepared backfill materials reports, for all backfill materials proposed for use on the project. Each, proposed material source will require a report and shall be sealed and signed a registered professional Geotechnical Engineer, in good standing with the State Board. To be accepted, the report(s) shall evaluate representative samples of the proposed backfill materials for use on the project, demonstrate and conclude that the backfill materials meet the requirements of these Specifications and the specifications of Federal, State and local authorities (where applicable).
- B. Backfill Material Certifications: The CONTRACTOR shall provide the

ENGINEER with manufacturer certificates which state the following: “The representative samples provided to and tested by the independent materials testing laboratory are representative of all of the backfill materials which will be furnished to this project and comply in all respects to the Specifications”.

- C. Compaction Testing: The CONTRACTOR is responsible for obtaining and paying all costs to employ an independent, materials testing laboratory to conduct compaction testing of backfill. The material testing laboratory shall be certified, and the testing shall be conducted under the direction of a registered professional Geotechnical Engineer, in good standing with the State Board.
- D. The materials testing laboratory will conduct, measure and document a minimum of four (4) trench compaction tests, every 50 feet along the trench (test at springline, at one-foot above the top of pipe and at two (2) other elevations within the remaining trench backfill as directed by the ENGINEER). Each test will document the station and location within the trench where the test was conducted.
- E. Quality Assurance: Additional material and compaction quality assurance testing may be conducted by the ENGINEER at anytime, with these tests being paid for by the OWNER, and not subject to claim by the CONTRACTOR for additional compensation or time due to requirements necessary to perform additional tests.
- F. If materials or compaction results fail to meet the requirements of these Specifications, the CONTRACTOR shall perform remedial work and retest, until the backfill material is placed in conformance with these Specifications, with all additional costs required to perform paid for by the CONTRACTOR.

3.08 TRENCH MAINTENANCE

- A. The CONTRACTOR shall be responsible for the condition of the trenches for a period of one (1) year from the date of the final acceptance of the CONTRACTOR'S work, or as required by state, county or local authorities, and any materials required for filling depressions caused by settlement or washout shall be supplied and placed by and paid for by the CONTRACTOR.

**** END OF SECTION ****

SECTION 02540

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The CONTRACTOR shall be responsible for the design, permitting, construction, maintenance and close-out of erosion and sedimentation systems, at the construction site and all areas disturbed during construction, including borrow areas and private property.
- B. In addition to the requirements of these specifications, the CONTRACTOR will comply with all rules and regulations and all other Federal, State and local requirements for erosion and sedimentation control.

1.2 STANDARDS

- A. The CONTRACTOR shall comply with the best management practices for erosion and sedimentation control standards, whether, Federal, State or local.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials such as seeds, mulch, bales, barriers, traps, etc, shall conform to the applicable Federal, State and local requirements.

PART 3: EXECUTION

2.2 GENERAL

- A. The CONTRACTOR shall execute the design, permitting, construction, maintenance, and close-out, of erosion and sedimentation system in conformance with the requirements of applicable Federal, State and local requirements.

***** END OF SECTION *****

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SECTION 02830

CHAIN LINK FENCE

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide all material, labor, equipment and service necessary for the furnishing and installation of chain link fencing and gates, as shown on the Drawings and as specified herein. The work includes, but is not limited to:
 - 1. Polyvinyl Chloride (PVC) coated and galvanized or aluminized chain link fencing, posts, rails, aluminum sliding gate and accessories.
 - 2. Finish hardware
 - 3. Replacement of unsatisfactory materials.
- B. Provide chain link fence complete units controlled by a single source including necessary erection accessories, fittings, and fastenings. The single source installer shall have not less than 5 years of successful experience in installation of chain link fences similar to those required for this project.
- C. Fence shall be erected by skilled craftsperson or tradesperson in accordance with the best practice of the trade and taking into account the recommendation of the fence Manufacturer's Institute.

1.2 RELATED WORK

- A. The WORK of the following Section applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 01300 – Submittals

1.3 SUBMITTALS

- A. Product Data: Submit the following to the Owner Representative for acceptance:
Submit manufacturer's technical data, and installation instructions for metal fencing, fabric, posts, rails, and accessories.
- B. Materials: Submit a two foot square sample evergreen color polyvinyl chloride coating over galvanized coating with a 1-inch mesh fencing fabric and sand colored privacy slat to the ENGINEER for approval.
- C. Shop Drawings: Submit shop drawings indicating thicknesses,

dimensions, fastenings, hinges, and post anchoring method to Owner Representative for review and approval. Provide separate drawings for each of the following:

1. Post layout and fence material.
2. Post anchoring system.
3. Fence layout, include the connection system of the fabric to the top and bottom rail.
4. Gates, including all hardware and appurtenances. Submit Shop drawings and manufacturer's literature (product data) to the ENGINEER for review in accordance with Section 01300 for acceptance.

PART 2 – PRODUCTS

2.1 FENCE FABRIC (IF NEEDED DURING CONSTRUCTION)

- A. Chain Link Fence Fabric for perimeter security fences shall be Polyvinyl Chloride (PVC)-Coated ASTM F668 Class 2b over zinc-coated steel wire with minimum coating weight of 2.0 ounces of zinc per square foot of coated surface. Fabric shall be fabricated of 9-gauge wire woven in 1-inch mesh. Fence height shall be 7 feet with top and bottom rails and one foot of barbed wire at top of fence, 8 feet overall height including barbed wire.
- B. Fence fabric shall conform to the following: PVC-coat fabric color shall be evergreen complying with ASTM F 934. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 PRIVACY SLATS (FINAL)

- A. Chain Link Fence Privacy Slats shall be made of High Density Polyethylene (HDPE) and have UV inhibitors (UV resistant color concentrates) to add color protection and guard against cracking, chalking, and fading in the sunlight, while also being resistant to severe weather conditions, salt water, sand, alcohol, alkaline, ammonia, petroleum distillates, and common environmental pollutants. 8 feet overall height, sand (tan) color.

2.3 GATES

- A. All gates shall conform to the ASTM F 900 standards per detail. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size shall be (NPS) 1.9 inch and coated with PVC per 2.01B. Gate post diameters shall be as shown on the drawings.
- B. Aluminum sliding gate frame material to be in accordance with ASTM F 1184 Type II Class 2. Grade shall be structural aluminum: 6063-T52 unless otherwise

specified. Color shall match with fabric.

- C. Gate Privacy Slats shall be HDPE, color shall be sand tan.
- D. 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. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by the method approved by the manufacturer. Welding is prohibited.
- E. Latches, hinges, stops, keepers, rollers, post caps, and other hardware items shall be furnished as required for the operation of the gate and painted evergreen to match fence (2 coats). Latches shall be commercial grade and arranged for padlocking so that the padlock will be accessible from both sides of the gate – except at double gates that require accessibility from the inside part of gate ONLY. Latch holes for the padlocks on vehicle gates shall be of sufficient diameter to accommodate SFPUC padlocks.

2.4 POSTS

- A. Metal Posts for Chain Link Fence: All metal posts for chain link fence shall conform to standard ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B, shall meet the strength and coating requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gatepost shall be for the gate type specified subject to the limitation specified in ASTM F 900. All posts shall be capped and shall have PVC coating per 2.01B.

2.5 BRACES AND RAILS

- A. ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043 and shall have PVC coating per 2.01B.

2.6 ACCESSORIES

- A. All posts shall be capped to prevent rainwater from filling the posts and shall have PVC coating per 2.01B.
- B. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.
- C. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment.

2.7 CONCRETE

- A. ASTM C 94, using 3/4-inch maximum size aggregate, and having minimum compressive strength of 4,000 psi at 28 days. Grout shall consist of one part Portland Cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared per drawings. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts as practical; however, runs between terminal posts shall not exceed 200 feet for security fences. Any damage to galvanized surfaces shall be repaired with paint containing zinc dust in accordance with ASTM A 780.
- B. All fence and gate bolts shall be mounted so that they cannot be easily removed from the unsecured side of the fence or gate.
- C. All fence and gates shall be installed so that the fence or gate cannot be easily climbed from the unsecured side of the fence/gate due to improperly mounted fence rails, fence hardware, or gate hardware.
- D. The gap at the bottom of the fence should be as small as possible to prevent prying. The fence bottom rail should be a maximum of 3 inches from the concrete/asphalt. The fence fabric SHALL extend below the bottom rail so that the maximum gap between the fabric and the concrete/asphalt is 2 inch.

3.2 EXCAVATION

- A. Postholes shall be cleared of loose material. Waste material shall be spread as directed by the Owner Representative. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a minimum clearance between the bottom rail and finish grade, asphalt, or concrete curb. For over excavated area, fill area with concrete or asphalt with strength similar to the concrete post.

3.3 POST INSTALLATION

- A. Post installation and footing as indicated on Drawings.
 - 1. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts.

2. Line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set.
3. Fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 RAILS

- A. Top and bottom rails shall be installed as indicated on Drawings. Field verify all horizontal and vertical angles and custom fabricate brackets as needed. Submit to Owner Representative for review.

3.5 CHAIN LINK PRIVACY SLATS

- A. Chain link privacy slats shall be installed based on manufactures recommendation.

3.6 GATE INSTALLATION

- A. Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal. Gates shall be constructed in such a manner as to prevent the ability of a person from climbing over the secured site of an unopened gate.

3.7 GROUNDING

- A. Pedestrian gates at fences shall be grounded as shown on the Drawings. See Electrical Drawings.

****END OF SECTION****

SECTION 03200
REINFORCING STEEL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes furnishing, fabricating, and installing all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300, Submittal Procedures
- B. Section 03300, Cast-In-Place Concrete
- C. Section 13202, Welded Steel Reservoir

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: The Building Code, as referenced herein, shall be the 2016 California Building Code (CBC).

- B. Commercial Standards

American Concrete Institute (ACI), latest edition

ACI 315 Details and Detailing of Concrete Reinforcement

ACI 318 Building Code Requirements of Reinforced Concrete

American Society for Testing and Materials (ASTM), latest edition

ASTM A 82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 775 Standard Specification for Epoxy Coated Steel Reinforcing Bars

ASTM A 884 Standard Specification for Epoxy Coated Steel Wire and Welded Wire Reinforcement

1.04 SUBMITTALS

- A. The Contractor shall furnish shop bending diagrams, placing lists, bar splices and drawings of all reinforcement steel and concrete inserts prior to fabrication. Each bending list submitted shall be complete, including corner bars as required. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The Contractor shall be fully responsible for accuracy of dimensions and details, and said dimensions and details will be checked in the field by the Engineer at the time of placement. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface.
- B. Mill test certificates shall be submitted to the Engineer to certify that the reinforcing steel meets the specified requirements.

PART 2 - PRODUCTS

2.01 REINFORCEMENT STEEL

- A. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement for deformed bars.
- B. All reinforcing steel shall be epoxy coated conforming to ASTM A 775.
- C. Wire reinforcement shall conform to ASTM A 884, Class A, Type 1.
- D. Accessories
 - 1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement.
 - 2. Bar supports shall conform to ACI 315.
 - 3. Tie wires shall be 16-gauge minimum, black, soft annealed.
 - 4. All reinforcement shall be retained in place true to indicated lines and grades, by the use of approved high density "adobes", stainless steel chairs or plastic spacers and shim plates (to support spacers for floor and footing reinforcing). High-density adobes shall, as a minimum, be no less in compressive strength or cement content in which it will be cast. Adobes manufactured from plastic or with low cement content will not be accepted. Brick, broken, concrete masonry units, spalls, rocks or similar material shall not be used for support of reinforcing steel.

5. Plastic spacers shall be Preco Barspan Wheels, as manufactured by the Preco Corporation (Telephone: 1-800-645-1258), Space Wheel, as supplied by Atlas Construction Supply, Inc., or equal.
6. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic, which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

PART 3 - EXECUTION

3.01 GENERAL

- A. All reinforcing steel and other appurtenances shall be fabricated and placed in accordance with the requirements specified herein, and as indicated on the plans.

3.02 FABRICATION

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

3.03 PLACING

- A. Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement. The supports shall be of sufficient strength and stability to maintain the reinforcement in place throughout the concreting operations. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete. Where concrete is to be placed on the ground, supporting concrete blocks (or adobes) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties, which are embedded in the blocks.
- B. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

- C. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.
- D. Placing Tolerances: Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- E. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- F. Place reinforcing steel a minimum of 2-inches clear of any metal pipe or fittings.

3.04 SPLICING

- A. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer. Splices in adjacent bars shall be staggered.
- B. Unless specified or shown otherwise, the bars at a lap splice shall be in contact with each other.
- C. The length of the lap for reinforcement bars, unless otherwise shown, shall be in accordance with ACI 318 for a Class B splice. In no case shall the lap be less than 40 diameters of the spliced bars.
- D. Unless shown otherwise, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in subsequent concrete placement.

3.05 BENDING OR STRAIGHTENING

- A. Steel bending process shall conform to the requirements of ACI 318.
- B. Reinforcement shall not be straightened or rebent in a manner that will injure the material.
- C. Bars with kinks or bends not shown shall not be used.
- D. All bars shall be bent cold.

- E. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the Engineer.

3.06 REINFORCEMENT AROUND OPENINGS

- A. Where reinforcing steel has to be cut to permit passage of pipe or to create openings, additional reinforcing shall be as detailed on the Plans.

3.07 CLEANING AND PROTECTION

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose mill scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.
- C. Steel reinforcement placed in the work shall be stored under cover to prevent rusting and shall be placed on blocking such that no steel touches any ground surface.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

- A. The CONTRACTOR shall furnish all labor, materials, tools and equipment to, provide cast-in-place concrete for new and replacement of existing structures as outlined below in accordance with Agency standards and these specifications.
- B. SUBMITTALS
 - 1. Shop drawings and manufacturer's literature for all materials.
 - 2. Surplus material disposal agreement(s).

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials for cast-in-place concrete shall be minimum 5,000 psi, 1-inch maximum aggregate concrete with maximum water-cement ratio of 0.45, furnished in accordance with applicable Greenbook.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Thrust Blocks: Where concrete thrust blocks are employed, they shall be furnished in accordance with the standard detail provided in the Drawings.
- B. Enclosure, Cabinet, and Surge Tank Pads: In accordance with detail shown on the Drawings or applicable Cal-Am Standard Detail
- C. Meter and Backflow Preventer Pad: In accordance with detail shown on the Drawings or applicable Cal-Am Standard Details.

3.2 MAINTENANCE

- A. During the entire period of construction of the project, all streets, curbs, drives and walks shall be kept in clean, usable and safe condition for public use.

***** END OF SECTION *****

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SECTION 03480

PRECAST CONCRETE VAULTS

PART 1 – GENERAL

1.01 DESCRIPTION

The work specified shall include all labor, materials, tools, equipment, services and incidentals necessary to furnish valve and air release vaults and similar structures, complete with frames and covers, manhole steps and appurtenances as shown on the Contract Drawings.

1.02 QUALITY ASSURANCE

A. Reference Codes and Standards:

1. ACI 318 – Building Code Requirements for Structural Concrete
2. American Association of State Highway and Transportation Officials (AASHTO)
3. ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing
4. ASTM C33 – Standard Specification for Concrete Aggregates
5. ASTM C150 – Standard Specification for Portland Cement
6. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
7. ASTM C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
8. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
9. AWWA Standards identified in other related sections
10. ASTM Standards identified in other related sections
11. ANSI Standards identified in other related sections
12. Occupational Safety and Health Administration (OSHA)

1.03 SUBMITTALS

A. Shop Drawings

1. Prior to any field construction, the CONTRACTOR shall submit stamped calculations and drawings by a California Registered Engineer and conformance data for materials to be used in the construction of vaults and inlets for review.

PART 2 – PRODUCTS

2.01 PRECAST CONCRETE STRUCTURES

- A. General: The following requirements apply to all precast concrete structures, chambers, and vaults constructed on this project.
1. Precast concrete structures shall be manufactured in accordance with ASTM C478, latest revision, and shall be designed for HS-20 Live Load, per AASHTO Standard Specifications for Highway Bridges.
 2. Precast concrete structures shall be of approved design and sufficient strength to withstand the loads to be imposed upon them. An approved watertight joint shall be provided between precast concrete sections.
 3. Mark date of manufacture and name or trademark of manufacturer on inside of precast concrete chamber section.
 4. Sizes of precast concrete structures shall be as shown on the drawings.
 5. All concrete in precast units shall have minimum compressive strength of 5,000 psi at 28 days and shall conform to the following specifications:
 - a. All concrete furnished and installed for precast concrete vaults shall be in accordance with ACI 318 Building Code Requirements for Structural Concrete.
 - b. Materials:
 - 1) Cement: Portland cement, ASTM C150, Type II/V.
 - 2) Admixtures: Admixtures other than air entraining shall not be used. Air entraining admixture shall conform to ASTM C260. Air content of concrete with $\frac{3}{4}$ -inch maximum size aggregate shall be 6 percent plus or minus 1 percent volume.
 - c. Water: Clean and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances.
 - d. Aggregates: aggregates shall conform to ASTM C33, latest revision.
 - e. Proportions of materials in concrete and strength of concrete shall be subject to the following conditions:
 - 1) Minimum 28-day compressive strength – 5,000 psi.
 - 2) Maximum water to cement ration by weight, 0.45.
 - 3) Minimum cement content 600 lbs/cubic yard.
 6. All precast concrete shall be manufactured by wet cast methods only and shall be approved design.
 7. All precast concrete shall be reinforced. Reinforcing shall be designed for all applicable loads and forces encountered. Steel reinforcing shall be epoxy coated conforming to ASTM A775, Grade 60.

9. Prior to backfilling, all below grade exterior faces of the concrete structures shall be painted with two coats of sealer. The sealer shall be Bitumastic 300-M, a comparable grade of Carboline, or approved equal.

2.02 CHAMBER, VAULT, AND MANHOLE CONSTRUCTION DETAILS.

- A. Precast concrete chamber, vault, bases, and manholes shall have monolithic reinforced concrete and shall have a keyway type joint between precast concrete sections.
- B. Joint between precast concrete section shall be sealed as recommended by manufacturer and shall be watertight upon completion of joint. Joints shall be buttered inside and outside with 1 to 2 cement brick sand mortar.
- C. Where the proposed piping passes through exterior walls of precast concrete chambers and vaults, the manufacturer shall provide an oversized opening and mechanical type seal or shall provide an assembly consisting of a flexible rubber boot with clamp assembly. The boot assembly shall meet the requirements of ASTM C-923 and shall have a stainless-steel power sleeve and clamps.
- D. Product and manufacturer:
 1. Oldcastle Precast;
 2. Jensen Precast;
 3. Or approved equal.

2.03 MISCELLANEOUS METALS.

- A. Ladders.
 1. For Vaults, provide approved ladders as follows:
 - a. Material Shall be Fiberglass with Stainless Steel Hardware.
 - b. Shall have 1-inch diameter rungs spaced a maximum of 12-inch on centers.
 - c. Conform to all applicable OSHA 1910.27 requirements for fixed ladders.
 - d. Designed for a single concentrated load of 200 pounds minimum.
 - e. Minimum ladder width of 16 inches.
 - f. Length as required to extend from underside of slab to top of floor.
 - g. Shall be attached to wall with stainless steel suitable for all loads imposed upon them and as recommended by the ladder manufacturer.
 - h. All ladders shall have a dismount system that enables the climber to safely dismount the vaults.

B. Hatch Cover Assembly (pressure reducing valve chamber and meter pits).

1. Hatch cover assembly shall be furnished with a riser for each precast concrete structure. Riser shall be manufactured from concrete meeting the requirements as outlined above for precast concrete vaults.
2. Hatch leaf shall be manufactured from diamond plate and shall be 5086 aluminum. Each hatch shall be furnished with an aluminum hold open arm.
3. Door lock shall open in 90° position and shall be supplied with an exposed padlock clip.
4. Hinges shall be heavy-duty type, brass alloy, with 65,000 psi tensile strength, and a 3/4-inch Grade 316 stainless steel pin.
5. Each hatch shall be furnished with an aluminum lift handle flush with top of diamond plate leaf. All aluminum shall have mill finish.
6. Hatch cover assembly shall be as manufactured by Bilco, US Foundry, or approved equal.

PART 3 – EXECUTION

3.01 INSPECTION

A. Precast Sections

1. Precast section shall be installed level on a flat stable subgrade. Where an unstable condition exists, the CONTRACTOR shall excavate the unstable material and replace with compacted granular material.
2. All joints shall be filled inside and out with mortar to provide a smooth and continuous surface.

B. Benchwalls and Inverts

Mortar surfaces of benchwalls and concrete floors shall be given a broom finish. Where inverts are required they shall be lined with a half section of pipe of the same type used for the sewer or shall be constructed of 5,000 psi concrete, shaped and troweled to produce a smooth circular cross-section.

C. Frames and Castings shall be set in a full bed of mortar a maximum of ½" thick. Where required to adjust the frames and castings to grade there shall be installed to a maximum of four brick courses.

D. Lifting holes shall be sealed tight with a solid rubber plug driven into hole and remaining void filled with a mix of 1-part cement and 2 parts sand mortar.

E. All precast concrete structures shall be free from visible leakage: each

structure shall be tested for leaks and inspected and all leaks shall be repaired in a manner subject to the ENGINEER'S approval.

F. Grading at Vaults:

1. All precast concrete vault structures in unpaved areas shall be constructed as shown or directed to an elevation 6-inches higher than the original ground.
2. The ground surface shall be graded to drain away from structure. Fill shall be placed around them to a level of the upper rim of the frame and cover, and the surface evenly graded on 1 to 5 slope to the existing surrounding ground.
3. All precast structures installed with or under pavement areas shall be constructed to an elevation, which permits the frame and cover to be set flush with the final paving grade.

*****END OF SECTION*****

SECTION 09900

PAINING AND COATINGS

PART 1: GENERAL

1.01 RELATED WORK

1.02 QUALITY ASSURANCE

A. Required Experience and Workmanship

1. All cleaning and painting work covered by this Section shall be performed by a firm having at least five (5) years successful experience in the painting field and shall have completed at least fifteen (15) projects of similar content and design.
2. All work shall be in accordance with the requirements hereinafter specified and the applicable requirements of the latest edition of standards provided by SSPC: The Society for Protective Coatings, 40 24th Street, Sixth Floor, Pittsburgh, PA, 15222 and the American Water Works Association (AWWA) 6666 W. Quincy Avenue, Denver, CO 80235.

B. Product Labeling

Labels to include:

1. Manufacturer's name
2. Type of paint
3. Manufacturer's stock and batch number
4. Color
5. Instructions for reducing, where applicable

C. Sampling of Materials

1. Obtain test samples from material stored at project site or source of supply.
2. Select samples at random from sealed containers

1.03 SUBMITTALS

A. Product Data

1. Provide written description and catalog cuts describing each coating in the system. Information shall include; product delivery, storage, handling, application and curing instructions and

limitations. Include technical data sheets to substantiate compliance with specifications.

B. Certification

1. Provide Manufacturers certification that the coatings proposed meet the specifications and are suitable for the intended use..

C. Containment

1. Submit with Bid a narrative description and sketch of the proposed containment system, if required, presenting the basic containment concept, materials of construction and method of support.

1.04 PRODUCTS DELIVERY AND STORAGE

A. Delivery and Storage of Materials

1. All paints and solvents shall be delivered directly from the manufacturer to the site in new factory sealed containers clearly labeled showing the type of paint or coating and batch numbers. Only new paint purchased specifically for the Work shall be used. Leftover paints from previous jobs are not allowed.
2. Store only acceptable materials purchased for this project.
3. Store in suitable and secure locations.
4. Restrict storage to paint materials and related equipment.
5. Comply with manufacturer's storage requirements.

1.05 JOB CONDITIONS

A. Environmental Regulations

1. Volatile Organic Compounds (VOC's) - VOC ratings (pounds per gallon (PPG) and grams per liter (GPL)). Verify that each coating to be used complies with Laws and Regulations. Thinning of coatings in excess of the manufacturer's recommendation is not permitted.
2. Contact With Water - All surfaces to be painted that make contact with potable water or water or residuals involved in the treatment process, shall meet the ANSI/NSF 61 Standards for Potable Water Contact. Verify coatings to be used meet the ANSI/NSF 61 Standards for Potable Water Contact.

3. Safety Requirements - Comply with all Laws and Regulations having jurisdiction, SSPC-PA Guide 3 requirements, and the recommendations or requirements of paint and abrasive manufacturers. Should vents, holes, rigging attachments, or other modification, cutting, or welding be required on permanent structures in order to meet safety standards, submit written details and sketches to ENGINEER prior to performing Work. ENGINEER will review to verify that existing structures will not be compromised relative to their intended permanent use.
4. Emissions - Comply with Laws and Regulations concerning the emission of solid, particulate or gaseous matter as a result of cleaning, painting or performance of other Work.
5. Waste Classification - Satisfy Laws and Regulations pertaining to the classification and disposal of waste. Waste to include abrasive blasting residuals, paint containers, unused paints and thinners, solvents and other materials to be disposed as a result of performing the Work.
6. Responsibility - Comply with Laws and Regulations without supervision by the ENGINEER, ENGINEER's Consultant, Resident Project Representative, OWNER or any party they may be responsible for.

B. Protection of Properties

1. Protect process water or potable water areas from coming in unintended contact with coatings, abrasives or waste materials. Cover openings to these areas to keep blasting abrasive and paint materials from entering the openings.
2. All permanent equipment and property shall be covered to protect it from abrasive and paint damage. Restrict and control wind borne fallout of residue and particulate matter from cleaning operations, and/or paint from the proximity of property or vehicles.
3. Schedule and coordinate Work to avoid damage from wind borne fallout. All damage to facilities, vehicles, property, etc. shall be cleaned, repaired or replaced.

C. Working Times

1. Unless otherwise approved, no Work is to be done between sunset and sunrise, local time. The times for work shall comply with Laws and Regulations.
2. Night Work: Submit to ENGINEER justification for the necessity of night work. If ENGINEER approves the need for night work, verify that the necessary dew point, humidity, surface and air

temperature requirements are met. Provide proper lighting, safety or other required equipment. ENGINEER may revoke approval if night work is not in the best interest of OWNER.

D. Access and Rigging

Inspect all rigging attachments prior to use and regularly during use. Assume responsibility for all existing and any added attachments.

E. Cleanliness

Work shall be performed in, or proximate to, a potable water processing facility and public water supply storage. Exercise extreme care to protect public water supplies. Maintain Work areas in clean and safe conditions at all times. Collect debris daily and place in covered containers. Store debris and waste in accordance with Laws and Regulations. Do not store in the vicinity of water processing or storage facilities. Dispose of debris and waste off site in accordance with Laws and Regulations.

F. Temperature and Humidity

Meet all temperature and humidity requirements of the paint manufacturer. No painting shall be performed when the relative humidity is greater than or expected to exceed 85%, or if the temperature of the substrate is, or is expected to become within 5 degrees Fahrenheit above the dew point during the application and the initial curing of the coatings.

1.06 COLOR AND PIPELINE MARKER SELECTIONS

A. GENERAL

1. Coatings

- a. OWNER will select colors to be used on the job. Prepare sample panels for finish and color, in advance, with the specified materials.
- b. Match existing color coding of surfaces, mechanical and electrical equipment, etc. unless otherwise specified.
- c. Process piping colors to meet Ten States Standards.
- d. For those areas requiring safety color coding in accordance with OSHA regulations, the following colors shall be furnished:
 - i. Fire Protection Equipment – Safety Red

- ii. Danger – Safety Orange
- iii. Caution – Safety Yellow
- iv. Safety – Safety Green

2. Pipeline markers

- a. Provide one-piece, custom-formed, snap-on, non-pressure sensitive, semi-rigid plastic markers for identifying the contents of each pipeline in conformance with ANSI A13.1-1981. Pipe Line identification schedule and marker location requirements as specified hereinafter. Provide markers with legend printed in filled gothic letters and printed four times around marker to allow 360 degree visibility. Markers are to include flow direction arrows.
- b. Materials: Provide markers with entire printed surface covered and sealed within outdoor grade acrylic plastic which is resistant to grease, acid, and other corrosive chemicals and conditions, and able to withstand temperatures from minus 40 to 180 degrees F. Furnish markers which are permanently self-tensioned to firmly grip pipe without the need for adhesives.

3. Small Pipe Markers: For outside pipe diameters 3/4-inch through 5 7/8-inch, provide markers that snap completely around the pipe.

4. Large Pipe Markers: For outside pipe diameters 6-inches and larger, provide strap-on type markers, which include stainless steel spring fasteners.

- a. Letter Size and Color Field: Use gothic-style lettering with letter size and minimum color field width in accordance with the following:

<u>Pipe Outside Diameter Inches</u>	<u>Color Field Minimum Width Inches</u>	<u>Letter Size Inches</u>
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

PART 2: PRODUCTS

2.01 MATERIALS

A. Paint Materials

1. Coating materials and thinners: manufactured by:

Tnemec Company, Inc.
P. O. Box 1749
Kansas City, MO 64141

Carboline Company
350 Hanley Industrial Court
St. Louis, Missouri, 63144.

2. Substitutions: Allowed only at the time of bidding in accordance with Section 01100. Submittals of alternative systems for approval shall provide complete descriptions of the systems as to product numbers, number of coats, film thickness, etc.

B. Abrasives

Abrasives used for blast cleaning shall be those contained in the specifications of the Society for Protective Coatings (formerly Steel Structures Painting Council). Particular attention shall be given to the maximum particle size requirements. Proprietary abrasive materials (such as Black Beauty 1240 or Clemtex No. 2) may be used only upon written approval of the ENGINEER. Unless otherwise specified herein, the profile of the substrate shall achieve a 3 to 4 mil profile using 8/20 Mesh Silica Sand, G-25 Steel Grit, S-330 or 390 Steel Shot, 16 Mesh Garnet, 16 Grit Aluminum Oxide.

C. Tinting

Deliver paints and coatings to the job site ready-mixed. Job mixing and tinting allowed only with written approval of ENGINEER. Mixing shall only be done in mixing pails placed in suitably sized non-ferrous or oxide resistant metal pans.

PART 3: EXECUTION

3.01 EQUIPMENT

- A. All equipment, including but not limited to compressors, sand pots and paint pumps, shall be in good operating condition and of sufficient capacity to provide satisfactory results for cleaning and painting.

- B. Spray equipment and tip size shall be used as recommended in the paint or coatings manufacturer's instructions.
- C. Compressed air for blasting and painting shall be free from detrimental amounts of water and oil. Adequate traps and/or dryers shall be provided.
- D. CONTRACTOR must have sufficient explosion proof ventilation equipment to properly and efficiently expel all dust and paint fumes around the work area to the atmosphere. All equipment to be used in a confined space shall be explosion proof.
- E. CONTRACTOR shall have available at the site, all inspection and measuring equipment and devices such as dry and wet film thickness gauges, wet bulk dry measuring equipment, substrate temperature measuring equipment, holiday detector equipment, etc. as required to determine compliance with specifications and manufacturer requirements or recommendations.

3.02 SURFACE PREPARATION

A. General

1. Clean substrates prior to any application of paint or coating. Surfaces shall be free of oils, grease, dirt, debris or any other contaminant that may affect the integrity of the specified coating.
2. Surface and ambient temperatures to be minimum 5 degrees Fahrenheit higher than the dew point temperature prior to, and during, surface preparation.
3. Inspect shop painted surfaces and touch-up all scratched, chipped or abraded areas. De-scale by wire brush, or other method, any coating of scale. Produce a suitable surface for re-coating.

B. Metal Substrates

1. Grind to remove sharp edges, weld protrusions and other protrusions. Grind sharp edges to a 1/8-inch radius minimum. Completely remove weld spatter.
2. Surfaces to be free from oil, grease, mud, dust, moisture, old paint, or other foreign matter.
3. Prime surfaces cleaned to bare metal before any rusting takes place. Cleaned surfaces shall not be allowed to stand overnight without a primer coat applied. Apply primer during the same daylight period that the cleaning was accomplished.

4. Feather and smooth existing coatings at edges where spot cleaning is specified. Achieve proper blending of new paint to old paint. Peeling of old paint is not acceptable.
5. Blow down with dry compressed air, sweep or vacuum surfaces following blast cleaning operations.
6. Clean surfaces in accordance with the Surface Preparation Specifications, latest edition, of the Society for Protective Coatings (formerly Steel Structures Painting Council) to the following degrees as specified in appendices to this specification section:

SSPC-SP1, Solvent Cleaning.
SSPC-SP2, Hand Tool Cleaning.
SSPC-SP3, Power Tool Cleaning.
SSPC-SP5, White Metal Blast Cleaning.
SSPC-SP6, Commercial Blast Cleaning.
SSPC-SP7, Brush-off Blast Cleaning.
SSPC-SPI0, Near-White Blast Cleaning.
SSPC-SP11, Power Tool Cleaning to Bare Metal.

B. Concrete and Masonry Substrates

1. Prepare concrete and masonry surfaces by removing all dirt, dust, oil, grease stains and efflorescence. Blast clean all concrete and masonry surfaces, except floors and building exteriors, using brush blasting per SSPC-SP7. Acid etch floors and hand power tool clean building exteriors. Allow twenty eight (28) days to cure for new concrete prior to surface preparation.

C. Wood and Drywall Substrates

1. Prepare wood and drywall substrates by removing all dirt, oil and other foreign substances with mineral spirits, scrapers, and sandpapers as required. Finished surfaces exposed to view shall be made smooth by sandpapering and shall be free of dust.

3.03 COATING SCHEDULE

A. The coating systems to be used for each surface are listed in each items specification.

B. The types, products, number of coats, minimum dry film thickness per coat and all other relevant information for each coating system to be applied under this CONTRACT are listed in Appendix #2 to this Specification Section.

3.04 COATING SYSTEM APPLICATION

A. General

1. Apply to a dry film thickness as specified by the manufacturer, unless otherwise specified herein. Allow proper curing times between re-coatings. Vary color slightly between successive coats.
2. Finish coats shall be smooth, uniform in color, free of brush marks, runs, laps, dry spray, overspray, holidays, missed or skipped areas. Cut sharp edge of paint, without overlapping, where work joins other materials or where a color change occurs.
3. Mix all paints and coatings in strict accordance with applicable portions of these Specifications and the paint manufacturer's recommendations.
4. Provide air-moving equipment as necessary to adequately ventilate Work areas. Exercise care when working within structures such that volatile gases do not accumulate possibly resulting in an explosion or fire hazard, or affecting the curing time of the paint.
6. Surfaces that have been shop primed in accordance with these specifications do not require field prime coats unless recommended by the coating manufacturer. Clean and prime all unprimed and abraded surfaces.
7. After proper cleaning and surface preparation, brush apply primer to all connection points, including weld seams, edges, rivets and other joints.
8. Roller covers shall be synthetic nap with nap thickness per the paint manufacturer's recommendations.
9. Remove all spilled, splashed or splattered paint from all surfaces. Touch up all damaged finishes. Leave Work areas in clean, pre-construction, conditions.
10. Shop Preparation and Primers
 - a. Shop Preparations - As specified, prepare metal surfaces in accordance with Society for Protective Coatings (formerly Steel Structures Painting Council) SSPC-SP10 "Near White Blast Cleaning". Remove all cleaning residue and dust before applying primer.
 - b. Shop Primers - Use specified primers for coatings system specified. Spray prime all metals to be field welded within

two inches of the plate edges to a dry film thickness of 3.0 mils.

- c. Field Surface Preparations - Clean field welded, unprimed, damaged or abraded metal surfaces in accordance with the Society for Protective Coatings (formerly Steel Structures Painting Council) SSPC-SP10 "Near White Blast Cleaning". Apply block filler to fill voids and irregularities for masonry and concrete surfaces. Sand wood substrates to fresh wood. Solvent clean galvanized substrates per Society for Protective Coatings (formerly Steel Structures Painting Council) SSPC-SP1, "Solvent Cleaning".
- d. Field Spot Primers - Use only primers specified within each coatings system.

3.05 INSPECTION

A. General

1. Inspect all cleaning, surface preparation and painting. Provide access for inspection by paint manufacturer and ENGINEER.
2. Notify ENGINEER at least two weeks in advance of all cleaning and priming including that to be performed in a shop.
3. Provide at the site SSPC VIS-1 Pictorial Standards and a dry film thickness gage for use by the ENGINEER. Dry film thickness gages shall conform to ASTM D-1186 and shall be of magnetic pull off or magnetic flux for coatings over ferrous metal substrates. Eddy current type gages shall be used on non-ferrous substrates. In no case shall destructive dry film thickness gages be allowed. Provide a low voltage holiday detector to check the finished paint film integrity.
4. Expeditiously correct all defective work.

***** END OF SECTION *****

SECTION 11700

PRESSURIZED STEEL TANKS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section includes providing fabricated welded steel pressurized surge control tanks for unfired use with **seawater**, and associated fittings, supports, protective coatings, and appurtenances.
- B. Contractor shall furnish and install two (2) horizontal, bladder surge tanks, of the size and location as shown on the drawings and as specified herein, with air/gas located only in the tank with the fluid media specifically inside the bladder for **seawater** surge control as shown on the Contract Drawings.
- C. All materials and coatings specified in the section shall be suitable for use with seawater. Materials and coatings that will be in contact with seawater shall be listed and/or certified in accordance with NSF/ANSI Standard 61.
- D. Tank shall be furnished with all enclosures, controls, accessories and appurtenances as shown on the drawings and as specified herein.
- E. The new discharge surge tank shall be installed on a new reinforced concrete structural foundation as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 01300 - Submittals

Section 09900 - Painting and Coatings

1.03 REFERENCES STANDARDS

- A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ASCE/SEI 7	Minimum Design Loads for Buildings and Other Structures.
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ASME Code	Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 1
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ASTM A 36	Specification for Structural Steel
49 CFR 172.101	Code of Federal Regulations, Part 172, Section 101 – Hazardous Materials Table
49 CFR 173.315	Code of Federal Regulations, Part 173, Section 315 - Compressed Gases in Cargo Tanks and Portable Tanks
49 CFR 178	Code of Federal Regulations, Part 178, Subpart J – Specifications for Containers for Motor Vehicle Transportation
NSF/ANSI 61	Drinking Water System Components – Health Effects
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code
UL	Underwriters Laboratories

1.04 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Specification Section 01300, "Submittals":
1. List of materials and coatings used.
 2. Detail drawings and manufacturer's literature to indicate compliance with the indicated requirements.
 3. Fabrication drawings to scale indicating tank dimensions, material thicknesses, flanged nozzle locations, access sizes and locations, saddle support dimensions, mounting and anchorage requirements, and dimensions and details of all required attached appurtenances and internal piping.
 4. Written procedures or shop drawing to describe fabrication process for proper alignment of tank fittings and support saddles.
 5. Form U-1A, Manufacturer's Data Report for Unfired Pressure Vessels, all documentation and testing verification necessary to show full compliance with ASME Code design.
 6. Interior and exterior coatings including surface preparation and coating and recoating requirements, minimum dry film thicknesses,

and colors or prime, intermediate, and final coats. Submit color samples (**tan, sand color**) for OWNER selection.

7. Calculations signed and sealed by a California registered Structural Engineer showing wind and seismic loading design calculations in accordance with applicable portions of CBC 2013 and ASCE 7-10.

1.05 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in compliance with Specification Section 01300, "Submittals":
 1. Certification and ASME data reports in accordance with 49 CFR 178.337 (or other similar Section for the tank specifications used). The certification shall include certification of post weld heat treatment, joint radiography and hydrostatic testing.
 2. Fabrication drawings.
 3. Copy of structural calculations for the support system signed by a Registered Structural Engineer registered in California.
 4. Paint coatings and recommended touch-up procedures.

1.06 FACTORY TESTING

- A. After fabrication but prior to application of linings each tank shall be fully tested in accordance with the ASME code.
- B. Report summarizing the results of the testing shall be prepared in accordance with ASME Code requirements and shall be submitted prior to shipping of each tank.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Shipping of the tanks and related accessories and appurtenances shall not occur until approved in writing by the ENGINEER and coordinated with the Contractor.
- B. After hydrostatic pressure or other wet testing, all tanks, fittings and appurtenances shall be drained and thoroughly dried prior to shipping. Nozzle fittings and other openings shall be properly protected to prevent the entrance of water and debris during shipment.

- C. Tank shall be properly prepared for shipping and protected against damage during delivery to the project site.
- D. Tank exterior coating and finished surface shall be protected from damage during loading, shipping and unloading operations. Tank exterior coating and finished surface shall be protected against damage from shipping straps or other shipping anchorage devices.
- E. All loose equipment and appurtenances shall be properly crated or boxed and protected against damage during shipment.
- F. Care shall be taken during loading and unloading operations to ensure tanks fittings and accessories, crates, boxes, etc., are handled in accordance with the Manufacturer's instructions and all applicable safety requirements for personnel protection.
- G. Prior to unloading at the project site, the Contractor and Manufacturer's Representative shall visually inspect tanks to verify that no apparent damage has occurred during shipping.
- H. The Installing Contractor shall be responsible for any damage caused to tanks subsequent to the pre-unloading inspection onsite, and during unloading operations, handling and installation operations until such time as the tanks and installed appurtenances have been started-up and accepted by the OWNER.

1.08 WARRANTY

- A. Tanks, accessories, and appurtenances shall be warranted by the Contractor and Manufacturer to be free from defects in workmanship, design, and materials, for a minimum period of one (1) complete year after Owner Acceptance or eighteen (18) months after shipping whichever is later. Failure of the tanks, accessories, and/or appurtenances during the warranty period shall require repair or replacement and restoration to service at no additional cost to the District.
- B. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exceptions to this provision reducing this requirement shall be allowed.

PART 2 MATERIALS

2.01 GENERAL

- A. Tank Schedule: The items specified under this Section shall be furnished by manufacturers having experience in the manufacture of similar products and having a record of successful installations. The following welded steel tanks are included in this Section:

I.D. No.	Service	Diameter (in.)	Capacity (gallons)	Max. Operating Pressure (psig)
N/A	PS Discharge	96	9800	250

- B. Nameplates and Code Stamps: Tanks shall be designed, fabricated and tested in accordance with the ASME code. Each tank shall bear a stainless steel ASME nameplate. Each nameplate shall bear the applicable code symbol. Manufacturer shall be certified by ASME and authorized by the same to apply the applicable code symbols.
- C. Pressure Rating: Unless otherwise indicated, all unfired pressure tanks shall be fabricated in accordance with the ASME code for unfired pressure vessels, for a pressure rating of at least 50 percent above the maximum operating pressure.
- D. All shell attachments for pipe supports, tank gages, instruments and other items shall be welded to the tank shell before application of the tank interior lining and exterior coating.
- E. Seismic Design Parameters: The tank saddles and anchoring system shall be designed for seismic loads in accordance with CBC 2013 and the following site specific parameters:
1. Seismic Importance Factor (I_p) 1.5
 2. Site Class D
 3. Seismic Design Category D
 4. Design Short Period MCE Spectral Response (S_s) 0.932g
 5. Design Short Period MCE Spectral Response (S_1) 0.353g
 6. Design Short Period MCE Spectral Response (S_{DS}) 0.701g
 7. Design Short Period MCE Spectral Response (S_{D1}) 0.399g

2.02 SURGE TANKS

- A. Design: Horizontal surge tanks shall be of the size indicated and shall be designed in accordance with the ASME Code.
1. Minimum design pressure shall be as stated in this section of the Specifications. Perform hydrostatic testing in shop. Test pressure shall be 150% of the design pressure of the tank.
 2. Complete anchor bolt assembly (studs, nuts, washers, etc.) to be provided by contractor.
 3. Provide a 1-inch flanged connection at the top of the tank to contain a gas charging valve and pressure gauge. Tank shell will be constructed of deep drawn carbon steel double sub-arc welded domes and side shells with double welded seams. Tank shall be equipped with an inverted heavy-duty PVC bladder. The pre-charge pressure will be exterior to the bladder. The manhole shall be removable to allow inspection and maintenance of the bladder. The bladder shall be sized to conform to the inner shape of the vessel. Bladder tank shall be of the horizontal configuration only.
 4. Bladders and replacement bladders shall be manufactured to a current and documentable ISO-9001:2015 certification by the tank manufacturer.
 5. Bladder tank must be equipped with a pressure differential system for monitoring the gas pre-charge pressure and liquid volume level. Monitoring system can be routed into control panel and to termination box for connection to Owner's SCADA system in order to provide real time monitoring of the surge tank pre-charge pressure and liquid volume level without isolating the tank from the pipeline.
 6. Bladder tank shall be National Board approved with Liquid Relief Valve set at the tank design pressure.
- B. Materials: Tank materials shall comply with Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 of said code being used. Provide ASME code stamp, National Board Registration number and pressure rating on tank. All material thickness calculations in accordance with ASME code shall include an additional minimum corrosion thickness allowance of 1/16-inch. Materials for the tank and shop fabrication and inspection
- C. Welding: Weld reinforcement shall be as specified by ASME code and excessive reinforcement shall be ground down to within the requirements, and as required to install the lining systems. All internal corners and edges

shall be ground to a 1/8-inch radius, or a greater radius if required by the lining system.

D. Fittings, Manways, and Attachments:

1. Fittings, manways and other attachments shall be located where shown on the Drawings. A grid pattern or similar template shall be used on the tank to properly locate and align fittings and attachments during fabrication. All connecting fittings and attachments shall be plumb and properly aligned. No extensions, supplemental fittings or splices will be permitted to make up for misalignment of fittings or attachments.
2. Nozzle Connections: All nozzle fittings 1-inch diameter and larger shall be flanged. Flanges shall be in accordance with ASME/ANSI B16.5, 150 lb or 300 lb class dependent upon tank pressure rating.
3. Manways: Manways shall be reinforced in accordance with the ASME Code with pressure ratings equal to or exceeding the ASME working pressure rating. Two (2) types of manways shall be provided on each tank.
 - a) Two (2) 24-inch diameter flanged manway located on the tank shell. The manway blind flange shall be provided with a lifting eye welded on the top center of the flange to allow removal and reinstallation with Owner's crane.
4. Isolation Valves: All tank nozzles shall be fitted with type 316 stainless steel ball valves as shown on the Drawings. Ball valves are specified in Section 15106.
5. Pressure Relief Valve: Each tank shall be fitted with an ASME approved Type 316 stainless steel pressure relief valve.
6. Enclosure: Each tank shall be equipped with a level instrument enclosure welded to the dished end of the tank as shown on the Drawings. The enclosure shall be equipped with a hinged access door and locking hasp. The enclosure shall be constructed of the same material as the tank shell and shall be coated interior and exterior in accordance with Article 2.03 of this specification section. The hinges shall be of the heavy-duty stainless steel lubricated bearing type of sufficient strength to allow door operation without sagging or bending.

- E. Site Glass: Provide site glass of the dimensions shown on the drawings complete with isolation valves, auto ball check valves, The interior coating system shall be:

1. unions, and related interconnecting threaded pipe spools. All fittings and valves shall be 316 Stainless Steel. Site glass shall be Ernst Model 446 or approved equal.
 2. Level Electrode System:
 - a) Fabricate and install Electrode Well in accordance with the details shown on the Drawings. Material of construction for well body, flanges, threaded connections, fittings, isolation valves and unions shall be 316 Stainless Steel.
 - b) Electrode Holder shall be 3-inch diameter with 316 Stainless Steel construction and male NPT threads. Electrode Holder shall be B/W Controls Type E-5 with electrodes as required. The Electrode Holder shall have integrated hexagonal style heavy duty nut design used for tightening threaded Electrode Holder onto Electrode Well.
 - c) Electrode plugs and solid electrode rods shall be furnished, assembled and wired into the electrode holder in accordance with the manufacturer's instructions. Electrode rods shall be 1/4" diameter Type 316 Stainless Steel with 1/4-20 thread suitable for use with plugs and electrode holder. Plugs shall have Type 303 Stainless Steel shells with Ceramic insulator and Teflon seal. Plugs and electrodes shall be B/W Controls, Type EP2 for plugs and Type A electrode rods. Rod lengths shall be as shown on the Drawings.
- F. Air Charging: Surge tank shall utilize the compressed air system specified in Specification Section 11630, "Compressed Air Equipment." The surge tank shall be charged with air in accordance with operating requirements of the pump station. Final adjustments in pressure shall be made during start-up.

2.03 SURGE TANK LINING AND COATING SYSTEMS

- A. The coating of the carbon steel vessel that will be exposed to salt water and salt spray requires two coats of Tnemec Series 66HS Epoxoline on the inside and one coat of Tnemec Series 94-H2O Hydro Zinc, one intermediate coat of Tnemec 66HS Epoxoline and a finish coat of the Tnemec Series 1095 Endura-Shield for the exterior or engineer-approved alternate.
- B. The interior coating system shall be:

Surface Preparation: SSPC-SP10 Near-White Blast with a 1.5-3 mil anchor profile.

Primer: Tnemec Series 66HS Epoxoline applied at 4.0 to 6.0 mils DFT

Finish: Tnemec Series 66HS Epoxoline applied at 4.0 to 6.0 mils DFT
Total dry film thickness: 8.0 to 12.0

C. The exterior coating system shall be:

Surface Preparation: SSPC-SP6 Commercial Blast with a 1.5-2 mil anchor profile. Primer: Tnemec Series 94-H2O Hydro-Zinc applied at 2.5 to 3.5 mils DFT Intermediate: Tnemec Series 66HS Epoxoline applied at 4.0 to 6.0 mils DFT Finish: Tnemec Series 1095 Endura-Shield applied at 3.0 to 4.0 mils DFT
Total dry film thickness: 9.5 to 13.5 mils

D. Abrasives for Surface Preparation

1. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:
 - a) Kleen Blast vitreous smelter slag #16-30.
 - b) 20 to 40 mesh garnet.
 - c) Crushed iron slag, 100% retained on No. 80 mesh.
 - d) SAE Grade G-40 or G-50 iron or steel grit.
2. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

2.04 TANK MANUFACTURERS

A. Products of the type indicated shall be provided by the following ASME certified pressure vessel manufacturers (or approved equal):

1. Surge tanks:
 - a) Blacoh
 - b) Charlatte
 - c) Young Engineering
2. The manufacturer shall be ISO-9001:2015 certified which includes engineering, design, manufacturing and testing complete components. System Vessel manufacturer shall manufacture their own vessels and provide bladders with the same level and certification of quality control through ISO-9001:2015.

3. Manufacture shall provide in-house x-rays of welds, hydrostatic test, and ASME inspection. The Engineer reserves the right to inspect the vessel manufacturing facility to confirm requirement above.

PART 3 EXECUTION

3.01 WEATHER CONDITIONS FOR LINING AND COATING APPLICATION

- A. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.
- B. Do not apply paint when the relative humidity is above 85%.
- C. Do not paint when temperature of metal to be painted is above 120°F.
- D. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.
- E. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

3.02 SURFACE PREPARATION PROCEDURES

- A. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.
- B. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
- C. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.
- D. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.

- E. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.
- F. Surface preparation shall conform with the SSPC specifications as follows:

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
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

- G. 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 (Society for Protective Coatings), surface preparation specifications listed above.
- H. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.
- I. Brush-off blasting of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.
- J. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Construction Manager. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Construction Manager. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Construction Manager.

- K. Do not apply any part of a coating system before the Construction Manager has reviewed the surface preparation. If coating has been applied without this review, if directed by the Construction Manager, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

3.03 ABRASIVE BLAST CLEANING

- A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
- B. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.
- C. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.
- D. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.04 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED COATS

- A. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.
- B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
- C. Cover shop-applied coats 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Handle shop-applied coats with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-applied coated items on the ground or on top of other work unless ground or work

is covered with a protective covering or tarpaulin. Place shop-applied coated items above the ground upon platforms, skids, or other supports.

3.05 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

- A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Rinse scrubbed surfaces with clean water.
- C. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- D. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.
- E. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- F. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
- G. Surfaces that are shop coated items shall receive a field touch-up of the same primer used in the original prime coat.

3.06 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 paints in the original, unopened containers.

3.07 PAINT STORAGE AND MIXING

- A. Store and mix materials only in areas designated for that purpose by the Construction Manager. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post “No Smoking” signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.
- B. 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 PROCEDURES FOR THE APPLICATION OF COATINGS

- A. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
- B. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
- C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
- D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.

- E. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.
- F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.
- G. Apply primer and intermediate STRIPE COAT by brush on welds, sharp edges, and irregular surfaces prior to the application of the primer and intermediate spray coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.
- H. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.
- I. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.
- J. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.
- K. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

3.09 DRY-FILM THICKNESS TESTING

- A. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.
- B. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, high-voltage type. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Razor or PCWI Instrumentation.
- C. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

- D. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.
- E. Perform tests in the presence of the Construction Manager.

3.10 REPAIR OF IMPROPERLY COATED SURFACES

- A. If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.11 CLEANING

- A. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
- B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
- C. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

3.12 INSTALLATION

- A. Install new tanks in strict accordance with the recommendations and instructions of the manufacturer and in the locations shown on the Drawings.
- B. Anchor bolts shall be sized and installed in accordance with the Drawings.
- C. Valves, piping and related tank appurtenances shall be installed in accordance with the specific manufacturer's requirements and per the Drawings.

3.13 INSPECTION AND TESTING

- A. The horizontal air/gas outside the bladder with fluid media internal bladder surge tank shall be provided with the manufacturer's services at the jobsite at no additional cost to the Owner. The tank manufacturer shall provide two (2) days of service of a qualified factory representative having complete knowledge of proper tank installation, maintenance and operation to inspect the installation and verify field testing and advise the Contractor during startup, testing, and final adjustment of each tank. Manufacturer must submit verifiable test results to engineer at start-up clearly demonstrating that the surge tank is in performance compliance with the drawings and specifications. In addition to this day, one additional full 8-hour day shall be provided on a separate trip to instruct the Owner's personnel in the operation and maintenance of the tank system.
- B. Testing shall not occur until after the tanks have been pressure tested and disinfected.
- C. Disinfect tanks in accordance with Section 15020 – Disinfection.
- D. Perform hydrostatic field testing of tanks in accordance with Section 15030.
- E. Testing of the surge system shall be performed at the same time as other operational and performance testing procedures. During the performance test period, the Contractor shall simulate a power outage with one pump running at full speed. Pressure readings shall be taken at each location and at each time interval indicated below in the Pressure Reading Schedule immediately after the pump shutdown. Data from the shutdown test shall be furnished to the District to compare with the computerized hydraulic surge model. Any defects or leakage identified following the surge system test shall be repaired by the Contractor at no additional cost to the District. Failure to satisfactorily complete the surge tank testing program will result in terminating the operational test procedure and require re-starting in accordance with Specification Section 01650, "Startup Requirements". Contractor shall provide calibrated pressure gauges at each location indicated and shall provide proof of calibration to the Construction Manager prior to the test.

Surge Tank Testing Program Pressure Reading Schedule

Location

1. Pump Manifold
2. Discharge Pipeline Immediately Downstream of Surge Tank
3. Discharge Pipeline Immediately Upstream of Surge Tank
4. Fire Hydrant at Station 30+25
5. Air Valve at Station 41+66
6. Air valve at Station 54+05

Time Interval (in seconds)

1. Time = 0, 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 90, 105, 120, 150, 180 and every 30 seconds up to 30 minutes following the shut-down.

*****END OF SECTION*****

SECTION 15000

PIPELINES - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 DRAWINGS

- A. Dimensions shown on Contract Drawings are approximate only. CONTRACTOR shall verify all piping geometry in the field and shall be responsible for insuring proper alignment and fit of all piping consistent with the intent of the Contract Drawings. Field layout drawings shall be submitted as required for approval.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S RESPONSIBILITY FOR MATERIAL

- A. The CONTRACTOR shall carefully examine all material for defects. Material which is known, or thought, to be defective shall not be installed.
- B. The ENGINEER reserves the right to inspect all material and to reject all defective material shipped to the job site or stored on the site. Failure of the ENGINEER to detect damaged material shall not relieve the CONTRACTOR from his total responsibility for the completed work if it leaks or breaks after installation. Lay all defective material aside for final inspection by the ENGINEER to determine if corrective repairs may be made, or if the material is to be rejected. The ENGINEER shall determine the extent of the repairs.
- C. The CONTRACTOR to classify defective pipe prior to ENGINEER's inspection as follows:
 - 1. Damage to interior and/or exterior paint seal coats.
 - 2. Damage to interior cement-mortar lining.
 - 3. Insufficient cement-mortar lining thickness.
 - 4. Poor quality interior paint seal coat.
 - 5. Pipe out of round.
 - 6. Damaged pipe barrel area to a point where pipe class thickness is reduced.
 - 7. Denting or gouges in plain end of pipe.

- D. The CONTRACTOR shall be responsible for all material, equipment, fixtures and devices furnished and such materials, equipment, fixtures and devices shall comply with the requirements and standards of all Federal, State and local laws, ordinances, codes, rules and regulations governing safety and health.
- E. The CONTRACTOR shall be solely responsible for the safe storage of all material furnished to or by him until it has been incorporated in the completed project and accepted by the ENGINEER.
- F. Pipe, fittings, valves, hydrants and related accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against other pipe. Handling of this material is to be in accordance with AWWA C600.
- G. Keep fittings and valves drained and stored before installation in a manner protecting them from damage due to freezing of trapped water in accordance with Section 01600.

2.2 CERTIFICATION

- A. All pipe, fittings, lining systems, valves and appurtenance in contact with water shall be certified and labeled in compliance with NSF/ANSI 61 requirements.
- B. All disinfectant chemicals used in the disinfection of pipelines and appurtenances shall be certified for potable water use in accordance with NSF/ANSI 60.
- C. All pipe, fittings, valves and appurtenance used within the potable water piping system shall comply with NSF/ANSI 372 and conform to "lead-free" plumbing requirements as defined by California and the latest U.S. Safe Water Drinking Act.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL REQUIREMENTS

- A. All pipe shall be laid and maintained to the required lines and depths. Fittings, valves and hydrants shall be at the required locations with joints centered, spigots home and all valve and hydrant stems plumb and otherwise in strict accordance with the Specifications.

- B. Pipe bell and fitting restraint systems shall be used where called for on the drawings. CONTRACTOR shall verify the restraint length of piping and fitting by including restrained length information on the pipe layout submittals.
- C. All buried steel lugs, rods, brackets and flanged joint bolts and nuts shall be given one (1) coat of Koppers #50 coal tar coating prior to backfilling and polyethylene encasement.
- D. No deviation shall be made from the required alignment, depth or grade except with the written consent of the ENGINEER.
- E. All pipe shall be laid to the depth specified. The depth shall be measured from the final surface grade to the top of the pipe barrel. The minimum pipe cover shall be as shown on the Drawings or as specified in the Specifications Special Conditions.
- F. Do not lay pipe in a wet trench, or when trench conditions are unsuitable for such work. If all efforts fail to obtain a stable dry trench bottom and the ENGINEER determines that the trench bottom is unsuitable for trench foundation, he will order in writing the kind of stabilization to be constructed.
- G. Thoroughly clean the pipes and fittings before they are installed and this material shall be kept clean until the acceptance of the completed work. Lay pipe with the bell ends facing in the direction of laying, unless otherwise shown on the Drawings, or directed by the ENGINEER. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs in the pipe line. No wedging or blocking is permitted in laying pipe unless by written order of ENGINEER.
- H. Before joints are made, bed each section of pipe the full length of the barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.
- I. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
- J. Walking or working on completed pipeline, except as necessary in tamping and backfilling, is not permitted until trench is backfilled one-foot deep over top of pipes.
- K. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.

- L. Take up and replace with new, such in-place pipe sections found to be defective. Replacement work shall be at CONTRACTOR's expense.
- M. Take necessary precautions to prevent the floating of the pipeline by the accumulation of water in the trench, or the collapse of the pipeline from any cause. Should floating or collapse occur, restoration shall be at the CONTRACTOR's expense.
- N. Bedding materials and concrete work for the pipe bedding and thrust restraint shall be as specified previously in Division 2 and 3 respectively.
- O. Take every precaution to prevent foreign material from entering the pipe while it is being placed. During laying operations, do not place debris, tools, clothing, or other materials in the pipe.
- P. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods.
- Q. Place enough backfill over the center sections of the pipe to prevent floating.
- R. Carry out the cutting of pipe only with equipment specifically designed for that purpose such as an abrasive wheel, rotary wheel cutter, a guillotine pipe saw or a milling wheel saw. The use of chisels or hand saws will not be permitted. Cut ends and rough edges should be ground smooth and for push-on connections, the cut end should be beveled lightly.
- S. In distributing material at the site of the Work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
- T. Each length of pipe shall be adequately blocked to prevent movement. Stockpiled pipe shall be adequately blocked to prevent movement. No pipe, material, or any other object shall be placed on private property, obstruct walkways or driveways, or in any manner interfere with the normal flow of traffic.
- U. In the case of PVC, prestressed concrete, gray and ductile iron pipe, special care shall be exercised, during handling temporary storage or construction to avoid damage to the bells, spigots or flanged ends. If damaged pipe cannot be repaired to the ENGINEER's satisfaction, it shall be replaced at the CONTRACTOR's expense. Damaged PVC pipe shall be replaced at CONTRACTOR's expense.

- V. The CONTRACTOR shall remove all existing pipe, fittings, valves, pipe supports and blocking and all other items necessary to provide space for making connections to existing pipe and installing all piping which is to be done under this Contract.
- W. The CONTRACTOR shall be responsible for maintaining the minimum required distance between the water line and other utility lines in strict accordance with all Federal, State and local requirements and all right-of-way limitations.
- X. Particular care shall be exercised to that no high points are established where air can accumulate. In the event that unforeseen field conditions necessitate a change in the pipe profile and, in the opinion of the ENGINEER, the resulting change requires the installation of an air release valve and manhole, install the same as extra Work to the Contract. If the CONTRACTOR requests a change in the pipe profile solely for ease of construction, and the requested change requires the installation of an air release valve and manhole as determined by the ENGINEER, then the cost of furnishing and installing the air release valve and manhole will be at the expense of the CONTRACTOR.

3.2 CONSTRUCTION METHODS TO AVOID CONTAMINATION

- A. Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is essential that the procedures of this section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.
- B. Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used where it is determined that watertight plugs are not practical and where thorough cleaning will be performed.
- C. Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the less likelihood of contamination.
- D. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

- E. Yarning or packing material shall consist of molded or tubular rubber rings, or rope of treated paper or other approved materials. Materials such as jute, asbestos or hemp shall not be used. Packing material shall be handled in a manner that avoids contamination.
- F. No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in closed containers and shall be kept clean.
- G. If dirt enters the pipe, and in the opinion of the ENGINEER the dirt will not be removed by the flushing operation, the interior of the pipe shall be cleaned by mechanical means and then shall be swabbed with a 1% hypochlorite disinfecting solution. Cleaning with the use of a pig, swab or "go-devil" should be undertaken only when the ENGINEER has specified such and has determined that such operation will not force mud or debris into pipe joint spaces.
- H. If it is not possible to keep the pipe and fittings dry during installation, every effort shall be made to assure that any of the water that may enter the pipe joint spaces contains an available chlorine concentration of approximately 25 mg/L. This may be accomplished by adding calcium hypochlorite granules or tablets to each length of pipe before it is lowered into a wet trench, or by treating the trench water with hypochlorite tablets.
- I. If the main is flooded during construction, it shall be cleared of the flood water by draining and flushing with potable water until the main is clean. The section exposed to the flood water shall then be filled with a chlorinated potable water that, at the end of a 24 hour holding period, will have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the main. After construction is completed, the main shall be disinfected using the continuous feed or slug method.

3.3 VALVE INSTALLATION

- A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Correct defective valves or hold for inspection by the ENGINEER.

- B. Set and join to the pipe in the manner specified in Section 3.01. Provide valves with special support, such as crushed stone or concrete pads, so that the pipe will not be required to support the weight of the valve. Set truly vertical.

- C. Provide all valves with a valve box. Set the top of the valve box neatly to the grade of the surface of the existing ground, unless directed otherwise by the ENGINEER. Do not transfer shock or stress to the valve, and center and plumb the box over the wrench nut of the valve. Do not use valves to bring misaligned pipe into alignment during installation. Support pipe in such manner as to prevent stress on the valve.

3.4 THRUST RESTRAINT

- A. Provide all plugs, caps, tees, and bends (both horizontal and vertical) with concrete thrust blocks and/or restrained joint pipe as detailed on the Drawings, and in accordance with the specifications.
- B. Place concrete thrust blocks between undisturbed solid ground and the fitting to be anchored. Concrete thrust blocks to be installed in accordance with Specification Section 03300. The thrust blocks, unless otherwise shown or directed, shall be located as to contain the resultant thrust force and so that the pipe and fitting joints will be accessible for repair.
- C. Temporary thrust restraint at temporary caps or plugs shall be the responsibility of the CONTRACTOR. Submit details of temporary restraint to the ENGINEER for approval.

3.5 REMOVAL AND DISPOSAL OF EXISTING PIPE & APPURTENANCES

- A. Existing pipe and appurtenances, including asbestos cement pipe, required to be removed for the installation of proposed facilities and as noted on the plans, shall be removed from the project site and disposed of by the CONTRACTOR in accordance with all current applicable Federal, State and Local standards and requirements. Removal and disposal costs shall be incorporated into bidding schedule items of work (no separate payment shall be allowed).

***** END OF SECTION *****

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SECTION 15020

DISINFECTING WATER MAINS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The CONTRACTOR shall disinfect and flush all water distribution facilities in accordance with ANSI/AWWA C651 Standard for Disinfecting Water Mains and these specifications.
- B. The OWNER will furnish water for testing, flushing and disinfecting pipelines. The OWNER will also perform bacteriological testing.
- C. All chlorination, flushing and sampling events shall be scheduled at least 48-hours in advance with the ENGINEER and OWNER.

1.2 SUBMITTALS

- A. Shop drawings and manufacturer's literature for all materials.
- B. Affidavit of Compliance with AWWA B300 and B301 from manufacturer.
- C. Plan for disposal of chlorinated water.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall use forms of chlorine in accordance with Section 4.1 of ANSI/AWWA C651 and the provisions of ANSI/AWWA B300 Standard for Hypochlorites and ANSI/AWWA B301 Standard for Liquid Chlorine.
- B. Backflow Protection shall be provided in accordance with the Soft Connection Detail in Cal-Am Standard Details and these specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall follow the basic disinfection procedure in accordance with Section 4.2 of ANSI/AWWA C651.

3.2 CONSTRUCTION PROCEDURES

- A. The CONTRACTOR shall follow the preventive and corrective measures during construction in accordance with Section 4.3 of ANSI/AWWA C651.
- B. The CONTRACTOR shall install backflow protection in accordance with the OWNERS requirements.

3.3 METHODS OF CHLORINATION

- A. The CONTRACTOR shall use a chlorination method in accordance with Section 4.4 of ANSI/AWWA C651.
- B. If the CONTRACTOR elects to chlorinate or is required to re-chlorinate using the continuous-feed or slug method, the CONTRACTOR shall obtain and submit an equipment design, sealed and signed by a Registered Engineer in good standing with the State Board, and employ a current Class 4 operator to perform the disinfection work.
- C. The OWNER will furnish water for filling and flushing water mains, through a CONTRACTOR provided and installed backflow protection device.

3.4 FINAL FLUSHING

- A. The CONTRACTOR shall follow the final flushing procedures in accordance with Section 4.5 of ANSI/AWWA C651.
- B. Heavily Chlorinated water shall not remain in contact with pipe and appurtenances for more than 48 hours after the applicable retention period.
- C. Heavily chlorinated water shall be neutralized with a neutralizing chemical listed in Appendix B, which is attached to AWWA C651.
- D. The CONTRACTOR shall be solely responsible for disposal of chlorinated water in accordance with all applicable Federal, State and local NPDES discharge requirements.
- E. The CONTRACTOR shall contact the local sewer department to arrange for disposal of the heavily chlorinated water to the sanitary sewer. If a sanitary sewer system is unavailable for disposal of the chlorinated water an alternative disposal site shall be provided by the CONTRACTOR.

3.5 FINAL CONNECTION TO EXISTING MAINS (REQUIRED)

- A. The CONTRACTOR shall follow the final connection procedures in accordance with Section 4.6 of ANSI/AWWA C651.
- B. Temporary blow-offs shall be removed by the CONTRACTOR and final connection pipe shall be provided and installed by the CONTRACTOR as indicated on the drawings.
- C. The CONTRACTOR shall assist the OWNER with any additional flushing the OWNER may perform.

3.6 CUTTING IN EXISTING MAINS

- A. The CONTRACTOR shall install pipe and fitting assemblies shown on the drawings in accordance with Section 4.7 of ANSI/AWWA C651, these assemblies shall be installed prior to chlorination of any water mains, to ensure that the final connection can be installed as indicated on the drawings.

3.7 BACTERIOLOGICAL TESTS

- A. The OWNER shall perform the bacteriological tests in accordance with Section 5.1 of ANSI/AWWA C651.
- B. Bacteriological tests shall demonstrate complete absence of coliform organisms. If tests show presence of coliform organisms, the CONTRACTOR will be required to perform additional flushing and disinfection of the pipeline until such time acceptable tests are obtained, all at no additional cost to the OWNER.
- C. The CONTRACTOR will not be charged for the additional water provided or bacteriological testing performed by the OWNER.

*** END OF SECTION ***

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SECTION 15025

CLEANING PIPELINES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. When it is determined that normal flushing will not sufficiently remove dirt and debris introduced during construction the CONTRACTOR shall clean the required pipelines installed under these Contract Documents. The cleaning shall use foam pigs, swabs or "go-devils" as described herein.

1.2 GENERAL

- A. After the installation of water mains normal flushing often may prove inadequate to remove all the entrapped air, loose debris and other objects that may have been left in the main during installation. Therefore, after the installation of water mains it may be necessary to use polyurethane foam pigs and/or polyurethane hard foam swabs to remove all foreign matter from the pipeline (i.e. "pig" the pipeline).

1.3 PROTECTION DURING FLUSHING AND CLEANING

- A. The CONTRACTOR shall assure that an adequate amount of flushing water at sufficiently high pressures exists and that disposal of the water can be done safely. Do not flush a large main supplied by a single smaller one as the volume available is usually inadequate for flushing.
- B. Prior to flushing, or cleaning, the CONTRACTOR shall notify OWNER, ENGINEER and the following:
 - 1. Fire Department
 - 2. Other utilities, such as gas, electric and telephone companies, who may have underground facilities in the area.
 - 3. Customers who may be inconvenienced by reduced pressure or dirty water.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. The CONTRACTOR shall furnish the foam cleaning plugs, labor and equipment as needed to pig all pipelines, and shall furnish all materials required for the expulsion of air and other debris from pipelines.

- B. As the cleaning described in this section pertains to new water mains, the use of pipe cleaning plugs which utilize Bristles, wire brushes, carbide abrasives, steel studs or any other Type abrasive is not permitted unless specifically approved by the ENGINEER.
- C. The CONTRACTOR is to consult a manufacturer of pipe cleaning plugs, such as Knapp Polly Pig (Houston, Texas), to determine the type and size of cleaning plug best suited for the application. Two types of plugs shall be considered and are described as follows:
 - 1. Swabs: Swabs used for cleaning mains shall be made of polyurethane foam. This foam has a density of 1 to 2 lb./cu. ft. Swabs shall be purchased from commercial manufacturers of swabs for pipes. Both soft and hard grade foam swabs are available. New mains are typically cleaned with hard foam swabs.
 - 2. Pigs: The other type of cleaning plug available is called a pig. Pigs, if used, shall be commercially manufactured for the specific purpose of cleaning pipes. They shall be made of polyurethane foam weighing 2 to 15 lb./cu.ft. Pigs are bullet shaped and come in various grades of flexibility and roughness.
 - 3. Sizing of Plugs: Use swabs cut into cubes and cylinders slightly larger than the size of the pipe to be cleaned. Cubes one inch larger in dimension than the nominal diameter of the pipe being cleaned have worked well for cleaning pipes up to 12-inches in diameter.
- D. For mains greater than 12-inches in diameter, the swab diameter must be considered individually for each operation. For new mains, swabs 3-inches larger than the pipe diameter have worked well. Swabs for the larger mains are usually 1-1/2 times the diameter in length.
- E. Use pigs typically 1/4-inch to 1/2-inch larger in diameter than the pipe to be cleaned. Consult suppliers for the proper size of plug to use on the specific job.

PART 3 - EXECUTION

3.1 PLUG INSTALLATION AND REMOVAL

- A. In general, the CONTRACTOR shall furnish all equipment, material, and labor to satisfactorily install or expose cleaning wyes, or other entry or exit points. Remove cleaning wye covers, etc., as required by the ENGINEER and to insert the plugs into the mains.

- B. In mains greater than 8-inches, Wyes shall be used at the entry and exit points. Fabricate the wye section one size larger than the main to ease the insertion and extraction of the plug. The use of wyes, as with the previously mentioned appurtenances, requires an outside source of pressurized water for launching. Cap the wye with a flange with a 2 to 6 inch fitting for connecting with the pressurized water source.
- C. Many pigs, since they are less flexible than swabs, are harder to insert into a pipe. Other methods acceptable to insert pigs include:
 - 1. winching with a double sling,
 - 2. winching with a rope attached to the pig,
 - 3. compression with a banding machine prior to insertion, and
 - 4. the use of a specially designed tapered steel pipe which is removed after use.
- D. During swab or pig installation, leave as much water as possible in the main to be cleaned. The water suspends the material being removed from the pipe and minimizes the chance of the material forming a solid plug. Water in the pipe also keeps the swab or pig from traveling through the pipe at excessive rates. If swabs or pigs travel too fast they will remove less material. The swab or pig will also wear more rapidly in such a case.
- E. At the exit point or blow-off, install a wye long enough to house the swab or pig. Attach temporary piping to the end cap to allow the drainage of the water.
- F. Where expulsion of the cleaning plugs is required through a dead end main, the CONTRACTOR shall prevent backflow of purged water into the main after passage of the cleaning plug. This can be accomplished by installing mechanical joint bends and pipe joints to provide a riser out of the trench. Additional excavation of the trench may serve the same purpose and is acceptable.

3.2 PRE-CLEANING PROCEDURES

- A. Preplan and prepare for the ENGINEER's review, a written cleaning plan.
- B. Suggested procedures prior to cleaning include the following:
 - 1. Identify mains to be cleaned on a map. Mark the location of the entry, water supply and exit points, any blow-offs to be used, main gates to be closed, and the path of the swab or pig.
 - 2. Assist OWNER to inspect and operate all valves and hydrants to be used

in the cleaning operation. Ensure that all operate correctly and that a tight shutdown is possible.

3. Check location and type of hydrants, launch and exit location, and blow-offs to be used. Make blow-off tap connections if necessary.
4. The OWNER will notify customers served by the main to be cleaned that their water will be off for a specified period on the day of the cleaning.
5. The OWNER will identify customers who may require temporary services during the main cleaning operation. The CONTRACTOR shall provide the temporary connections.
6. Determine the number and size of plugs to be used.

3.3 CLEANING PROCEDURE

A. After review by the ENGINEER of the CONTRACTOR's cleaning plan the following cleaning procedures as applicable shall be performed by the CONTRACTOR:

1. Swab Cleaning Procedures

- a. Open the water supply upstream of the swab. Throttle the flow in the main at the discharge (plug exit) point so that the swab passes through the main at a speed of 2 to 4 fps. At this velocity, swabs will effectively clean pipes for distances of up to 4000 feet before disintegrating to a size smaller than the main. Use pitot gauges at the exist hydrant or blow-off to estimate the flow rate in the main
- b. Note the time of entry of the swab into the main and estimate its time or arrival at the exit point. If the swab does not reach the exit point in the estimated time plus ten minutes, then a blockage has probably occurred. Reverse the flow in the main and note the time required for the swab to reach the original entry point. From the return travel time, approximate the location of the blockage. The ENGINEER may require a swab to which a transmitter has been attached to be used to accurately locate a blockage.
- c. Once the first swab has been recovered, typically, make two to three runs of four to five swabs each depending on how quickly flushing water clears.
- d. Continue operations until the water behind the swabs emerging at the exit clears up within one minute. Account for all swabs inserted into

the main.

- e. After the last swab has been recovered, flush the main to remove swab particles. This may require up to an hour of flushing.

2. Pig Cleaning Procedures

- a. Remove all air valves along the line. This will provide pressure relief should the pig suddenly stop and assure that no air is trapped in the main.
- b. If the pig is inserted directly into the main, set it in motion by opening the upstream gate valve and a downstream fire hydrant or blow-off valve (usually the valve on the capped end at the exit point). If the pig is launched from a wye, fire hydrant, or other appurtenance, use an external pressurized water source to inject the pig into the main as described in Section 3.01.
- c. Once the pig is in motion in the main, control it's speed by throttling the discharge at a downstream fire hydrant or blow-off. Operate pigs typically at 1 fps. This slow speed will help prevent pressure surges when the pig passes through undersized valves, enters smaller pipes, or turns through tees or crosses. Speeds of up to 2 fps. can be used on straight runs with no restrictions or sharp turns.
- d. Make sufficient passes of the pig to obtain thorough cleaning. Two pigs may be used in tandem to save time and water. Sufficient cleaning is established when the water discharging after the pig becomes clear within one minute.

3.4 POST CLEANING PROCEDURE

- A. After successful completion of cleaning the main shall be tested, flushed and disinfected in accordance with applicable sections of these Specifications.

***** END OF SECTION *****

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SECTION 15030

PRESSURE AND LEAKAGE TESTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The CONTRACTOR shall test all piping, valves and appurtenances installed under these Contract Documents. Testing shall be performed concurrent with installation. Unless otherwise approved by the ENGINEER no more than 1000 feet of pipe shall be installed without being tested.

1.2 SUBMITTALS

- A. The CONTRACTOR shall prepare and submit to the ENGINEER schedules and procedures for testing of all parts of the water main installed in accordance with these Contract Documents. The schedule shall be submitted seven days prior to any testing.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The pump, pipe connections, and all necessary apparatus for the pressure and leakage tests, except gauges and metering devices, shall be furnished by the CONTRACTOR. The OWNER will furnish gauges and metering devices for the tests, but the CONTRACTOR shall make all excavations and backfills, and furnish all necessary assistance for conducting the tests.

PART 3 - EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall follow the hydrostatic testing method in accordance with ANSI/AWWA C600, Section 5.2 Hydrostatic Testing, and these specifications.
- B. Air shall be vented from all high points in the line. If required, Contractor shall provide a corporation stop in a saddle at these points to provide venting. All valves controlling the section to be tested shall be closed. A test pressure of 200 psi minimum, or 1-1/2 times the normal working pressure, whichever is greater, shall be applied and held for a period of 2 hours. Contractor shall provide the necessary pump and a calibrated container for measurement of make-up water required to replace leakage during this 2-hour period.

- C. Allowable leakage in the section during this test shall conform to the following method:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

- L = allowable leakage, in gallons per hour
N = number of joints
D = nominal diameter of pipe, in inches
P = average test pressure during test, in psig (gauge)

- D. All defective items discovered during the pressure test shall be repaired or replaced by the CONTRACTOR at no additional cost to the OWNER. Test shall be repeated after any repair until the system meets the above leakage requirement. The test will be witnessed by an OWNER representative and the ENGINEER.

3.2 FILLING AND TESTING

- A. Each segregated section of pipeline will be slowly filled with water insuring that all air is expelled. Extreme care must be taken to insure all air is expelled from the pipeline during the filling of pipe with water. The line shall stand full of water for twenty-four hours prior to testing to allow all air to escape. If necessary, tap the main at points of highest elevation so that air can be expelled as the pipe is filled with water. After successful completion of filling and air expulsion, but prior to testing, the corporation stops shall be removed and the taps tightly plugged.

***** END OF SECTION *****

SECTION 15034

GAUGES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing pressure gauges including fittings, snubbers, connections, gaskets, supports, and accessories.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 15100 Valves, General
 - 2. Section 15106 Ball Valves

1.3 CODES AND STANDARDS

- A. The WORK of this Section shall comply with the current editions of the following codes and standards:
 - 1. California Plumbing Code
 - 2. NSF/ANSI 61 / 372
 - 3. Cal-Am Standard Drawings and Material

PART 2 - PRODUCTS

2.1 PRESSURE AND VACUUM GAUGES

- A. General: Pressure gauges shall be installed on each side of pressure reducing valves, and where otherwise indicated.
- B. Gauge Construction: Gauges shall have Type 316 stainless steel movement and stainless steel case. Except as otherwise indicated, gauges shall have a 3-1/2-inch dial, ¼-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. Gauges shall be calibrated to read with an accuracy of ±1 percent to 150 percent of the indicated pressure. Gauges shall be vibration and shock resistant. Gauges on potable service should have cases filled with a fluid suitable for potable water use.

2.2 MANUFACTURERS

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

1. Ashcroft Industrial Instruments (Dresser)
2. Foxboro/Jordan, Inc.
3. Marsh Instrument Company Marshalltown Instruments, Inc

B. Snubbers shall be manufactured by one of the following (or equal)

1. Weksler Instruments,
2. Corp.Ronningen-Petter

PART 3 - EXECUTION

3.1 INSTALLATION

A. Gauges shall be installed in accordance with the Manufacturer's installation instructions and per Section 15100.

B. Gauges shall be installed with the face in the vertical position at the indicated locations. Gauges shall be installed to minimize the effect of water hammer and vibrations, and, where indicated, gauges shall be mounted independently, with flexible connectors

END OF SECTION

SECTION 15065

DUCTILE-IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. The CONTRACTOR shall furnish all labor, materials, tools and equipment required to install ductile-iron pipe and fittings, and related work as shown on the drawings and in accordance with the specifications.

1.2 RELATED WORK

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK:

- | | |
|------------------|--------------------------------|
| 1. Division 1 | General Requirements |
| 2. Division 2 | Site Work |
| 3. Section 03300 | Cast-in-Place Concrete |
| 4. Section 15000 | Pipelines – General Provisions |
| 5. Section 15020 | Disinfecting Pipelines |
| 6. Section 15030 | Pressure and Leakage Tests |

1.3 SUBMITTALS

- A. Submit to Engineer for approval, manufacturer's shop drawings, and technical information in accordance with the General Conditions and Section 01300 - Submittals.
- B. Submit Piping Layout Drawings showing all pipe, fittings, valves and appurtenance locations. Layout Drawings shall clearly show locations and sizes of thrust block and locations of pipe and fitting restraint devices and length of restraint.

1.4 COORDINATION OF WORK

- A. The location of the work will be on the CEMEX owned property which is under active construction with other contractors. CONTRACTOR shall review requirements of Section 01410 – Work Restrictions and follow requirements of that Section for coordination and access.

PART 2 - PRODUCTS

2.1 PIPE

- A. General: Ductile-Iron pipe shall conform to the latest specifications as adopted by the American National Standards Institute, Inc., (ANSI) and the American Water Works Association (AWWA). Specifically, all Ductile-Iron water pipe shall be designed in accordance with ANSI/AWWA C150/A21.50 Standard for Thickness Design of Ductile-Iron Pipe. Ductile-iron pipe shall be new and manufactured in accordance with ANSI/AWWA C151/A21.51 Standard for Ductile-Iron, Centrifugally Cast, for Water. Ductile-iron pipe shall be coated outside with a bituminous coating in accordance with ANSI/AWWA C151/A21.51.

Each length of pipe shall be subjected to a hydrostatic proof test as required by ANSI/AWWA C151/A21.51.

- B. Class: Ductile-iron pipe shall be minimum Thickness Class 50 or Pressure Class 350 below grade, and Thickness Class 52 above grade or as otherwise stated on the drawings.
- C. Lining: Ductile-Iron water pipe shall be cement-mortar lined and seal coated in accordance with ANSI//AWWA C104/A21.4 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water. The lining shall comply with ANSI/NSF Standard 61.
- D. Corrosion Protection: Ductile-Iron water pipe shall be encased with one (1) layer of 12-mil linear low-density polyethylene film in accordance with ANSI/AWWA C105/A21.5 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems. The film shall be pigmented with 2 to 2 ½ percent of well-dispersed carbon black with stabilizers. The polyethylene film supplied shall be clearly marked, at a minimum of every two feet along the ductile-iron water pipe length, containing the following information:
1. Manufacturer's name or trademark
 2. Year of Manufacture
 3. ANSI/AWWA C105/A21.5
 4. Minimum film thickness
 5. Material type (LLDPE)
 6. Applicable range of nominal pipe diameters sizes
 7. Warning – Corrosion Protection – Repair any Damage

E. Joints:

1. Push-On: Push-on joints for ductile-iron pipe with manufacturer

supplied styrene butadiene rubber gaskets and accessories in accordance with ANSI/AWWA C111/A21.11 Standard to Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

2. Flanged: When specified by the contract documents, flanged joints shall be in accordance with ANSI/AWWA C115/A21.15 Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

All flanged joints shall be furnished with 1/8-inch thick, EPDM Rubber gaskets. The bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in American Standard for Wrench Head Bolts and Nuts and Wrench Openings (ANSI B18.2). For bolts of 1-3/4-inches in diameter and larger, bolt studs with a nut on each end are required. Material for bolts and nuts shall conform to ASTM A307.

2.2 FITTINGS

- A. General: Ductile-Iron fittings shall be new and manufactured in accordance with ANSI/AWWA C110/A21.10 Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 24 in. for Water Service in accordance with the contract documents. Compact ductile-iron fittings shall be new and manufactured in accordance with ANSI/AWWA C153/A21.5 Standard for Ductile-Iron Compact Fittings, 3 in. through 24 in. ANSI/AWWA C110/A21.10 fittings shall be supplied, unless otherwise noted.
- B. Class: Fittings shall be of the following pressures class (pound per square inch) listed below, unless otherwise noted:

<u>Size</u> 3" through 24"	<u>Standard</u> 350	<u>Compact</u> 350
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- C. Coating (Interior and Exterior): Ductile-Iron fittings shall be fusion-bonded epoxy lined and coated in accordance with ANSI/AWWA C116/A21.16 Standard for Protective Coatings for the Interior and Exterior of Ductile-Iron and Gray-Iron Fitting for Water Supply Service. A Certificate of Compliance shall be provided in accordance with Section 6.3 of the C116 Standard. The coating shall comply with ANSI/NSF Standard 61.
- D. Corrosion Protection: Ductile-Iron fittings shall be encased with one (1) layer of 8-mil linear low-density polyethylene film in accordance with ANSI/AWWA C105/A21.5 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems. The film shall be pigmented with 2 to 2 ½ percent of well-dispersed carbon black with stabilizers. The polyethylene film supplied shall be clearly marked, at a minimum of every two feet along the ductile-iron water pipe

length, containing the following information:

1. Manufacturer's name or trademark
2. Year of Manufacture
3. ANSI/AWWA C105/A21.5
4. Minimum film thickness
5. Material type (LLDPE)
6. Applicable range of nominal pipe diameters sizes
7. Warning – Corrosion Protection – Repair any Damage

E. Joints:

1. Mechanical Restrained: Mechanical joints for ductile-iron pipe with manufacturer supplied EPDM rubber gaskets and accessories in accordance with ANSI/AWWA C111/A21.11 Standard to Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

All mechanical joints shall be restrained with the appropriate restraint series and accessories as manufactured by, EBAA Iron, Inc (Megalug).

2. Flanged: When specified by the contract documents, flanged joints shall be in accordance with ANSI/AWWA C115/A21.15 Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

All flanged joints shall be furnished with a minimum 1/8-inch, thick red rubber or styrene butadiene rubber gasket. The bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. For bolts of 1-3/4-inches in diameter and larger, bolt studs with a nut on each end are required. Material for bolts and nuts shall conform to ASTM A307.

2.3 MISCELLANEOUS

- A. Tracing Wire: All ductile-iron pipe and fittings shall be installed with a solid No. 10 American Wire Gage soft copper insulated wire in accordance with the California American Water Standard Details.
- B. Concrete Thrust Blocking: Concrete thrust blocks shall be in accordance with details provided on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: The Contractor shall assume total responsibility for selecting the appropriate means and methods to install ductile-iron pipe, fittings and appurtenances in accordance with AWWA Standards, the contract documents and manufacturer recommendations while complying with OSHA Standards for construction. The provisions specified in Section 15000 shall be strictly followed in addition to the following requirements.
- B. Push-On Joints: The surfaces with which the rubber gasket comes in contact shall be thoroughly cleaned just prior to assembly. The gasket shall then be inserted into the groove in the bell. Before starting joint assembly, a liberal coating of pipe manufacturer lubricant shall be applied to the gasket and the spigot end. With the spigot end centered in the bell, the spigot end is pushed home in accordance with manufacturers recommendations.
- C. Restrained Mechanical Joints: All components shall be cleaned and lubricated with soapy water prior to assembly. Slip the follower gland and gasket over the pipe plain end making sure the small side of the gasket and lip of the gland face the bell socket. Insert the plain end into socket. Push gasket into position with fingers, gasket should be evenly seated. Slide gland into position, insert bolts and tighten must by hand. Bolts are then tightened alternately (across from one another) in accordance with manufacturers recommendations.
- D. **Joint Bonding:** Except where otherwise indicated, all buried pipe joints shall be bonded. The pipe shall be cleaned to bare bright metal at the point where the bond is installed, and the bonding cable attached with an exothermic weld.
- E. Encountering Contaminated Soil: Research has documented that certain pipe materials (such as polyvinyl chloride, polyethylene, and polybutylene) and certain elastomers (such as those used in gasket material) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products supplied under this section have been selected based on the non-expectation of encountering petroleum products or organic solvents.

If during the course of pipeline installation, the CONTRACTOR identifies, or suspects, the presence of petroleum products or any unknown chemical substance, or a wastewater leach field, the ENGINEER is to be notified immediately. Installation of any further piping in the area of suspected contamination shall be stopped until direction is provided by the ENGINEER.

***** END OF SECTION *****

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SECTION 15100
VALVES, GENERAL

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing general requirements for valves including epoxy coating, installing, adjusting, testing of valves and valve boxes above grade.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 15000 Piping Components
2. Section 15150 Gate Valves
3. Section 15151 Check Valves
4. Section 15155 Butterfly Valves

1.3 SPECIFICATIONS AND STANDARDS

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

- | | |
|----------------------|--|
| 1. ANSI B16.1 | Cast Iron Pipe Flanges and Flanged Fittings, Class 125 and 250 |
| 2. ANSI B16.5 | Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys |
| 3. ANSI/ASME B1.20.1 | General Purpose Pipe Threads (Inch) |
| 4. ANSI B16.42 | Pressure Class 250 |

- | | | |
|-----|----------------|---|
| 5. | ASTM A 126 | Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| 6. | ASTM A320 | Specification for Alloy-Steel Bolting Materials for Low Temperature Service |
| 7. | ASTM A 536 | Specification for Ductile Iron Castings |
| 8. | ANSI/AWWA C500 | Gate Valves for Water and Sewerage Systems |
| 9. | ANSI/AWWA C504 | Rubber-Seated Butterfly Valves |
| 10. | ANSI/AWWA C507 | Ball Valves 6 Inches Through 48 Inches |
| 11. | ANSI/AWWA C509 | Resilient-Seated Gate Valves for Water and Sewage Systems |
| 12. | AWWA C550 | Protective Interior Coatings for Valves and Hydrants |

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Manufacturer's product data including catalogue cuts.
2. Manufacturer's installation instructions.
3. Shop drawings showing details and dimensions.
4. Manufacturer's certification that products comply with the indicated requirements.
5. Schedule of valves indicating valve identification and location.
6. Manufacturer's certification that epoxy coatings have been factory tested and comply with the **indicated requirements (i.e. seawater)**

1.5 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:
1. Manufacturer's installation and operating instructions.
 2. Manufacturer's maintenance procedures.
 3. List of special tools.
 4. Schedule of valves indicating valve identification and location.

1.6 FACTORY TESTING

- A. General: Valves shall be tested in compliance with the AWWA Standards as indicated. Except as otherwise indicated, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

1.7 FIELD TESTING

- A. Testing: Valves shall be field-tested for compliance with the indicated requirements.

PART 2 - PRODUCTS

2.1 VALVES

- A. General: Shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions.
- B. Valve Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D, ANSI B16.1 125-lb class, or ANSI B16.5 150-lb class, flat face.
- C. Gate Valve Stems: Gate valve stems shall be fabricated with Tpe 316 Stainless Steel. Gate valve stems shall be designed for minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10 percent in 2 inches, as determined by a test coupon poured from the same ladle from which the valve stems are poured.
- D. Protective Coating: Except where otherwise indicated, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves

4-inch and larger, and exterior surfaces of submerged valves, shall be fusion-bonded epoxy coated conforming to ANSI/AWWA C213 with a dry film thickness equal to 12 mils. **Flange faces of valves or pipes shall not be epoxy coated.**

- E. Valve Operators: Operators of the same type shall be furnished by the same manufacturer. Valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.
- F. Nuts and Bolts: Unless otherwise indicated, bolts, nuts and washers shall be of Type 316 stainless steel conforming to ASTM A320 Grade B8M Class 2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut a minimum of 1/4-inch, but in no case more than 1/2-inch beyond the nut.

- G. Valve Flanges: All-thread studs may be used only on valve flange connections where space restrictions preclude the use of regular bolts.
- H. Castings: Castings shall conform to the requirements of ASTM A 48 unless otherwise indicated.

2.2 NAMEPLATES, TOOLS AND SPARE PARTS

- A. Nameplates: Except as otherwise indicated, a label shall be provided on all valves. The label shall be stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve.
- B. Spare Parts: Two sets of packings, O-rings, gaskets, discs, seats, and bushings shall be furnished with each valve, as applicable.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. General: Valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's installation instructions. Valves shall be independently supported to prevent stresses on the pipe.

- B. Access: Valves shall be installed to provide easy access for operation, removal, and maintenance and to prevent interferences between valve operators and structural members or any other obstructions.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the combinations shall be properly assembled and installed to ensure that systems are compatible and operating properly.

***** END OF SECTION *****

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SECTION 15106

BALL VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish all labor, materials, tools and equipment required to install ball valves with related work at the locations shown on the drawings and in accordance with the specifications.
- B. The WORK of this Section includes providing manually-operated ball valves.

1.2 RELATED SECTIONS

- A. The WORK of the following Section applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 15034 Gauges
 - 2. Section 15100 Valves, General

1.3 FACTORY TESTING

- A. Valves shall be tested in compliance with AWWA C507 and Section 15100.

PART 2 - PRODUCTS

2.1 BALL VALVES

- A. Body: Ball valves up to 1-1/2 inches in size shall have bronze or forged brass 2 or 3-piece bodies with ends threaded and shall be designed for a pressure rating of not less than 300 psi.
- B. Balls: The balls shall be fabricated of Type 316 stainless steel, with full openings.
- C. Stems: The valve stems shall be of the blow-out proof design, and fabricated of Type 316 stainless steel and shall include reinforced Teflon seals.
- D. Seats: The valve seats shall be of Buna-N or EPDM.

2.2 MANUFACTURERS

A. Ball valves shall be manufactured by the following (or equal):

1. Jenkins Bros.
2. Jamesbury Corporation
3. Lunkenheimer Flow Control
4. Wm. Powell Company
5. Worcester Controls

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance the Manufacture's written instructions and in accordance with Section 15100.

***** END OF SECTION *****

SECTION 15121

POLYVINYL CHLORIDE PIPE (PVC) PIPE (6" THROUGH 42").

PART 1 - GENERAL

1.1 SCOPE

- A. The CONTRACTOR shall furnish all labor, materials, tools and equipment required to install PVC pipe, and related work as shown on the drawings and in accordance with the specifications.

1.2 RELATED WORK

- A. The WORK of the following Section applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Division 1	General Requirements
2. Division 2	Site Work
3. Section 03300	Cast-in-Place Concrete
4. Section 15000	Pipelines – General Provisions
5. Section 15020	Disinfecting Pipelines
6. Section 15030	Pressure and Leakage Tests
7. Section 15065	Ductile Iron Pipe and Fittings

1.3 SUBMITTALS

- A. Shop drawings and manufacturer's literature for all materials.

1.4 COORDINATION OF WORK

- A. The location of the work will be on the CEMEX owned property which is under active construction with other contractors. CONTRACTOR shall review requirements of Section 01410 – Work Restrictions and Section 0100 Summary of Work and follow requirements of those Sections for coordination and access.

PART 2 - PRODUCTS

2.1 PIPE

- A. General: Polyvinyl Chloride (PVC) water pressure pipe shall conform to the latest specifications as adopted by the American National Standards institute, Inc., (ANSI) and the American Water Works Association (AWWA). PVC pipe shall be new and manufactured in accordance with ANSI/AWWA C905 Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 6 in. through 42 in. for Water Distribution. PVC Pipe shall be with cast-iron-pipe equivalent outside diameters in

20-foot lengths.

- B. Class: PVC pipe shall be Pressure Class 165 (DR 25).
- C. Tracing Wire: All PVC pipe shall be installed with a solid No. 10 American Wire Gage soft copper insulated wire in accordance with California American Water Standard Details.
- D. Joints: Joints shall consist of an integral bell end in conformance with ASTM D 3139 Standard Specifications for Joints for Plastic Pressure Pipes Using Elastomeric Seals, with an elastomeric seal (gasket) in conformance with ASTM F 477 Standard Specification Elastomeric Seals (Gaskets) for Joining Plastic Pipe. The use of solvent cement connections shall not be allowed.

2.2 FITTINGS

- A. All PVC pipe shall be joined to ductile-iron fittings only in accordance with Section 15065. The use of PVC pressure fittings shall not be allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: The Contractor shall assume total responsibility for selecting the appropriate means and methods to install PVC pipe and appurtenances in accordance with AWWA Standards, the contract documents and manufacturer recommendations while complying with OSHA Standards for construction.

The provisions of Section 15000 of these specifications shall be strictly followed in addition to the following requirements.

- B. Pipe Joint Assembly: The assembly of joints should be performed as recommended by the pipe manufacturer. The elastomeric gaskets may be supplied separately in cartons or positioned in the bell joint or coupling at the factory. When gaskets are color coded, be sure to consult the pipe manufacturer or his literature for the significance. In all cases, clean the gasket, the bell or coupling interior, especially the groove area (except when gasket is permanently installed) and the spigot area with a rag, brush or paper towel to remove any dirt or foreign material before the assembling. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. When gaskets are separate, use only gaskets which are designed for and supplied with the pipe. Insert them as recommended by the manufacturer.

Lubricant should be applied as specified by the pipe manufacturer. Bacterial growth, damage to the gaskets or the pipe, may be promoted by use of non-approved lubricants. Use only lubricant supplied by the pipe manufacturer.

After lubrication, the pipe is ready to be joined. Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or "stab" the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion.

To join field-cut pipe, it is necessary to first prepare the pipe end. A square cut is essential for proper assembly. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. Use a factory-finished beveled end as a guide for proper bevel angle, and depth of bevel plus the distance to the insertion reference mark. The end shall be beveled using a pipe beveling tool or a wood rasp which will cut the correct taper. A portable sander or abrasive disc may also be used to bevel the pipe end. Round off any sharp edges on the leading edge of the bevel with a pocket knife or a file.

- C. Encountering Contaminated Soil: Research has documented that certain pipe materials (such as polyvinyl chloride, polyethylene, and polybutylene) and certain elastomers (such as those used in gasket material) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products supplied under this section have been selected based on the non-expectation of encountering petroleum products or organic solvents.

If during the course of pipeline installation the CONTRACTOR identifies, or suspects, the presence of petroleum products or any unknown chemical substance, or a wastewater leach field, the ENGINEER is to be notified immediately. Installation of any further piping in the area of suspected contamination shall be stopped until direction is provided by the ENGINEER.

*** END OF SECTION ***

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SECTION 15125

HIGH-DENSITY POLYETHYLENE (HDPE) PIPE (6" THROUGH 42").

PART 1 – GENERAL

1.1 SCOPE OF WORK

This specification covers the material (pipe and fittings), joining methods and general installation practice for high density polyethylene pipe (HDPE) piping systems for water and wastewater utility use as indicated on the Drawings.

1.2 RELATED WORK

A. The WORK of the following Section applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

- | | |
|------------------|--------------------------------|
| 1. Division 1 | General Requirements |
| 2. Division 2 | Site Work |
| 3. Section 15000 | Pipelines – General Provisions |
| 4. Section 15020 | Disinfecting Pipelines |
| 5. Section 15030 | Pressure and Leakage Tests |

1.3 SUBMITTALS

- A. Submit Shop drawings and manufacturer's literature (product data) to the ENGINEER for review in accordance with the Section 01300 for all pipe and appurtenances.
- B. Furnish in duplicate to the ENGINEER confirmation that product shipped meets or exceeds the standards set forth in this specification. This shall be in the form of a written document from the manufacturer attesting to the manufacturing process meeting the standards.
- C. Provide a statement in writing from the HDPE pipe manufacturer that it is listed with the Plastic Pipe Institute as a qualified extruder for the polyethylene resin being used to manufacture the pipe for this project.
- D. Provide a statement that personnel responsible for fusing the pipe have been trained and qualified.
- E. Contractor shall also submit the following to the Engineer for approval:
1. Details of fittings and specials such as elbows, wyes, tees, outlets, connections, test bulkheads, bosses and nozzles or other specials

where shown on the Construction Drawings, which indicate amount and position of reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure both circumferential and longitudinal, and the external loading conditions as indicated in the Contract Documents. Shop Drawings shall clearly detail special castings indicating all pertinent dimensions.

2. The Supplier of the material shall submit, through the Contractor, a Certificate of Compliance that the pipe, fittings and other products or materials furnished for this project have been inspected at the plant and comply with all applicable provisions of these Specifications. The Contractor shall submit these certificates to the Engineer prior to installation of the pipe materials.

1.4 REFERENCE DOCUMENTS AND STANDARDS

Unless otherwise specified, references to documents shall mean the latest published edition of the referenced document in effect at the bid date of the project.

ANSI/AWWA

- ANSI/AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
- ANSI/AWWA C651 Standard for Disinfecting Water Mains

ASTM

- ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- ASTM F905 Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
- ASTM F 1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings
- ASTM F 2164 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
- ASTM F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
- ASTM F 2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- ASTM D 2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM F 2880 Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3/4 in. to 65 in.

- ASTM F 3124 Standard Practice for Data Recording the Procedure Used to Produce Heat Butt Fusion Joints
- ASTM D 3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- ASTM D 3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- ASTM D 3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

Plastics Pipe Institute, PPI

- PPI Handbook of Polyethylene Pipe – 2009 (2nd Edition)
- PPI Material Handling Guide for HDPE Pipe and Fittings
- PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects
- PPI TR-46 Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe

PART 2 – PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE MATERIALS

A. Resin and Material Requirements

1. All material shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D 3350 with a minimum cell classification of 445474C. HDPE pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. HDPE products shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

B. HDPE Pipe

1. Pipe shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black of not less than 2 percent. The manufacture of the HDPE resin shall certify the cell classification indicated.
2. Pipe sizes 3” and large shall have a manufacturing standard of ASTM F 714, while pipe smaller than 3” shall be manufactured to the dimensional requirements listed in ASTM D 3035. Dimension Ratio (DR) and Outside Diameter (IPS/DIPS) shall be as specified on plans.

3. Pipe shall meet AWWA C901 (1/2" to 3") or AWWA C906 (4" to 63"), and shall be listed as meeting NSF-61.
4. Pipe shall be manufactured by an ISO 9001 certified manufacturer. The pipe manufacturer shall have an ongoing Quality Control program for incoming and outgoing materials and shall assure that the pipe will meet the material requirements of this specification. HDPE resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. The facility shall have the necessary testing equipment to verify that pipe meets the AWWA and NSF standards. Pipe shall be checked for outside diameter, wall thickness, length, and surface finish on the inside and outside. The Manufacturer's production facilities shall be open for inspection by the Owner or Engineer.
5. All pipe shall be color coded for the intended service. The color coding shall be permanently co- extruded stripes on the pipe outside surface as part of the pipe's manufacturing process. Painting HDPE pipe to accomplish color coding is not permitted. Color coding shall be as follows:
 - a. Sewer – green
 - b. Water – blue
 - c. Reclaim – purple

C. HDPE Fittings

1. Butt Fusion Fittings- Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by owner/engineer. All fittings shall meet the requirements of AWWA C901 or C906.
 - a. Molded fittings shall comply with the requirements of ASTM D 3261.
 - b. All fabricated elbows, tees, reducing tees and end caps shall be produced and meet the requirements of ASTM F 2206, as manufactured by ISCO Industries, Inc or other approved manufacturer holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F 2206 section 10 including the nominal size and fitting EDR, which will meet or exceed the pipe DR identified for the project. Fabricated fittings shall be manufactured using a McElroy DataLogger to record fusion pressure and temperature and shall be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for

all fusion joints made producing fittings shall be maintained for a minimum of 5 years as part of the quality control and will be available upon request of owner. Test results to validate ASTM F 2206 section 7.3 and 9 shall be provided to owner or owner's representative upon request.

2. Socket fittings shall meet ASTM D 2683. Electrofusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in 2.01.A. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans. For potable water systems, all electrofusion fittings shall have AWWA approval
3. Bolted Connections – Flanged and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206. Flanges and MJ Adapters shall be fused onto the pipe and have a minimum pressure rating equal to or greater than the pipe unless otherwise specified on the plans.
 - a. Flange Adapters shall meet the dimensional and material requirements of ASTM F 2880.
 - b. Metallic back-up rings (Van-Stone style lap joint flanges), shall have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings shall have bolt pattern that will mate with AWWA C207 Class D (or B or E), ASME/ANSI B 16.5 Class 150, ASME/ANSI B 16.1 Class 125, or ASME/ANSI B16.47 Series A.
 - c. Flange assemblies shall be assembled and torqued according to PPI TN-38, "Bolt Torque for Polyethylene Flanged Joints."
 - d. Where shown on the drawings, 4" and larger transitions to mechanical joint fittings and valves shall be accomplished using a MJ Adapter with kit. The D.I./HDPE mechanical joint adaptor shall consist of:
 - i. A molded or fabricated HDPE mechanical joint transition fitting.
 - ii. A rubber gasket.
 - iii. A mechanical joint backup drive ring.
 - iv. Corten mechanical joint tee bolts.
4. Mechanical Fittings: The use of mechanical coupling and saddles shall be approved by the owner or engineer prior to installation. Mechanical Fittings shall be designed for use and compatible with HDPE pipe.

Mechanical fittings shall have a pressure rating equal to or greater than the pipe.

- a. Couplings without self-restraining capabilities (integrated serrated teeth or grippers) shall include a plan for external restraint or isolation from pipeline generated forces.
- b. Mechanical Saddles shall have wide straps for distribution of clamping loads. No U- bolts shall be allowed.
- c. When required by mechanical coupling manufacturer, pipe stiffeners shall be employed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel, with a wedged style design to fit the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE.

D. Fusion Unit Requirements

1. All Fusion Equipment, whether new or used, rented or owned, shall comply with the requirements of ISO 12176-1 "Equipment for Fusion Jointing Polyethylene Systems".
2. If the contractor owns butt fusion equipment, the equipment must be serviced within 3 months prior to use for this project. The machine must be environmentally friendly and in satisfactory working order. The hydraulic system must be leak free. The pressure gage and thermometer must be checked for accuracy. For projects with pipe quantities of 5000' or longer, the fusion equipment should be serviced by a McElroy Authorized Service and Repair Center with at least one McElroy Certified Master Mechanic on staff within 3 months from the first fusion on the project.
3. Rental Fusion Equipment must be maintained by a McElroy Authorized Service and Repair Center with at least one McElroy Certified Master Mechanic on staff. When requested by owner or his authority, an inspection report detailing the components inspected within 3 months prior to arrival at jobsite will be provided.

E. Approved Suppliers

1. All Pipe, Fittings, and Fusion Equipment shall be provided by one supplier. Approved suppliers are ISCO Industries, Inc. JM Eagle, or

approved equal.

2.2 PIPELINE LOCATING MATERIALS

- A. Detectable Marker Tape- Plastic marker tape shall be 5 mil minimum thickness with a solid aluminum core of .35mil minimum thickness and a minimum width of 2". The background of the tape shall be colored based on pipe service with black lettering continuously printed. Marker tape shall have a minimum 35 lbs./inch tensile strength. The installation of the tape shall be at 18 inches below finish grade.
- B. Tracer Wire- All HDPE pipe 4" and greater shall be installed with an extra high-strength, copper clad steel tracer wire including 45 mil HDPE jacket that has a minimum average break load of at least 1150 lbs. The jacket shall be colored based on pipe service, with blue for potable water or green for sewer. Tracer wire gauge shall be 12 AWG, 10 AWG, or 8 AWG depending upon application and installation procedure. This wire shall to be continuous and brought up in the valve boxes at the ends of each line segment with splices made only by methods per the equipment manufacturer's recommendation. All miscellaneous splicing components shall be furnished and installed by the Contractor.

PART 3 – EXECUTION

3.1 GENERAL

- A. All HDPE pipe and fittings shall be cut, joined, and installed in accordance with the manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with polyethylene pipe systems.

3.2 TRANSPORTATION, UNLOADING, AND STORAGE

- A. The manufacturer shall package product in a manner designed to deliver the pipe and fittings to the project neatly, intact and without physical damage. During transportation each pipe shall rest on suitable pads, strips skids, or blocks securely wedged or tied in place. The transportation carriers shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked and restrained during transportation such that the pipe is not nicked, gouged, or physically damaged. The transportation carrier shall provide tarpaulins to cover any potable water pipe subject to exposure to diesel exhaust or smoke.
- B. During loading, transportation, and unloading, every precaution should be taken to prevent damage to the pipe. Cuts or gouges that reduce the

wall thickness by more than 10% is not acceptable and must be cut out and discarded.

- C. Handle the pipe in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2. All pipe and accessories shall be loaded and unloaded by lifting with hoists or by skidding in order to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be rolled or skidded against pipe on the ground. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or interior of the pipe. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.
- D. Materials, if stored, shall be kept safe from damage. The contractor shall be responsible for all security, damage and loss of pipe, excluding Acts of God. The interior of the pipe as well as all sealing surfaces of mating components (i.e. flange faces) shall be kept free from dirt or foreign matter at all times.
- E. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tiers shall be kept off the ground on timbers, rails, or concrete. Pipe shall not be stored close to heat sources.
- F. The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged to prevent animals or foreign material from entering the pipe line or pipe section. The practice of stuffing cloth or paper in the open ends of the pipe will not be permitted. Waterproof nightcaps of approved design may be used but they shall be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and will be secured to the pipe in such a manner that the wind cannot blow them loose.
- G. Where possible, the pipe shall be raised and supported at a suitable distance from the open end such that the open end will be below the level of the pipe at the point of support.

3.3 PIPE INSPECTION

- A. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are installed or lowered into the trench to be laid. Defective, damaged, or unsound pipe will be rejected. Cuts, punctures, or gouges that penetrate or reduce the wall thickness by 10% or more are not acceptable and must be removed and discarded. Joints or fittings that do

not conform to these specifications will be rejected and must be removed immediately by the Contractor.

3.4 HANDLING PIPE

- A. The handling of the pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Sections of the pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.
- B. Refer to the PPI Material Handling Guide for HDPE Pipe and Fittings for recommendations, guidelines and instructions regarding the handling, lifting, loading, storing and installing polyethylene pipe and fittings.

3.5 PIPE JOINING AND INSTALLATION

A. Direct Burial

- 1. Buried HDPE pipe and fittings shall be installed in accordance with ASTM D 2321 or ASTM D 2774 for pressure systems and AWWA Manual of Practice M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 (page 65 of 2006 version) shall be considered acceptable design and installation conditions.
- 2. Pipe embedment - Embedment material should be Class I, Class II, or Class III materials as defined by ASTM D-2321 Section 6. The use of Class IV and Class V materials is not recommended, however it may be used only with the approval of the engineer and appropriate compaction. Bedding: Pipe bedding shall be in conformance with ASTM D 2321 Section 8. Compaction rates should be as specified in ASTM D 2321. Deviations shall be approved by the engineer.
- 3. Haunching and backfill shall be as specified in ASTM D 2321 Section 9 with Class I, II, or III materials. Compaction shall be in excess of 85% Proctor.

B. Trenchless Installation Methods

- 1. Installation of HDPE Pipe by Directional Boring shall follow the guidelines for ASTM F 1962 or PPI TR-46. See Section XXXXX of this Specification.

C. Fusion Joining Requirements:

- 1. All HDPE pipe shall be joined to itself by the heat fusion process which produces homogeneous, seal, leak tight joints. Tie-ins between sections of HDPE pipe shall be made by butt fusion whenever possible.

2. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F 2620. Considerations should be given to and provisions made for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by the owner/engineer.
3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290, PPI TN 34, and PPI Municipal Advisory Board (MAB) Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe. The process of electrofusion requires an electric source, commonly called an electrofusion processor that has wire leads and a method to read electronically (by laser) or otherwise input the barcode of the fitting. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence electrofusion training within the past year on the equipment to be utilized for this project.

D. Fusion Operators:

1. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all qualification and training records of that individual.
2. All HDPE fusion equipment operators shall be qualified to the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.
3. For Projects with at least 5,000 feet or with pipe larger than 24 inches, operators or their supervisor must have a current McElroy Fusion Training Certificate for the equipment to be used on the project.
4. When the fusion machine operator is employed by the HDPE pipe and fusion machine supplier, the supplier shall maintain an ISO 9001 Certified Quality Management System.

E. Butt Fusion Equipment:

1. For 6” and larger pipe sizes, the pipe butt fusion machine shall be a self-contained hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord (25' minimum), and hydraulic extension hoses (minimum of four). The butt fusion machine will be McElroy, or approved equivalent.
2. In areas where there may be insufficient space to lay out the entire length of fused pipe to be pulled-back, the Contractor shall utilize a continuous HDPE pipe fusion equipment such as a PolyHorse by McElroy or other means in order to fuse the length of pipe necessary for the installation. The Contractor shall be responsible for securing and obtaining permission/permits from adjacent property if necessary, for staging and/or fusing of the pipe and HDD equipment at no additional cost to the Owner.

F. Fusion Data Recording:

1. For 6” and larger pipe sizes, McElroy DataLogger or equivalent fusion data recorder shall be used to record all fusion welds on hydraulically operated fusion machines. The device shall be capable of meeting the requirements of ASTM F 3124, “Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings”. The device, or combination of devices, shall record the following variables of each fused joint:
 - a. Heater surface temperature immediately before inserting the heater plate. Alternatively, the heater plate may be measured with a pyrometer and entered into the weld record.
 - b. Gauge pressure during the initial heat cycle
 - c. Gauge pressure and elapsed time during the heat-soak cycle
 - d. Heater removal (dwell) time
 - e. Gauge pressure and elapsed time during the fusing/cool cycle
 - f. Drag pressure
 - g. Pipe diameter and wall thickness
 - h. Type of HDPE material (Specification and Classification) and manufacturer
 - i. Fusion Machine Identification
2. The device shall record the operator, a unique operator ID number, the date and time of each weld.
3. Records showing the device is up to date on all required calibration

should be available for presentation when requested.

4. All fusion welds should be traceable to the report (via operator and weld ID) with an indentation weld stamp or by permanent paint marker/pen next to fusion weld.
5. When requested prior to commencement of work, a weld location map may be requested by the owner or owner's representative.

G. Butt Fusion Examination and Testing:

1. Examinations

- a. Visual: For pipe sections, examine the full exterior circumference for bead uniformity before cutting. After cutting the pipe section, review the interior bead. All beads should have visually acceptable bead formation as shown in Fig 4 and Appendix X2 of ASTM F 2620. In addition, the following characteristics are expected:
 - i. There shall be no evidence of cracks or incomplete fusing
 - ii. There shall be no evidence of captured objects (e.g., pipe shavings, facer ribbons) between bonded surfaces.
 - iii. Variations in upset bead heights on opposite sides of the cleavage and around the circumference of fused pipe joints are acceptable.
 - iv. The apex of the cleavage between the upset beads of the fused joint shall remain above the base material surface
 - v. Fused joints shall not display visible angular misalignment, and outside diameter mismatch shall be less than 10% of the nominal wall thickness
 - vi. Fusion data record review that meet criteria of section 6-2.1 can be used as additional verification of visual indicators.
- b. Fusion Data Record Review
The fusion data record for each fused joint shall be compared to the approved fusion procedure. The reviewer shall verify the following:
 - i. That all data required by section 6-1.1 was recorded
 - ii. Interfacial pressure was within the acceptable range
 - iii. Heater surface temperature was within the acceptable range
 - iv. Butt fusion pressure applied during the fusing/cool cycle was correctly calculated to include drag pressure, fell within the acceptable range for the applicable size and agrees with the recorded hydraulic fusing pressure.
 - v. Butt fusing pressure was reduced to a value less than or equal to drag pressure at the beginning of the heat soak cycle.
 - vi. Fusing machine was opened at the end of the heat soak

cycle, the heater was removed, and the end were brought together at the fusion pressure with the acceptable time range

vii. Cooling time at butt fusing pressure met the minimum time specified

- c. If the recorded data in section 3.05.G.1.b is outside the limits of the acceptable range, the joint is unacceptable.
- d. Frequency. Records for test fusion joints should be reviewed immediately after the joint is completed. Fusion joints for jobsite fusions should be reviewed daily or before being covered with backfill.

2. Mechanical Tests

- a. Contractor shall mechanically test the first fusion of each operator and each machine used on the project. Installation shall not continue until a fusion test has passed the test. Additional mechanical test is not required as long as long as the fusion are reviewed with the frequency specified in section 3.05.G.1.d. Testing of fusion joints with no fusion data record review shall be at a frequency specified by the Owner or Engineer.
- b. The fusion shall be allowed to cool completely, then fusion test straps shall be cut out.
- c. All samples shall be labeled with operator information. Testing must be done at 73 degrees F plus or minus 5 degrees. The test temperature and sample size are critical to testing. Testing performed at cold or elevated temperatures may not give similar results to tests performed at ambient temperatures.
- d. Each pipe sample weld shall be subjected to testing at two locations 180 degrees apart from each other in the joint weld. All specimens shall be tested by one of the following methods:
 - i. Reverse Bend Test are allowed for pipe sizes 4" IPS or smaller. The specimens shall be removed and tested in accordance with ASTM F 2620, Appendix X4.
 - ii. Guided Side Bend Test are allowed for all pipe sizes 4" IPS and larger. The specimens shall be removed and tested in accordance to recommendations and procedures provided by McElroy Manufacturing.
 - iii. Hydrostatic Burst Test is allowed for pipe sizes 2"-24". The specimen length should measure 6 times pipe diameter with the butt fusion joint in the center of the specimen. The specimen should be tested in a tank

filled with water, and testing conditions monitored and recorded with computerized equipment. The specimen will be tested at 4 times pipe rated pressure for 5 minutes with no failure of joint allowed.

- e. Results of any mechanical test should be documented. Information on the weld and operator should be transferred from the sample to the testing record.

****END OF SECTION****

SECTION 15150

GATE VALVES

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

- A. The CONTRACTOR shall furnish all labor, materials, tools and equipment required to install gate valves with related work at the locations shown on the drawings and in accordance with the specifications.
- B. The WORK of this Section includes the installation of gate valves to the tapping sleeves and other various locations to provide isolation from the system as indicated, complete and operable, with all accessories specified herein.
- C. The gate valve shall be new and of current manufacture. All materials shall be suitable for the intended application in potable water. Materials not specified shall be a high-grade standard commercial quality, free from defects and imperfections that may affect the serviceability of the product for the purpose for which it is intended.

1.2 RELATED WORK

- A. WORK of the following Section applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK
 - 1. Section 15100 Pipelines – General Provisions

1.3 SUBMITTALS

- A. Submit to Engineer for approval, shop drawings, technical information on completed valve assembly including all options, appurtenances and cavitation report in accordance with the General Conditions and General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Gate valves shall be furnished in accordance with the project plans, details and the specifications.

2.2 MATERIALS

- A. Gate valves shall be new and manufactured in accordance with ANSI/AWWA C509 Standard for Resilient-Wedge Seated (Viton or EPDM rubber) Gate Valves for Water Supply Service, corrosion resistant to seawater.

- B. Valves shall have a maximum working pressure rating of 250-psi. Valves shall be hydrostatically tested to at least 400-psi.
- C. Valves shall be non-rising stem, opened to the left (counter-clockwise) and provided with a 2-inch square operating nut. Stems shall be Type 316 Stainless Steel.
- D. Stuffing boxes shall be o-ring seal type with a minimum of two (2) rings located in the stem above the thrust collar. Low friction tongue reduction thrust bearing shall be located both above and below the stem collar.
- E. Coatings: Interior and exterior exposed surfaces of the gate valve shall be coated with a fusion-bonded epoxy in accordance with ANSI/AWWA C550 Standard for Protective Epoxy Interior Coatings for Valves and Hydrants and certified to ANSI/NSF Standard 61, 12 mill thickness, min. 8 mil.
- F. Flanged joints shall be in accordance with ANSI/AWWA C115/A21.15 Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
- G. All flanged joints shall be furnished with a minimum 1/8-inch, neoprene rubber gasket. The bolts shall be type 316 Stainless Steel and have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2.
- H. Corrosion Protection: Gate valves shall be encased interior and exterior with one (1) layer of 12-mil linear low-density polyethylene film in accordance with ANSI/AWWA C105/A21.5 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems. The film shall be pigmented with 2 to 2 ½ percent of well-dispersed carbon black with stabilizers. The polyethylene film supplied shall be clearly marked as follows:
 - 1. Manufacturer's name or trademark
 - 2. Year of Manufacture
 - 3. ANSI/AWWA C105/A21.5
 - 4. Minimum film thickness
 - 5. Material type (LLDPE)
 - 6. Applicable range of nominal pipe diameters sizes
 - 7. Warning – Corrosion Protection – Repair any Damage

2.3 MANUFACTURERS

- A. Gate valves shall be manufactured by one of the following (or equal) In addition to the above requirements, gate valves supplied to the project shall be:
 - 1. Mueller Series A2360
 - 2. U.S. Pipe Metroseal

3. Clow

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation requirements contained in Specification Section 15000 and 15100 shall be strictly followed.

***** END OF SECTION *****

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SECTION 15151

CHECK VALVES

PART 1: GENERAL

1.01 SCOPE

Furnish and install all check valves as shown on the Drawings. This specification covers the design, manufacture, and testing of 2 in. (50 mm) through 48 in. (1200 mm) Silent Globe Check Valves suitable for cold working pressures up to 250 psig (1725 kPa), in seawater.

1.02 RELATED WORK

Specification Section 15000 - Piping - General Provisions.

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature to the ENGINEER for approval in accordance with Specification Section 01300.

PART 2: PRODUCTS

2.01 VALVES

Furnish and install full flow body type silent globe check valve with domed access cover and only one moving part (flexible disc), as shown on the Contract Drawings. Check valves shall be designed, manufactured, tested and certified to American Water Works Association Standard ANSI/AWWA C508 and this specification.

2.02 CONNECTIONS

The Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.

2.03 DESIGN

A. The valve body shall be full flow equal to nominal pipe diameter at all points ~through the valve. The 4 in. (100mm) valve shall be capable of passing a 3 in. (75mm) solid. The seating surface shall be on a 45 degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion device without special tools or removing the valve from the line.

B. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be

domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.

- C. The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface and reinforced with stainless steel. The flex portion of the disc contains nylon reinforcement and shall be warranted for twenty-five years. Non-Slam closing characteristics shall be provided through a short 35 degree disc stroke and a memory disc return action to provide a cracking pressure of 0.25 psig.
- D. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures.

2.04 MATERIALS

- A. The valve body and cover shall be constructed of ASTM A-536 Ductile Iron and coated interior and exterior fusion bonded epoxy with minimum 12 mil thickness.
- B. The disc shall be 316 Stainless Steel with seat material made of Buna-N (NBR), ASTM D2000-BG. Optional disc material includes Viton or EPDM.

2.05 OPTIONS

- A. A screw-type backflow actuator shall be provided (when specified) to allow opening of the valve during no-flow conditions. Buna-N seals shall be used to seal the stainless steel stem in a Lead-Free bronze bushing. The backflow device shall be of the rising-stem type to indicate position. A stainless steel T-handle shall be provided for ease of operation.
- B. A mechanical indicator shall be provided (when specified) to provide disc position indication on valves 3" (80 mm) and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.
- C. A pre-wired limit switch will be provided (when specified) to indicate open/closed position to a remote location. The mechanical type limit switch shall be activated by the mechanical indicator. The switch shall be rated for NEMA 4, 6, or 6P and shall have U.L. rated 5 amp, 125 or 250 VAC contacts.

2.06 MANUFACTURE

- A. Manufacturer shall demonstrate a minimum of five (5) years' experience in the manufacture of resilient, flexible disc check valves with hydraulic cushions.
- B. All valves shall be hydrostatically tested and seat tested to demonstrate zero leakage. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.
- C. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- D. Silent Globe Check Valves shall be manufactured by Cla-Val, Val Matic, Mueller, or approved equal.

PART 3: EXECUTION

3.01 SETTING VALVES

Install the valves in strict accordance with the requirements of Specification Section 15000. All valves shall be restrained.

3.02 PROTECTION

After field installation of the valve all external bolts shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill.

*****END OF SECTION*****

SECTION 15155

BUTTERFLY VALVES

PART 1: GENERAL

1.01 SCOPE

Furnish and install all butterfly valves shown on the Drawings and/or the Specification Special Conditions.

1.02 RELATED WORK

Specification Section 15000 - Piping - General Provisions.

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature to the Engineer for approval in accordance with Specification Section 1300.

PART 2: PRODUCTS

2.01 VALVES

- A. Furnish and install rubber-seated butterfly valves as shown on the Contract Drawings. Butterfly valves shall conform to Class 150B of the AWWA Standard C504 and this specification unless working pressure is greater than 150 psi in which case, the butterfly valve shall conform to Class 250B of the AWWA Standard C504. All valves furnished shall open (left or right) in accordance with the Owner's standard.
- B. Valve bodies shall be ductile iron with flange ends. All valve materials shall meet the requirements of NSF 61.
- C. Valve shafts shall consist of one-piece units extending through the discs of 18-8 stainless steel Type 316. Shaft diameter shall be in accordance with Table 3 of AWWA Standard C504.
 - 1. Valve discs shall be nickel-aluminum bronze (C95500) disc, ASTM B 505 and ASTM B 271, with stainless steel edge.
 - 2. Valve seats shall be Buna or EPDM rubber, mounted in the valve body.
 - 3. Valve bearings shall be stainless steel with nylon or Teflon.

- D. The valve interior and exterior shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA Standard C550 (10-12 mil average, 8 mil minimum).
- E. All elastomers used in the butterfly valves must be suitable for service in seawater.**
- F. Manual buried operators, if provided, shall be either worm gear or traveling nut type and shall be furnished with 2-inch AWWA nuts and extension shafts. Input required at nuts to produce specified output torque shall be less than 150 ft.-lbs. Operators shall be designed to withstand an input at the nut of 300 ft.-lb. without damage to any operator components.
- G. Acceptable manufacturers: Mueller Company (Henry Pratt Company Division only) and DeZurik Water Controls.

PART 3: EXECUTION

3.01 SETTING VALVES

Install the valves in strict accordance with the requirements of Specification Section 15000. All butterfly valves shall be restrained.

3.02 PROTECTION

After field installation of the valve all external bolts except the operating nut shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut exposed and free to be operated.

*****END OF SECTION*****

SECTION 15158

PUMP (SOLENOID) CONTROL VALVE

PART 1: GENERAL

1.01 SCOPE

Furnish and install all solenoid control valves as shown on the Drawings. This specification covers the design, manufacture, and testing of 6-inch Deep Well Pump Control Valve suitable for cold working pressures up to 250 psig (1725 kPa), in seawater.

1.02 RELATED WORK

Specification Section 15100 - Valves - General Provisions.

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature to the ENGINEER for approval in accordance with Specification Section 01300.

PART 2: PRODUCTS

2.01 VALVES

Furnish and install deep well pump control valve as shown on the Contract Drawings. Control valves shall be designed, manufactured, tested and certified to American Water Works Association Standard ANSI/AWWA C508 and this specification.

2.02 CONNECTIONS

The Valves shall be provided with flat face flanges in accordance with ANSI B16.1, Class 125.

2.03 DESIGN

A. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.

B. The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface and reinforced with stainless steel.

The flex portion of the disc contains nylon reinforcement and shall be warranted for twenty-five years.

- C. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures.
- D. Each well pump piping system will require ½-inch flexible stainless-steel tubing to connect operating pressure connection of the pump control valve to the system side of the check valve and the pump discharge. Will also require a type 316 stainless steel shuttle valve (i.e. Cla-Val model CVS-1) to be able to use the greater of the two pressures.

2.04 MATERIALS

- A. The valve body and cover shall be constructed of ASTM A-536 Ductile Iron and coated interior and exterior fusion bonded epoxy with minimum 12 mil thickness.
- B. The trim shall be 316 Stainless Steel with seat material made of Viton. Optional disc material includes Buna-N and EPDM.
- C. Diaphragm shall be Nylon reinforced Buna-N Rubber
- D. Stem, Nut, and Spring shall be type 316 stainless steel.

2.05 OPTIONS

- A. Pilot system shall be type 316 stainless steel.
- B. "Y" Strainer with blow-off valve on pilot piping
- C. Opening / Closing Speed control

2.06 MANUFACTURER

- A. Deep Well Pump Control Valve shall be manufactured by Cla-Val.
- B. All valves shall be hydrostatically tested, and seat tested to demonstrate zero leakage. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.
- C. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- D. The Control Valve shall be complete and supplied by a single control valve manufacturer and installed by the Contractor. The system shall be complete and functional. The control valve manufacturer shall

provide a factory representative to verify proper installation and set-up of the control valve system.

PART 3: EXECUTION

3.01 SETTING VALVES

Install the valves in strict accordance with the requirements of Specification Section 15100. All valves shall be restrained.

3.02 PROTECTION

After field installation of the valve all external bolts shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill.

*****END OF SECTION*****

SECTION 15171

TAPPING SLEEVES AND SADDLES

PART 1: GENERAL

1.01 SCOPE

Furnish, install and test all tapping sleeves, tapping valves, and tapping saddles as shown on the Drawings.

1.02 RELATED WORK

Specification Section 15000 - Piping - General Provisions

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature to the Engineer for approval in accordance with Specification Section 01300.

PART 2: PRODUCTS

2.01 GENERAL

All tapping sleeves, saddles and valves shall be designed for a working pressure of at least 250 psig for 12-inch and smaller. The valves shall be designed for a minimum differential pressure of 250 psi and a minimum internal test pressure of 300 psi unless otherwise noted on the plans.

2.02 DUCTILE IRON TAPPING SLEEVES

Verify the type of existing pipe and the outside diameter of the pipe on which the tapping sleeve is to be installed.

Tapping sleeves shall be ductile iron dual compression type unless otherwise specified on the Drawings. The Drawings may require the use of corrosion resistant tapping sleeves in addition to polywrap in areas with corrosive soils. The sleeves shall be made in two halves which can be assembled and bolted around the main. Sleeves shall meet the requirements of NSF 61. Outlet flanges shall conform to the flange requirements of AWWA C110. All valves furnished shall open (left or right) in accordance with the Owner's standard.

Acceptable manufacturers: McWane (Clow and M&H), U.S. Pipe (Mueller), and AFC (Waterous).

2.03 TAPPING VALVES

The horizontal tapping valve shall conform to the applicable requirements of AWWA Standard C509. All tapping valves, 3 inches through 12 inches NPS, shall be ductile iron body, resilient-seated, nut-operated, non-rising stem gate valves suitable for buried service. The valve interior and exterior shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA Standard C550 (6-8 mil average, 4 mil minimum). The tapping valves shall have flanged inlets with mechanical joint outlets, enclosed bevel gears, bypass valve, rollers, tracks and scrapers. All valves furnished shall open (left or right) in accordance with the Owner's standard.

Acceptable manufacturers: McWane (Clow and M&H), U.S. Pipe (Mueller), and AFC (Waterous).

2.04 STAINLESS STEEL TAPPING SLEEVES

The stainless-steel band flange shall be manufactured in compliance with AWWA C207, Class D ANSI B.16.1 drilling, recessed for tapping valve MSS-SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint by mechanical joint resilient wedge gate valves per ANSI/AWWA C509-94 and be NSF 61 approved.

A. Tapping sleeves from 4" through 12"

Tapping sleeves to be attached to 4" through 12" nominal pipe diameter shall meet the following minimum requirements.

1. The entire fitting shall be stainless steel type 304 (18-8). The body, lug, and gasket armor plate shall be in compliance with ASTM A240. The Flange shall be cast stainless steel in compliance with ASTM A743. The MJ outlet shall be one-piece casting made of stainless steel. The test plug shall be 3/4" NPT in compliance with ANSI B2.1 and shall be lubricated or coated to prevent galling. All metal surfaces shall be passivated after fabrication in compliance with ASTM A-380.
2. The gasket shall provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under the combinations of joint and gasket tolerances. The materials used shall be vulcanized natural or vulcanized synthetic rubber with antioxidant and antiozonant ingredients to resist set after installation. No reclaimed rubber shall be used. A heavy-gauge-type 304-stainless armor plate shall be vulcanized into the gasket to span the lug area.
3. The lugs shall be heliarc welded (GMAW) to the shell. The lug shall have a pass-through-bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts shall NOT BE

integrally welded to the sleeve. Finger Lug designs are not approved; it is the intent of these specifications to allow a tapping sleeve that has a lug design similar to the approved models.

4. Bolts and nuts shall be type 304 (18-8) stainless steel and Teflon coated or as specified in the bolt section below at the discretion of the Engineer. Bent or damaged units will be rejected.
5. Quality control procedures shall be employed to insure that the shell, lug, (4" and Larger Nominal Pipe Diameter) armor plate, gasket and related hardware are manufactured to be free of any defects. Each unit, after proper installation, shall have a working-pressure rating up to 250 psi.
6. The sleeve construction shall provide a positive means of preventing gasket cold flow and/or extrusion.
7. Each sleeve shall be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings shall be permanent type, water resistant, that will not smear or become illegible.

2.05 FABRICATED STEEL TAPPING SLEEVES

The fabricated steel tapping sleeve shall be manufactured in compliance with AWWA C207. Sleeves shall be fabricated of minimum three-eighths (3/8) inch carbon steel meeting ASTM A285 Grade C. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150 lb. drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel to AWWA C111 (ANSI A21.11). Gasket shall be vulcanized natural or synthetic rubber. Sleeve shall have manufacturer applied fusion bonded epoxy coating, minimum 12 mil. thickness, Class D ANSI B.16.1 drilling recessed for tapping valve MSS-SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint by mechanical joint resilient wedge gate valves per ANSI/AWWA C509-94 and be NSF 61 approved.

2.06 TAPPING SADDLES

Unless otherwise specified by the Drawings, tapping saddles conform to the requirements of AWWA Standard C800 for the High-Pressure class tapping saddles. Tapping saddles shall consist of ductile iron outlet castings, attached to the pipeline with high strength stainless steel straps. Castings shall be sealed to pipeline with O-ring seals. Saddles shall have ANSI A21.10 flanged outlets counterbored for use with tapping valves and tapping equipment.

2.06 BOLTS

All bolts shall be Type 316 stainless steel and have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Bolts shall be Xylan or FluoroKote #1 suitable for direct bury in corrosive soils.

PART 3: EXECUTION

3.01 INSTALLATION

Install the tapping sleeves, saddles, and valves in strict accordance with the requirements of Specification Section 15000. Install the tapping sleeves, tapping saddles, and tapping valves in accordance with the manufacturer's instructions. The tapping procedure is to be in accordance with the tapping machine manufacturer's instructions.

3.02 PROTECTION

After field installation of the valve all external bolts except the operating nut shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire sleeve and valve assembly shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut of the tapping valve exposed and free to be operated

3.03 PRELIMINARY TESTING

Perform a hydrostatic test of the tapping sleeve and valve assembly in accordance with Specification Section 15030 after installation of the tapping sleeve and valve, but prior to making the tap. The test shall be made with the valve open using a tapped mechanical joint cap. No leakage is acceptable. The test pressure shall be maintained for a minimum of 15 minutes.

Perform hydrostatic test of tapping saddles in accordance with AWWA Standard C800.

*****END OF SECTION*****

SECTION 15171

TAPPING SLEEVES AND SADDLES

PART 1: GENERAL

1.01 SCOPE

Furnish, install and test all tapping sleeves, tapping valves, and tapping saddles as shown on the Drawings.

1.02 RELATED WORK

Specification Section 15000 - Piping - General Provisions

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature to the Engineer for approval in accordance with Specification Section 01300.

PART 2: PRODUCTS

2.01 GENERAL

All tapping sleeves, saddles and valves shall be designed for a working pressure of at least 250 psig for 12-inch and smaller. The valves shall be designed for a minimum differential pressure of 250 psi and a minimum internal test pressure of 300 psi unless otherwise noted on the plans.

2.02 DUCTILE IRON TAPPING SLEEVES

Verify the type of existing pipe and the outside diameter of the pipe on which the tapping sleeve is to be installed.

Tapping sleeves shall be ductile iron dual compression type unless otherwise specified on the Drawings. The Drawings may require the use of corrosion resistant tapping sleeves in addition to polywrap in areas with corrosive soils. The sleeves shall be made in two halves which can be assembled and bolted around the main. Sleeves shall meet the requirements of NSF 61. Outlet flanges shall conform to the flange requirements of AWWA C110. All valves furnished shall open (left or right) in accordance with the Owner's standard.

Acceptable manufacturers: McWane (Clow and M&H), U.S. Pipe (Mueller), and AFC (Waterous).

2.03 TAPPING VALVES

The horizontal tapping valve shall conform to the applicable requirements of AWWA Standard C509. All tapping valves, 3 inches through 12 inches NPS, shall be ductile iron body, resilient-seated, nut-operated, non-rising stem gate valves suitable for buried service. The valve interior and exterior shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA Standard C550 (6-8 mil average, 4 mil minimum). The tapping valves shall have flanged inlets with mechanical joint outlets, enclosed bevel gears, bypass valve, rollers, tracks and scrapers. All valves furnished shall open (left or right) in accordance with the Owner's standard.

Acceptable manufacturers: McWane (Clow and M&H), U.S. Pipe (Mueller), and AFC (Waterous).

2.04 STAINLESS STEEL TAPPING SLEEVES

The stainless-steel band flange shall be manufactured in compliance with AWWA C207, Class D ANSI B.16.1 drilling, recessed for tapping valve MSS-SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint by mechanical joint resilient wedge gate valves per ANSI/AWWA C509-94 and be NSF 61 approved.

A. Tapping sleeves from 4" through 12"

Tapping sleeves to be attached to 4" through 12" nominal pipe diameter shall meet the following minimum requirements.

1. The entire fitting shall be stainless steel type 304 (18-8). The body, lug, and gasket armor plate shall be in compliance with ASTM A240. The Flange shall be cast stainless steel in compliance with ASTM A743. The MJ outlet shall be one-piece casting made of stainless steel. The test plug shall be 3/4" NPT in compliance with ANSI B2.1 and shall be lubricated or coated to prevent galling. All metal surfaces shall be passivated after fabrication in compliance with ASTM A-380.
2. The gasket shall provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under the combinations of joint and gasket tolerances. The materials used shall be vulcanized natural or vulcanized synthetic rubber with antioxidant and antiozonant ingredients to resist set after installation. No reclaimed rubber shall be used. A heavy-gauge-type 304-stainless armor plate shall be vulcanized into the gasket to span the lug area.
3. The lugs shall be heliarc welded (GMAW) to the shell. The lug shall have a pass-through-bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts shall NOT BE

integrally welded to the sleeve. Finger Lug designs are not approved; it is the intent of these specifications to allow a tapping sleeve that has a lug design similar to the approved models.

4. Bolts and nuts shall be type 304 (18-8) stainless steel and Teflon coated or as specified in the bolt section below at the discretion of the Engineer. Bent or damaged units will be rejected.
5. Quality control procedures shall be employed to insure that the shell, lug, (4" and Larger Nominal Pipe Diameter) armor plate, gasket and related hardware are manufactured to be free of any defects. Each unit, after proper installation, shall have a working-pressure rating up to 250 psi.
6. The sleeve construction shall provide a positive means of preventing gasket cold flow and/or extrusion.
7. Each sleeve shall be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings shall be permanent type, water resistant, that will not smear or become illegible.

2.05 FABRICATED STEEL TAPPING SLEEVES

The fabricated steel tapping sleeve shall be manufactured in compliance with AWWA C207. Sleeves shall be fabricated of minimum three-eighths (3/8) inch carbon steel meeting ASTM A285 Grade C. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150 lb. drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel to AWWA C111 (ANSI A21.11). Gasket shall be vulcanized natural or synthetic rubber. Sleeve shall have manufacturer applied fusion bonded epoxy coating, minimum 12 mil. thickness, Class D ANSI B.16.1 drilling recessed for tapping valve MSS-SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint by mechanical joint resilient wedge gate valves per ANSI/AWWA C509-94 and be NSF 61 approved.

2.06 TAPPING SADDLES

Unless otherwise specified by the Drawings, tapping saddles conform to the requirements of AWWA Standard C800 for the High-Pressure class tapping saddles. Tapping saddles shall consist of ductile iron outlet castings, attached to the pipeline with high strength stainless steel straps. Castings shall be sealed to pipeline with O-ring seals. Saddles shall have ANSI A21.10 flanged outlets counterbored for use with tapping valves and tapping equipment.

2.06 BOLTS

All bolts shall be Type 316 stainless steel and have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Bolts shall be Xylan or FluoroKote #1 suitable for direct bury in corrosive soils.

PART 3: EXECUTION

3.01 INSTALLATION

Install the tapping sleeves, saddles, and valves in strict accordance with the requirements of Specification Section 15000. Install the tapping sleeves, tapping saddles, and tapping valves in accordance with the manufacturer's instructions. The tapping procedure is to be in accordance with the tapping machine manufacturer's instructions.

3.02 PROTECTION

After field installation of the valve all external bolts except the operating nut shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire sleeve and valve assembly shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut of the tapping valve exposed and free to be operated

3.03 PRELIMINARY TESTING

Perform a hydrostatic test of the tapping sleeve and valve assembly in accordance with Specification Section 15030 after installation of the tapping sleeve and valve, but prior to making the tap. The test shall be made with the valve open using a tapped mechanical joint cap. No leakage is acceptable. The test pressure shall be maintained for a minimum of 15 minutes.

Perform hydrostatic test of tapping saddles in accordance with AWWA Standard C800.

*****END OF SECTION*****

SECTION 15191

AIR RELEASE VALVES AND RELATED COMPONENTS

PART 1: GENERAL

1.01 SCOPE

Furnish and install air release valves at the locations shown on the Drawings or as directed by the Engineer.

1.02 SUBMITTALS

Submit shop drawings and manufacturer's literature for equipment to be supplied to the Engineer for approval in accordance with Specification Section 01300. All Products shall meet the requirements of NSF 61 and due to conveying seawater all wetted parts to be stainless steel, Type 316.

1.03 REFERENCES

Refer to current AWWA Standards: AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for waterworks Service C512

PART 2: PRODUCTS

2.01 WELL SERVICE AIR VALVE WITH THROTTLING VALVE

Provide 2" Val-Matic® (Elmhurst, IL) Model for mains 12" and smaller unless noted otherwise on the plans. Combination valves shall be double acting to prevent accumulation of air in the pressurized main and to permit air to enter the pipe when pressure seriously drops. Bodies shall be cast iron with stainless steel floats.

2.02 PIPELINE COMBINATION AIR/VACUUM RELEASE VALVES

Provide 4" Val-Matic® (Elmhurst, IL) Model unless noted otherwise on the plans. Combination valves shall be double acting to prevent accumulation of air in the pressurized main and to permit air to enter the pipe when pressure seriously drops. Bodies shall be cast iron with stainless steel floats.

2.03 CORPORATION STOPS

Corporation stops shall be of the stainless-steel valve type manufactured in accordance with AWWA Standards. The inlet connection shall have standard AWWA tapered threads unless otherwise required by the Engineer. The outlet connection shall be a compressed fitting end. The sizes shall range from 1/2" to 2" and shall match the size of specified pipe material.

Acceptable manufacturers are:

- Ford Meter Box Company
- Mueller
- A.Y. McDonald

2.04 CURB STOPS

Curb stops shall be stainless steel construction, ball valves, with Double O-ring stem seals. Curb stops shall conform to AWWA Standard C800. End connections shall be suitable for flared copper connection. If required by the Engineer, valves shall be furnished with square gate valve operating nuts. Sizes shall be from 3/4" to 2" and shall match the service line size.

Acceptable manufacturers and model numbers:

- Ford Meter Box Company – B22 Series
- Mueller – B-25204
- A.Y. McDonald – 6100 Series

2.05 MISCELLANEOUS SERVICE LINE FITTINGS

Miscellaneous service line fittings such as couplings, adaptors, saddles, bends, plugs, water service electrical insulators, etc. shall conform to AWWA Standard C800.

Acceptable manufacturers:

- Ford Meter Box
- Mueller
- A.Y. McDonald

PART 3: EXECUTION

3.01 INSTALLATION

See Specification Section 15000 for pipe installation. See Detail Drawings showing installation details for air/vacuum release valve assemblies and air blow-off assemblies.

3.02 INSTALLATION OF CORPORATION STOPS

- A. Use experienced craftsmen familiar with installation of water service lines when tapping water mains. Make all taps with a suitable tapping machine (Mueller, Ford, Hays or Dresser type) using the proper combined drill and tap. Hand held drilling equipment is not acceptable.
- B. Inspect corporation stops for cleanliness, damaged threads, and proper operation of the ball valve prior to installation. Do not install corporation stops that fail this inspection.
- C. The main may be tapped at the horizontal centerline on the top of the pipe as shown on Detail Drawings. Use a tapping saddle when the water main wall thickness or material (plastic, concrete or asbestos cement pipeline material) make it unsuitable for direct tapping.
- D. Install all corporation stops so that between 2 and 3 threads extend beyond the inside wall of the main. If necessary, make a test tap with the boring bar marked to the proper depth. The corporation stop, when properly installed, will not be shouldered with the main. Do not use lubricants of any type when installing the corporation stop.
- E. Use the procedure outlined in AWWA Standard C600 for installing taps on grey iron or ductile iron mains encased in polyethylene.

*****END OF SECTION*****

SECTION 16000 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. It is the intent of this section of the Specifications that the Contractor furnishes all labor, supervision, tools, equipment, and materials necessary for erecting complete and ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and hereinafter specified.
- B. These Specifications are intended to provide a broad outline of the work and equipment required but are not intended to include all the details of design and construction. The Owner reserves the right to make minor changes to the location of the equipment at no cost change in the contract.
- C. The electrical plans are diagrammatic, approximately to scale. However, they shall not be used for exact locations. The Contractor shall verify all dimensions from the detailed drawings and approved shop drawings and shall coordinate these dimensions with the actual field conditions. Actual distances, locations, and elevations will be governed by field conditions.
- D. Allowance has been made in the design for the number of conduits, cables and conductors that the Owner considers adequate for feeding various drives and equipment. These circuits and diagrams are based on available data pertaining to a particular design of equipment and portray the systems that the Owner has chosen to affect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, connections or form from that shown.
- E. The plans do not, and are not intended to, show all equipment (including but not limited to pull boxes and junction boxes) required nor to indicate all mechanical or structural difficulties that may be encountered that would necessitate routing alteration, offsets, or fittings. Items not specifically mentioned in these Specifications or noted on the Plans or approved shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.
- F. Discrepancies shown on the different Plans, between the Plans and actual field conditions, or between the Plans and Specifications shall be promptly brought to the attention of the Owner for a decision.
- G. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, when the ambient temperature of the air is 40°C except where specified otherwise.
- H. Electrical conductors including cable, bus bars, etc. shall be copper, except where specified otherwise.
- I. Without limiting the generality of other requirements of these Specifications, arrange for the submittal, by the subcontractor, of a reproducible Mylar of the complete schematics and wiring diagrams or drawings to include all installed field

and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, point to point diagrams with a cable, wire, tube and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "Record Drawings."

1.02 SCOPE OF WORK

- A. General: The Contractor shall provide all the materials and equipment and perform all the work necessary for the complete execution of the electrical work as shown on the electrical plans and as specified, including electrical work indicated on other Plans that is specifically included in the electrical work. The Contractor shall provide all labor and materials not specifically shown on the Plans or specified herein yet required to ensure proper and complete operation of any system(s) or design intent inherent in the project except as specifically excluded.
- B. In general, the electrical work shall consist of, but not be limited to, the items listed as follows:
 - 1. Metered switchgear (MSG-1)
 - 2. Low Voltage Switchboards (SWBD-100/200/300/400/500/600)
 - 3. Variable Speed Drives (VFD-101/201/202/301/401/501/502)
 - 4. Panelboards in Low Voltage Switchboards
 - 5. Transformers in Low Voltage Switchboards
 - 6. Control Panels, as indicated in Section 17000, installed in Low Voltage Switchboards
 - 7. All conduit, wiring and connections for work specified elsewhere in these Specifications and as shown on the Drawings.

1.03 CODES AND STANDARDS

- A. All the equipment and materials shall conform to the latest revision of the following standards:
 - 1. State of California Administrative Code, Title 8, Electrical Safety Orders
 - 2. American National Standards Institute (ANSI)
 - 3. Institute of Electrical and Electronic Engineers (IEEE)
 - 4. National Electrical Manufacturers Association (NEMA)
 - 5. Underwriters' Laboratories (UL)
 - 6. Insulated Power Cable Engineers Association (IPCEA)
 - 7. American Society for Testing and Materials (ASTM)

8. National Electrical Code (NEC)
 9. California Building Code (CBC)
- B. Responsibility for complying with all applicable government regulations shall be as required in the Special Conditions.
 - C. All electrical equipment and materials, and the design, construction, and installation thereof, shall comply with all applicable provisions of the Federal Occupational Safety and Health Act (OSHA), state building standards, and applicable local codes and regulations.
 - D. Where the Plans or these Specifications call for equipment and workmanship to be of better quality or higher standard than required by the above codes, standards, rules, and regulations, then said Plans and Specifications shall prevail. Nothing on the Plans or in these Specifications shall be construed to permit work in violation of the above codes, standards, rules, and regulations and the Contractor shall be held responsible for any work that is not acceptable.
 - E. In case of differences between the building codes, specifications, state law, local ordinances, industry standards, utility company regulations, fire insurance carrier's requirements, and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Owner in writing of such differences.

1.04 COORDINATION OF WORK AND TRADES

- A. Electrical work shall conform to the construction schedule and progress of other trades. The electrical construction shall be performed in cooperation with all other trades so that a neat and orderly arrangement of the work as a whole shall be obtained.
- B. Before any work is started, the Contractor shall verify with the equipment manufacturers that equipment dimensions and arrangements will allow for equipment installation in the spaces provided for on the Plans for the Main Switchgear, panelboards, motor control centers, transformers, and other major items of electrical equipment or apparatus and that the installation indicated will provide for all required ventilation, clearances, access, and work space.
- C. Before installing any equipment, materials, or raceways, the Contractor shall examine the complete set of Plans and Specifications and approved shop drawings and verify all dimensions and space requirements. All equipment utilized as "approved equal" to the specified manufacturers' reference shall be Contractor-coordinated in all aspects for the assurance of proper space, mounting, installation, testing and related operation.

1.05 COORDINATION OF THE ELECTRICAL SYSTEM

- A. The Contractor shall verify all actual equipment and motor full-load and locked rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are shown on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment

furnished with the branch circuit conductor size, the controller size, the motor starter, and the branch circuit over-current protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full load and rated voltage.

- B. The motor running overcurrent protection devices shall be rated or selected to trip at no more than 125 percent of the motor full-load current rating for motors marked to have a temperature rise not over 40°C or motors marked with a service factor not less than 1.15, and at no more than 115 percent for all other types of motors.
- C. The motor branch circuit overcurrent protection device shall trip open in 30 seconds or less on locked-rotor current of the motor. This device shall also protect the motor branch circuit conductors and the motor control apparatus against overcurrent due to short-circuits or grounds. The motor control circuits shall have overcurrent protection of the type indicated on the plans.

1.06 UTILITY COMPANY REQUIREMENTS

- A. All work for electrical power shall be performed in accordance with the requirements of the respective serving utility companies.
- B. Within 30 days after the notice of contract award, the Contractor shall notify the serving utilities that the project is under construction and provide them with all pertinent information, including the dates on which the electrical service modification will be required. For electrical services, the Contractor shall install a new concrete transformer pad with slab box, Service Switchgear, and conduits between the transformer pad, Main Switchgear, and existing electric utility facilities. Contractor shall also install (2) customer owned 4160V-480/277V Wye Transformers: (1) 1500 kVA and (1) 1000 kVA with precast slab boxes. Construction of these facilities shall be installed to accommodate equipment and cable of the serving utility and shall conform to all requirements of the serving utility.
- C. The Contractor shall coordinate details and timing of service entrance installation with the utility, provide all required temporary service, and include all utility connection fees for temporary service in his proposal. The Owner will pay for all permanent electrical services.
- D. Electrical service is provided by Pacific Gas and Electric (PG&E).

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1.07 PERMITS AND INSPECTIONS

- A. The Contractor shall obtain all permits and inspections and he shall pay all fees, therefore, as indicated in the Special Provisions. At the conclusion of the work

on the project, the Contractor shall furnish to the Owner, properly executed, all required certificates of final inspection and approval before the work will be accepted as complete. The Owner will inspect the daily construction progress for conformance with the Plans and Specifications.

1.08 EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. It is the intent of these Specifications and of the Plans to secure high quality in all equipment and materials, and to require first-class workmanship, in order to facilitate trouble-free operation and minimum maintenance of the electrical system.
- B. All equipment and materials shall be new, listed by UL, and bear the UL label, unless exception to this requirement is inherent to an individual item specified herein, or an exception is otherwise granted by the Owner.
- C. Equipment and materials shall be the products of reputable, experienced manufacturers. Similar items in the project shall be the products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.
- D. All work, including installation, connection, calibration, testing and adjustment, shall be done by qualified, experienced personnel who are technically skilled in their trades, are thoroughly instructed, and are competently supervised. The resulting complete installation shall reflect professional quality work, employing industrial standards and methods.

1.09 SEISMIC REQUIREMENTS

The equipment and major components including the metered switchboard, motor control center, and control panel shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the California Building Code (CBC). Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs. Seismic anchorage calculations shall be submitted for each major component. These calculations shall be signed and stamped by a structural engineer registered in the State of California.

1.10 AREA DESIGNATIONS

For purposes of defining electrical enclosure and electrical installation requirements of this project, certain areas have been classified on the Plans and in these Specifications as defined below. Electrical equipment and installations within these areas shall conform to the code requirements for the areas involved.

A. General Purpose Locations

Electrical work installed in areas that are not specifically classified shall be "general purpose." Workmanship, materials, and enclosures in these locations shall comply with the general requirements of this Specification.

Conduit installed for the utility electrical service shall be PVC Schedule 40 encased in concrete per the approved utility service plan. Instruments and control cabinets, panels, switchboards, cover plates, and motor control centers located outdoors shall be "weatherproof." Enclosures shall be mounted with a 1/4-inch air space from walls unless otherwise noted on the plans.

1.11 SUBMITTALS

Shop drawings shall be submitted for the following items of major equipment in accordance with General Conditions and as indicated in Division 16 sections.

- A. Metered switchboard, panelboards, switchboards, NEMA 3R enclosure 316 Stainless Steel, transformers, solid state starter, conduits, enclosures, and other major equipment or apparatus.
- B. Control panels and other specially fabricated or custom-made equipment.
- C. Seismic calculations.
- D. The Contractor shall submit a detailed test procedure checklist to verify proper operation of the electrical system in accordance with the General Operations section of these Specifications.

1.12 GROUNDING

- A. A grounding system shall be installed in accordance with the National Electrical Code and all state and local codes and regulations. The grounding system shall bond together and effectively ground all exposed non-energized metal surfaces containing energized parts, devices or conductors, all building steel, all metallic electrical raceways and the neutrals of all transformers. An equipment grounding conductor shall be installed in all conduits carrying power to be sized in accordance with NEC Article 250-122.

1.13 WARNING SIGNS

- A. Permanent warning signs shall be mounted at all mechanical equipment that may be started automatically or from remote locations. Signs shall be made in accordance with Porcelain Enamel Institute Specification S-103 and shall be suitable for exterior use. Mounting details shall be in accordance with manufacturer's recommendation. Signs shall be located as approved by the Owner.
- B. Warning signs shall be 7-inches high by 10-inches wide, colored yellow and black, on not less than 18-gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

1.14 QUALITY ASSURANCE

- A. The plans indicate diagrammatically the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined in the field based on the physical size and arrangement of equipment, finished elevations, and obstructions. Locations indicated on the Plans, however, shall be adhered to as closely as possible.
- B. All conduit and equipment shall be installed in such a manner as to avoid all obstructions, preserving headroom, and keeping openings and passageways clear. Luminaires, switches, convenience outlets, and similar items shall be located as indicated on the Plans. Where these Plans do not indicate exact locations, such determined locations shall be approved by the Owner. Where equipment is installed without approval and must be moved, it shall be moved without additional cost.
- C. The installation of all materials and equipment shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until accepted by the Owner.
- E. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint, and all moving parts shall be kept clean and dry.
- F. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no additional expense.

1.15 TESTING

- A. The Contractor shall perform and record the tests described hereinafter and any other tests that may be required by the Owner or other authorities having jurisdiction. The entire electrical installation shall be tested, adjustments made, and defects corrected as an obligation under the work of this section. The Contractor shall furnish all necessary replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation.

The following testing, as a minimum, shall be accomplished:

1. Insulation resistance tests
2. Continuity test of all wiring
3. Completely test the grounding system with a low ohm resistance meter under simulated service conditions to assure compliant operation of the wiring and the proper functioning of all equipment.

4. Test for short circuits in the system
 5. Test for all luminaire connections
 6. Complete operational test on all equipment
 7. Verify field performance and operation of electrical system utilizing the approved testing procedure.
- B. The Contractor shall test all power and control feeder circuits in the presence of the Owner by means of a 1,000-volt megohmmeter to ensure that they are free of open circuits and grounds before energizing.
- C. The Contractor shall perform a functional checkout on control circuits. The checkout shall consist of energizing each control circuit and operating each control, alarm, or malfunction device, and each interlock in turn to verify that the specified action occurs.
- D. After each electrical installation is complete, it shall be tested thoroughly to demonstrate that the entire system is in proper working order and in accordance with the Plans and Specifications. In no case shall the tests be less than those outlined hereinafter.

1.16 COORDINATION STUDY

- A. The Contractor shall provide a complete coordination study of relays, fuses, circuit breakers, and all other protective devices.
- B. The coordination study shall include the entire distribution system starting with the smallest 480 volt, 3 phase, 60 Hz circuit protective device on the load end to the nearest protective device on the power company's line side, or for work in the OWNER's existing facilities, to the nearest protective device on the OWNER's distribution system.
- C. The study shall include, but not be limited to the following:
1. A tabulation of all protective relay and circuit breaker trip settings and recommended fuse sizes and types.
 2. Motor starting profiles for all motors sized 50 hp and above.
 3. Transformer damage curves and protection evaluated in accord with ANSI/IEEE C57.109.
 4. Coordination curve(s) from the power company if available.
- D. The Contractor shall be responsible for obtaining all of the required relay, fuse, and circuit breaker coordination curves; transformer damage curves; motor data; etc., for all new and existing electrical equipment.
- E. The Contractor shall be responsible for coordinating with the Power Company to obtain the required protective device curves.

- F. The Contractor shall be responsible for all field work required to obtain necessary data on existing relays, circuit breakers, fuses, and transformers to be included in the coordination study.
- G. The coordination study shall be bound in a standard 8½ by 11 inch sized report. The study shall be provided in accordance with the submittal section. Final selection of all protective device settings or sizes shall be subject to review and acceptance by the Engineer.
- H. The Contractor shall provide a database of input information for the complete electrical installation including voltage, ampere, and fault current ratings of the switchboards and motor control centers; insulation ratings and sizes of wiring; identification of conduit types; and circuit breaker ratings and settings, available fault current from the utility.
- I. The coordination study shall be signed and stamped by an electrical engineer registered in the State of California.

1.17 ARC FLASH ANALYSIS

- A. Provide an Arc Flash analysis to identify protection boundaries, incident energy levels (IE) and personal protective equipment (PPE) to be worn by maintenance personnel when working on energized equipment.
- B. The analysis shall be based on the calculation methods and recommendations in NFPA 70E, Standard for Electrical Safety in the Workplace, 2009 Edition or better. Provide calculations utilizing software as provided by ETAP or SKM. The electrical system shall be modeled to include the utility incoming utility service, utility transformer, switchboard, motor control centers, emergency generators, VFDs, solid state starters, motors, circuit breakers, auxiliary equipment, step-down transformers and wiring between electrical components. Completion of the coordination study is required prior to performing the flash analysis. The purpose of the coordination study is to select the settings for each protective device which result in appropriate coordination between protective devices. Protective devices shall be plotted on a coordination curve with the downstream and upstream protective devices to verify the resulting system coordination.
- C. Using the selected protective device settings, provide analysis of alternative scenarios to determine the worst case incident energy levels and select appropriate PPE levels. The scenarios shall include but not limited to: (1) maximum available short circuit current available from the utility; (2) minimum short circuit current available from the utility; and (3) available short circuit current when operating the electrical system from the emergency generator.
- D. The Arc Flash Analysis shall be provided in a report format which includes the single line diagram, coordination curves, selected protective device settings, available short circuit currents, documentation of input characteristics for the electrical system, incident energy levels, protection boundaries and PPE levels. Provide a sample of the Arc Flash labels in the report.

- E. The analysis shall be provided in accordance with the submittal section. After review and acceptance of the Arc Flash analysis by the Engineer, Contractor shall provide and install Arc Flash labels on the equipment.
- F. The Contractor shall provide a database of input information for the complete electrical installation including voltage, ampere, and fault current ratings of the switchboards and motor control centers; insulation ratings and sizes of wiring; identification of conduit types; and circuit breaker ratings and settings, available fault current from the utility.
- G. The study shall be signed and stamped by an electrical engineer registered in the State of California.

1.18 CLEANUP

- A. All parts of the electrical materials and equipment shall be left in a clean condition. Exposed parts shall be clean of cement, plaster and other materials, and all oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- B. During the progress of the work, the Contractor shall clean up after his men and shall leave the premises and all portions of the site in which he is working free from debris and surplus materials.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Equipment used for the same purpose shall be of the same make. Outdoor equipment, luminaires, and wiring devices shall be of approved weatherproof construction or shall be in a weatherproof enclosure.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16000 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. It is the intent of this section of the Specifications that the Contractor furnishes all labor, supervision, tools, equipment, and materials necessary for erecting complete and ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and hereinafter specified.
- B. These Specifications are intended to provide a broad outline of the work and equipment required but are not intended to include all the details of design and construction. The Owner reserves the right to make minor changes to the location of the equipment at no cost change in the contract.
- C. The electrical plans are diagrammatic, approximately to scale. However, they shall not be used for exact locations. The Contractor shall verify all dimensions from the detailed drawings and approved shop drawings and shall coordinate these dimensions with the actual field conditions. Actual distances, locations, and elevations will be governed by field conditions.
- D. Allowance has been made in the design for the number of conduits, cables and conductors that the Owner considers adequate for feeding various drives and equipment. These circuits and diagrams are based on available data pertaining to a particular design of equipment and portray the systems that the Owner has chosen to affect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, connections or form from that shown.
- E. The plans do not, and are not intended to, show all equipment (including but not limited to pull boxes and junction boxes) required nor to indicate all mechanical or structural difficulties that may be encountered that would necessitate routing alteration, offsets, or fittings. Items not specifically mentioned in these Specifications or noted on the Plans or approved shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.
- F. Discrepancies shown on the different Plans, between the Plans and actual field conditions, or between the Plans and Specifications shall be promptly brought to the attention of the Owner for a decision.
- G. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, when the ambient temperature of the air is 40°C except where specified otherwise.
- H. Electrical conductors including cable, bus bars, etc. shall be copper, except where specified otherwise.
- I. Without limiting the generality of other requirements of these Specifications, arrange for the submittal, by the subcontractor, of a reproducible Mylar of the complete schematics and wiring diagrams or drawings to include all installed field

and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, point to point diagrams with a cable, wire, tube and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "Record Drawings."

1.02 SCOPE OF WORK

- A. General: The Contractor shall provide all the materials and equipment and perform all the work necessary for the complete execution of the electrical work as shown on the electrical plans and as specified, including electrical work indicated on other Plans that is specifically included in the electrical work. The Contractor shall provide all labor and materials not specifically shown on the Plans or specified herein yet required to ensure proper and complete operation of any system(s) or design intent inherent in the project except as specifically excluded.
- B. In general, the electrical work shall consist of, but not be limited to, the items listed as follows:
 - 1. Metered switchgear (MSG-1)
 - 2. Low Voltage Switchboards (SWBD-100/200/300/400/500/600)
 - 3. Variable Speed Drives (VFD-101/201/202/301/401/501/502)
 - 4. Panelboards in Low Voltage Switchboards
 - 5. Transformers in Low Voltage Switchboards
 - 6. Control Panels, as indicated in Section 17000, installed in Low Voltage Switchboards
 - 7. All conduit, wiring and connections for work specified elsewhere in these Specifications and as shown on the Drawings.

1.03 CODES AND STANDARDS

- A. All the equipment and materials shall conform to the latest revision of the following standards:
 - 1. State of California Administrative Code, Title 8, Electrical Safety Orders
 - 2. American National Standards Institute (ANSI)
 - 3. Institute of Electrical and Electronic Engineers (IEEE)
 - 4. National Electrical Manufacturers Association (NEMA)
 - 5. Underwriters' Laboratories (UL)
 - 6. Insulated Power Cable Engineers Association (IPCEA)
 - 7. American Society for Testing and Materials (ASTM)

8. National Electrical Code (NEC)
 9. California Building Code (CBC)
- B. Responsibility for complying with all applicable government regulations shall be as required in the Special Conditions.
 - C. All electrical equipment and materials, and the design, construction, and installation thereof, shall comply with all applicable provisions of the Federal Occupational Safety and Health Act (OSHA), state building standards, and applicable local codes and regulations.
 - D. Where the Plans or these Specifications call for equipment and workmanship to be of better quality or higher standard than required by the above codes, standards, rules, and regulations, then said Plans and Specifications shall prevail. Nothing on the Plans or in these Specifications shall be construed to permit work in violation of the above codes, standards, rules, and regulations and the Contractor shall be held responsible for any work that is not acceptable.
 - E. In case of differences between the building codes, specifications, state law, local ordinances, industry standards, utility company regulations, fire insurance carrier's requirements, and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Owner in writing of such differences.

1.04 COORDINATION OF WORK AND TRADES

- A. Electrical work shall conform to the construction schedule and progress of other trades. The electrical construction shall be performed in cooperation with all other trades so that a neat and orderly arrangement of the work as a whole shall be obtained.
- B. Before any work is started, the Contractor shall verify with the equipment manufacturers that equipment dimensions and arrangements will allow for equipment installation in the spaces provided for on the Plans for the Main Switchgear, panelboards, motor control centers, transformers, and other major items of electrical equipment or apparatus and that the installation indicated will provide for all required ventilation, clearances, access, and work space.
- C. Before installing any equipment, materials, or raceways, the Contractor shall examine the complete set of Plans and Specifications and approved shop drawings and verify all dimensions and space requirements. All equipment utilized as "approved equal" to the specified manufacturers' reference shall be Contractor-coordinated in all aspects for the assurance of proper space, mounting, installation, testing and related operation.

1.05 COORDINATION OF THE ELECTRICAL SYSTEM

- A. The Contractor shall verify all actual equipment and motor full-load and locked rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are shown on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment

furnished with the branch circuit conductor size, the controller size, the motor starter, and the branch circuit over-current protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full load and rated voltage.

- B. The motor running overcurrent protection devices shall be rated or selected to trip at no more than 125 percent of the motor full-load current rating for motors marked to have a temperature rise not over 40°C or motors marked with a service factor not less than 1.15, and at no more than 115 percent for all other types of motors.
- C. The motor branch circuit overcurrent protection device shall trip open in 30 seconds or less on locked-rotor current of the motor. This device shall also protect the motor branch circuit conductors and the motor control apparatus against overcurrent due to short-circuits or grounds. The motor control circuits shall have overcurrent protection of the type indicated on the plans.

1.06 UTILITY COMPANY REQUIREMENTS

- A. All work for electrical power shall be performed in accordance with the requirements of the respective serving utility companies.
- B. Within 30 days after the notice of contract award, the Contractor shall notify the serving utilities that the project is under construction and provide them with all pertinent information, including the dates on which the electrical service modification will be required. For electrical services, the Contractor shall install a new concrete transformer pad with slab box, Service Switchgear, and conduits between the transformer pad, Main Switchgear, and existing electric utility facilities. Contractor shall also install (2) customer owned 4160V-480/277V Wye Transformers: (1) 1500 kVA and (1) 1000 kVA with precast slab boxes. Construction of these facilities shall be installed to accommodate equipment and cable of the serving utility and shall conform to all requirements of the serving utility.
- C. The Contractor shall coordinate details and timing of service entrance installation with the utility, provide all required temporary service, and include all utility connection fees for temporary service in his proposal. The Owner will pay for all permanent electrical services.
- D. Electrical service is provided by Pacific Gas and Electric (PG&E).

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1.07 PERMITS AND INSPECTIONS

- A. The Contractor shall obtain all permits and inspections and he shall pay all fees, therefore, as indicated in the Special Provisions. At the conclusion of the work

on the project, the Contractor shall furnish to the Owner, properly executed, all required certificates of final inspection and approval before the work will be accepted as complete. The Owner will inspect the daily construction progress for conformance with the Plans and Specifications.

1.08 EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. It is the intent of these Specifications and of the Plans to secure high quality in all equipment and materials, and to require first-class workmanship, in order to facilitate trouble-free operation and minimum maintenance of the electrical system.
- B. All equipment and materials shall be new, listed by UL, and bear the UL label, unless exception to this requirement is inherent to an individual item specified herein, or an exception is otherwise granted by the Owner.
- C. Equipment and materials shall be the products of reputable, experienced manufacturers. Similar items in the project shall be the products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.
- D. All work, including installation, connection, calibration, testing and adjustment, shall be done by qualified, experienced personnel who are technically skilled in their trades, are thoroughly instructed, and are competently supervised. The resulting complete installation shall reflect professional quality work, employing industrial standards and methods.

1.09 SEISMIC REQUIREMENTS

The equipment and major components including the metered switchboard, motor control center, and control panel shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the California Building Code (CBC). Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs. Seismic anchorage calculations shall be submitted for each major component. These calculations shall be signed and stamped by a structural engineer registered in the State of California.

1.10 AREA DESIGNATIONS

For purposes of defining electrical enclosure and electrical installation requirements of this project, certain areas have been classified on the Plans and in these Specifications as defined below. Electrical equipment and installations within these areas shall conform to the code requirements for the areas involved.

A. General Purpose Locations

Electrical work installed in areas that are not specifically classified shall be "general purpose." Workmanship, materials, and enclosures in these locations shall comply with the general requirements of this Specification.

Conduit installed for the utility electrical service shall be PVC Schedule 40 encased in concrete per the approved utility service plan. Instruments and control cabinets, panels, switchboards, cover plates, and motor control centers located outdoors shall be "weatherproof." Enclosures shall be mounted with a 1/4-inch air space from walls unless otherwise noted on the plans.

1.11 SUBMITTALS

Shop drawings shall be submitted for the following items of major equipment in accordance with General Conditions and as indicated in Division 16 sections.

- A. Metered switchboard, panelboards, switchboards, NEMA 3R enclosure 316 Stainless Steel, transformers, solid state starter, conduits, enclosures, and other major equipment or apparatus.
- B. Control panels and other specially fabricated or custom-made equipment.
- C. Seismic calculations.
- D. The Contractor shall submit a detailed test procedure checklist to verify proper operation of the electrical system in accordance with the General Operations section of these Specifications.

1.12 GROUNDING

- A. A grounding system shall be installed in accordance with the National Electrical Code and all state and local codes and regulations. The grounding system shall bond together and effectively ground all exposed non-energized metal surfaces containing energized parts, devices or conductors, all building steel, all metallic electrical raceways and the neutrals of all transformers. An equipment grounding conductor shall be installed in all conduits carrying power to be sized in accordance with NEC Article 250-122.

1.13 WARNING SIGNS

- A. Permanent warning signs shall be mounted at all mechanical equipment that may be started automatically or from remote locations. Signs shall be made in accordance with Porcelain Enamel Institute Specification S-103 and shall be suitable for exterior use. Mounting details shall be in accordance with manufacturer's recommendation. Signs shall be located as approved by the Owner.
- B. Warning signs shall be 7-inches high by 10-inches wide, colored yellow and black, on not less than 18-gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

1.14 QUALITY ASSURANCE

- A. The plans indicate diagrammatically the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined in the field based on the physical size and arrangement of equipment, finished elevations, and obstructions. Locations indicated on the Plans, however, shall be adhered to as closely as possible.
- B. All conduit and equipment shall be installed in such a manner as to avoid all obstructions, preserving headroom, and keeping openings and passageways clear. Luminaires, switches, convenience outlets, and similar items shall be located as indicated on the Plans. Where these Plans do not indicate exact locations, such determined locations shall be approved by the Owner. Where equipment is installed without approval and must be moved, it shall be moved without additional cost.
- C. The installation of all materials and equipment shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until accepted by the Owner.
- E. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint, and all moving parts shall be kept clean and dry.
- F. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no additional expense.

1.15 TESTING

- A. The Contractor shall perform and record the tests described hereinafter and any other tests that may be required by the Owner or other authorities having jurisdiction. The entire electrical installation shall be tested, adjustments made, and defects corrected as an obligation under the work of this section. The Contractor shall furnish all necessary replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation.

The following testing, as a minimum, shall be accomplished:

1. Insulation resistance tests
2. Continuity test of all wiring
3. Completely test the grounding system with a low ohm resistance meter under simulated service conditions to assure compliant operation of the wiring and the proper functioning of all equipment.

4. Test for short circuits in the system
 5. Test for all luminaire connections
 6. Complete operational test on all equipment
 7. Verify field performance and operation of electrical system utilizing the approved testing procedure.
- B. The Contractor shall test all power and control feeder circuits in the presence of the Owner by means of a 1,000-volt megohmmeter to ensure that they are free of open circuits and grounds before energizing.
- C. The Contractor shall perform a functional checkout on control circuits. The checkout shall consist of energizing each control circuit and operating each control, alarm, or malfunction device, and each interlock in turn to verify that the specified action occurs.
- D. After each electrical installation is complete, it shall be tested thoroughly to demonstrate that the entire system is in proper working order and in accordance with the Plans and Specifications. In no case shall the tests be less than those outlined hereinafter.

1.16 COORDINATION STUDY

- A. The Contractor shall provide a complete coordination study of relays, fuses, circuit breakers, and all other protective devices.
- B. The coordination study shall include the entire distribution system starting with the smallest 480 volt, 3 phase, 60 Hz circuit protective device on the load end to the nearest protective device on the power company's line side, or for work in the OWNER's existing facilities, to the nearest protective device on the OWNER's distribution system.
- C. The study shall include, but not be limited to the following:
1. A tabulation of all protective relay and circuit breaker trip settings and recommended fuse sizes and types.
 2. Motor starting profiles for all motors sized 50 hp and above.
 3. Transformer damage curves and protection evaluated in accord with ANSI/IEEE C57.109.
 4. Coordination curve(s) from the power company if available.
- D. The Contractor shall be responsible for obtaining all of the required relay, fuse, and circuit breaker coordination curves; transformer damage curves; motor data; etc., for all new and existing electrical equipment.
- E. The Contractor shall be responsible for coordinating with the Power Company to obtain the required protective device curves.

- F. The Contractor shall be responsible for all field work required to obtain necessary data on existing relays, circuit breakers, fuses, and transformers to be included in the coordination study.
- G. The coordination study shall be bound in a standard 8½ by 11 inch sized report. The study shall be provided in accordance with the submittal section. Final selection of all protective device settings or sizes shall be subject to review and acceptance by the Engineer.
- H. The Contractor shall provide a database of input information for the complete electrical installation including voltage, ampere, and fault current ratings of the switchboards and motor control centers; insulation ratings and sizes of wiring; identification of conduit types; and circuit breaker ratings and settings, available fault current from the utility.
- I. The coordination study shall be signed and stamped by an electrical engineer registered in the State of California.

1.17 ARC FLASH ANALYSIS

- A. Provide an Arc Flash analysis to identify protection boundaries, incident energy levels (IE) and personal protective equipment (PPE) to be worn by maintenance personnel when working on energized equipment. The analysis shall be provided in accordance with American Water Arc Flash criteria. The minimum
- B. The analysis shall be based on the calculation methods and recommendations in NFPA 70E, Standard for Electrical Safety in the Workplace, 2009 Edition or better. Provide calculations utilizing software as provided by ETAP or SKM. The electrical system shall be modeled to include the utility incoming utility service, utility transformer, switchboard, motor control centers, emergency generators, VFDs, solid state starters, motors, circuit breakers, auxiliary equipment, step-down transformers and wiring between electrical components. Completion of the coordination study is required prior to performing the flash analysis. The purpose of the coordination study is to select the settings for each protective device which result in appropriate coordination between protective devices. Protective devices shall be plotted on a coordination curve with the downstream and upstream protective devices to verify the resulting system coordination.
- C. Using the selected protective device settings, provide analysis of alternative scenarios to determine the worst case incident energy levels and select appropriate PPE levels. The scenarios shall include but not limited to: (1) maximum available short circuit current available from the utility; (2) minimum short circuit current available from the utility; and (3) available short circuit current when operating the electrical system from the emergency generator.
- D. The Arc Flash Analysis shall be provided in a report format which includes the single line diagram, coordination curves, selected protective device settings, available short circuit currents, documentation of input characteristics for the electrical system, incident energy levels, protection boundaries and PPE levels. Provide a sample of the Arc Flash labels in the report.

- E. The analysis shall be provided in accordance with the submittal section. After review and acceptance of the Arc Flash analysis by the Engineer, Contractor shall provide and install Arc Flash labels on the equipment. Provide labels per American Water Arc Flash criteria requirements. American Water requires both the calculated incident energy and the PPE Level included on labels. When incident energy at the switchgear/switchboard exceeds 40 Cal/Cm², the switchgear/switchboard shall be labeled "DANGER NO PPE EXIST" and provided with external test port to confirm absence of voltage when the disconnect is turned off, before the door can be opened.
- F. The Contractor shall provide a database of input information for the complete electrical installation including voltage, ampere, and fault current ratings of the switchboards and motor control centers; insulation ratings and sizes of wiring; identification of conduit types; and circuit breaker ratings and settings, available fault current from the utility.
- G. The study shall be signed and stamped by an electrical engineer registered in the State of California.

1.18 CLEANUP

- A. All parts of the electrical materials and equipment shall be left in a clean condition. Exposed parts shall be clean of cement, plaster and other materials, and all oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- B. During the progress of the work, the Contractor shall clean up after his men and shall leave the premises and all portions of the site in which he is working free from debris and surplus materials.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Equipment used for the same purpose shall be of the same make. Outdoor equipment, luminaires, and wiring devices shall be of approved weatherproof construction or shall be in a weatherproof enclosure.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16040: ELECTRIC MOTORS

PART 1 - GENERAL

1.01 WORK OF THIS SECTION

- A. The Contractor shall provide electric motors, accessories, and appurtenances, complete and operable, in accordance with the Contract Documents. The provisions of this section apply to all electric motors.

1.02 RELATED SECTIONS

- A. The work of the following section applies to the work of this section. Other sections, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Section 15130 – Pumps
 - 2. Section 16050 – Basic Electrical Materials and Methods

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the work of this section:
 - 1. ANSI/NEMA MG 1 Motor and Generator
 - 2. ANSI/NEMA MG12.53 Motor Testing
 - 3. ANSI/IEEE 112 Standard Test Procedure for Polyphase Induction Motors and Generators
 - 4. IEEE 43 Recommended Practice for Testing Resistance of Rotating Machinery
 - 5. IEEE 841 Recommended Practice for Chemical Industry Severe-Duty Squirrel Cage Induction Motors
 - 6. IEEE RP-841 Recommended Practice for Chemical Industry Severe Duty Squirrel Cage Induction Motors

1.04 CONTRACTOR SUBMITTALS

- A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01330, Contractor Submittals.
- B. Motor Data: Complete motor data shall be submitted in the shop drawings for driven machinery. Motor data shall include:
 - 1. Machine name and specification number of driven machine.
 - 2. Name of the motor manufacturer.
 - 3. Motor type or model and dimension drawing. Include motor weight.

4. Nominal horsepower.
5. NEMA design.
6. Enclosure.
7. Frame size.
8. Winding insulation class and temperature rise class.
9. Voltage, phase and frequency ratings.
10. Service factor.
11. Full load current at rated horsepower for application voltage.
12. Full load speed.
13. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at 1/2 and 3/4 load.
14. Type of thermal protection or over temperature protection, if included.
15. Wiring diagram for devices such as motor leak detection, temperature, or space heaters, as applicable.
16. Space heater voltage and full load amperes, as applicable.
17. Bearing data, with recommended lubricants for relubricatable type bearings.
18. If used with a variable frequency controller, provide written verification that motor is inverter duty type and that insulated bearings are included. Indicate minimum speed at which motor may be operated for the driven machinery.
19. Power factor at 1/2, 3/4 and full load.
20. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.
21. Dimensions and location of all conduit termination boxes.
22. Quantity and size of conduit openings for each conduit box. Openings shall accommodate the quantity and size of conduits indicated on the Drawings.
23. Winding Temperature Setpoints: Alarm, Shutdown
24. Bearing Temperature Setpoints: Alarm, Shutdown

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Identical Motors: Electric motors driving identical machines shall be identical.
- B. Maximum Motor Loading: Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.
- C. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads that may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the Owner. In addition, any changes caused by increase in motor horsepower shall be made by the Contractor at no additional cost to the Owner; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.
- D. Exempt Motors: Motors that are for valve operators, submersible pumps, or motors that are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus, may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.02 DESIGN REQUIREMENTS

- A. General: All electric motors shall comply with ANSI/NEMA MG 1 - Motor and Generator.
- B. NEMA Design: Electric motors shall be NEMA Design B, (except as indicated in the equipment specifications for motors controlled for variable speed operation and other special motors,) constant speed squirrel-cage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings.
- C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:
 - 1. Motors below 1/3 hp shall be rated 115 V, single-phase, 60-Hz. Dual voltage motors rated 115/230 V, 115/208 V, or 120-240 V are acceptable, provided all leads are brought out to the conduit box.
 - 2. Motors 1/3 hp and larger shall be rated 230 V, or 460 V, 3-phase, 60-Hz, as required and as indicated. Dual voltage motors rated 230/460 V or 208/230/460 V are acceptable, provided all leads are terminated in the conduit box at the motor.

- D. Insulation: All three-phase motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 104°F and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42. Single-phase motors shall have Class F insulation with temperature rise not to exceed the insulation class.
- E. Motors in Nonhazardous Areas: Motors shall have a service factor of 1.15 unless otherwise indicated.
- F. Motor Enclosure: Motor enclosure for P-101, P-201, P-202, P-301, P-401, P-501 and P-601 shall be ODP, WP I, WP II, TEFC.
- G. High Efficiency Motors:
 - 1. Motors with a nameplate rating of 1 hp and above shall be NEMA premium efficiency units with nominal efficiencies meeting the NEMA published values. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112-Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.
 - 2. Efficiency Index: Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 12.53 - Motor Testing; these values shall be stated in the shop drawing submittal.

2.03 ACCESSORY REQUIREMENTS

- A. General: Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall be gasketed. Conduit boxes shall be sized one size larger than the standard conduit box. Motors less than 3 hp shall have the manufacturer's standard conduit boxes. Conduit boxes shall be provided with conduit openings to accommodate the quantity and size of conduits as indicated on the Drawings.
- B. Lifting Devices: All motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.
- C. Special Requirements: Refer to individual equipment specifications for special requirements such as motor winding thermal protection, multi-speed windings, etc.
- D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated on the Drawings.
- E. Nameplate: All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

2.04 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: All single-phase 120, 208, or 230 V motors shall have integral thermal overload protection or shall be inherently current limited.
- B. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally open contact. The thermostat switch point shall be pre-calibrated by the manufacturer. Thermostats shall be provided for 3 phase pump motors 200HP and below. Provide separate terminal box for thermostats. Terminal box shall be provided with conduit openings to accommodate the quantity and size of conduit as indicated on the Drawings.
- C. RTDs shall be provided for pump motors 200HP and above. RTDs shall be 100-ohm platinum. Provide bearing RTDs and/or winding RTDs (two per phase). Provide separate terminal box for RTDs. Terminal box shall be provided with conduit openings to accommodate the quantity and size of conduit as indicated on the Drawings.

2.05 MOTOR SPACE HEATER

- A. Provide motor space heater as indicated on the drawings. Provide separate terminal box for space heater. Terminal box shall be provided with conduit openings to accommodate the quantity and size of conduit as indicated on the Drawings.

2.06 MOTOR BEARINGS

- A. Bearing Life: All motors greater than 2 hp shall have bearings designed for a minimum rated L-10 life of 10 years or 100,000 hours, whichever comes first.
- B. Fractional Horsepower: Fractional horsepower through 2-hp motors shall be furnished with Lubricated-for-Life ball bearings.
- C. Horizontal Motors over 2 Horsepower: Motors larger than 2-hp shall be furnished with relubricatable ball bearings.
- D. Vertical Motors over 2 Horsepower: Vertical motors larger than 2-hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per the manufacturer's recommendation for smooth operation and long life of the bearings.
- E. Where motors will be driven by a variable frequency inverter, provide insulated bearings to mitigate shaft currents.

2.07 MANUFACTURERS

- A. The Contractor's designated equipment supplier shall have the responsibility to select and supply suitable electric motors for the driven equipment. The choice of motor manufacturer shall be subject to review by the Construction Manager. Such review will consider the future availability of replacement parts and

compatibility with driven equipment. Acceptable manufacturers include the following, or equal:

1. U.S. Motors.
2. Baldor
3. GE

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.
- B. Electrical work involving connections, controls, switches, and disconnects, shall be as indicated in Division 16.
- C. Capacitors shall be connected to the output terminals of the motor starter. Motor overload elements shall be adjusted downwards to reflect the reduction in line current resulting from power factor correction.

3.02 FACTORY TESTING

- A. Motors rated 100 hp and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Test reports shall include heat run, performance, bearing (temperature, noise), locked rotor, speed torque, no-load saturation, surge, and megohmmeter/dielectric absorption ratio. Test report shall indicate test procedure and instrumentation used to measure and record data.
- B. Test report shall be certified by the motor manufacturer's test personnel and be submitted.

3.03 FIELD TESTING

- A. The Contractor shall perform the following field tests:
 1. Inspect each motor installation for any deviation from rated voltage, phase or frequency; or improper installation.
 2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.
 3. Check winding and bearing temperature detectors and space heaters for functional operation.
 4. Test for proper rotation before connection to the driven equipment.

5. Test insulation (megger test) of all new as well as reused motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

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SECTION 16050: BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

This section includes the following:

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding methods and materials.
- D. Conduit and equipment supports.
- E. Equipment and anchoring.
- F. Anchors and fasteners.
- G. Nameplates and labels.
- H. Wire markers.
- I. Raceway markers.

1.02 REFERENCES

- A. NECA (National Electrical Contractors Association) - "Standard Practice of Good Workmanship in Electrical Construction."
- B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NFPA 99 (National Fire Protection Association) - Health Care Facilities.

1.03 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Rod electrode.
 - 2. Active electrode.
- B. Anchor and fasten electrical products to building elements and finishes as follows:
 - 1. Conduit placed against concrete or masonry above ground shall be fastened to the concrete with pipe straps or one-hole conduit clamps attached to the concrete by means of expansion anchors and bolts.
 - 2. Factory-made pipe straps shall be one-hole malleable iron or two-hole galvanized clamps for rigid steel conduits. Straps shall be PVC-coated for PVC-coated rigid conduits.

3. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket. Rods shall be 3/8 inch for 2-inch conduit hangers and smaller and shall be 2 inch for 2-1/2-inch conduit hangers and larger.
 4. Hanger straps, rods, or pipe supports under concrete shall be attached to inserts set at the time the concrete is poured. Under wood, use bolts, lag bolts, or lag screws; under steel joints or trusses, use beam clamps.
 5. Wire, perforated strap, or plumber's tape shall not be used in the support of conduit. Conduit shall not be secured to suspended ceiling hanger wires or to the suspended ceiling structure.
- C. Identify electrical components as follows:
1. Nameplate for each electrical distribution and control equipment enclosure.
 2. Nameplate for identification of individual wall switches and receptacles, and control device stations.

1.04 DESIGN REQUIREMENTS

- A. Select materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and raceway, including weight of wire and cable in raceway.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions.
- B. Product Data: Submit grounding electrodes and connections, fastening components, and nameplates.
- C. Test Reports: Indicate overall resistance to ground.

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 ROD ELECTRODES

- A. Material: Copper-clad steel.
- B. Diameter: 3/4 inch
- C. Length: 10 feet

2.02 ACTIVE ELECTRODES

- A. Manufacturers:
 - 1. Lyncole XIT Grounding.
 - 2. Lightning Eliminators Maintenance Free Chem-Rod Model.
 - 3. Superior Grounding Systems.
- B. Description: Metallic-salt-filled 2-inch diameter copper-tube electrode. Top and bottom of the tube shall be capped to prevent loss of salts.
- C. Prior to shipment, the manufacturer shall drill breather holes into the top and drainage holes in the underside of the shaft. These penetrations shall be sealed with tape for shipment from the manufacturer. The grounding system shall be provided complete with a protective box and backfill material. The grounding shall be UL listed and conform to applicable ANSI standards.
- D. Shape: Straight.
- E. Length: 12 feet.
- F. Connector: Connector for exothermic welded connection.
- G. Grounding system shall be warranted to maintain its performance for 25 years without chemical recharging or other maintenance.

2.03 MECHANICAL CONNECTORS

- A. Description: Copper alloy connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.04 EXOTHERMIC CONNECTIONS

- A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.05 GROUNDING WIRE

- A. Material: Stranded copper.

- B. Size: As indicated on the Drawings.

2.06 GROUNDING WELL COMPONENTS

- A. Well Pipe: 12 inch NPS by 24-inch long concrete pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.07 ANCHORS AND FASTENERS

- A. Materials and Finishes: Corrosion resistant.

2.08 EQUIPMENT PADS AND ANCHORING

- A. All floor-standing equipment shall be mounted on raised concrete pads. Pad size and height shall be as indicated on the Plans. Pads not indicated shall extend out 4 inches beyond enclosure and shall be 4 inches above finished grade.
- B. All equipment shall be securely anchored to pads. Anchorage shall be in accordance with OSHA and other applicable standards for earthquake protection. All panels shall be designed, constructed and attached to resist stresses produced by seismic forces.
- C. Earthquake Design Data
Submit with the shop drawings a complete set of detailed calculations or test results, details of constructions, and method of attachment for all panels showing compliance with earthquake design restraint. The calculations and details shall be signed by a professional engineer who has demonstrated proficiency in structural engineering or civil engineering and is registered in the state of California. The calculations shall be performed specifically for this job, during the time frame of the job and be dated by the Engineer performing them. No control panels shall be delivered and mounted at project without approved submittal data.

2.09 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- B. Letter Size: 1/4-inch letters.
- C. Nameplate shall identify equipment and/or function.
- D. Convenience receptacles shall be identified with originating panel and circuit number (for example, PNLA, Cir #3).

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Grounding and Bonding Installation:

1. Install electrodes at locations as indicated on the Plans.
2. Install grounding well pipe with cover as indicated on the Contract Drawings. Install the well pipe top flush with finished grade.
3. Active electrodes, if required by the Drawings, shall be installed in accordance with the manufacturer's recommendations with the backfill supplied for the system. Tapes on breather holes shall be removed prior to installation and retained for verification on grounding system installation.
4. Grounding continuity for underground duct banks may be maintained by the installation of a bare copper conductor installed in the concrete envelope. Ground continuity shall be maintained through all manholes and pull boxes. All metal parts in manholes shall be connected to the grounding system.
5. Install bonding meeting regulatory requirements.
6. Metallic raceways shall be terminated with double lock nuts and bushings. Conduits terminating in switch boards and motor control centers shall be equipped with grounding bushing and connected to equipment ground bus.
7. All metallic raceway, non current-carrying parts of the electrical system shall be grounded.
8. Install separate, green insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
9. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard Practice of Good Workmanship in Electrical Construction."
10. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
11. Do not use spring steel clips and clamps.
12. Do not use powder-actuated anchors.
13. Do not drill or cut structural members.

B. Supports:

1. Fabricate supports from structural steel or formed steel members. Rigidly weld members or install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.

2. Install surface mounted cabinets and panelboards with a minimum of four anchors.
 3. In wet and damp locations, install steel channel supports to stand cabinets and panelboards 1-inch off the wall.
- C. Identification Components:
1. Degrease and clean surfaces to receive nameplates.
 2. Install nameplate parallel to equipment lines.
 3. Secure nameplate to equipment front using adhesive.
 4. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION

SECTION 16051: MISCELLANEOUS ELECTRICAL DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes materials and installation of miscellaneous electrical devices and equipment, such as surge protective devices, disconnect switches, thermostats, photoelectric switches, time switches, intrusion alarm switches, and intrusion override key switches.

1.02 RELATED SECTIONS

- A. Section 16000 – General Electrical Requirements

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions.
- B. Submit ratings and characteristics including voltage ratings, continuous current ratings, conduit entry restrictions, and enclosure type and dimensions.

PART 2 - MATERIALS

2.01 DISCONNECT SWITCHES

- A. Provide non-fusible disconnect switches with ampere rating and number of poles as indicated in the drawings. Switches for use on circuits 240 volts and below shall be NEMA general duty Type LD. Switches for use on 480-volt circuits shall be NEMA heavy-duty Type HD. Unless indicated otherwise, provide switches indoors in NEMA Type 1 enclosures and outdoors, or where indicated to be weatherproof, in NEMA Type 3R rain-tight enclosures. Mechanisms shall have quick-make and quick-break operating handles and provisions for padlocking in the "OFF" position. The switch shall have an interlock to prevent unauthorized opening of the hinged cover when the switch is in the "ON" position and an interlock to prevent closing the switch mechanism with the hinged cover open. On the front of the enclosure, attach a nameplate that identifies the load per Section 16010.
- B. Provide heavy duty single throw disconnect switch of the voltage and amperage shown on the Drawings. The switch shall be housed in a NEMA 3R enclosure and shall meet UL 98 standards for enclosed switches and NEMA KA-1. The switch shall be horsepower rated and shall have a quick-make, quick-break switching mechanism. Disconnect shall have a pad lockable operating handle.

2.02 THERMOSTATS

- A. Thermostats shall be line voltage type. Thermostats shall have 70°F to 140°F set point range, and motor current rated contacts. Provide Honeywell T631A-1022 or equal.

2.03 PHOTOELECTRIC SWITCHES

- A. Photoelectric switches shall provide automatic switching of outdoor lighting by natural daylight by switching lights on when daylight diminishes and off at sunrise.
- B. Photoelectric switches shall be tamperproof, hermetically sealed cells with adjustable turn-on light level selector. Switches shall be enclosed in a die-cast aluminum or zinc housing, gasketed for weatherproofing. Units shall operate in a temperature range of 0°F to 140°F with fail-safe operation. Provide switches with a delay of up to two minutes to prevent false switching. Provide single-pole single-throw snap action switches rated 2,000 watts (tungsten), 120/277-volt a-c. Provide Tork Model 2100 or equal.

2.04 TIME SWITCH

- A. Provide a microprocessor-based, solid-state time controller with DPDT, 15-ampere resistive rated contacts, 100 hours of power outage carry-over with an alkaline battery, 24-hour programming capability, astro feature, automatic leap year correction, and manual override. Provide Paragon Electric Company, Inc., EC71ST or equal.

2.05 INTRUSION ALARM SWITCHES

- A. Provide concealed magnetic contact type switch with SPDT contacts rated for 24-volt d-c and 10 volt-amperes. Switches shall be UL listed.
- B. Provide magnetic contact switches with stainless steel flex cable, GE Series 2500, or approved equal.

2.06 INTRUSION OVERRIDE KEY SWITCHES

- A. Intrusion override key switches shall be the access control type. Key switches shall come complete with mortise cylinder and 24-volt a-c/d-c SPDT maintained contacts. Key the lock to match District's master key.
- B. Intrusion override key switches shall be Square D 30.5mm, Class 9001, 2 position key switch # KS11K1H13.

2.07 POSITION LIMIT SWITCHES FOR VALVES

- A. Position limit switches for valves, NEMA 4 or IP65/66 limit switches for indication of valves as shown in Drawings. Provide single pole double throw contact rated for 3 amps break minimum at 120 volts AC, 35% power factor. Provide an adjustable mounting bracket to permit the actuation point to be held adjustable at any point of the valves travel. Switch to be Square D, Allen-Bradley, or equal.

2.08 SURGE PROTECTIVE DEVICES

- A. SPDs shall be UL 1449, 3rd Edition listed.

- B. Each protection device shall have a capacitive filtering system connected in each Line to Neutral (L-N)(Wye) mode or Line to Line (L-L)(Delta) mode to provide EMI/RFI noise attenuation.
- C. Protection modes: The SPD shall provide Line to Neutral (L-N)(Wye), Line to Ground (L- G)(Wye or Delta), Line to Line (L-L)(Delta) and Neutral to Ground (N-G)(Wye) protection.
- D. SPD shall contain a technology that utilizes multiple thermally protected metal oxide varistors (MOV) per mode.
- E. All primary transient paths shall utilize copper wire, aluminum bus bar and lugs of equivalent capacity to provide equal impedance interconnection between phases. No plug- in module or components shall be used in surge carrying paths.
- F. Switchboard and MCC SPDs shall be:
 - 1. SPD shall be a multi-stage parallel protector. Refer to one-line diagram and panelboard schedule to confirm voltages. SPD's minimum surge current capacity shall be 200 kA per phase (L-N plus L-G) and 100 kA per mode (L-N, L-G, L-L and N-G).
 - 2. SPD shall be modular design with field replaceable modules per phase. Each protection module shall have a visual indicator that signifies that the protection circuitry is powered. The unit shall not be taken off line to verify integrity of system. Redundant status indicators shall be mounted on the front of the door that monitors the system protection circuitry.
 - 3. SPD shall be labeled as minimum Type 2. Every component of every mode, including N-G, shall be protected by internal thermal protection. SPDs relying upon external or supplementary installed safety overcurrent protection do not meet the intent of this specification.
 - 4. SPD shall provide the following monitoring features: dry contacts, digital surge counter and audible alarm with alarm disable switch.
 - 5. SPD shall be provided with an integral disconnect switch.
 - 6. SPDs shall be as manufactured by LEA International Inc. – PV Series, Current Technology - SL2 Series, Liebert – SI Series or equal.

PART 3 - EXECUTION

3.01 INSTALLING INTRUSION ALARM SWITCHES

- A. The switches shall be interfaced with the PLC. Mount switch on inside door frame such that when the door is opened, the normally closed switch contacts shall close and, when door is closed, the normally closed switch contacts shall open.

3.02 INSTALLING INTRUSION OVERRIDE KEY SWITCHES

- A. Key switch shall be flush mounted on the Telemetry Panel as shown on the Drawings. Mount 48 inches above finished floor or grade.

3.03 FIELD TESTING

- A. Operate each disconnect switch three times, under load, and verify that all phases of the load are disconnected each time.
- B. Thermostats: Adjust thermostats above and below the ambient temperature. Verify that the equipment controlled operates per the plans or other sections of these specifications.
- C. Intrusion Alarm and Override Switches: Verify operation by closing and opening each door or hatch and operating key switch and checking receipt of signals at the PLC.
- D. Photoelectric Switch: Simulate nighttime by placing object over sensor or witness nighttime automatic controls. Verify lights turn on and off.

END OF SECTION

SECTION 16121: MEDIUM VOLTAGE CABLE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish, install and test the medium voltage cables and accessories as shown on the Drawings and as specified herein.
- B. This Section shall apply to all temporary and permanent feeders used on the project

1.02 REFERENCES

- A. Medium voltage cables shall meet or exceed the specifications and requirements of the latest Insulated Cable Engineers Association (ICEA) and the Association of Edison Illuminating Companies (AEIC) publications, except as modified by this Section.
- B. Cables shall comply with Underwriters Laboratories (UL) Standard 1072.
- C. Loadbreak elbows shall comply with Institute of Electrical and Electronic Engineers (IEEE) Standard 386, Standard for Separable Connectors.
- D. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the International Electrical Testing Association (NETA Standard ATS-2005) unless otherwise modified by this Section.
- E. National Electrical Code (NEC) NFPA 70.
- 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. Shop drawings and product data in accordance with Section 01300, showing materials of construction and details of installation:
- B. Submit, in accordance with Section 01300, the following:
 - 1. Product data sheets
 - 2. Factory and field test reports
 - 3. Cable samples
- C. Statement of Qualifications:

1. Cable Accessories: The manufacturer shall be able to document a minimum of five years successful field experience as well as demonstrating technical life assessment as requested. The manufacturer shall establish and document a Quality Assurance Program implementing suitable procedures and controls for all activities affecting quality. The program shall provide documentation that verifies the quality of production joint kits and traceability back to inspection records, raw material and the original designs and design proof tested joints.

1.01 QUALIFICATIONS

A. Qualifications:

1. Cable: The general construction of the cable and the insulation material used shall be similar to that used for cable of the same size and rating in continuous production for at least 20 years and successfully operating in the field in substantial quantities.
2. Cable: Upon request, the manufacturer shall submit a copy of his Quality Assurance Manual detailing the quality control and quality assurance measures in place at his facility.
3. Cable: The manufacturer shall have available for audit detailed descriptions of the method by which his various manufacturing processes and production test are recorded, thus enabling the "traceability" of the completed cable. All steps in the manufacturing process, from receipt of raw material to the final tests, are to be included. Where multiple records are used, the method for cross-referencing shall be noted.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site:

1. Check for reels not completely restrained, reels with interlocking flanges or broken flanges, damaged reel covering or any other indication of damage.

B. Storage and Protection:

1. Unload reels using a sling and spreader bar or by two lifting forks perpendicular to the reel ends. The lift shall not contact the cable.
2. Roll reels in the direction of the arrows shown on the reel and on surfaces free of obstructions that could damage the cable.
3. Do not drop reels from any height.
4. Store cable on a solid, well drained location. Unjacketed armored cable shall be stored indoors. Cover cable reels with plastic sheeting or tarpaulin. Do not lay reels flat.
5. Seal cable ends with heat shrinkable end caps. Do not remove end caps until cables are ready to be terminated.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The manufacturer's name, the voltage class, type of insulation, thickness of insulation, conductor size, UL listing and date of manufacture shall be printed on the jacket.
- B. Cables shall be suitable for use in partially submerged wet locations, in non-metallic or metallic conduits, underground duct systems and direct buried installation.
- C. Cables shall be able to operate continuously at 90 degrees C conductor temperature.
- D. Medium voltage cable shall be shielded unless specifically shown otherwise on the Drawings.
- E. Medium voltage cables shall have the following physical characteristics in accordance with ICEA, AEIC, and RUS U-1 standards:
 - 1. Conductors: Unilay compressed stranded 1350-H16/26 aluminum phase conductor.
 - 2. Insulation: semi-conducting cross-linked polyethylene strand shield, a tree retardant cross-linked polyethylene primary insulation, and a semi-conducting polyethylene insulation shield. Concentric neutral of bare copper wire is applied over the insulation shield.
- F. Acceptable manufacturers:
 - 1. Okonite Company, Inc.
 - 2. General Cable Co.
 - 3. Southwire

2.02 CABLE SHOP TESTING

- A. Perform manufacturers standard production testing and inspection in accordance with Section 6 of the referenced ICEA standards. If requested by the Engineer, the manufacturer shall submit certified proof of compliance with ICEA design and test standards.
- B. Provide certified test reports indicating that the cable has passed the following tests:
 - 1. Vertical tray flame test in accordance with IEEE 1202 where applicable to the size cable.

2.03 CABLE RATINGS AND TYPE

- A. 5/8 kV Cable

1. Cable type: Single conductor.
2. Insulation level as required by UL 1072: 175 mils/100 percent
3. Operating voltage; 4160 Volts, 3 Phase, 60 Hz, grounded distribution system.

2.04 CABLE ACCESSORIES

A. General

1. Cable termination and splicing material shall be as manufactured by Raychem; 3M Corp.; Elastimold or equal. All material used in terminating and splicing medium voltage cables shall be as recommended by the cable manufacturer. Cables shall be terminated and spliced in accordance with the kit supplier's Drawings.
2. Cable terminations shall meet or exceed IEEE Standard 48, Class I requirements.
3. Cable accessories shall be by one manufacturer to assure adequate installer training and application assistance.

B. Cable end caps shall be heat shrinkable polyelofin, 3M Corp., Type SKE, or equal.

C. Loadbreak Elbow Connectors

1. Elbows shall be fully shielded and insulated plug-in termination for connecting underground cable to transformers. Elbows shall be rated for 15kV, 200A and be in accordance with IEEE Standard 386 for Separable Connectors.
2. Elbows shall be molded from high quality peroxide cured insulating and semiconducting EPDM rubber. Loadbreak probe shall be tin plated copper with arc-ablative tip. Pulling eye shall be stainless steel reinforced for positive switching operations.

D. Lugs and Connectors

1. Copper lugs and connectors shall be crimped with standard industry tooling. All connections of copper stranded wire in sized No. 6 AWG through 1000 kcmil shall be made electrically and mechanically secured. The lugs and connectors shall have a current carrying capacity equal to the conductors for which they are rated and meet UL 486 requirements. Lugs larger than 4/0 AWG shall be two-hole lugs with NEMA spacing. The lugs and connectors shall be rated for operation through 35 kV. The lugs shall be of closed end construction to exclude moisture migration into the cable conductor.

E. Electrical Grounding Braid

1. Conducting metal braid shall be woven from 240 strands of 30 AWG tinned copperwires and be capable of carrying fault current comparable to that of 6 AWG copper wire, 3M Corp., Scotchbrand 25, or equal.

F. Cable Marking Systems

1. A 7-mil, flame retardant, cold and weather-resistant vinyl plastic electrical tape shall be used for phase identification, 3M Corp.; Scotch 35 Tape, or equal.
2. Cable tags shall be heat stamped nylon secured by polypropylene cable ties, Thomas & Betts No. TC228-9, or equal.

G. Pulling Compounds

1. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. The material shall be UL listed and compatible with the cable insulation and jacket.
2. Acceptable manufacturers are Ideal Company; Polywater, Inc.; Cable Grip Co., 3M Corp. WL Series, or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Determine the cutting lengths, reel arrangements and total lengths of cable required and shall furnish this data to the cable manufacturer as soon as possible to assure on-time delivery of cable.
- B. Make use of the field engineering services available from the cable manufacturer.

3.02 INSTALLATION

- A. Install cable and cable accessories as required or shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.
- B. Cable Installation
 1. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
 2. Use loose pulling eyes unless factory pulling eyes have been installed.
 3. Pull cables from direction that requires the least tension.
 4. Feed cables into raceway with zero tension and without cable crossover at raceway entrance.
- C. Splicing and Terminating
 1. Splices and terminations shall be made with either manufactured splice and termination kits or premolded cable accessory components.

2. Separable connector junctions and accessories shall be mounted on a metal rack system.
 3. The work area shall be kept warm, dry and ventilated during splicing and terminating of the cables.
 4. Splicing and terminating shall be performed by electricians having at least 80 hours of formal training and a minimum of five years field experience in this type of work.
 5. Prepare cables in accordance with splice or termination kit manufacturers installation details.
 6. Clean cables for splicing or terminating with cleaning kits included with the splice or terminating kit. If a cleaning kit is not provided with the kit use a 3M Corp. CC-2 preparation kit, or equal.
 7. Maintain shield continuity around splices. Bond cable shields at each terminal or splice location.
 8. Install a neoprene tape wrap around each splice and bonding jumper to provide a watertight environmental seal.
 9. Insulate and seal each cable-to-bus termination with heat shrinkable bus connector kits.
- D. Marking and Identification
1. Plastic nameplates shall be installed in each manhole, pull box and at splice and terminating points. These nameplates shall show the phase and feeder designations and the date when the cable was installed or splice or termination was made. The feeder designation shall be as indicated on the Drawings. Nameplates shall be tied to each cable with self-locking nylon ties.

3.03 FIELD TESTING

- A. Equipment testing and inspection shall be performed in accordance with NETA Standard ATS and shall include the following:
1. Visual and mechanical inspection.
 2. Shield continuity test.
 3. Insulation resistance test.
 4. DC Hipot test per IEEE Standard 400.
- B. Submit certified copies of the test results and leakage plots to the Owner in accordance with Section 01300 within five days of completion of the tests.
- C. Immediately notify the Owner and do not energize the cables if any of the following conditions occur:

1. Cable damage.
 2. Improper installation or grounding.
 3. Shield discontinuity or high resistance.
 4. Dielectric absorption ratio and polarization index below 1.5.
 5. Abnormal plot of leakage current versus voltage.
- D. Defective or Damaged Cables

END OF SECTION

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SECTION 16123: WIRE AND CABLE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes wire and cable; nonmetallic-sheathed cable; and wiring connectors and connections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 16000 – General Electrical Requirements

1.03 REFERENCES

- A. NECA 1-2010 “Standard Practice of Good Workmanship in Electrical Construction.”
- B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SYSTEM DESCRIPTION

Product Requirements: Provide products as follows:

- A. Stranded conductor for feeders and branch circuits 10 AWG and smaller.
- B. Stranded conductors for control circuits.
- C. Power conductors not smaller than 12 AWG.
- D. Conductor not smaller than 14 AWG for control circuits.

1.05 DESIGN REQUIREMENTS

- A. All conductors shall be copper.

1.06 SUBMITTALS

- A. Submittals shall be in accordance with General Conditions.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Test Reports: Indicate procedures and values obtained.
- D. Project Record Documents: Record actual locations of components and circuits.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on the drawings.

1.09 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.01 WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: NFPA 70; Type THHN/THWN/THWN2 insulation for feeders and branch circuits. Sizes 8 and larger shall be rated THWN2.
- E. Conductors shall have thermoplastic, solid color thermosetting, polyvinyl chloride insulation with nylon jacket. The insulated conductors shall conform to Underwriter's Laboratories standards for type THHN/THWN2. The overall jacket for a multi-conductor cable shall be polyvinyl chloride.
- F. Wire and cable designated "Shielded" on the Drawings and required for the instrumentation signal circuits shall be shielded cable. Signal voltage and current will be 24 volts DC and 4-20 milliamperes DC, respectively. The cables shall be 600 volt AC rated, with a laminated aluminum-polyester tape shield and a copper drain wire, with a plastic jacket over all, and shall be UL approved as type TC tray cable, 90°C in dry locations, and 75°C in wet locations. The conductors in the cable shall be stranded and twisted bare copper wires with a minimum of seven strands and insulated with a minimum thickness of 0.020 inch of flame retardant and moisture resistant, high quality, cross-linked, polyethylene insulation. The wires shall be color coded and covered with a minimum of 0.001/0.001 inches of laminated aluminum-polyester tape shield and a #20 AWG tinned and stranded copper drain wire, with a minimum of ten strands. Over the twisted and shielded cable assembly, there shall be a minimum thickness of 0.045-inches of moisture, flame, and sunlight resistant, polyvinyl chloride (PVC) outer jacket.
- G. All conductors shall be soft-drawn copper, 97 percent conductivity minimum.
- H. All conductors within fluorescent fixtures shall have type AVA or RHH 600 volt insulation except fixtures with approved wireways for 75°C wire.
- I. Instrumentation cable shall be single or multi-conductor shielded pairs as indicated. Conductors shall be No. 16 AWG coated copper.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify mechanical work likely to damage wire and cable has been completed.
- B. Verify raceway installation is complete and supported.

3.02 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

- A. Route wire and cable to meet project conditions.
- B. Install wire and cable in accordance with NECA "Standard Practice of Good Workmanship in Electrical Construction."
- C. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- D. Identify and color code wire and cable. Identify each power and control conductor with tube type wire markers, indicating the conductor's circuit designation and starting, ending, and splice locations.
- E. Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install wire 4 AWG and larger with pulling equipment with tension monitored.
 - 3. Wire lubricants shall be UL approved.
- F. Cable:
 - 1. Protect exposed cable from damage.
 - 2. Use suitable cable fittings and connectors.
- G. Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. All low DC and AC (below 100V) voltages and signals shall be grounded separately from above power grounds. 600 volt conductors, No. 8 AWG and larger, shall be terminated spliced with compression type connectors and insulated with three layers of UL-approved vinyl insulating tape. 600 volt conductors, No. 10 AWG and smaller, shall be spliced with pre-insulated coil spring type connectors. Terminations and splices in all

motor connection boxes shall be made with compression type connectors.

4. Termination splices shall be insulated with varnished cambric tape, overlapped with three (3) layers of a high temperature, UL-approved, tape.
5. Control conductors shall be spliced with pre-insulation crimp type connectors and terminated with split tongue pre-insulated, crimp type connectors.

H. Splicing

1. Wires and cables for control and power circuits shall be continuous without splices between terminals, except where otherwise specifically approved by the Engineer. All splices shall be made in an approved manner. Mechanical connectors and terminal devices shall be the soldered-type, or the compression-type that is indented or crimped on to the conductor.
2. Splices and terminations of instrument cable shall be with pre-insulated crimp type connectors. Shields shall be electrically continuous at spliced joints with two layers of UL-approved electrical insulating tape over splices. Connectors for terminations shall be split tongue or ring type. Shields shall be grounded at the receiving end of cables.
3. Splices in manholes and underground pull boxes for 600-volt conductors and below shall be waterproofed using encapsulating epoxy resin splice kits.

3.04 WIRE COLOR

A. General

1. Wire and cable shall be factory color coded by integral pigmentation with a separate color for each phase and neutral. On conductors larger than 8 AWG, color tape or colored plastic bands will be permitted.
2. Each system shall be color coded and shall have it maintained throughout.

Phase	120/240	120/208	277/480 Volts	Control Wires	DC Conductors
A	Black	Black	Brown	Purple	Blue
B	Red	Red	Orange		
C	N/A	Blue	Yellow		
Neutral	White	White	Gray		
Ground	Green	Green	Green		

- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.05 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

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SECTION 16130: RACEWAY AND BOXES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.02 REFERENCES

- A. ANSI C80.1 (American National Standards Institute) - Electrical Rigid Steel Conduit.
- B. NECA 1-2010 "Standard Practice of Good Workmanship in Electrical Construction."
- C. NEMA FB 1 (National Electrical Manufacturers Association) - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. NEMA OS 1 (National Electrical Manufacturers Association) - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- E. NEMA OS 2 (National Electrical Manufacturers Association) - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- F. NEMA RN 1 (National Electrical Manufacturers Association) - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- G. NEMA TC 2 (National Electrical Manufacturers Association) - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- H. NEMA TC 3 (National Electrical Manufacturers Association) - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- I. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on the Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

1.04 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified. Where conduit sizes are not shown, they shall be one size larger than required by NEC.
- B. All wiring, except as specifically noted, shall be in conduit.

- C. All wiring runs in earth shall be installed in PVC coated rigid steel conduit. Conduits for electric utility services shall be Schedule 40 PVC conduit encased in concrete. PVC conduit shall have PVC coated rigid steel risers.
- D. Unless specifically noted otherwise, all exposed raceway shall be PVC coated rigid galvanized steel.

1.05 SUBMITTALS

Product Data: Submit shop drawings for the following in accordance with General Conditions.

- A. Liquid-tight flexible metal conduit.
- B. Nonmetallic conduit.
- C. Raceway fittings.
- D. Conduit bodies.
- E. Surface raceway.
- F. Wireway.
- G. Pull and junction boxes.
- H. Handholes.

1.06 CLOSEOUT SUBMITTALS

Submit project record documents that:

- A. Record actual routing of all conduits.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.08 COORDINATION

- A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

2.01 PVC COATED STEEL CONDUIT AND FITTINGS

- A. Product Description: Rigid steel conduit with external PVC coating, 40 mils thick, shall comply with UL-6 and NEMA RN 1. Conduit and fittings shall be manufactured by Perma-Cote, Calbond, Thomas & Betts, or approved equal.
- B. A two-part urethane chemically cured coating shall be applied at a nominal 2-mil thickness to the interior of all conduit and fittings. The coating shall be sufficiently flexible to permit field bending of the conduit without cracking or flaking of the coating.
- C. PVC coated steel fittings and bodies shall comply with NEMA FB 1. Fittings with external PVC coating shall match the conduit.

2.02 RIGID METAL CONDUIT

- A. Product Description: rigid metal conduit shall be hot dipped, zinc coated galvanized steel manufactured in accordance with ANSI C80.1, UL-6, and Federal Specification WW-C-581E.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked galvanized construction with a smooth moisture and oil-proof abrasive-resistant reopened jacket.
- B. Fittings: NEMA FB 1.

2.04 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 PVC rated for 90°C.
- B. Fittings and Conduit Bodies: NEMA TC 3.
- C. Install non-metallic conduit for electric utility services or as otherwise specifically indicated on the Plans. The plastic conduit shall be installed in accordance with the manufacturer's printed recommendations. Bends, sweeps, end-bells, and other fittings, as required, shall be of the same material as the conduit.

2.05 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1 one-piece knockout type, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2-inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Weatherproof Outlet Boxes: Nonferrous metal with threaded conduit entry and gasketed covers.

- C. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Furnish gasketed cover by box manufacturer.

2.06 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Pull boxes shall be painted with two coats of primer and one finished coat of light gray enamel, ANSI No. 61.
- C. Boxes shall be fabricated of structural quality flat rolled steel sheet free from irregularities, mill scale, surface corrosion, or other defects and shall be neatly and accurately formed with corners mitered and sides joined by continuous welding. After fabrication, each box and cover shall be galvanized.
- D. Galvanizing shall be in accordance with the requirements of ASTM Standard A123. The galvanizing shall stand seven 1-minute immersions when tested in accordance with the methods set forth in ASTM Standard A239. Articles shall be straightened after galvanizing, if necessary, to remove wavy surfaces or distortion.
- E. Cast-Type Boxes
Cast-type boxes shall be malleable iron with cadmium finish or copper-free aluminum with threaded hubs for installation on exposed conduit work outdoors, in vaults, and miscellaneous structures as shown on the Drawings. Cast-type boxes shall be Crouse-Hinds "Condulets," Appleton Electric Products "Unilets," or equal.
- F. Underground Pull boxes
 1. Pull boxes shall be precast type designed and manufactured for heavy traffic loading with heavy duty, hot dipped galvanized steel, traffic type covers.
 2. All pull boxes shall have bolt-down covers complete with fiber gaskets for a weather-tight fit.
 3. All joints between precast sections shall be sealed.
 4. Box covers shall be permanently identified as follows:
 - a. Electrical systems 600 volts and less - "E"
- G. Precast and reinforced concrete for pull boxes shall conform to the requirements in Section 03480 Precast Concrete Vaults for corrosion resistance.
- H. Pull boxes shall be code gauge steel with removable covers secured with machine screws. The pull box shall be painted with two coats of primer and one finished coat of light gray enamel, ANSI No. 61. Pull boxes shall meet all code requirements as to size for number and size of conduits terminating.

- I. Weatherproof pull boxes shall be hot dip galvanized with two coats of primer paint and one coat of enamel, ANSI No. 61 gray. Covers shall be gasketed and made completely weathertight.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 INSTALLATION

- A. Install work in accordance with state and municipality standards.
- B. Install raceway and boxes in accordance with NECA 1-2010 "Standard Practice of Good Workmanship in Electrical Construction."
- C. Ground and bond raceway and boxes in accordance with Section 16050.
- D. Fasten raceway and box supports to structure and finishes in accordance with Section 16050.
- E. Identify raceway and boxes in accordance with Section 16050.
- F. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.03 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. The exact locations shall be determined by the Contractor to suit the structural details. Route raceways to complete wiring system.
- B. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- C. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- D. Do not attach raceway to ceiling support wires or other piping systems.
- E. Route exposed raceway parallel and perpendicular to walls.
- F. Route conduit in and under slab from point-to-point.
- G. Maintain clearance between raceway and piping for maintenance purposes. Conduit shall be kept at least 6 inches from the covering on hot water pipes, 18 inches from the covering on flues and breechings, and 3/4 inch from all water-bearing walls, unless shown otherwise on the Plans. The open ends of all conduits shall be sealed during the construction of the facility. Use approved conduit unions where union joints are necessary. Running threads will not be permitted.

- H. Exposed conduit, stubbing up through floor slab into bottom of exposed panels, cabinets, or equipment, shall be lined up, properly spaced, and shall be straight and plumb. Conduits shall be installed at sufficient depth below slab to eliminate any part of the bend above top of slab.
- I. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- J. Join nonmetallic conduit using cement as recommended by the manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for a minimum of 20 minutes.
- K. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- L. Install no more than equivalent of three 90-degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2-inch size.
- M. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- N. Install suitable pull cord of 200-pound strength in each empty raceway except sleeves and nipples.
- O. All spare conduits shall be stubbed up to a flush coupling and plugged. Conduit shall run continuously between outlets and shall be provided with conduit junction boxes where connections are made, except in special pull boxes where indicated on the Plans.
- P. Flexible steel conduit may be used in runs from adjacent junction boxes to motors, benches, and in certain locations where, for structural or other reasons, it is impractical to use rigid conduit and where specific permission to do so has been granted by the Owner. Flexible conduit shall be used with PVC coated steel conduit fittings and bushings. All exposed conduits and all conduit stub-ups shall be PVC jacketed steel.
- Q. Threading shall be done with dies with guide sleeves bored out to allow for increased diameter of conduit. Conduit bends shall be made with next larger size EMT bender or next larger sized shoe bushed for proper fit. Cuts or damaged areas shall be repaired with an approved paste material.

3.04 UNDERGROUND DUCT INSTALLATION

- A. Underground ducts shall be installed in a concrete encasement as indicated on Plans and elsewhere in these Specifications. Concrete shall be Class C (3250 psi). Concrete envelope shall be colored with red iron oxide pigment that is integrally mixed with the concrete in the proportion of 2 pounds per sack of cement and 3250 psi per yard of concrete. Pigment shall be commercially pure hydrate oxide, insoluble in water, free from soluble salts and acids, with calcium sulfate less than 10 percent. Pigment shall be dry batched with the aggregate.

Reinforcement shall conform to ASTM A 615, Grade 60, and shall be required for arrays of three or more ducts.

- B. Top of concrete duct banks shall be a minimum of 30 inches below finished grade. Ducts shall be installed on a minimum grade line of 2 inches fall per 100 feet, sloping toward manhole or pull box.
- C. Install duct spacers to provide horizontal and vertical spacing and stress relief for conduits encased in concrete. Duct spacers shall be provided and installed in accordance with the conduit manufacturer's recommendations.
- D. Changes in direction shall be made with long sweeps with minimum radius of 24 times duct diameter.
- E. The installed ducts shall be cleaned by: (1) pulling a flexible mandrel through each duct; or (2) pulling a wire brush and swab through each duct. The mandrel shall be 1/4 inch less in diameter than the duct diameter. Spare ducts shall have a 200-pound strength nylon cord installed with at least 36 inches of slack on each end.

3.05 CONDUIT FITTINGS AND OUTLET BOXES

- A. Cast, non-ferrous fittings shall be installed for all exposed conduits including fittings for switches and receptacles. Fittings installed in pipe and filter gallery or exterior to buildings shall have a PVC coating bonded to the surface and a PVC sleeve extended from all hubs. Stainless-steel screws shall be used to attach the cover to the conduit fitting.
- B. All outlet boxes that finish to an exposed concrete block surfaces shall have 2-1/8-inch deep tile rings and shall be set to allow concrete block facing over the ring to frame the opening. Tile rings shall not be grouted into exposed concrete block walls. Center outlet in course of concrete block.
- C. Standard plaster rings will not be accepted.
- D. Unless otherwise specified or noted on the Plans, boxes for the various outlets shall be as follows:
 - 1. For light outlet boxes, use minimum of 4 inches square, 2-1/8 inches deep, equipped with plaster ring and fixture-supporting device as required by the unit installed.
 - 2. For wall switch outlets, use 4-inch boxes with single or two-gang boxes with gang plaster rings for more than two switches, unless noted otherwise on the Plans.
 - 3. For convenience outlets, use 4-inch boxes with single-gang plaster rings. All conduit fittings, sealing devices, junction boxes, and devices used in hazardous areas shall be UL approved and as manufactured by Crouse-Hinds or Appleton.

- E. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation.
- G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- H. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Install adjustable steel channel fasteners for hung ceiling outlet box.
- K. Do not fasten boxes to ceiling support wires or other piping systems.
- L. Support boxes independently of conduit.
- M. Install gang box where more than one device is mounted together. Do not use sectional box.
- N. Install gang box with plaster ring for single device outlets.

3.06 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 16050.
- B. Locate outlet boxes to allow luminaries positioned as indicated on the Drawings.
- C. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.07 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

3.08 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16140: WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes convenience receptacles, light switches and device plates.
- B. Related Sections:
 - 1. Section 16130 - Raceway and Boxes: Outlet boxes for wiring devices.

1.02 REFERENCES

- A. NECA 1-2010 "Standard Practice of Good Workmanship in Electrical Construction."
- B. NEMA WD 1 (National Electrical Manufacturers Association) - General Requirements for Wiring Devices.
- C. NEMA WD 6 (National Electrical Manufacturers Association) - Wiring Device - Dimensional Requirements.

1.03 SUBMITTALS

- A. Product Data: Submit the manufacturer's catalog information for each type of receptacle, switch and device plate showing dimensions, colors, ratings and configurations.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3 years of experience.
- B. All devices shall be U.L. listed.

1.05 EXTRA MATERIALS

- A. Furnish two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

2.01 RECEPTACLES

- A. Product Description: NEMA WD 1, heavy-duty general use receptacle.
- B. Device Body: Brown plastic.
- C. Configuration: NEMA WD 6, type as indicated on the Drawings.
- D. Convenience Receptacle: Type 5-20.

- E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. Receptacles shall be rated 20 amperes and comply with UL-943.
- F. Weatherproof Receptacle: Convenience receptacle with polycarbonate NEMA 3R "while-in-use" cover to protect electrical connections when receptacle is being used. Weatherproof receptacles shall comply with NEC 406.8(B)(1).

2.02 COVER PLATES

- A. Provide engraved or etched cover plates to indicate equipment or area served for pilot switches, control circuit switches, three-gang or larger gang switches, and switches from which the equipment controlled cannot be readily seen. Lettering shall be 1/8 inch high with filler of black color. Provide a separate nameplate mounted above receptacle for receptacles without cover plates or where engraving or etching is impractical. Nameplate shall be as described in Section 16050 except with 1/8-inch-high lettering.
- B. In wet areas, areas subject to hosing down, areas identified as "Corrosive Area," or where indicated, use individually gasketed weatherproof cover plates.
 - 1. Switch plates shall be gray polycarbonate lift-cover type.
 - 2. Receptacle plates shall be polycarbonate and NEMA 3R rated while in use. Manufacturer shall be Tay Mac Corporation or equal.
- C. Provide satin stainless 430 plates in all remaining locations.
- D. Decorative Cover Plate: Smooth Type 302 stainless steel.
- E. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover.

2.03 SWITCHES

Switches shall be NEMA WD 1, molded composition, brown, specification grade, single pole, three-way and four-way as shown in the Drawings.

- A. 120- or 277-Volt Lighting: Provide switches rated 20 amperes, 120/277-volt a-c. Provide quiet operation, toggle-type switches.
- B. Switches with Pilot Lights: Provide switches with 125-volt, neon light with red jewel that is lighted when the switch is ON.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and completely covered by wall plates.

- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

- A. Clean debris from outlet boxes.

3.03 INSTALLATION

- A. Install in accordance with NECA 1-2010 "Standard Practice of Good Workmanship in Electrical Construction."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Do not share neutral conductor on load side of dimmers.
- E. Install receptacles with grounding pole on top.
- F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- G. Install decorative plates on switch, receptacle, and blank outlets.
- H. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights as specified and as indicated on the Drawings.

3.05 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify each receptacle device is energized. Test each receptacle with a circuit tester that checks voltage, polarity, and grounded conditions. Repair or replace defective receptacles and repeat the test.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation. GFI receptacles shall be tested with the circuits energized. Devices shall be tested with a portable GFI receptacle tester capable of circulating 7.5 mA of current, when plugged in, between the "hot" line and "ground" to produce tripping of the receptacle. Resetting and tripping shall be checked at least twice at each GFI receptacle.

3.06 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16265: VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes variable frequency drives installed as individual units or in a motor control center as noted on the plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 16425 – Low Voltage Switchboards

1.03 REFERENCES

- A. IEEE C62.41 (Institute of Electrical and Electronics Engineers) - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE Standard 519 (Institute of Electrical and Electronics Engineers) - Harmonic Limits.
- C. NEMA ICS 3.1 (National Electrical Manufacturers Association) - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- D. NEMA ICS 7 (National Electrical Manufacturers Association) - Industrial Control and Systems: Adjustable Speed Drives.
- E. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown, ventilation, conduit entrance locations and requirements, and nameplate legends.
- C. Product Data: Submit catalog sheets showing voltage, drive size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 3.1. Include procedures for starting and operating drives, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience and with service facilities within 100 miles of project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with the manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency drives.

1.09 WARRANTY

- A. Furnish a 1-year manufacturer warranty for variable frequency drive. The VFD manufacturer shall offer extended service warranty contracts for purchase by the Owner after the startup.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of variable frequency drive for 1 year from the date of substantial completion.

1.11 MAINTENANCE MATERIALS

- A. Furnish two of each air filter, where required.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY DRIVE

- A. Variable Frequency Drives
Provide individual adjustable frequency drives suitable for controlling the NEMA Design B squirrel cage induction motors with the horsepower as indicated on the Drawings.

- B. Product Description: NEMA ICS 7, enclosed 18-pulse variable frequency drive suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 3.1. Drive shall be UL listed.
- C. Ratings:
1. Rated Input Voltage: 480 volts, three-phase, 60 hertz, with an available short circuit current of 65,000 amperes symmetrical.
 2. Motor Nameplate Voltage: 460 volts, three-phase, 60 hertz.
 3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
 4. Operating Ambient: 0°C to 40°C.
 5. Minimum Efficiency at Full Load: 97 percent at motor base speed and rated torque.
- D. Design Features:
1. Employ microprocessor-based inverter logic isolated from power circuits.
 2. The drives shall utilize a full wave diode bridge rectifier to convert incoming fixed voltage and frequency to a fixed DC voltage, a filter network, and an insulated gate bipolar transistor (IGBT) inverter. The output will be sinusoidal wave, pulse width modulated (PWM) voltage waveform.
 3. The drive shall employ 18-pulse technology so that the completed installation meets all requirements specified in IEEE Standard 519. The drive system shall be field tested over its full operating speed range and a report submitted listing both current harmonic distortion (TDD) and voltage harmonic distortion (THD) with a compliance statement that the installation meets the IEEE 519 requirements.
 4. The output frequency drift shall be no more than plus or minus 0.5 percent of maximum frequency.
 5. In the event of a power loss, the unit shall shut down without component failure. Upon return of utility power, the unit shall be capable of automatically returning to normal operation.
 6. Operator interface shall be provided from a door-mounted keypad and digital display. Parameters shall be arranged in an organized format to provide ease of programming and fast access to parameters.
 7. User adjustable functions through the operator interface shall include:
 - a. Increase or decrease output frequency.
 - b. Control mode selection (manual, off or auto).

- c. Run and stop (manual mode operation only).
 - 8. The following interface points shall be provided for operation with the PLC:
 - a. Digital Output:
Hand, Off, Auto Status, Run, Alarm Drive Fault, Alarm Motor Fault
 - b. Digital Input:
Enable
 - c. Analog Output
Speed (4-20 mA) Isolated
 - d. Analog Input:
Speed (4-20 mA) Isolated
 - e. RS-232 Output
 - f. Door Mounted Items:
 - 1) Digital display
 - 2) HOA
 - 3) Lights: yellow = call, green = run, red = fault.
- E. Safeties and Interlocks:
 - 1. Includes undervoltage release.
 - 2. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power when door is opened; include means for defeating interlock by qualified persons.
 - 3. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
 - 4. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
 - 5. Electronic Overloads and Safeties: Unit to have over and under voltage, over temperature, ground fault, and over and under current stall protection.
- F. Critical Speed Lockout
The drive shall be capable of being adjusted to prevent operation at critical pump speeds.
- G. Fabrication:

1. Wiring Terminations: Match conductor materials and sizes as indicated on the drawings.
 2. Enclosure: NEMA 12, suitable for equipment application in interior locations.
 3. Finish: Manufacturer's standard enamel.
- H. Output Line Reactor
- Provide output line reactor in drive enclosure to limit voltage reflections at the motor. The line reactor shall be sized to accommodate the motor lead length and horsepower as indicated on the Drawings.
- I. RTD Module
1. Provide a door mounted RTD sensing module for over temperature and under temperature protection.
 2. The motor mounted RTDs are 100 ohm.
 3. Each unit shall monitor up to eight motor mounted RTDs and shall have one output relay each for alarm, trip and fault.
 4. Customer contacts shall be rated 5A-250V AC resistive.
- J. Manufacturers:
1. Allen Bradley
 2. Eaton
 3. Square D

2.02 SOURCE QUALITY CONTROL

- A. Shop inspect and perform standard productions tests for each drive.
- B. Make completed drives available for inspection at the manufacturer's factory prior to packaging for shipment. Notify the Owner at least 7 days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at the manufacturer's test facility. Notify the Owner at least 7 days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify building environment is maintained within service conditions required by the manufacturer.

3.02 INSTALLATION

- A. Install in accordance with NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing drive.
- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor drives to match installed motor characteristics.
- E. Install engraved plastic nameplates in accordance with Section 16050.
- F. Neatly type label inside drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- G. Ground and bond drive in accordance with Section 16050.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 3.1.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Prepare and startup variable frequency drive.

3.05 TRAINING

- A. Furnish 8 hours of instruction to be conducted at project site with the manufacturer's representative.

3.06 COMMUNICATION

- A. Supply complete software, interface, and cable for drive programming.

END OF SECTION

SECTION 16345: MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

This section includes the following:

- A. Furnish and install 5 KV medium voltage metal-clad switchgear equipment as shown on the Drawings and as specified herein.
- B. Install metering transformers furnished by the electrical utility (PG&E).

1.02 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI/IEEE C37.20.2 Standard for Metal-Clad and Station Type Cubicle Switchgear
 - 2. ANSI C37.20.7 - Guideline for Testing of Metal-Enclosed Switchgear for Internal Arcing Faults
 - 3. ANSI/NECA 430 - Standard for Installing Medium Voltage Metal Clad Switchgear
 - 4. ANSI/IEEE C37.04a - Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 5. ANSI/IEEE C37.06 AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
 - 6. ANSI/IEEE C37.09 Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 7. ANSI/IEEE C37.11 Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 8. ANSI/IEEE C37.55 Conformance Testing Procedure of Metal-Clad Switchgear
 - 9. ANSI/IEEE C57.13 Requirements for Instrument Transformers
 - 10. ANSI C37.90.1 - Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA SG4 – Alternating Current High Voltage Circuit Breakers.
 - 2. NEMA SG5 – Power Switchgear Assemblies
- C. Electrical Equipment Manufacturers Association of Canada (EEMAC)

1. EEMAC G14-1 Procedure for Testing the Resistance of Metal-clad Switchgear under Conditions of an Internal Fault.
- D. National Fire Protection Association (NFPA)
1. NFPA 70 - National Electric Code.
- E. International Electrical Testing Association (NETA)
1. NETA ATS - Acceptance Testing Specifications.
- F. Underwriters Laboratories
- G. Electrical Utility Service Equipment Requirements Committee (EUSERC) where required by electric utility (PG&E).
- H. Where reference is made to one of the above standards, the revision in effect at the time of the bid shall apply.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions.
- B. Product Data. Shop drawings shall include the following information:
1. Master drawing index
 2. Front elevation view
 3. Floor plan layout
 4. Top view
 5. Dimensions, weight, and shipping splits
 6. Single line diagrams
 7. 3-phase elementary and schematic diagrams
 8. Nameplate schedules
 9. Component list including metering, protective relays, accessories and control equipment
 10. Conduit entry/exit locations
 11. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current

- d. Bus material and ratings
 - 12. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
 - d. Basic impulse level
 - 13. Cable terminal lug sizes
 - 14. Product data sheets and catalog numbers for circuit breakers and relays. List all options and accessories furnished specifically for this project.
 - 15. Detailed shop drawings of the utility metering compartment and pull section compartments to the electric utility (PG&E) for review and approval.
- C. Submit the following additional information where applicable:
- 1. Busway connection
 - 2. Connection details between close-coupled assemblies
 - 3. Composite floor plan of close-coupled assemblies
 - 4. Key interlock scheme drawing and sequence of operations
- D. Design Data:
- 1. Provide seismic anchoring details, coordinated with the equipment mounting provision, prepared and stamped by a licensed professional engineer. Mounting recommendations shall be based upon manufacturers shake table tests used to verify the seismic design of the equipment
- E. Submit manufacturer's installation instructions for the complete assembly and each major component:
- 1. Shipping, storage, and handling instructions
 - 2. Installation bulletins
 - 3. Supplemental instruction bulletins.
 - 4. Application software
 - 5. Instructions necessary for proper seismic mounting of the equipment.

1.04 CLOSEOUT SUBMITTALS

- A. Submit record document information in accordance with the General Conditions.

- B. Submit the following information for record purposes:
 - 1. A complete set of manufacturers "As Built" shop drawings incorporating all changes made during the manufacturing process.
 - 2. "As Built" point-to-point compartment wiring diagrams for metering, relay and control circuits. Show wire and terminal numbers.
 - 3. Field wiring interconnection drawings illustrating all field components and electric connections to the systems supplied under this Section.
 - 4. Confirm and record all protective device settings.
- C. Furnish electronic copies of switchgear drawings, one-lineS, and wiring diagrams in AutoCAD native file format. Drawings shall include any field modifications or changes to reflect actual as built conditions after completion of start-up and final acceptance by the Owner.

1.05 QUALIFICATIONS

- A. The equipment furnished under this Section shall be the product of a manufacturer who has produced this same type of equipment for a period of at least 10 consecutive years.
- B. The switchgear equipment shall be designed, assembled and tested by the manufacturer of the major components and circuit protective devices used within the switchgear assembly.
- C. Manufacturer shall maintain permanent records of each circuit breaker produced and the production test results.
- D. Regulatory Requirements:
 - 1. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 (NEC) unless more stringent requirements are specified or indicated.
 - 2. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, CBC: a peak of 2.15g's, and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
- E. Certifications
 - 1. The manufacturer shall maintain a documented ISO 9001 or 9002 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.

2. The switchgear shall be UL certified. Design tests, to verify ANSI/IEEE ratings shall be documented as required by ISO 9001 and available for review and inspection.
3. The equipment manufacturer shall certify that the equipment will function following a seismic event, including both vertical and lateral required response spectra referenced in the specified codes.

1.06 SYSTEM DESCRIPTION

A. General:

1. Furnish and install, where indicated, 5 kV free-standing, dead-front type medium voltage metal-clad switchgear equipment, utilizing drawout vacuum type circuit breaker devices as specified herein and as shown on the Contract Drawings. The switchgear shall include a utility underground pull section and a utility metering section.
2. Contractor shall obtain utility company (PG&E) approval of the underground pull section and utility metering section.
3. Modules and provisions shall include: circuit breaker compartments and circuit breakers, primary bus system, ground bus system, auxiliary compartments and transformers, protection and control devices, and connection provisions for primary, ground and control circuits.

B. System Responsibility:

1. Equipment specified under this Section shall be furnished as an integrated assembly by the manufacturer who shall have sole responsibility for furnishing all the parts and components required for a complete and operable system.

C. Design Requirements:

1. Voltage rating: as indicated on the drawings.
2. The entire switchgear assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as shown on the drawings and as required by PG&E.
3. The equipment and components shall operate continuously at its rated current under the specified environmental conditions without damage or degradation of operating characteristics or life:
 - a. Operating Ambient Temperature: 0 degrees C to 40 degrees C maximum ambient temperature.
 - b. Storage Temperature: -30 degrees C to 65 degrees C.
 - c. Relative Humidity: 0 to 95%, non-condensing.

- d. Altitude: Operating to 6500 ft, de-rate for higher elevations.
 - e. Vibration: Seismic Zone 4.
4. The bus shall be designed to carry its rated continuous current in the specified ambient temperature without exceeding the temperature rise limits specified in ANSI Standard C37.20.2.
 5. Equip useable blank spaces and spaces indicated for future devices with vertical bus, multi-ratio current transformers, metering and relaying as per one line diagram. The cubicle shall be quipped for a future breaker element.
 6. Switchgear shall be capable of extension from either end at a future date without modification to existing structural members.
 7. The manufacturer shall develop logic and interlocks and provide all programming as required to implement the protective relay philosophy, key interlocking schemes, metering and network communications as specified and indicated on the Contract Drawings.
 8. The manufacturer shall develop logic and interlocks and provide all programming as required to implement the breaker transfer schemes as specified and indicated on the Contract Drawings.

D. Performance Requirements:

1. Minimum short circuit interrupting rating: buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers and shall be braced to withstand fault currents equal to the close and latch rating of the circuit breakers.
2. Main bus continuous current rating: as indicated on the drawings. Line and load bus connections to circuit breakers shall be rated to carry the full continuous current of the device frame.
3. Power circuit breaker ratings: per ANSI Standard C37.06.
 - a. Maximum Voltage: 5 kV
 - b. BIL Rated: 60 kV
 - c. Continuous Current: circuit breaker frame sizes shall be as shown on the Drawings.
 - d. Short-Circuit Current At Rated Maximum KV: 25 kA
 - e. Closing and Latching Capability: 67 kA rms
 - f. Short Time Rating: 25 kA

- g. Rated Interrupting Time: 3cycles
 - 4. Control voltage: breakers shall be electrically operated by the following control voltages: 120 VAC close and trip.
 - 5. Surge Withstand Capability: per ANSI/IEEE C62.41 without damage.
 - 6. Metering accuracy: minimum accuracy of the complete system, including current sensors, auxiliary CTs, and the meter display, shall be +/- 1% of full scale for current values, and +/- 2% of full scale for power and energy values.
 - 7. Metering sequence compartment shall conform to the specifications of the Pacific Gas and Electric Company (PG&E). In the event of a conflict, PG&E Specifications shall supersede the Contract Documents.
- E. Metering Requirements
- 1. Schweitzer electric power revenue meter SEL 735 or equal.

1.07 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

- 1. Equipment shall be handled and stored in accordance with manufacturer's instructions.
- 2. Shipping groups shall be designed to be shipped by truck. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

B. Acceptance at Site

- 1. Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

C. Storage and Protection

- 1. Refer to General Conditions.

1.08 NOMENCLATURE AND IDENTIFICATION

- A. Provide engraved laminated plastic nameplates on all doors for unit load description and for each control or indicating device. Nomenclature shall be 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 use white letters on a black background. The engraving shall extend through the black exterior lamination to the core. Nameplates shall be screw fastened.
- B. The manufacturer shall fasten a master NEMA nameplate to the front of the switchgear indicating model number, serial number, order number, manufacturing date, bus amperes, volts, overall short circuit rating, etc.

- C. Each circuit breaker shall be identified with an individual serial number permanently mounted on the breaker by means of a metal nameplate.
- D. Provide permanent electrical hazard warning signs marked per OSHA requirements.

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. Products of the following manufacturers are acceptable. No substitutes will be considered.
 - 1. Eaton / Cutler-Hammer
 - 2. General Electric
 - 3. Siemens
 - 4. Square D
- C. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

2.02 MATERIALS

- A. Wiring
 - 1. Low voltage instrument and control wiring: UL/CSA approved stranded copper, minimum size No. 14 AWG, with 600 Volt, 90 degree C, flame retardant, Type SIS. Current transformer circuits shall utilize minimum size No. 10 AWG wire.
 - 2. Low level signal and communication circuit wiring: twisted shielded pair cables to minimize electromagnetic interference. Shielded wire grounded at one point.
 - 3. Physical protection: Enclose control wiring in a grounded metal raceway when routed through a high voltage compartment. Exposed wiring shall be neatly bundled and secured with nylon wire ties and protected against contact with sharp metal edges by protective grommets. Control wiring passing from cubicle to door shall be spiral wrapped to prevent damage.
 - 4. Control circuit protective devices: dead-front pullout fuse blocks shall be used for circuit protection and disconnect. Charge circuits and close and trip circuits shall be separately fused.
 - 5. Control wiring terminations: provide insulated locking spade terminals, except where saddle type terminals are provided integral to a device.

Current transformer secondary leads shall first be connected to conveniently accessible shorting type terminal blocks before connecting to any other device. Provide current and voltage test plugs for field monitoring and maintenance.

6. Terminal blocks: Groups of control wires leaving the switchgear shall be provided with terminal blocks with numbering strips. Provide a minimum of 10% spare terminals on each terminal block.
7. Wiring identification: provide molded plastic clip-sleeve or heat shrinkable type wire markers at each termination point, marked with identification corresponding to appropriate designations on manufacturer's wiring diagrams, color coding per ANSI standards and the NEC.
8. Component identification: fuse blocks, relays, pushbuttons, switches, etc., shall be marked with identification corresponding to appropriate designations on manufacturer's wiring diagrams.
9. Power cable terminations: two hole NEMA bus pads with provisions for attaching clamp compression/crimp type cable terminals suitable for copper cable of the number and sizes shown on the Drawings. Provide adequate vertical clearance for electric stress cone cable terminations.
10. Grounding lugs: provided in the incoming line section for connection of the main conductor with additional lugs for supplemental grounding conductors as indicated on the drawings.

B. Buses

1. Main and riser bus: tin-plated copper with a flame retardant, track resistant fluidized bed epoxy insulation system. Bus joints shall be plated, bolted and insulated with removable PVC boots.
2. The main and vertical riser busses shall be enclosed in a segregated metal compartment with removable covers for accessibility. The main bus pass through insulators and main bus standoff insulator supports shall be molded of cycloaliphatic epoxy.
3. Circuit breaker load side runbacks shall be copper bus with epoxy insulation and porcelain support bushings. Circuit breaker primary connections shall be mounted in insulated contact tube assemblies, bolted to the rear of each breaker cell compartment.
4. For rigidity during fault conditions, all connections to roll-out potential transformer trays and control power transformer trays shall be rigid bus bars insulated to the full voltage rating of the switchgear assembly.

C. Grounding

1. Ground bus: provide a plated copper ground bus extending throughout the entire length of the switchgear, firmly secured to each vertical section

structure and equipped with lugs for external ground connections, sized for cables shown on the Drawings.

2. Make provisions for connection of incoming and outgoing cable sheaths and for the copper grounding conductors shown on the Drawings.
3. Provide a ground bus riser assembly in each cable compartment connected to the ground bar in each circuit breaker or potential transformer drawout assembly compartment. Connect metering, relaying and instrument transformer grounds to this riser assembly.
4. Provide a grounding disconnecting device between each circuit breaker removable element and the equipment ground bus which shall maintain contact at all times, except when the primary disconnecting devices are separated at a safe distance.
5. Provide a static grounding device on each voltage transformer drawout carriage to contact the primary fuses in the disconnected position. Each drawout carriage shall be bonded to the ground riser bus assembly.

D. Potential Transformers

1. Potential transformers: Two-winding, encapsulated drawout type with primary and secondary fuses. Voltage ratings and accuracy shall be as required for the application in accordance with ANSI C57.13. Voltage transformers shall have 120 volt secondaries unless otherwise specified and a burden capacity equal to twice the initial load.
2. Voltage transformers shall be designed to withstand the basic impulse level of the switchgear. Current limiting fuse protection shall be provided on the primary side of each voltage transformer.
3. Where physical size restrictions do not allow the voltage transformer to be mounted in a drawout assembly, the voltage transformer may be stationary mounted with the fuses only mounted in the drawout unit. The appropriate interlocks shall be provided to insure maximum operator safety.
4. When moved to the withdrawn position, the transformer drawout unit shall automatically ground the transformer primary windings and the fuses. A visible indication of positive ground is required. The ground may be a momentary or sweeping action that occurs as the unit moved out of the connected position.

E. Current Transformers

1. Current transformers: Auxiliary ring core type current transformer (CT) shall be located behind the shutters. They shall be bushing-mounted and accessible from the front. Bushings shall accommodate up to four standard accuracy CT's per phase for all ratings.

2. Current transformers shall be fully rated for the appropriate voltage class. Each current transformer shall be rated to withstand the thermal and mechanical stresses imposed by the short circuit rating of the applied circuit breaker.
3. CT ratings and accuracy shall be in accordance with ANSI/IEEE, C57.13 and C37.20.2. The CT winding shall terminate in a screw type terminal on the CT housing and shall be wired to shorting terminal blocks. Current transformers shall have 5 amperes rated secondary current unless otherwise specified.

F. Pilot Devices

1. Circuit breaker control switches: 600 Volt switchgear rotary cam type, with engraved face plates, rated 20 Amps continuous, momentary contact, spring return type having mechanical target or flag and a fixed, pistol grip handle.
2. Indicator lights: LED type. Provide green, red and amber pilot lights for each circuit breaker OPEN, CLOSED and TRIP indication.
3. Selector type control switches (Auto-Manual-Scada) shall have oval handles.

G. Surge Arresters

1. Provide station class surge arresters in each incoming circuit section.
2. Provide surge suppressors on each outgoing circuit using a vacuum circuit breaker.

2.03 EQUIPMENT

- A. Switchgear shall consist of the required number of vertical sections bolted together to form a rigid framework of preformed steel channels or angles covered with bolted steel sheets. Each individual breaker/metering cell shall be completely segregated from adjacent compartments and sections by steel barriers at top, bottom, rear and sides. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- B. All sections of the switchgear shall be front and rear aligned with depth as shown on Drawings. Devices shall be front removable and load connections front and rear accessible. Rear access shall be provided.
- C. Rear cable compartments: isolated from the main and riser bus by insulated or grounded steel barriers with cable supports in each vertical section. Cable compartments shall be of sufficient depth to accommodate the number and size conduits shown on the drawings, with bending space in accordance with the NEC.

D. Enclosure

1. 316 Stainless Steel NEMA 3R Enclosure consisting of side, top and rear covers bolted to steel frame structure members. Front doors shall be hinged and gasketed with captive quarter turn fasteners.

E. Utility Metering

1. Where utility metering is indicated on the drawings, furnish a separate barriered utility metering compartment complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers or potential taps as required by the utility company. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements.

F. Customer Metering

1. Where indicated on the drawings, provide a separate customer metering compartment with a front facing hinged door and include the following:
 - a. Current transformers for each meter. Current transformers shall be wired to shorting- type terminal blocks.
 - b. Potential transformers including primary and secondary fuses with disconnecting means for metering as shown on the drawings.

G. Drawout cells: equip breaker cells with drawout rails and primary and secondary disconnecting contacts, and safety interlocks.

1. Power disconnecting means: moving finger contacts on the power circuit breaker studs to engage stationary contacts extending through a glass polyester insulating support barrier only in the connected position. Provide multiple silver-to-silver full floating high-pressure point contacts with uniform pressure on each finger maintained by springs. A metal or lexan shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell.
2. Secondary control power disconnecting means: plated pin and socket type plug-in connectors mounted on the removable unit and engaging floating plug-in connectors at the front of the compartment.
3. Racking mechanism: Each breaker shall have a self-contained racking mechanism to move the breaker between the TEST/DISCONNECT and CONNECTED positions and to align and secure the primary disconnects in the CONNECTED position. Circuit breakers shall be capable of being racked in or out with the compartment door closed.
4. Position indicator: color-coded visual indication of the breaker cell position.

5. Interlocks: provide interlocks to prevent the following operations:
 - a. Racking a closed breaker into or out of the CONNECTED position with the door in the open position.
 - b. Opening the compartment door unless the circuit breaker is in the disconnected position and safety shutters are closed. This interlock shall also include an indication of shutter position on the front of the compartment door.
 - c. Withdrawing a circuit breaker from the cubicle while the closing springs are charged.
 - d. Insertion of a circuit breaker of incorrect frame size or inadequate interrupting capacity.
 - e. Interlocks shall be provided to prevent closing of a breaker between CONNECTED and TEST/DISCONNECT positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the CONNECTED and TEST/DISCONNECT positions.
6. Removable element (TOC) auxiliary switch contacts: provide 4 normally open and 4 normally closed, break-before-make auxiliary contacts wired to terminal blocks to indicate breaker position in the cell.

2.04 POWER CIRCUIT BREAKERS

- A. Power circuit breakers: removable, electrically operated, vacuum interrupter type with stored energy trip/close mechanism, mounted in a heavy gauge steel frame with a removable front panel cover. The following mechanical indicators and devices shall be visible and accessible through the front cover:
 1. Open/close indicator
 2. Operations counter
 3. Spring charge indicator
 4. Manual charging arm
 5. Racking screw
- B. Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily.
- C. Contact wear gap indicator: indicate available contact life for each vacuum interrupter. Indicator shall be easily visible when the breaker is removed from its compartment. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

- D. Secondary contacts: silver-plated contacts that automatically engage in the breaker operating position, and can be manually engaged in the breaker test position.
- E. Circuit breaker position: provide 4 spare "a" and 4 spare "b" mechanism operated (MOC) auxiliary switch contacts wired to terminal blocks for remote status indication of breaker open/close condition.
- F. Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.

2.05 AUXILIARY CONTROL POWER

A. AC Control Power

1. Control power transformer shall be sized for switchgear components, plus any additional station loads as shown on the Drawings.
2. Control power transformers: Two-winding dry type with primary fuses, secondary circuit breaker, sized for the application per NFPA 70 (NEC).
3. Control power transformers shall be fixed mounted for sizes above 15kVA with the primary current limiting fuses mounted in a drawout unit. When moved to the withdrawn position, the fuse drawout unit shall automatically ground the fuses.
4. Each control power transformer shall have a secondary molded case circuit breaker interlocked with the drawout assembly so that the load is disconnected prior to drawout.
5. All control power transformers shall be provided two 2.5% taps above and below rated voltage.
6. Secondary winding shall be 120 V, single phase, 60Hz, 3 wire unless otherwise specified.

B. AC Capacitor Trip

1. Each breaker shall be electrically operated at 120 Volts from a 120 VAC control power transformer power supply as shown on the Drawings. Breaker operating mechanism shall be electrically charged, stored energy type. Charging motor shall include a limit switch feature and an anti pump relay. Make provisions for manual charging of the mechanism and for slow closing of the contacts for inspection and adjustment.
2. Each breaker shall be equipped with an AC capacitor trip device. The capacitor shall maintain charge for not less than 48 hours after loss of control power.

2.06 METERING AND CONTROL

- A. Schweitzer electric power revenue meter SEL 735 or equal.

- B. Inputs: Provide external voltage and current transformers with rating as indicated on the drawings. Control power shall be supplied internally from the switchgear.

2.07 PROTECTIVE RELAYS

A. General

1. The switchgear manufacturer shall furnish and install in the metal-clad switchgear the quantity, type and rating of protection relays as indicated on the drawings and described hereafter in this specification. Protective relays shall be Schweitzer (SEL) SEL-751A or equal.
2. Microprocessor based multi-function solid state relays shall be provided. Single function relays may be used for specific applications to supplement the features of the multi-function relays. Protective relays shall be drawout type with removable dust tight viewing covers, front accessible connection plugs, built-in test capability, and external reset.
3. Relays shall operate from the 5-ampere secondary output of current transformers.
4. Current and potential test blocks and plugs shall be provided for all metering and protection circuits.

- B. Each incoming Main Breaker shall be provided with a Schweitzer SEL 751A or equal, drawout, utility grade, multi-function protective relay. Provide the following minimum protective functions for each Main Breaker:

1. Instantaneous/Time Overcurrent (50/51) function, 3-phase, percent adjustable, utilizing ANSI trip curves.
2. Under/Over Voltage (27/59) function, 3-phase, percent adjustable, percent reset, with time delay.
3. Over/Under Frequency (81 O/U) function, single phase, percent adjustable, percent reset, with time delay.
4. Phase Sequence/Phase Failure (47) function, 3-phase, percent adjustable, with time delay.
5. Reverse Power (32) function, 3-phase, percent adjustable with time delay.
6. Directional Instantaneous/Time Overcurrent (67) function, 3-phase and directional ground overcurrent (67N/67G) with time delay.
7. Lock-out (86) relay, manual reset.
8. Four-channel fiber-optic arc-flash detector inputs and protection elements. Provide settable arc-flash phase and neutral overcurrent elements combined with arc-flash light detection elements to secure reliable, and fast acting arc-flash event protection.

- C. Each outgoing Feeder Distribution Breaker shall be provided with a Schweitzer SEL-751A or equal, drawout, utility grade, multi-function protective relay. Provide the following minimum protective functions for each Feeder Distribution Breaker:
 - 1. Instantaneous/Time Overcurrent (50/51) function, 3-phase, percent adjustable, utilizing ANSI trip curves.
 - 2. Lock-out (86) relay, manual reset.
 - 3. Four-channel fiber-optic arc-flash detector inputs and protection elements. Provide settable arc-flash phase and neutral overcurrent elements combined with arc-flash light detection elements to secure reliable, and fast acting arc-flash event protection.

2.08 NETWORK COMMUNICATIONS

- A. Provide interface hardware, cabling, and software to enable the following microprocessor-based devices to communicate over fiber optic with the plant-wide Modbus TCP/IP Ethernet:
 - 1. Metering devices
 - 2. Protective relays
- B. Communications gateway (Managed Ethernet Switch): Provide a distributed data logging gateway, interface hardware, cabling, and software to connect local microprocessor-based devices to a plant-wide Ethernet TCP/IP fiber optic communications network.

2.09 SURFACE PREPARATION AND SHOP COATING

- A. All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchgear shall be ANSI 61 light gray.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install the switchgear as shown on the Drawings and in accordance with NECA 430, the manufacturer's instructions, and approved shop drawings.

3.02 FIELD CONNECTIONS

- A. Provide driven ground rods as specified in Section 16660. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment ground bus.
- B. Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 -inches below grade connecting to the grounding electrode system.
- C. Make wiring interconnections between shipping splits.

- D. Install bus splice plates and torque the connections.
- E. Install medium voltage cables per Section 16121. Bond cable sheaths to the switchgear ground bus.
- F. Field low voltage wiring shall be grouped by circuit and tie wrapped. Terminations shall not be stressed.
- G. Insulate the primary cable connections to bus pads and lightning and surge arrestors. Fill voids around bolted connections with 3M Brand SCOTCHFIL electrical putty and apply tape insulation or heat shrink insulating boots in accordance with the switchgear manufacturer's installation instructions.

3.03 INSTALLATION

- A. Remove temporary lifting angles, lugs and shipping braces. Remove all current transformer shunts after completing secondary circuits.
- B. The equipment shall be leveled and anchored directly to a concrete equipment pad or finished floor as shown on the Drawings. Provide hardware and metal shims for installation. Grout and caulk all voids beneath the equipment base.
- C. Locate conduit and cable entrances in the space designated by the equipment manufacturer. Install conduits to prevent water from entering the enclosure. Bond all conduits including stubs to the equipment ground bus. Seal voids around conduit openings in the slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits three inches above slab surface.
- D. Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.
- E. Repair damage to galvanized coatings using zinc rich paint.

3.04 FIELD TESTING

- A. Perform physical, electrical, and mechanical inspections in accordance with the manufacturer's recommendations and the following. Provide all temporary power for testing.
 - 1. Compare equipment nameplate data with specifications and approved shop drawings.
 - 2. Inspect physical, electrical, and mechanical condition.
 - 3. Verify appropriate anchorage, required area clearances, and correct alignment.
 - 4. Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
 - 5. Verify that current transformer ratios and polarity correspond to approved shop drawings.

6. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
7. Inspect insulating materials and structure for evidence of physical damage, reduced clearances, or contaminated surfaces.
8. Verify that field wiring is adequately separated from live busses. Physically secure the field wiring to withstand the effects of fault currents.
9. Check all devices for damage and make all necessary repairs or replacements, prior to energizing.
10. Verify correct barrier and shutter installation and operation.
11. Exercise all active components.
12. Inspect all mechanical indicating devices for correct operation.
13. Verify that vents are clear.
14. Test operation, alignment, and penetration of disconnecting contacts.
15. Inspect control power transformers.
16. Verify all ground connections have been made.
17. Verify operation of space heaters.
18. Verify that all maintenance devices such as special tools and gauges specified by the manufacturer are available for servicing and operating the breaker.
19. Verify the unit is clean.
20. Perform all mechanical operation tests on the operating mechanism in accordance with manufacturer's published data.
21. Measure critical distances such as contact gap as recommended by manufacturer.
22. Inspect bolted electrical connections for high resistance using one of the following methods:
 - a. Use of low-resistance ohmmeter.
 - b. Verify tightness of accessible bolted electrical connections by calibrated torque- wrench method in accordance with manufacturer's published data.
 - c. Perform thermographic survey.
23. Verify cell fit and element alignment.

24. Verify racking mechanism operation.
 25. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 26. Record as-found and as-left operation counter readings
- B. Perform electrical acceptance tests on the switchgear in accordance with NETA ATS, including;
1. Conduct an electrical insulation resistance test to verify that the equipment and field wiring are free from short circuits and grounds. Test phase-to-ground, phase-to-phase, and phase-to-neutral, with the circuit breakers opened.
 2. Overpotential tests.
 3. Insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
 4. Control wiring performance test.
 5. Primary current injection tests on the entire current circuit in each section of assembly.
 6. Phasing check on double-ended switchgear to ensure correct bus phasing from each source.
 7. Conduct earth resistance ground testing.
 8. Insulation power factor and resistance test for surge arresters.
- C. Perform the electrical acceptance tests on circuit breakers and protective relays in accordance with NETA ATS, including;
1. Contact resistance tests.
 2. Insulation resistance tests.
 3. Perform minimum pickup voltage tests on trip and close coils in accordance with manufacturer's published data.
 4. Trip circuit breaker by operation of each protective device. Reset all trip logs and indicators.
 5. Perform vacuum bottle integrity (dielectric withstand voltage) test across each vacuum bottle with the breaker in the open position in strict accordance with manufacturer's published data.
 6. Test instrument transformers.
 7. Perform diagnostic testing on protective relays.

- D. Perform the following before energizing the equipment:
 - 1. Retighten all accessible electrical connections to the manufacturer's torque values.
 - 2. Place all circuit breakers in the OPEN position before energizing the bus.
 - 3. Adjust ground overcurrent protective devices to their most sensitive settings during start- up. Reset the devices after startup is complete and the equipment has been successfully energized.
 - 4. Reinstall all parts and barriers removed to facilitate wiring and installation.
 - 5. Before closing the enclosure, remove all metal chips, scrap wire, and other debris from the switchgear interior. Remove accumulated dust and dirt by using a brush, vacuum cleaner or clean, lint-free rags.
 - 6. Install covers, close doors, and make certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.
- E. Performance Test.
 - 1. Verify complete system operation including all hardware, software and communication devices.
 - 2. Verify networking performance with all interfacing systems by other manufacturers.

3.05 ADJUSTMENT

- A. Perform field adjustments and programming of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit and protective device coordination study.
- B. Provide the following services for starting up and programming of the power management system and metering devices:
 - 1. Set all the adjustable or programmable parameters of all devices in the equipment.
 - 2. Coordinate startup with other manufacturer's equipment.
 - 3. Verify the integrity of the data communications network and troubleshoot as necessary.
 - 4. Set all the network addresses of all devices in the equipment.

3.06 CLEANING

Remove all rubbish and debris around the switchgear. Remove dirt, dust, and concrete spatter from the exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags.

END OF SECTION

SECTION 16425: LOW VOLTAGE SWITCHBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish and install the low voltage switchboard equipment as shown on the Drawings and as specified herein.

1.02 RELATED SECTIONS:

- A. Section 16000 – General Electrical Requirements
- B. Section 16265 – Variable Frequency Drives
- C. Section 16442 – Panelboards
- D. Section 16461 – Dry Type Transformers
- E. Section 17000 – Instrumentation, Control and Monitoring Requirements

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI C37.50 - Test Procedures for Low-Voltage AC Power Circuit Breakers Used In Enclosures.
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA PB 2 – Deadfront Distribution Switchboards.
 - 2. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- C. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. ANSI/IEEE C37.13 - Low-Voltage AC Power Circuit Breakers Used in Enclosures.
 - 2. ANSI/IEEE C37.90.1 - Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- D. Underwriters' Laboratories (UL).
 - 1. UL 891 - Dead-Front Switchboards.
 - 2. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 3. UL 1066 - Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

- E. National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code.
- F. International Electrical Testing Association (NETA)
 - 1. NETA ATS- Acceptance Testing Specifications.
- G. Where reference is made to one of the above standards, the revision in effect at the time of the bid shall apply.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions.
- B. Shop drawings shall include the following information:
 - 1. Master drawing index
 - 2. Front elevation view
 - 3. Floor plan layout
 - 4. Top view
 - 5. Dimensions, weight, and shipping splits
 - 6. Single line diagrams
 - 7. Schematic diagrams
 - 8. Nameplate schedules
 - 9. Component list including metering, protective relays, accessories and control equipment
 - 10. Conduit entry/exit locations
 - 11. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - d. Bus material and ratings
 - 12. Major component ratings including:
 - a. Voltage
 - b. Continuous current

- c. Interrupting ratings
- 13. Cable terminal lug sizes
- 14. Product data sheets and catalog numbers for circuit breakers and fused switches. List all options, trip adjustments and accessories furnished specifically for this project.
- C. Submit the following additional information where applicable
 - 1. Busway connection
 - 2. Connection details between close-coupled assemblies
 - 3. Composite floor plan of close-coupled assemblies
 - 4. Key interlock scheme drawing and sequence of operations
- D. Design Data
 - 1. Provide seismic anchoring details, coordinated with the equipment mounting provision, prepared and stamped by a licensed professional engineer. Mounting recommendations shall be based upon manufacturers shake table tests used to verify the seismic design of the equipment.
- E. Submit manufacturer's installation instructions for the complete assembly and each major component:
 - 1. Shipping, storage, and handling instructions
 - 2. Installation bulletins
 - 3. Supplemental instruction bulletins.
 - 4. Application software
 - 5. Instructions necessary for proper seismic mounting of the equipment.
- F. Project Record Documents
 - 1. Submit record document information in accordance with the General Conditions.
 - 2. Submit the following information for record purposes:
 - a. A complete set of manufacturers "As Built" shop drawings incorporating all changes made during the manufacturing process.
 - b. "As Built" point-to-point compartment wiring diagrams for metering, relay and control circuits. Show wire and terminal numbers.

- c. Field wiring interconnection drawings illustrating all field components and electric connections to the systems supplied under this Section.
 - d. Confirm and record all protective device settings
 - 3. Furnish electronic copies of switchboard drawings, single line diagrams, and wiring diagrams in AutoCAD native file format. Drawings shall include any field modifications or changes to reflect actual as built conditions after completion of start-up and final acceptance by the Owner.
- G. Operation and Maintenance Data
 - 1. Submit operation and maintenance manuals in accordance with the General Conditions.
 - 2. Provide equipment operation and maintenance manuals with each shipped assembly including instruction leaflets, instruction bulletins and renewal parts lists for the complete assembly and each major component.
 - 3. Manuals shall include the following as a minimum:
 - a. A comprehensive index.
 - b. A list of the equipment supplied, including serial numbers, ranges and pertinent data.
 - c. Full product specifications for each item.
 - d. Service, maintenance and operation instructions for each item.
 - e. Special maintenance requirements particular to this system shall be clearly defined, along with set up and test procedures.
 - f. Renewal parts list with stock numbers.
- H. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, NEMA rating of enclosure, ventilation calculations, ventilation equipment ratings, and time and current curves of equipment and components. Provide single line diagram for motor control center.
- I. Provide anchorage calculations in accordance with specification section 16050.
- J. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- K. Test Reports: Indicate field test and inspection procedures and test results.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations, configurations, and ratings of motor control centers and major components.
- B. Operation and Maintenance Data: Submit a replacement parts list for drives.

1.06 QUALITY ASSURANCE

A. Qualifications

- 1. Manufacturer: The equipment furnished under this Section shall be the product of a manufacturer who has produced this same type of equipment for a period of at least 10 consecutive years.
- 2. The switchboard equipment shall be designed, assembled and tested by the manufacturer of the major components and circuit protective devices used within the switchboard assembly.

B. Regulatory Requirements

- 1. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 (NEC) unless more stringent requirements are specified or indicated.
- 2. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) for Seismic Design Category D. Guidelines for the installation consistent with these requirements shall be provided by the manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45g's (3.2-11 Hz), and a ZPA of 0.98g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
- 3. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

C. Certifications

- 1. All sections and devices shall be UL listed and labeled. Service equipment shall be UL labeled as suitable for use as service entrance equipment.
- 2. The equipment manufacturer shall certify that the equipment will function following a Code Level seismic event, including both vertical and lateral required response spectra referenced in the specified codes.

1.07 SYSTEM DESCRIPTION

A. General

1. It is the intent of these Contract Documents that the Contractor furnish and install, where indicated, free-standing, dead-front type low voltage distribution switchboard equipment, utilizing group mounted feeder circuit protective devices as specified herein, and as shown on the contract Drawings.

B. System Responsibility

1. Equipment specified under this Section shall be furnished as an integrated assembly by the manufacturer who shall have sole responsibility for furnishing all the parts and components required for a complete and operable system; however, all equipment need not be manufactured by a single manufacturer.

C. Design Requirements

1. The switchboard shall be arranged so that the uppermost operating handle shall not exceed 6-ft 6-in from the floor when the switchboard is mounted on a 4-in high equipment pad.
2. Provide key interlocks if indicated on the Drawings.
3. Provide full height, nominal 26 inch wide section for Control Panel back panel as specified in Section 17000. Install back panel and coordinate installation with Control Panel supplier.

D. Performance Requirements

1. Minimum short circuit interrupting rating:
 - a. The assembly shall be rated to withstand mechanical forces exerted during short- circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage unless otherwise shown on the Drawings.
2. Voltage and current ratings: as indicated on the Drawings.
3. Surge Withstand Capability: per ANSI/IEEE C62.41 without damage.
4. The equipment and components shall operate continuously at its rated current under the following environmental conditions without damage or degradation of operating characteristics or life:
 - a. Operating Ambient Temperature: 0 degrees C to 40 degrees C maximum ambient temperature.
 - b. Storage Temperature: -40 degrees C to 65 degrees C.

- c. Relative Humidity: 0 to 95%, non-condensing.
- d. Altitude: Operating to 3300 ft, de-rate for higher elevations.

5. Metering accuracy: minimum accuracy of the complete system, including current sensors, auxiliary CTs, and the meter display, shall be +/- 1% of full scale for current values, and +/- 2% of full scale for power and energy values.

E. Metering Requirements

- 1. At each main breaker there shall be a Schweitzer Electric 735 power revenue meter.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

- 1. Equipment shall be handled and stored in accordance with manufacturer's instructions and NEMA PB 2.1.

B. Acceptance at Site

- 1. The assembly shall be provided with adequate lifting means for moving into the installation position.

C. Storage and Protection

- 1. Refer to General Conditions.

1.09 MAINTENANCE

A. Spare Parts

- 1. Provide the following spare parts in the quantities specified
 - a. 3 Fuses of each type and size.
 - b. 3 Pilot lamps of each type.
- 2. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of package. Identify each item with manufacturer's name, description and part number.

1.10 NOMENCLATURE AND IDENTIFICATION

- A. Provide engraved laminated plastic nameplates on all external dead front covers for unit load description and for each control or indicating device. Nomenclature shall be 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 use white letters on a black background. The engraving shall extend through the exterior lamination to the core. Nameplates shall be screw fastened

- B. The manufacturer shall fasten a master NEMA nameplate to the front of the switchboard indicating model number, serial number, order number, manufacturing date, bus amperes, volts, overall short circuit rating, etc.
- C. Provide permanent electrical hazard warning signs marked per OSHA requirements.
- D. Provide permanent arc flash PPE signs marked per OSHA requirements.

1.11 MANUFACTURERS SERVICES

- A. Provide the services of service representative for testing and start-up, as required in Section 16000.
- B. Furnish the services of a service representative for a minimum period of one 8-hour day for setup and programming of the power management system and metering devices. The representative shall be factory-trained and shall have a thorough knowledge of the software, hardware, and system programming.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA ICS 2 service conditions during and after installation of motor control centers.

1.13 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

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. Products of the following manufacturers are acceptable. No substitutes will be considered.
 - 1. Eaton / Cutler-Hammer
 - 2. General Electric
 - 3. Siemens
 - 4. Square D
- C. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service

2.02 MATERIALS

A. Wiring

1. Low voltage instrument and control wiring: Stranded copper, minimum size No. 14 AWG, with 600 Volt, 90-degree C, flame retardant, Type MTW, bundled and secured with nylon ties. Provide wire markers at each end of all control wiring.
2. Control wiring terminations: provide insulated manufacturer's standard terminals, except where saddle type terminals are provided integral to a device. Current transformer secondary leads shall first be connected to conveniently accessible shorting type terminal blocks before connecting to any other device.
3. Terminal blocks: Groups of control wires leaving the switchboard shall be provided with terminal blocks with numbering strips.
4. Wiring identification: provide heat shrinkable wire markers at each termination point, marked with identification corresponding to appropriate designations on manufacturer's wiring diagrams, color coding per NEMA standards and the NEC.
5. Component identification: fuse blocks, relays, pushbuttons, switches, etc., shall be marked with identification corresponding to appropriate designations on manufacturer's wiring diagrams.
6. Line and load terminations: mechanical type terminals, suitable for 75 or 90 degrees C, copper or aluminum cable of the size indicated on the Drawings.
7. Grounding lugs: provided in the incoming line section for connection of the main conductor with additional lugs for supplemental grounding conductors as indicated on the Drawings.

B. Buses

1. Buses: non-tapered, tin-plated copper. Provide a fully rated neutral bus where a neutral bus is indicated on the Drawings.
2. Bus bracing: exceed the specified equipment short circuit current rating, but not less than 65,000 amperes RMS symmetrical.
3. Bus joints: welded connections or accessible bolted joints with high-tensile strength, zinc-plated hardware and conical spring-type washers.
4. Ground bus: provide a copper ground bus extending throughout the entire length of the switchboard, firmly secured to each vertical section structure and equipped with lugs for external ground connections, sized for cables shown on the Drawings.

C. Control and Metering Transformers

1. Potential transformers: Two-winding, encapsulated type with primary and secondary fuses. Voltage ratings shall be as required for the application. Thermal rating and metering accuracy per ANSI Standard C57.13.
2. Current transformers: 600 volt rated toroidal type with accuracy class per ANSI Standard C57.13 requirements for the specified metering application.
3. Control power transformers: Two-winding dry type with primary fuses, secondary circuit breaker, sized for the application per NFPA 70 (NEC).

2.03 EQUIPMENT

- A. 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.
- B. All sections of the switchboard shall be rear aligned. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall. Side access shall not be required. All connections and bus maintenance shall be from the front or the top.
- C. Enclosure
 1. NEMA 1 enclosure consisting of side, top and rear covers bolted to steel frame structure members.
- D. Customer Metering
 1. Where indicated on the drawings, provide a separate customer metering compartment with a front facing hinged door and include the following:
 - a. Current transformers for each phase. Current transformers shall be wired to shorting- type terminal blocks.
 - b. Potential transformers including primary and secondary fuses with disconnecting means.
- E. Distribution Sections
 1. The distribution sections shall consist of group mounted molded-case circuit breakers as indicated.
 2. Provide dry type transformer and branch circuit panelboard with main and branch circuit breakers as indicated on the drawings.

2.04 MOLDED CASE CIRCUIT BREAKERS

- A. Molded case circuit breakers: provide inverse time and instantaneous tripping characteristics, listed per UL 489 for applications at 100% of their continuous ampere rating in their intended enclosure.
- B. Trip mechanism: quick-make, quick-break, mechanically trip-free over-center switching mechanism operated by a toggle-type handle. Handle shall indicate breaker position. A push- to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- C. Contacts: non-welding silver alloy with arc extinction accomplished via arc chutes.
- D. Minimum symmetrical interrupting capacity: not less than overall switchboard interrupting rating. Provide current limiting circuit breakers where indicated or required to meet the specified short circuit rating.
- E. Main circuit breakers shall have Arc-Flash Reduction Maintenance Switch to reduce fault clearing time.
- F. Trip units for circuit breakers below 250 ampere frame: thermal-magnetic trip units.
- G. LSIG trip units for 250 ampere frame circuit breakers and larger: adjustable, microprocessor- based, electronic overcurrent trip device with true three phase RMS sensing of sinusoidal and non-sinusoidal currents, and the following minimum features and functions:
 - 1. Rating plugs shall be adjustable and interlocked so they are not interchangeable between frames and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

2.05 METERING AND CONTROL

- A. Digital Metering – Schweitzer Electric 735 power revenue meter.

2.06 INTEGRATED EQUIPMENT:

- A. The switchboard manufacturer shall integrate and assemble surge protection into the switchboard as shown on the Drawings.
 - 1. Transient voltage surge suppression: as specified in Section 16051.

2.07 NETWORKED COMMUNICATIONS

- A. Provide interface hardware, cabling, and software to enable the following microprocessor- based devices to communicate with the plant-wide Ethernet/Modbus TCP network:
 - 1. Two Schweitzer Electric 735 power revenue meters
 - 2. PLC for source transfer controls

3. Ethernet switch

2.08 SURFACE PREPARATION AND SHOP COATINGS

- A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be manufacturer's standard light gray.
- B. Unpainted non-current carrying parts shall be galvanized to prevent corrosion.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install the switchboard as shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.
- B. Install the equipment in accordance with NEMA PB 2.1.

3.02 FIELD CONNECTIONS

- A. Provide driven ground rods as specified in Section 16660. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment ground bus.
- B. Provide bare copper cable not smaller than No. 3/0 AWG not less than 24 -inches below grade connecting to the grounding electrode system.
- C. Make wiring interconnections between shipping splits.
- D. Install bus splice plates and torque the connections.
- E. Install field wiring per Section 16120. Field wiring shall be grouped by circuit and tie wrapped. Terminations shall not be stressed.

3.03 INSTALLATION

- A. Remove temporary lifting angles, lugs and shipping braces. Remove all current transformer shunts after completing secondary circuits.
- B. Mount indoor switchboards on a four-inch thick concrete slab, unless otherwise indicated. Edges shall have 1/2-inch chamfer. The slab shall extend at least four inches beyond the equipment.
- C. Unless otherwise indicated, the thickness of the concrete slab shall be increased to eight inches thick for outdoor applications, reinforced with 6-in by 6-in No. 6 mesh placed uniformly 4-in from the top of the slab. Slab shall be placed on a 6-in thick, well-compacted gravel base.
- D. The assembly shall be bolted directly to floor sills set level in concrete per manufacturer's recommendations. Floor sills are not required if the floor is level

to 1/8-inch per 3-foot distance in any direction. Provide all necessary hardware to secure the assembly in place.

- E. Locate conduit and cable entrances in the space designated by the equipment manufacturer. Install conduits to prevent water from entering the enclosure. Bond all conduits including stubs to the equipment ground bus. Seal voids around conduit openings in the slab with water and oil resistant caulking or sealant. Cut off and provide bushings for conduits three inches above slab surface.
- F. Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.
- G. Repair damage to galvanized coatings using zinc rich paint.

3.04 FIELD TESTING

- A. Perform physical, electrical, and mechanical inspections in accordance with the manufacturer's recommendations and the following. Provide all temporary power for testing.
 - 1. Compare equipment nameplate data with specifications and approved shop drawings.
 - 2. Inspect physical, electrical, and mechanical condition.
 - 3. Confirm correct application of manufacturer's recommended lubricants.
 - 4. Verify appropriate anchorage, required area clearances, and correct alignment.
 - 5. Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
 - 6. Verify that fuse and circuit breaker sizes and types correspond to approved shop drawings.
 - 7. Verify that current transformer ratios correspond to approved shop drawings.
 - 8. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - 9. Inspect insulating materials and structure for evidence of physical damage, reduced clearances, or contaminated surfaces.
 - 10. Verify that field wiring is adequately separated from live busses. Physically secure the field wiring to withstand the effects of fault currents.
 - 11. Check all devices for damage and make all necessary repairs or replacements, prior to energizing.
 - 12. Verify correct barrier and shutter installation and operation.

13. Exercise all active components.
 14. Inspect all mechanical indicating devices for correct operation.
 15. Verify that vents are clear.
 16. Test operation, alignment, and penetration of disconnecting contacts.
 17. Inspect control power transformers.
 18. Verify all ground connections have been made.
- B. Perform the following before energizing the equipment in accordance with NEMA PB2.1:
1. Retighten all accessible electrical connections to the manufacturer's torque values.
 2. Retighten the wire clamping members of all accessible mechanical pressure wire type connectors to the values specified by the manufacturer.
 3. Retighten conical spring washers according to manufacturer's instructions.
 4. Turn all circuit breakers and fusible switches to the OFF position before energizing the bus.
 5. Adjust ground fault and instantaneous protective devices to their most sensitive settings during start-up. Reset the devices after startup is complete and the equipment has been successfully energized.
 6. Reinstall all parts and barriers removed to facilitate wiring and installation.
 7. Before closing the enclosure, remove all metal chips, scrap wire, and other debris from the switchboard interior. Remove accumulated dust and dirt by using a brush, vacuum cleaner or clean, lint-free rags.
 8. Install covers, close doors, and make certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.
- C. Performance Test
1. Verify complete system operation including all hardware, software and communication devices.
 2. Verify networking performance with all interfacing systems by other manufacturers.

3.05 ADJUSTMENT

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be

in accordance with the approved short circuit and protective devices coordination study.

- B. The contractor's representative shall provide the following services for starting up and programming of the power management system and metering devices:
 - 1. Set all the adjustable or programmable parameters of all devices in the equipment.
 - 2. Coordinate startup with other manufacturer's equipment.
 - 3. Verify the integrity of the data communications network and troubleshoot as necessary.
 - 4. Set all the network addresses of all devices in the equipment.

3.06 CLEANING

- A. Remove all rubbish and debris from inside and around the switchgear. Remove dirt, dust, and concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags.
- B. Vacuum clean the interior of the equipment. Do not use compressed air.

END OF SECTION

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SECTION 16430: PAD MOUNTED TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes pad mounted oil type transformers.
- B. Related Sections:
 - 1. Section 16050 – Basic Electrical Materials and Methods.
 - 2. Section 16121 – Medium Voltage Cable.

1.02 REFERENCES

- A. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.
- B. IEEE Standard 462A, B-1978 Short Circuit Requirements Supplement to ANSI C57.1200-1973.
- C. NECA (National Electrical Contractors Association) -Standard of Installation.
- D. NEMA Standard TRI – Transformers, Regulators and Reactors.
- E. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. Western Underground Committee Guide 2.13 for Vandal Resistance.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data (in accordance with the General Conditions):
 - 1. Equipment sectional and plan views, bottom plan showing conduit openings and anchor bolt pattern, bushing arrangement, dimensions, weight and construction details.
 - 2. Winding and core arrangement, materials, ratings and insulation details.
 - 3. Transformer diagrammatic nameplate information.
 - 4. Itemized bill of materials for accessories.
 - 5. Certified shop test results.
 - 6. Field test results.
 - 7. Installation and maintenance manuals.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record drawings of transformer as indicated above.

- B. Operation and Maintenance Data: Submit manufacturers recommended spare parts listing; source and current prices of replacement parts and supplies; and recommended operation and maintenance procedures and intervals.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 10-years documented experience.

1.06 MANUFACTURERS

- A. ABB – ASEA Brown Boveri
- B. Cooper Power Systems (Eaton)
- C. Square D
- D. General Electric

PART 2 - PRODUCTS

2.01 RATINGS

- A. Transformer self-cooled kVA rating shall be as shown on the Drawings. Winding temperature rise shall not exceed 65 degrees C above a 30-degree C ambient temperature, with a maximum ambient not to exceed 40 degrees C operating at full rated kVA load.
- B. Primary windings shall have the following ratings:
 - 1. Voltage: As shown on the Drawings.
 - 2. Connection: As shown on the Drawings.
 - 3. Basic Impulse Level (BIL): 60 kV
- C. Secondary windings shall have the following ratings:
 - 1. Voltage: As shown on the Drawings.
 - 2. Connection: As shown on the Drawings.
 - 3. Basic Impulse Level (BIL): 30 kV
- D. Transformer impedance shall range between 2.6 and 5.4 percent for 500 kVA units and smaller. Impedance of 750 kVA units and above shall be 5.75 percent.

2.02 CONSTRUCTION

- A. Transformers shall be compartmental type, liquid filled, self-cooled, tamper resistant, weatherproof and suitable for mounting on a concrete pad.

- B. Transformer tank shall utilize welded steel construction, sealed to withstand an internal pressure of up to 7 PSI without distortion and top oil temperatures ranging from 50 to 105 degrees C. Tank cover shall be designed to permit access to internal components for inspection or repair. Heavy duty, non-removable lifting lugs and jacking pads shall be provided. When required, welded cooling panels or radiators shall be provided on the back and sides of the tank.
- C. The high and low voltage compartments shall be located side-by-side separated by a steel barrier. When facing the transformer, the low voltage compartment shall be on the right. Terminal compartments shall be full height, air filled with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened. The low voltage door shall have a 3-point latching mechanism with vault type handle having provisions for a single padlock. The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. The front sill of the compartment shall be removable to allow the transformer to be rolled or skidded into position over conduit stub-ups. ANSI tank grounding provisions shall be furnished in each compartment.
- D. The core shall be five-legged. Windings and internal leads shall be aluminum, insulated and braced to prevent phase flashovers during fault conditions. Transformers with wye connected primary and secondary windings shall have the primary neutral insulated from the secondary bushings shall be externally connected to the tank with removable copper straps.
- E. Transformer insulation oil shall be less flammable seed-oil based fluid ABB Biotemp, Environtemp FR3 or equal. Insulation oil shall be of PCB contamination or any EPA listed toxic chemical. The transformer manufacturer shall test the insulating oil for PCB after filling the tank.
- F. Furnish a no load, externally operated lockable, five-position primary winding tap changer located in the secondary terminal compartment. The tap setting must be clearly visible with the compartment door in the open position. Tap adjustments shall be as follows:
 - 1. For 480Y277 Volt secondary: (2) 2.5 percent taps above and below rated primary voltage.
- G. Terminations
 - 1. High voltage terminations shall be arranged for dead front radial feed or loop feed as indicated on the drawings and conform to ANSI C57.12.26 requirements. Provide universal type bushing wells and parking stands for disengaged elbows. Bushings or wells shall be externally clamped to allow external replacement. The transformer manufacturer shall furnish 600 Amp load-break elbow terminators for each bushing in accordance with ANSI C119.2.
 - 2. Low voltage secondary bushings shall be externally clamped, molded epoxy, spade type with NEMA standard four or six hole arrangement.

Neutral shall be brought out through an insulated bushing and grounded to the tank wall with a removable grounding strap.

H. Primary Fusing

1. Transformer primary shall have bayonet type fuse and back-up oil immersed current limiting fuse. The Bay-O-Net fuse shall be an externally removable loadbreak expulsion type with flapper valve on the assembly. In series with the bayonet fuse shall be an ELSP under-oil partial-range current limiting backup fuse with an interrupting rating of 50,000 Amps. Fuse shall be sized per transformer manufacturers recommendations.

2.03 ACCESSORIES

A. Each transformer shall be furnished the following accessories

1. Nameplate in the low voltage compartment/
2. One-inch drain valve with sampling device.
3. One-inch upper filling plug.
4. Automatic pressure relief device.

2.04 SURFACE PREPARATION AND SHOP COATINGS

- A. All welds shall be ground smooth and all metal surfaces cleaned of oil, grease and weld splatter using a hot phosphate chemical treatment. A zinc-rich, heat cured epoxy primer shall be applied to inhibit rust.
- B. The equipment shall receive an intermediate coat of a heat cured epoxy finish color, followed by an air-dried finish coat of ANSI 61. After finish painting all bottom surfaces and sides up to a minimum of one inch above the ground shall be protected against corrosion by an epoxy tar coating.

2.05 SHOP TESTING

- A. Perform manufacturers standard production testing and inspection in accordance with ANSI Test Code C57.12.90 and NEMA TR1. As a minimum, testing shall include the following:
 1. No load losses at rated current.
 2. Total losses at rated current.
 3. Percent impedance at rated current.
 4. Excitation current test.
 5. Winding resistance measurement tests.
 6. Ratio tests using all tap settings.

7. Polarity and phase relation tests.
 8. Induced potential tests.
 9. Full wave and reduced wave impulse test.
 10. Toxic chemical test (PCB).
 11. Short circuit capability of transformer design.
- B. Manufacturer shall certify compliance with transformer coating performance per ANSI C57.12.28.
- C. Results of the above tests including no load loss data shall be submitted with final drawings the form of certified test reports.
- D. Transformers shall conform to efficiency levels for liquid immersed distribution transformers as specified in the Department of Energy Ruling 10 CFR Part 431 Energy Conservation Program, April 2013.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The equipment shall be leveled and anchored directly to a concrete equipment pad as shown on the Drawings. Provide hardware and metal shims for installation. Anchor bolts shall be ½-inch galvanized steel.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Remove temporary packing and shipping braces. Touch-up damaged paint finishes.

END OF SECTION

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SECTION 16442: PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes distribution panelboards.
- B. Related Sections:
 - 1. Section 16050 – Basic Electrical Materials and Methods.
 - 2. Section 16425 – Low Voltage Switchboards.

1.02 REFERENCES

- A. NECA (National Electrical Contractors Association) -Standard of Installation.
- B. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.
- C. NEMA ICS 2 (National Electrical Manufacturers Association) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
- D. NEMA ICS 5 (National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices.
- E. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- F. NEMA PB 1 (National Electrical Manufacturers Association) - Panelboards.
- G. NEMA PB 1.1 (National Electrical Manufacturers Association) - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Shop Drawings (in accordance with the General Conditions): Indicate outline and support point dimensions, voltage, main bus ampacity, short circuit ampere rating, circuit breaker arrangement and sizes.
- B. Product Data: Submit catalog data showing specified features of standard products.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

- B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

PART 2 - PRODUCTS

2.01 BRANCH CIRCUIT PANELBOARDS

- A. Product Description: NEMA PB 1, circuit breaker type panelboard.
- B. Panelboard Bus: Copper, current carrying components, ratings as indicated on the Drawings. Furnish copper ground bus in each panelboard.
- C. Minimum short circuit rating: 10,000 amperes RMS symmetrical or as shown on the Drawings.
- D. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Circuit breakers shall be pad-lockable.
- E. Enclosure: Panelboard shall be installed in a section of the low voltage switchboard as shown on the Drawings.
- F. Cabinet Front: Surface.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and NECA "Standard of Installation."
- B. Panelboards shall be an integral part of the low voltage switchboards.
- C. Install filler plates for unused spaces in panelboards.
- D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- E. Install engraved plastic nameplates in accordance with Section 16050.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

END OF SECTION

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SECTION 16448: ELECTRICAL CONTROLS AND RELAYS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes pushbutton and selector switches, control stations, relays, time delay relays, control power transformers, and control panels.
- B. Related Sections:
 - 1. Section 17000 – Instrumentation, Control and Monitoring Requirements.

1.02 REFERENCES

- A. NECA (National Electrical Contractors Association) - Standard of Installation.
- B. NEMA ICS 1 (National Electrical Manufacturers Association) - Industrial Control and Systems: General Requirements.
- C. NEMA ICS 4 (National Electrical Manufacturers Association) - Industrial Control and Systems: Terminal Blocks.
- D. NEMA ICS 5 (National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices.
- E. NEMA ICS 6 (National Electrical Manufacturers Association) - Industrial Control and Systems: Enclosures.
- F. NEMA ST 1 (National Electrical Manufacturers Association) - Specialty Transformers (Except General Purpose Type).

1.03 SUBMITTALS

- A. Section 01000 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Comply with NEMA ICS 1 and indicate control panel layouts, wiring connections and diagrams, dimensions, and support points.
- C. Product Data: Submit catalog data for each component showing electrical characteristics and connection requirements.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.05 COORDINATION

- A. Install control switches and indicating lights, as indicated on the Drawings.

PART 2 - PRODUCTS

2.01 CONTROL SWITCHES

- A. Product Description: NEMA ICS 5, heavy-duty, oil-tight devices.
- B. Selector Switch Operator: Rotary.
- C. Pushbutton Operator: Push to actuate-type.
- D. Indicating Lights: Indicating lights for mounting in motor control centers or motor starter enclosures shall be round, oil-tight type, complete with color of lens indicated and legend plate. Lights for mounting in control panels shall be square with single or multi-function indication as indicated. All lights shall be 120-volt AC. Provide 12 spare lamps. All indicating lights shall have push to test feature.
- E. Control switches for mounting in motor control centers or motor starter enclosures shall be round. Control switches for mounting in control panels shall be square push to actuate type.
- F. Provide legend plates to indicate function.
- G. Provide quantity of contact blocks for functionality as required on the Drawings.

2.02 MAGNETIC CONTROL RELAYS

- A. Product Description: NEMA ICS 5, magnetic control relay.
- B. Contacts: Form C.
- C. Contact Ratings: Class A150.
- D. Coil Voltage: 120 volts, 60 Hz., AC.
- E. Enclosure: NEMA ICS 6, to meet conditions of installation.

2.03 TIME DELAY RELAYS

- A. Product Description: NEMA ICS 5, time delay relay with time delay as indicated on the drawings.
- B. Contacts: Form C.
- C. Contact Ratings: Class A150.
- D. Coil Voltage: 120 60 Hz., AC
- E. Enclosure: NEMA ICS 6, Type 1.

2.04 LIMIT SWITCH

- A. Manufacturers:

1. Allen Bradley Model 802 or equal.
- B. Product Description: NEMA ICS 5, heavy duty, lever-operated double pole, double pole contacts shall be rated 5 amperes, 120-volt inductive load limit switch.
- C. Contacts: Form C.
Limit switches shall be mounted on all equipment as indicated or specified and shall be equipped with proper mounting hardware and actuator.
- D. Contact Ratings: Class A150.
- E. Enclosure: NEMA ICS 6, to meet conditions of installation.

2.05 CONTROL POWER TRANSFORMER

- A. Product Description: NEMA ST 1, machine tool transformer with isolated secondary winding.
- B. Power Rating: As indicated on the Drawings.
- C. Voltage Rating: 480 volts primary; 120 volts secondary.

2.06 TERMINAL BLOCKS

- A. Product Description: NEMA ICS 4, terminal blocks.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Include ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install individual relays and time delay relays in enclosures.
- C. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 16050.
- D. Install cabinet fronts plumb.
- E. Make electrical wiring interconnections as indicated on the Drawings.
- F. Install engraved plastic nameplates in accordance with Section 16050.
- G. Ground and bond controls and relays in accordance with Section 16050.

END OF SECTION

SECTION 16461: DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes two-winding transformers.

1.02 RELATED SECTIONS:

- A. Section 16425 – Low Voltage Switchboards

1.03 REFERENCES

- A. NEMA ST 20 (National Electrical Manufacturers Association) - Dry-Type Transformers for General Applications.
- B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

- A. Product Data: Submit outline and support point dimensions of the enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record the actual locations of the transformers.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect the units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with the manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 TWO-WINDING TRANSFORMERS

- A. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers. Transformer shall be UL listed.
- B. Primary Voltage: As indicated on the Drawings.
- C. Secondary Voltage: As indicated on the Drawings
- D. Insulation system and average winding temperature rise for rated KVA as follows:
 - 1. 10-500 KVA: Class 220 with 80°C rise.
- E. Winding Taps:
 - 1. Two 0.5 percent taps above and below normal.
 - 2. Sound Levels: Maximum sound levels shall be at a minimum of 3 dBA below those indicated in NEMA ST-20 for the KVA rating indicated in the drawings.
- F. Basic Impulse Level: 10 Kv.
- G. Ground core and coil assembly to the enclosure by means of a visible flexible copper grounding strap.
- H. Mounting:
 - 1. 10-75 KVA: Suitable for mounting in a low voltage switchboard.
- I. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- J. Isolate core and coil from enclosure using vibration-absorbing mounts.
- K. Nameplate: Include transformer connection data.

2.02 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify mounting supports are properly sized and located.

3.02 INSTALLATION

- A. Transformer shall be mounted in section in low voltage switchboard.

- B. Use flexible conduit for connections to transformer case.
- C. Support transformers in accordance with Section 16050.
- D. Provide seismic restraints.
- E. Install grounding and bonding in accordance with Section 16050.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

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SECTION 16510: LUMINAIRES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes interior and exterior luminaires, lamps, ballasts, and accessories.

1.02 REFERENCES

- A. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
- B. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
- C. Illuminating Engineering Society of North America (IESNA) RP-8-00 - American National Standard Practice for Roadway Lighting.
- D. ANSI LM79 - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
- E. ANSI LM80 - IES Approved Method of Measuring Lumen Maintenance of LED Light Sources.
- F. UL 1598 "Luminaires"
- G. UL 844 "Luminaires for Use in Hazardous (Classified) Locations"

1.03 SUBMITTALS

- A. Shop Drawings in Accordance with the General Conditions: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- B. Product Data: Submit dimensions, ratings, and performance data.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of 3-years documented experience.

1.05 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.06 MAINTENANCE MATERIALS

- A. Furnish two of each plastic lens type.
- B. Furnish one replacement lamps for each lamp installed.
- C. Furnish two of each ballast type.

PART 2 - PRODUCTS

2.01 INTERIOR LUMINAIRES

- A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.02 FLUORESCENT BALLASTS

- A. Product Description: Electronic ballast start less than 10 percent THD, suitable for lamps specified, with voltage to match luminaire voltage.

2.03 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Product Description: ANSI C82.4, high pressure sodium lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.04 LIGHT EMITTING DIODE (LED) LIGHT SOURCES

- A. Product Description: Complete LED luminaire including driver as shown on the Drawings.
- B. LED luminaires shall have a correlated color temperature (CCT) of 3000K \pm 300K.
- C. LED luminaires shall pass 3G vibration testing in accordance with ANSI C136.31.
- D. Luminaires shall produce no measurable light at or above 90 degrees.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories furnished with each luminaire.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Install specified lamps in each luminaire.
- D. Ground and bond interior luminaires in accordance with Section 16050.

3.02 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

- A. Aim and adjust luminaires.

3.04 CLEANUP

- A. Remove dirt and debris from enclosures.

- B. Clean photometric control surfaces as recommended by the manufacturer.
- C. Clean finishes and touch up damage.
- D. Clean all luminaire reflectors, globes, lenses, and diffusers that appear noticeably dirty.
- E. Replace all burned out lamps.

3.05 PROTECTION OF FINISHED WORK

- A. Relamp luminaires having failed lamps at substantial completion.

END OF SECTION

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SECTION 16520: PRESSURE TRANSMITTERS AND SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes materials and installation of the following calibrated field mounted instruments:
 - 1. Pressure transmitters.
 - 2. Tubing, valves, fittings, and manifolds.
 - 3. Pressure switches.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17100 – General Operations.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with 2003 Greenbook Section 2-5.3.

PART 2 - MATERIALS

2.01 PRESSURE TRANSMITTER

- A. The pressure transmitter shall be of the microprocessor-based type 2-wire system. The transmitter shall operate from a 12-24 VDC source. The output signal shall be 4 mA to 20 mA DC. The transmitter shall be housed in a NEMA 4 enclosure and shall be FM approved explosion-proof.
- B. Configuration data shall be stored in nonvolatile EEPROM memory in the sensor. This data shall be retained when power is interrupted, so the transmitter shall be functional immediately upon power up or if the transmitter electronics module should be changed for upgrade or repair. The transmitter shall perform continuous self-tests. In the event of a problem, the transmitter shall activate the user-selected analog output warning.
- C. The pressure transmitter shall provide a 4 mA to 20 mA signal proportional to the calibrated pressure range. The pressure-sensing element shall be silicone oil filled with a process media operating temperature range of -40°F to 250°F.
- D. An integral stainless steel block/bleed manifold (pre-assembled to the transmitter and leak checked) shall be provided for each transmitter. The manifold shall have a block and a vent/test valves.
- E. Provide the pressure transmitter with the following features:
 - 1. Independent pushbutton zero and span adjustments.
 - 2. Overrange protection.

3. Vent/drain valve.
 4. Integral digital indicator, calibrated in engineering units.
 5. Panel mounting bracket.
 6. Two electrical conduit connections, ½-inch NPT female.
 7. ½-inch NPT connection
- F. Accuracy of the pressure transmitter shall be $\pm 0.2\%$ of calibrated span.
- G. The pressure transmitter shall be as manufactured by Foxboro, Rosemount, or approved equal.

PRESSURE INDICATING TRANSMITTERS

1. Tag No.	PIT-0101, 0201, 0301, 0401, 0501	PIT-0700
2. Service	Outlet Pressure	Common Outlet Pressure

TRANSMITTER

3. Diaphragm Material	316 SS	316 SS
4. Output Signal	4-20 mA DC	4-20 mA DC
5. Output Signal To	PLC	PLC
6. Static Press. Rating	2,000 psig	2,000 psig
7. Press. Element Range	0-10/300 psig	0-10/300 psig
8. Press Element Calibrated Range	0 to 300 psig	0 to 300 psig
9. Elect. Class	NEMA 4	NEMA 4

SERVICE CONDITIONS

10. Process Media	Potable Water	Potable Water
11. Specific Gravity	1.0	1.0
12. Oper. Press Psig (min./max.)	0 to 300	0 to 300

- H. Pressure transmitter shall have an integral 4 digit LCD display with indication accuracy of $\pm 0.25\%$ of calibrated span and display resolution of $\pm 0.5\%$ of calibrated span.

2.02 TUBING, VALVES, FITTINGS, AND MANIFOLDS

- A. Instrument tubing connections between process lines and instruments shall be ½ inch in diameter with 0.035-inch seamless wall, annealed ASTM A 269, Type 316 stainless steel.
- B. Fittings shall be Type 316 stainless-steel double ferrule design. Fittings shall be Swagelok, Parker CPI, or equal.
- C. Valves shall be full port ball valves with Type 316 stainless-steel body and Teflon seats and packing. Valves shall be Parker CPI, Whitey, or equal.

2.03 PRESSURE SWITCHES

- A. Pressure switches shall be Type 403 stainless steel bourdon tube actuating an enclosed, metal contact snap-action switch. Switch shall have separate set point and reset point adjustments. Contact shall be connectable as normally open or normally closed. Adjustment of the switch set points shall be accomplished without having to gain access to the interior of the unit. Pressure switch range shall be as directed in the field. Enclosure shall be NEMA 4. Provide Square D 9012 GAW-xxx, GBW-xxx, GCW-xxx, as applicable.

2.04 FLOW SWITCHES

- A. Provide inline flow switch with paddle type system, reed contact, brass body, brass pipe section. The size of the inline body shall be (1/2", 3/4", 1"). Switch shall be rated at 362 psi maximum pressure, 110°C maximum process temperature, 80°C maximum ambient temperature. Switch shall be rated 1A maximum switching current; 230VAC, 48VDC maximum switching voltage; maximum rating 26VA, 20 Watt; 15% set point tolerance; plug connector suitable to outer cable diameter 4.57 to 6.85 mm (0.18" to 0.27"). Switch shall be Omega model number FSW3, or approved equal.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 16920: INTEGRATED POWER ASSEMBLY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes integrated power assemblies.
- B. The specification covers requirements applicable to the provision of Integrated Power Assembly (IPA). The IPA shall be environmentally controlled and shall consist of a coordinated grouping of electrical power and control equipment as indicated on the drawings. Any data sheets, drawings, or any other related documents accompanying this specification shall be considered a part of this specification.
- C. The IPA supplier shall furnish, install, interconnect and test the equipment and materials specified herein, as well as any equipment specified in any related documents. The contractor shall be responsible for the complete installation including enclosure, all electrical equipment and all interconnecting wiring and cabling.
- D. Site conditions shall be shown on the data sheet(s). These conditions shall be considered when sizing and designing equipment, air conditioning unit and structures.
- E. Related Sections:
 - 1. Section 16050 – Basic Electrical Materials and Methods.
 - 2. Section 16265 – Variable Frequency Drives.
 - 3. Section 16425 – Low Voltage Switchboards.
 - 4. Section 16700 – Instrumentation, Control and Monitoring.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC)
- B. American National Standard Institute (ANSI)
- C. American Society of Testing and Materials (ASTM)
- D. American Welding Society (AWS)
 - 1. AWS D1.1 Structural Welding Code – Steel
- E. National Fire Protection Association (NFPA)
- F. National Electric Code (NEC)
- G. National Electrical Manufacturers Association (NEMA)

- H. Underwriters' Laboratories (UL)
- I. California Building Code (CBC)
- J. State Modular Building Code Programs where applicable
- K. NECA (National Electrical Contractors Association) -Standard of Installation.

1.03 SUBMITTALS

- A. Shop Drawings (in accordance with the General Conditions):
 - 1. Structural drawings including:
 - a. General notes.
 - b. Building plan view.
 - c. Building base skid detail.
 - d. Building elevations.
 - e. Stair and landing details.
 - f. Stamped structural calculations.
 - g. Air conditioning mounting details.
 - 2. HVAC unit sizing calculations.
 - 3. Electrical drawings including:
 - a. Electrical notes.
 - b. Building electrical plan, including conduit, cable tray, subfloor wireway, and any other means of wiring transit. Drawings shall also include conduit fill.
 - c. Building services wiring diagrams.
 - d. Grounding system plan.
 - e. Interconnection wiring diagrams.
- B. Product Data: Submit catalog data showing specified features of standard products.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process.

2. Wiring diagrams.
 3. Certified structural calculations.
 4. Installation information including equipment anchorage provisions.
 5. Seismic certification as specified.
- B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

- A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. Provide Seismic tested equipment as follows:
1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the [latest California Building Code (CBC)].
 2. The Project Structural Engineer shall provide site specific ground motion criteria to establish the S_{DS} values required for the equipment. The CONTRACTOR shall evaluate the S_{DS} values published on the Manufacturer's website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
 3. The I_P rating of the equipment shall be 1.5.
 4. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The CONTRACTOR shall employ and pay for the services of a licensed Civil or Structural engineer in the State of California to provide equipment anchorage details and calculations, coordinated with the equipment mounting provision locations provided by the equipment manufacturer. Mounting recommendations based upon those used in actual testing shall be provided by the manufacturer to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand ($I_P = 1$) and function ($I_P = 1.5$) following a seismic event, including both vertical and lateral required response spectra as specified in the above codes. Seismic qualification shall be considered achieved when the capability of the equipment meets or exceeds the specified response spectra.

PART 2 - PRODUCTS

2.01 INTEGRATED POWER ASSEMBLY

- A. The Integrated Power Assembly (IPA) shall be designed and constructed for outdoor use, under wind and seismic load conditions per the CBC guidelines for the job site.
- B. The building and all components mounted thereon shall be designed for, and anchored sufficiently for, transportation to the job site.
- C. The skid shall be of concrete construction.
 - 1. Concrete construction shall consist of six-inch ribbed construction with proper rib size and spacing to meet the required floor loadings. Increased floor thickness (up to 8") may be required to meet floor live load requirements. Properly reinforced 5000-PSI lightweight concrete should be used for all floor panels. Concrete ribs will be placed a maximum of 48" on center. Concrete ribs will be of adequate size to resist the loadings applicable of the building design. Reinforcement should be properly placed in the concrete panel to provide adequate reinforcement, spacing and cover as required by ACI 318. Panels should be poured to include all attachments necessary to lift and fully assemble the building units. All concrete units should be poured on flat smooth steel form-work. Floor must be bolted to adjoining walls. All structures to be shipped with floor systems fully assembled to walls.
- D. The floor shall be a minimum of 1/4-inch H.R. ASTM-A36 minimum smooth steel plate, welded to the perimeter and longitudinal and/or transverse structural members of the skid. The floor loading shall be no less than 250 PSF.
 - 1. The floor shall be provided with gasketed floor cutouts where required for power and control cable entry/exit from the equipment. The cutouts shall be provided with 12 gauge galvanized or painted coverplates.
- E. Building construction:
 - 1. Building walls, roof and ceiling shall be fabricated from properly reinforced 5000-PSI lightweight concrete. Exterior walls, exterior roof and interior ceiling shall be self-framing, interlocking design, with maximum panel width of 16-inch, or framed construction with maximum panel width of 36-inch.
 - 2. Exterior walls shall be properly reinforced 5000-PSI lightweight concrete or minimum of 18-gauge thickness for self-framing and interlocking design, or 24-gauge thickness framed construction design, but rated to withstand the loading requirements of the job site.
 - 3. Interior walls shall be constructed of six-inch "ribbed" panel construction, bolted to adjoining walls, that is properly reinforced 5000-PSI lightweight concrete, but rated to withstand the loading requirements of the job site.

4. Exterior roof shall be properly reinforced 5000-PSI lightweight concrete for self-framing and interlocking design but rated to withstand the loading requirements of the job site. The roof shall be sloped away from the personnel doors, where feasible. Gutters and downspouts shall be provided when the roof slope is directly over personnel or rear access equipment doors.
 5. Interior ceiling shall be properly reinforced 5000-PSI lightweight concrete but rated to withstand the loading requirements of the job site.
- F. For a building which must be shipped in multiple shipping sections, miscellaneous NEMA 1 junction boxes will be provided at the shipping splits for easy breakdown of the building wiring for shipment and reconnection at the job site. Prior to shipment the open end/sides of each shipping section will be crated (weatherproofed) for transit to the job site. The crating must be performed by a company recognized and experienced in the trade which includes the IPA manufacturer.
 - G. Where wall bulkhead penetrations are required, the cutouts shall be completely framed with 1/4" aluminum cover plates with neoprene gasket.
 - H. All fastening hardware shall be zinc plated, stainless steel or aluminum. Welding of galvanized steel and rivets shall not be the primary method of exterior fastening. Rivets can be used for mounting non-load-bearing trim members.
 - I. The building shall be provided with a minimum of two (2) entrance doors. The doors shall be double wall construction, with brushed aluminum panic hardware with cylinder lock and thumb latch, brushed aluminum automatic closure with built-in hold open device, prime coat or stainless steel hinges, threshold, weather-stripping, drip shields/water flashing, "**DANGER, HIGH VOLTAGE, KEEP OUT**" sign, and a 12-inch removable transom above the equipment door, when required. The personnel door shall be 36-inch x 84-inch. The equipment door shall be 48-inch x 84-inch.
 1. The supplier shall provide landings and stairs for the building. The stairs shall be built in compliance with the CBC code, and shall be hot-dipped galvanized after fabrication
 - J. For equipment requiring rear access, the supplier shall provide 14-gauge minimum galvanized steel, gasketed and hinged equipment rear access doors, with 3-point latching system with galvanized padlockable handles, "**DANGER HIGH VOLTAGE**" sign, and drip shields/water flashing.
 - K. The walls, roof and floor shall be fully insulated, with a minimum of R-11 insulation. The walls and roof shall be provided with fiberglass batt type insulation, minimum R-11. The floor shall be provided with polyurethane spray foam insulation, minimum R-6.
 - L. The building shall be provided with a paint system per the following:

1. The skid shall be prepared to the appropriate SSPC standard (SSPC-1, SSPC-2, SSPC-3) for removal of rust and scale prior to painting. A 2-3 mil application of Zinc rich primer shall be provided.
 2. The floor shall be provided with a 2-3 mil application of "Red" epoxy iron oxide primer, followed by a 2-3 mil application of ANSI-61 gray epoxy, with a non-skid finish.
 3. The exterior and interior of the building shall be provided with a 0.3-0.6 mil application of a vinyl wash primer, followed by a 2-3 mil application of white epoxy paint
- M. The building shall be provided with a HVAC system, sized and provided by the supplier, considering the ambient site conditions, the dimensions of the building, the solar heating of the building, and the heat generated by the equipment within the building. The system shall be designed such that the sensible cooling capacity, not the total cooling capacity, will maintain an ambient temperature within the building of between 55°F winter and 80°F summer at design conditions. The system shall be provided with an electronic, automatic changeover thermostat.
- N. The supplier shall furnish all electrical distribution equipment necessary for the proper operation of building services within and without the building. The operating voltage of all distribution equipment shall be 120/208, three-phase. The primary side of any distribution transformers shall be 480 V, three-phase.
- O. The building shall be provided with twin tube, rapid start, fluorescent lighting fixtures, controlled via three-way wall switches to be located at each entry door.
- P. The building shall be provided with 125 V, 20 A duplex receptacles at each entry door.
- Q. The building shall be provided with LED exterior lights at each entry door, controlled via photocell and H-O-A switch.
- R. All wiring shall be type THWN, #12 AWG minimum for power circuits, minimum #14 AWG for control circuits. For all control interconnection wiring, both ends of the wire shall be provided with polyolefin sleeve type wire markers.
- S. EMT conduit shall be utilized for interior applications. PVC coated rigid galvanized steel conduit shall be utilized for outdoor applications.
- T. Any cable tray necessary shall be aluminum, 6-inch high with 9-inch rung spacing. All fittings shall have a minimum of 12-inch radius.
- U. 1/4-inch x 2-inch copper ground bar running the length of the building shall be provided, mounted approximately 6-inch above floor and connected to each end of the equipment ground bar. A #4/0 green insulated copper ground cable shall be provided from the ground bar to the exterior ground pads. A green insulated copper ground wire/cable will be provided from the ground bar to all auxiliary electrical equipment per NEC Table 250-95.

PART 3 - EXECUTION

3.01 TESTING AND INSPECTION

- A. The following testing and inspection shall be performed on the building:
 - 1. Continuity checks of all wiring installed by the supplier.
 - 2. Operational check of all supplier furnished and installed electrical apparatuses.
 - 3. Switchgear and Motor Control Center shipping sections' bus shall be re-spliced, torqued and meggered.
 - 4. A certified test report shall be provided by the supplier's Quality Assurance Manager
 - 5. If necessary, secondary control power shall be provided for customer use. Available control power voltages shall be 120/240 volt, 1-phase.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

END OF SECTION

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SECTION 17000: INSTRUMENTATION, CONTROL & MONITORING REQUIREMENTS

PART 1 - GENERAL

1.01 WORK REQUIREMENTS

- A. Instrumentation work shall be provided as indicated, specified and required. The intent of this section is to require that the complete instrumentation, control and monitoring system, including all parts of this section, i.e., primary elements, panel mounted and miscellaneous field instruments, etc. shall be furnished by a single ICM system supplier to assure system uniformity, subsystem compatibility and coordination of all system interfaces. Deviations shall be considered in special circumstances but must be approved by the Owner.
- B. Furnish all equipment, materials, supplies and special tools required for proper installation of the ICM system. Provide all supervision and coordination required by the electrical contractor to ensure conduit runs, signal and power wiring is consistent with the requirements of all equipment as specified in this section. Perform all operational testing of individual systems and the complete start-up of the system as indicated on the Drawings and as specified herein.
- C. Provide all the necessary equipment components and interconnections and the services of the manufacturers' engineering representatives for the engineering, implementation, start-up, operation and instruction, to ensure that the Owner receives a completely integrated and operational ICM as herein specified.
- D. The ICM supplier shall provide, install and program the PLC and OIT to operate the facility as stated in Section 17100, General Operations.
- E. The ICM supplier shall provide a written plan to verify that each control/instrumentation component is fully functional and provides the appropriate input to the PLC as stated on the Drawings and is capable of providing the interface with the future City-installed fiber optic system.
- F. Programming shall be provided a District selected vender, with no equal. The fee for programming services is pre-negotiated as listed in the Bid Schedule.

1.02 RELATED WORK NOT INCLUDED IN THIS SECTION

- A. Process piping, installation of in-line instrumentation, i.e., primary elements, items in process pipelines, air compressors, main air supply headers and miscellaneous mechanical work, shall be as specified in other sections, if required.
- B. Electrical power distribution, all conduit, and wire for power and signal distribution shall be provided by the electrical contractor as specified in Division 16. Any special cable required between sensors and transmitters will be provided by the ICM system supplier. All other required wire and conduit will be provided by the electrical contractor. Special cable will be installed by the electrical contractor.

1.03 SYSTEM RESPONSIBILITY

- A. The Contractor's attention is directed to the fact that the ICM system as specified in this section is an integrated system and, therefore, shall be provided by a single competent, qualified instrumentation system supplier (hereinafter in this section referred to as the ICM system supplier), who shall have total responsibility for the work of this section. Entire system including calibration, validation, start-up, operation testing and training shall be performed by qualified personnel, possessing all the necessary equipment and who have had experience performing similar work. The ICM system shall be integrated using the subcontractor's latest, most modern proven design and shall, as far as practical, be of one manufacturer. Overall system performance shall be guaranteed by the specified ICM system supplier.
- B. The Contractor shall select the system supplier to perform the work under this section. The qualified ICM system supplier shall perform said work but it shall be understood that this shall not relieve the Contractor from any responsibility under the Contract. Although many references made herein are to work requirements and responsibilities of the ICM system supplier, such references shall only mean that responsibility shall pass through the ICM system supplier but in the final analysis shall rest with the Contractor.
- C. The ICM system supplier shall be responsible for the correct installation for all hardware and systems specified in this section. Certain primary elements, final control elements, etc., although provided as a part of this section, shall be installed in the process lines under other sections of these Specifications; however, this installation shall be under the *direct supervision* of the ICM contractor.
- D. The ICM system supplier shall be responsible to see that all components of the instrumentation system, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling and alarming devices and all appurtenances, are completely compatible and shall function as outlined, and he shall furnish such additional equipment, accessories, etc. as are necessary to meet these objectives at no additional cost.

1.04 ICM SYSTEM SUPPLIER

The complete control system shall be furnished by a single supplier who shall assume responsibility for the satisfactory performance of the complete system. The ICM supplier shall provide the following minimum criteria:

- A. Demonstrate the company's ability to successfully complete projects of similar size and nature. Provide references (including contact name and telephone number) for at least three projects where the following tasks were performed by personnel directly employed by your firm as a system supplier, system engineering and documentation including panel assembly, schematics, and wiring diagrams, software configuration and documentation; field testing, calibration and start-up, and operating instructions and maintenance training.
- B. Name the individual persons who will be responsible for office engineering and project management, software configuration, field testing, calibration and start-

up, and operator instruction and maintenance training. References called for in the previous item shall include recent projects of these individual persons.

- C. Document that the company is actively in the business of furnishing integrated instrumentation, telemetry, control and electrical equipment for the water and wastewater industries.
- D. Have a qualified service facility with permanent employees located within 100 miles of the job site. Facility to include all tools, spare parts and test equipment to repair, calibrate, test and start-up the equipment to be provided on this Contract.
- E. Pre-approved ICM system suppliers are listed below.
 - 1. Norman S. Iseri, P.E.
RKI Engineering LLC
2029 Verdugo Blvd #109
Montrose, CA 91020
(818) 317-3003
rki-engr@earthlink.net
 - 2. Dave Stone
Control Technologies
5726 Corporate Avenue
Cypress, CA 90630
(714) 527-3500
davids@control-technologies.com
 - 3. Tom Visosky, P.E.
CDM Smith
600 Wilshire Boulevard, Suite 750
Los Angeles, CA 90017
(213) 457-2133
visoskyta@cdmsmith.com
 - 4. Jerry Horst
TESCO Controls, Inc.
8440 Florin Road
Sacramento, Ca. 95829-9007
(916) 799-0182
jhorst@tescocontrols.com

1.05 CERTIFICATION BY SYSTEM SUPPLIER

At the time of quoting to the Contractor prior to bid opening, the prospective system supplier shall execute and submit a written certification of intent to assume full responsibility for the complete requirements of the Contract Documents. A signed copy thereof shall be supplied to each prospective contractor for inclusion by him with his bidding documents. Failure by a bidding system supplier to provide this written certification shall be treated by the Contractor as *NO BID* and that system supplier will not be acceptable. The Contractor shall include with his proposal the certification, required above, only for the system supplier for whom he has inserted a price in the

bidding documents. The certification shall be on the named system supplier's letterhead, it shall be signed by his authorized responsible representative, and it shall include the following statements:

- A. (Corporate name of system supplier) hereby certifies intent to assume and execute full responsibility to select, furnish, supervise installation and connection, test and calibrate, place into operation all specified instrumentation, equipment and all assemblies, components, and accessories needed to place into service complete operating instrumentation and control system all in full compliance with the requirements of the contract documents.
- B. In addition, it is certified that drawings and data will be prepared and submitted, specified field services will be performed by qualified personnel, the Owner's operating and maintenance personnel will be instructed, and technical manuals will be prepared and submitted.
- C. Finally, it is certified that the quotation offered provides for full and complete compliance with the requirements of the Contract Documents without exception.

1.06 QUALITY ASSURANCE

A. Qualification and Product

The ICM system supplier shall, in fact, be a recognized supplier of primary elements, panel and field instruments, panels, etc., of the general type specified herein and shall have been regularly engaged in providing this equipment on a single system responsibility basis for municipal water and wastewater treatment processes. Also, the personnel employed for system engineering, supervision, start-up, operational testing and training shall be regularly employed and factory trained by the ICM system supplier. Actual installation may or may not be performed by the ICM system supplier employees, but the ICM system supplier shall be responsible for the technical supervision of the installation to ensure that it is proper in all respects.

B. Standard of Quality

1. The ICM supplier shall furnish equipment of the types and sizes specified which has been demonstrated to operate successfully. Wherever on the drawings and in these Specifications, materials or equipment have been specified by using the name of products or manufacturers, no substitutes will be allowed. Material or equipment, so specified, has been selected as being most suitable. The order of listed manufacturers shall not be construed as a preference or order of quality. Where the manufacturers listed are followed by "or equal," the burden of proof of equivalency in quality and performance shall rest with the ICM system supplier and shall require the Owner's written approval. The procedure for submission of products for approval as equivalent shall be as specified under submittals below.
2. All electrical equipment and materials, including their installation, shall conform to Division 16, unless specified otherwise in this section.

C. Factory Inspection

1. The Owner may inspect fabricated equipment at the factory. Notify the Owner in sufficient time so that factory inspection can be arranged. Factory inspection shall be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations. Approval of equipment at the factory only allows the manufacturer to ship the equipment to the site, and does not constitute final acceptance by the Owner.
2. The Owner shall indicate on return of the approval submittal each item requiring factory inspection. Lack of such indication by the Owner shall constitute a waiver of factory inspection.

D. Coordination with Electrical

Conduits and wire for instrumentation are supplied under Division 16. Prior to installation of any instrumentation conduit, verify conduit size and conduit runs with the electrical supplier. Notify the Owner of any conflicts or deviations prior to installation.

E. Drawings

1. Information on the Drawings

The following information relative to the work of this section is indicated on the Drawings.

- a. Location of all primary elements, control panels and final control elements.
- b. Location of instrumentation power junction boxes for instrument electrical power connection.
- c. Location of all equipment having alarm and equipment status contacts.
- d. General control system and control panel layouts.

2. Information Not Shown on the Drawings

The following information relative to the work of the section may differ from the Drawings, but shall be the responsibility of the ICM system supplier to determine, furnish and coordinate with the applicable other sections, based on the system specified.

- a. Coordinate with electrical the actual number and size of conduit runs and tubing for power between instrument power junction boxes, signal conduit stub-outs, main headers and control panels, field mounted primary elements, field instruments and final control elements.
- b. Number or sizes of conductors or tubing required for all electric, pneumatic and hydraulic signals.

- c. Point of connection to any hydraulic or pneumatic supply lines.
- d. Detailed control panel layouts.

1.07 SUBMITTALS

- A. Refer to Section 01000 for required method of preparation and transmittal, and conform to requirements herein.
- B. Presubmittal Conference
 - 1. A conference shall be arranged between the ICM system supplier and the Owner or his representative within 60 days after award of the contract for the purpose of informally discussing in detail and verifying the correctness of the ICM system supplier system engineering methods and equipment and to generally provide a framework for communication and coordination. This conference shall be attended by ICM system suppliers, the Engineer and duly authorized representatives of the Contractor and Owner.
 - 2. A draft of the submittal for review shall be prepared. The draft shall include the following, as a minimum:
 - Listing of major items proposed for this section. Identify item tag number, description, function, manufacturer, model number, descriptive literature and statement as to whether item is "as specified" or "equivalent." Items identified as "equivalent" shall be accompanied by a comparative listing of the published specifications for the item specified and for the item proposed.
- C. Shop Drawings
 - 1. Before proceeding with any manufacturing, submit shop drawings for review in complete bound sets indexed by specification number. Describe the items being submitted. The manufacturer's specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Submit only complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with tag numbers. Submit fabrication, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing all equipment and tag numbers on all panels. Include space for the City-installed fiber patch panel and Vilink unit. Include material specifications lists where applicable.
 - 2. An "Equipment Specification Data" form shall be submitted for each item of equipment that shall summarize the specification features as called for in these Specifications and include such other necessary data as would provide a complete and adequate specification for reordering an exact duplicate of the original item from the manufacturer at some future date.

3. The assigned tag numbers and manufacturer's part numbers shall be included but will not be considered as a substitute for any of the required statement of specifications. More than one tag numbered item may be included on a sheet.

D. Software Documentation Summary

The submittal phase shall also include with the shop drawings as specified in this section, software documentation for the PLC and the proposed screen displays for the operator interface unit. The software documentation shall provide a narrative description of PLC functions including setpoints, adjustable ranges available, control sequences, I/O, and general operation summary. The screen displays shall allow full operator observation of all PLC inputs/outputs as well as the capability of setting local automatic set-points and PLC programming. The portable station programmer shall be utilized for station start-up and it shall also include software documentation.

E. Record Drawings

1. Process and Instrumentation Diagrams

"Record" process and instrumentation diagrams shall be prepared and submitted for all work included in this section.

2. Record Drawings

Without limiting the generality of other requirements of these Specifications, arrange for the submittal, by the subcontractor, of a reproducible Mylar of complete schematics and wiring diagrams or drawings to include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, point to point diagrams with a cable, wire, tube and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "Record."

F. Instruction Manuals

The ICM supplier shall furnish 10 sets of instruction manuals and parts lists for instrumentation equipment provided under this section. Obtain data from the manufacturers, and format and bind as specified. Obtain distribution method instructions from the Owner or his representative.

1. Schedule

Copies of manuals shall be delivered no later than the equipment shipment date.

2. Contents

Manuals shall include not less than the following final version of information, as applicable, for each instrument, equipment, subsystem and/or control loop.

- a. General, introduction and overall description, purpose, functions, simplified theory of operations, etc.

- b. Specifications (including equipment specification data sheet as described above under shop drawings).
- c. Installation instructions, procedures, sequences, tolerances and precautions.
- d. Operational procedures.
- e. Shut-down procedures.
- f. Maintenance, calibration and repair instructions.
- g. Parts list and spare parts recommendations.
- h. Register bit assignments (Excel format).

G. Format

Drawings and pictorials shall be used to illustrate the text to the extent necessary to ensure a clear, concise presentation. If manuals have been written to cover a family of similar instruments or equipment, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles or boxes; whichever provides the clearest and neatest presentation.

Manuals shall be grouped by system control panels, including field instrumentation connected or associated with the panel. Where identical instruments are used in more than one control loop or subsystem, include only one instruction manual, per panel grouping; however, an index by tag number for all instruments shall identify its location in that manual.

Control loop and/or subsystem operational descriptions shall identify the function of each instrument and its reaction to the other instruments in the loop.

H. Binding

Each manual shall be bound in a cover that indicates the panel or process area to which it applies, the manufacturer's name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three-ring binders and include the system name and subcontractor's name on the binding.

I. Accessory and Maintenance Materials

The following items shall be furnished as specified herein and delivered to the Owner, as directed, with an itemized list in a letter of transmittal accompanying each shipment.

1. Special Tools and Accessories

Special tools, instruments and accessories for maintaining instruments and equipment requiring periodic repair and adjustment shall be furnished as specified elsewhere herein. Also, special lifting and handling devices for equipment requiring such devices shall be furnished.

2. Maintenance Materials and Spare Parts

The spare parts and maintenance materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.

Spare parts shall consist of the following basic items:

- a. One minimum of each type of plug-in, etched or printed circuit board assembly. Provide 5 percent spares for boards in multiple use.
- b. Two of each type switch used.
- c. Ten percent but not less than six of each type light bulb and fuse used.

J. ICM System Supplier Certified Reports

The ICM system supplier shall submit a written report for each control panel and associated field instruments certifying that (1) the equipment had been properly coordinated and installed under his supervision, (2) the equipment is in accurate calibration, (3) he was present when the equipment was placed in operation, (4) he has checked, inspected, calibrated and adjusted the equipment as necessary, (5) equipment has been operated under maximum power variation conditions and operated satisfactorily, and (6) the control panel and associated field instruments are fully covered under the terms of the guarantee.

K. Demonstration and Final Operation Test Plans and Results

The ICM supplier shall submit for approval the following:

1. A written plan for demonstrating that each system of equipment provided under this section meets the specified operational requirements.

The written plan shall include a checklist based upon the PLC I/O, OIT, hardwired connection diagrams and field instrumentation components. Each item identified on the checklist shall be signed by the Contractor's system integrator and the Owner's Representative. This checklist shall be submitted to the Owner for approval prior to scheduling the control/instrumentation verification.

Control/instrumentation verification shall be conducted in the presence of the Owner's Representative and other personnel as designated by the Owner.

In general, the control/instrumentation verification procedure shall consist of the following:

- The Contractor to demonstrate that wiring is installed between each instrumentation/control component and the PLC per the plans.
- The Contractor to demonstrate that each PLC I/O is installed per the plans.
- The Contractor shall demonstrate that each I/O point provides the functionality and as required in the contract documents.

- The Contractor shall demonstrate that instrumentation is calibrated at 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of span per the Specifications.
 - The Contractor shall demonstrate that hardwired control/instrumentation is installed and operates per the plans and Specifications.
 - The Contractor shall demonstrate that the communication link between the PLC and the operator interface terminal (OIT) is properly installed and functional.
2. A written plan for procedures to be used in final operation testing of entire systems including a description for each system of test methods and materials, testing all instruments, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary by-passes and like facilities.
 3. Submit three copies of test results and records for all final operation tests including equipment calibration dates.

L. Screen Displays

The operator interface panel shall display, as a minimum, the following screens:

1. Station alarms.
2. Station graphic showing well pump status, and check and drain valve status. Pump shall be able to be started and stopped from this screen, independent from SCADA control.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The ICM system supplier shall box, crate or otherwise enclose and protect instruments and equipment during shipment, handling and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element that could degrade the equipment.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

1.09 JOB CONDITIONS

- A. Drawings are diagrammatic and show the intended arrangement for system operation, piping and appurtenances. Drawings shall be conformed to as closely as possible and care shall be exercised (1) to secure neat arrangement of piping, valves, conduit, and like items, and (2) to overcome structural interferences. Dimensions and conditions at the place of work shall be verified so that all materials and equipment can be installed in the available spaces.

1.10 GUARANTEE AND WARRANTIES

- A. All work of this section shall be guaranteed in accordance with Section 01000 and Section 16000. With respect to instruments and equipment, guarantee shall cover (1) faulty or inadequate design; (2) improper assembly or erection; (3)

defective workmanship or materials; and (4) leakage, breakage or other failure not caused by Owner misuse. For equipment bearing a manufacturer's warranty in excess of 1 year, a copy of the warranty shall be furnished to the Owner with the Owner named as beneficiary.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials and Standard Specifications

Instruments, equipment and materials shall be suitable for service conditions and meeting standard specifications such as ANI, ASTI, IA and SAGA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant; i.e., all instruments in the plant, supplied by the ICM system supplier, of the same type shall be by the same manufacturer. This allows the stocking of the minimum number of spare parts.

B. Structural Steel Fabrications

All fabrications shall be designed for dynamic and vibratory loadings. Structural steel shapes shall conform to ASTI A36, A440, A500, A501, A570, A618 or equal, as applicable. Welding shall conform to AWS D2.0 Code. Specific items shall be galvanized in accordance with ASTI A123 or A336 as applicable; use galvanized bolts and fasteners with galvanized assemblies. Minimum 1/4-inch thickness steel shall be used for entirely or partially submerged during equipment operation. Design calculations shall be submitted and show adequate structural integrity for the intended purpose.

C. Mountings

Equipment shall be mounted and installed as indicated. Where not shown, field instruments shall be mounted according to best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with the supplier's recommendation. Where mounted in control panels, mounting shall conform to requirements of that section.

Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting and non in-line indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet nor higher than 5 feet above walkways, platforms, catwalks, etc. All such equipment shall be weather and splash proof, and electrical equipment shall be in NEMA 4 cases. If mounted in a designated hazardous area, the equipment shall be explosion proof or rated intrinsically safe, whether so specified herein or not. Antenna cables shall enter cabinet from side or bottom to minimize water intrusion damage.

D. Instrument Identification

All major instrumentation and equipment items or systems specified in this section are identified by system and tag numbers. This same number appears in the tag number designations on the drawings and on the schedules of these Specifications. All instrumentation and equipment shall be identified by nameplates or tags. Nameplates for panels and panel mounted equipment shall

be as specified in the section for panels and control room hardware. Field equipment shall be tagged with assigned instrumentation tag number. Tags shall be laminated plastic and shall be positioned and lined up to provide a neat appearance. They shall be attached to the cleaned metal surfaces with Type 316 stainless steel screws. For field panel or large equipment cases, use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part. In all cases the tag shall be plainly visible to a standing observer. In addition to tags, field mounted control stations shall have a nameplate indicating their function and the variable controlled. The nameplate shall be attached by one of the above methods.

E. Electronic Equipment

If the equipment is electronic in nature, provide solid-state equipment to the extent practicable. Select components of construction for their suitability and reliability. Employ adequate components de-rating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Design units or operation without forced cooling, unless such cooling is an integral part of the device.

F. Equipment Operating Conditions

All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:

1. Electrical

120 volts AC ± 10 percent, 60 Hz ± 1 -Hz single-phase, except where specifically stated otherwise on the Drawings or in the Specifications.

2. Air

20 psig, ± 1 psig.

3. Field Instruments

a. Outdoor Areas

Ambient Temperature: 15°F to 120°F

Ambient Relative Humidity: 5 percent to 100 percent

Weather: Rain, sleet, snow and ice

Provide, as necessary, enclosures, sunshields, thermostatically controlled heaters, etc., to assure normal operations under these conditions.

b. Indoor Unheated Areas

Ambient Temperature: 35°F to 120°F

Ambient Relative Humidity: 5 percent to 100 percent

c. Indoor Environmentally Controlled Areas

40° to 90°F

G. Power Supplies

Electrical instruments and control devices shall be provided for operation on 120 volts, 60 Hz single-phase current. This requirement is to prevent total loss of control because of the failure of a common DC power supply. This requirement shall be waived upon demonstration to the satisfaction of the Owner that the ICM system supplier shall install dual DC power supplies in each panel with automatic failure detection and annunciation and switch over without loss of control functions. These dual power supplies shall be totally independent with all solid-state rectifiers, regulators, failure sensing, and output switching. Source of operating power shall be 120 volts, 60 Hz single-phase commercial power. Units shall be rack mounted within the control panels.

H. Signal Isolators, Converters and Conditioners

Ensure that input-output signals of all instruments and control devices are compatible. Unless otherwise specified, signals between field and panels shall be 4 to 20 mA DC unless specifically indicated otherwise. Granting such approval does not relieve the ICM system supplier from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application. Provide items as manufactured by AGM Electronics, Action Instruments, or equal.

I. Auxiliary Contacts by Others

Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

J. Air Supply Valves

Provide valves for instrument air supply shut-off, regulating, switching, metering, valve manifolds, etc, equal to valves manufactured by Whitey Company, Nupro Company, Tylok International or equal.

K. Instrument Piping

Provide instrument air and instrument pneumatic piping, as specified in other sections and as necessary and/or as specified herein. Instrument air header shall be furnished and installed under other sections. Connect to main instrument air header at a point not more than 10 feet distant from air consuming device(s). All connections to equipment shall be made with separable or union type fittings and shall include shut-off valves. All hydraulic and/or pneumatic piping shall be tested for leaks prior to placing the system in operation. Provide quality of instrument pneumatic air fittings equal to Swagelok as manufactured by Crawford Fitting Company, Cajon as manufactured by Cajon Company, Tylok International, or equal.

L. Painting

The Contractor shall provide factory paint for all instruments and equipment except where in pipelines. Paint shall be as required in Section 09900 of these Specifications for cabinets, boxes, structural supports, brackets, etc.

M. Electrical

1. The construction work shall include all the power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified and required and not specifically included under Section 16000.
2. Wiring installations shall include cables, conductors, terminals connectors, wire markers, and all other required materials not specifically included in other sections. For wiring materials, refer to Section 16000 and details on the electrical drawings.
3. Provide the materials and complete all the required installations for equipment grounding as specified in Section 16000 of these Specifications, and indicated on the electrical Drawings.
4. Incidental items, not included in the Contract Documents, that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided by the ICM system supplier.
5. Field Wiring: The Contractor shall use 14-gauge or larger stranded cable for multiple conductors for instrument signal wiring of low voltage service. Shielded conductors shall be provided if necessary for proper performance and operation of equipment. Use insulation rated for intended service. Signal wiring shall be rung out prior to termination. Wire number tags shall be provided and marked in indelible waterproof form of slip-on type or equal for each termination. Pre-insulated crimp-on connectors shall be provided for wire terminations. A ratchet-type crimping tool shall be used that does not release until proper crimp pressure has been applied. All alarm and status signals shall be 30 volt DC maximum.

N. Process Connections

Instrument impulse piping, tubing and capillary tubing shall be provided to meet the intended process service and ambient environmental condition for corrosion resistance, etc. Lines shall be sloped according to service to promote self-draining or venting back to the process. Connection shall be terminated to process lines or vessels in a service rated block valve, provided under other sections that will permit closing off the impulse line or removal of the element without requiring shut-down of the process. Blow-down of drip legs and valves shall be included for terminations of impulse lines at the instruments. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished and installed under other sections of these Specifications.

O. Programmable Controller Connections

Relays with isolated contacts shall be provided at the field instruments for outputs from the programmable controller. Refer to the schedules for inputs to the programmable controller.

P. Schedules

Schedules, where required, are attached in the following sections. The schedules shall not be construed as a bill of materials. Refer to the Drawings and Specifications for the scope of work.

2.02 PRIMARY ELEMENTS

A. Quality Assurance

1. Manufacturer

In addition to requirements of this section, instrumentation and control equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacturer of similar equipment. All equipment furnished shall be new and of current design.

2. Maintainability

All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

3. Materials and Installation

Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

2.03 LIMIT SWITCHES

A. Limit switches shall be mounted and wired in conjunction with the PLC as shown in the control diagrams and shall be Allen Bradley #802MC-AY5, or equal.

2.04 PANEL MOUNTED AND MISCELLANEOUS INSTRUMENTS

A. Description

Requirements of Section 16000 and other portions of this section form a part of this section. This section specifies the panel mounted and miscellaneous field instruments and equipment to perform the required functions in conjunction with information and equipment specified in other parts of this section.

1. Unit Responsibility

It shall be the responsibility of the qualified single firm as described in this section to ensure that the instruments and equipment furnished under this section are compatible with the equipment furnished under parts of this section and other sections of these Specifications, and that the signal transmission methods are compatible.

2. Control and Performance Terminology

Control and performance terminology used hereinafter in this section shall be defined in SAGA Standard PMC20-2-1970, "Process Measurement and Control Terminology."

3. Cases

Cases of front of panel-mounted instruments shall be of uniform design and color scheme wherever possible. The front of case colors shall be compatible with panel colors subject to final approval by the Owner. Normally, compatible standard colors of the manufacturer shall be acceptable.

B. Manufacturer

In addition to requirements of other portions of this section, instrumentation and control equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design. Except where stated otherwise, the instruments furnished under this section shall be as manufactured by Rosemount or approved equal. Unless otherwise stated, ancillary equipment shall be as manufactured by the above or Action Instruments, AGM Electronics, or equal.

All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

Materials and Installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

2.05 UNINTERRUPTIBLE POWER SYSTEM

- A. An uninterruptible power system shall be supplied to provide a constant AC power source to the PLC. Input voltage shall be 120V plus or minus 10 percent nominal with switch to inverter at 96 VAC. The transfer to commercial (line) power will occur at 101 VAC. Maximum allowable transfer time is 4 milliseconds. Unit shall include current limiting for overload protection. The maximum allowable harmonic distortion is 7 percent. Battery supply shall be sealed lead acid type and the battery charger shall be an integral part of the UPS. The power rating of the UPS shall be rated in volt-amperes (VA) and shall operate at half load for 10 minutes minimum. The UPS shall be capable of communicating with the PLC via an RS 232 communication port. The unit shall be a rack-mount type unit, Eaton Ferrups, or approved equal. The UPS shall be installed in the control panel and the 120 VAC input power shall be wired to the UPS terminals (no power card to receptacle allowed). The power input shall not be connected to a GFI source.

2.06 OPERATOR INTERFACE PANEL

- A. The operator interface shall be flush mounted on the panel front of CP-1. The operator interface shall have a 10.4-inch color TFT screen. The operator interface shall be as manufactured by Allen Bradley, model number 2711P-B10C4D9.

2.07 ETHERNET INTERFACE SWITCH

- A. Provide an Ethernet switch capable of interfacing with the PLC, operator interface terminal, and the existing City SCADA system as shown on the Drawings.
- B. Acceptable manufacturers: Hirschmann, or approved equal.

2.08 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. General Characteristics
 1. The programmable logic controller hardware shall be provided in a modular version. The modular system shall be expandable up to three chassis that include AC, DC, pulse accumulation and relay contact points on modules that plug into the I/O chassis.
 2. The logic controller is a multiplexed system. The PLC system consists of a power supply, inputs, outputs, and a processor that contains the memory. Wiring terminals on the PLC system shall terminate the field wiring from the I/O points.
 3. The systems must offer connectivity with the operator interface panel, solid state motor controllers, flow metering system, chemical metering pumps and communication systems, as specified in the Drawings and elsewhere in this section.
 4. The small logic controller shall have diagnostic indicators to show the following:
 - a. CPU Ready
 - b. CPU Running
 - c. Battery Low
 - d. Ethernet Active
 - e. Memory Write – Protected
 - f. Modbus Active
 - g. Modbus + Active
 - h. Modbus Error

- B. Manufacturer (CompactLogix)

The CPU shall be Allen Bradley CompactLogix 1679-L33ERM, no equal.

C. Specific Characteristics

1. User Logic Memory: 1.5 MB
2. Communication:
 - a. Modbus (RS-232): 2 serial port (9-pin D-shell)
 - b. Ethernet: 10/100 BASE-T
3. Total Number of Racks: 8
4. Type of Memory Storage: RAM, Flash

D. Input/Output (I/O) Characteristics

1. The input circuits shall be available in discreet input, 4-20 mA analog current, and pulse accumulation as shown on the Drawings. The input terminals shall have self-lifting pressure plates to allow for easy wire insertion and secure connections. The terminals shall accept up to two #14 AWG wires. A hinged protective cover shall be provided and have write-on areas for identifications of external circuits. All input circuits shall have optical isolation (1500 volt minimum) and filtering to guard against high voltage transients from the externally connected devices.
2. The output circuits shall be available in 120 VAC relay contacts, and 4-20 mA analog current as shown on the Drawings. The output terminals shall have self-lifting pressure plates to allow for easy wire insertion and secure connections. The terminals shall accept up to two #14 AWG wires. A hinged protective cover shall be provided and have write-on areas for identifications of external circuits.
3. Status indicators shall be provided for each of the input and output circuits and shall be illuminated when the circuit is energized.
4. Provide I/O cards as follows:
Analog Input: Allen Bradley 1769-IF8
Analog Output: Allen Bradley 1769-OF4
Digital Input: Allen Bradley 1769-IQ16
Digital Output: Allen Bradley 1769-OB16
5. Contractor shall supply additional cards as necessary to provide 20% spare I/O capacity.

E. Special Function Characteristics

1. Program timers shall be available in both on-delay and off-delay with a time base selection of 0.01 seconds, and timer range from 0.01 to 327.67 seconds. Additional time bases and longer timing intervals can also be supported.

2. Counters shall be available in both count up and count down with a range of -32,768 to 32,767.
3. Sequences shall have a minimum capacity of 16 bits by 100 steps and be cascadable, time- or event-driven.
4. Shift registers shall be available with a minimum of 16-bit groups and be cascadable, time- or event-driven.
5. Provide PLC programming for pulse accumulators.

F. Service and Installation Conditions

1. The logic controller, excluding programming tools, shall be capable of operating in an ambient temperature of 0°C to 60°C with humidity of 5-95 percent, non-condensing.
2. The PLC shall meet NEMA standard ICS 2-230 for noise immunity and be both UL 508 listed and CSA22.2-K2 certified.

G. Power Supply

1. The logic controller's power supply shall be rated 30 watts and accept AC power of 120 VAC, 60 Hz. It shall be capable of withstanding a power loss for a minimum of 20 milliseconds while still remaining in operation.
2. The incoming line wiring terminals shall include self-lifting pressure plates, shall allow for easy wire insertion and secure connections. Terminals shall accept two #14 AWG wires. A hinged protective cover shall be provided.

H. Mechanical

The logic controller shall withstand vibration of 0.015-nch peak to peak displacement, 2.5g peak (maximum) acceleration, 1 hour/axis.

2.09 RADIO

- A. Radio shall be MDS entraNET 900.

2.10 ANTENNA

- A. Antenna shall be Yagi directional type. Antenna installation shall include antenna cable, polyphaser lightning arrestor and all connectors required for a complete installation. Antenna shall be mounted on the roof of the building as shown on the plans. Mounting height and direction shall be provided by the Owner. Contractor to coordinate exact requirements with Owner prior to installation.

2.11 CONTROL PANEL

- A. Earthquake Design and Restraint
- All panels shall be designed, constructed and attached to resist stresses produced by seismic forces.

B. Earthquake Design Data

Submit with the shop drawings a complete set of detailed calculations or test results, details of constructions, and the method of attachment for all panels showing compliance with earthquake design restraint. The calculations and details shall be signed by a professional engineer who has demonstrated proficiency in structural engineering or civil engineering and is registered in the state of California. The calculations shall be performed specifically for this job, during the time frame of the job and be dated by the Engineer performing them. No control panels shall be delivered and mounted at project without approved submittal data.

C. Minimum Earthquake Forces

The minimum earthquake forces shall be those prescribed for essential facilities by the Uniform Building Code and applicable supplements as published by the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California 90601.

D. Construction

Control panels shall be furnished completely pre-wired, with factory or shop mounted instruments and controls and factory tested prior to shipment. Factory test reports, and tag number descriptions shall be submitted for review prior to shipment.

1. Piping and Wiring

Piping and wiring within each panel shall be done in a workmanlike manner and grouped and supported to give a neat appearance. All control components not flush mounted on the front of the panel shall be mounted on fully accessible subpanels or racks within the panels for easy removal. All signal lines leaving the panels shall terminate at bulkhead fittings or terminal blocks and shall be tagged to facilitate field connections.

2. Size and Supports

Panels shall be of sufficient size to adequately enclose all instruments designated as "panel-mounted" plus ample interior clearance to allow for installation, general servicing, and maintenance of the instruments. Weight of the instruments shall be supported by Unistrut, Famet, Caine or approved equal channel supports.

3. Exterior Panel Color

The exterior panel color shall complement adjacent panels and will be gray and be approved by the Owner. Short angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.

4. Attachment methods shall be detailed on the panel fabrication drawing submittals. If requested by the Owner, structural calculations for the panels shall be furnished. This does not apply to calculations for seismic

forces. Heavy panels shall be attached by anchor bolts embedded in beams supporting the floor. See the structural drawings for location of beams.

5. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to control panel manufacturer in sufficient time for wiring. Coordination of the instruments and controls to be located on each panel are shown on the instrumentation drawings, electrical schematics, and/or in the individual section.

6. Switching Circuit Schematics

Switching circuit schematics shown are illustrative of the desired function only; the Contractor may elect to perform the required functions by other standard logic techniques. Components and circuits used shall be subject to review. All switching circuits shall be checked and verified by testing before shipment.

7. Control Voltage

When the control voltage is not specified in the schematics, the Contractor shall use 120 VAC single-phase power as supplied from the power panels supplied under Section 16000; however, he shall provide a separate low voltage circuit for the indicating lamps or provide individual transformers with lamps. In any event, the lamp voltage shall not exceed 30 volts AC or DC. Manual disconnect switches (and relays if necessary) shall be provided internal to the panel to isolate process related groups of circuit elements from panel power and foreign voltages to permit trouble shooting without disabling controls for other processes.

8. Input-Output Terminal

The input-output terminal shall be labeled for easy identification, either labeled directly at the terminal with the appropriate identification, or the wires and terminals shall be numbered with a cross-reference chart mounted in a plastic holder mounted within the cabinet. Input and output terminals shall be located in a single location in the panel.

9. Arrangement

Where so indicated, the instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.

10. Louvers shall be provided, when required for cooling, near the bottoms and tops on the rear doors and sides of panels. 80-mesh screens shall cover the insides of louvers.

E. Panel Mounting

Control panels shall be mounted full height dedicated control section of switchboard indicated on the drawings.

F. Panel Accessories

1. Relays and Timers

Relays and timers and other internally mounted equipment, if required, shall be of the types specified in Section 16448 of these Specifications.

2. Panel Face Mounted

Panel face mounted equipment shall be of the types specified in this section. Face mounted equipment shall be mounted on the face of the switchboard.

3. Selector Switches, Push Buttons and Pilot Lights

Selector switches, push buttons and pilot lights shall be oil-tight Microswitch types CMC PM and PML, or equal.

4. Panels

Panels shall be internally lighted by fluorescent lamps, provided with guards and a three-way switch located convenient to each access door. Two duplex-grounded type receptacles shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120-volt, 60-hertz, single-phase supply.

5. Nameplates

Nameplates shall be black lamicaid with minimum 3/16-inch high white letters for major area titles, 5/21-inch for component titles, and 1/8-inch for subtitles and shall be fastened with a permanent but dissolvable adhesive or by screws.

6. Terminals

Electrical terminals shall be screw-type with 600-volt barrier for signals greater than 30 volts and 300 volt barriers for signals 30 volts or less.

7. Terminal Connections

Terminals shall be connected by compression spade lugs.

8. Wiring

Wiring may be bundled and laced or tied with plastic ties and supported to prevent sagging or damage during shipment. If preferred, wiring may be enclosed in plastic wireways, in which case it need not be laced inside the wireway. All wiring shall be made with PVC insulated stranded wire. Terminal blocks shall be sectional barriered type with tubular clamp and white plastic identification strip (Buchanan Miniature, Phoenix, or approved equal). Each terminal shall be identified on the marker strip with a number neatly printed in ink. Where wires are terminated on screw terminals, insulated, crimped spade lugs shall be used. Wires shall be color coded with black for unswitched hot or power, red for switched hot or control, white for neutral, and green for ground. Wire size shall be 20 AWG stranded 600-volt insulation except where larger wire is required for

a single load. Wiring shall have permanent markers at each end. Except as otherwise stated herein, Section 16000 requirements shall apply. No control wire shall be installed jointly in electrical power conduit.

PART 3 - EXECUTION

3.01 GENERAL

A. Inspection

Inspect each instrument and piece of equipment for damage, defects, completeness and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of the instruments and equipment.

B. Preparation

Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing the instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

C. Factory Testing of Control Panels

Verify, at the factory, wiring continuity and verify panel operation by simulated inputs and outputs. Provide a report certifying the control panels are operable and meet the requirements of these Specifications.

D. Manufacturers' Installation and Supervision

Furnish the services of authorized factory personnel especially trained and experienced in the installation of the equipment to: (1) supervise the installation in accordance with the approved instruction manual; (2) be present when the instruments and equipment are first put into operation; (3) inspect, check, adjust as necessary and approve the installation; (4) calibrate the instruments, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable; and (5) prepare and submit the specified manufacturers' certified report. Include all costs for the representative's services in the contract price.

E. Instrument Calibration

Provide the services of factory trained instrumentation technicians, tools, and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration. Each instrument shall be calibrated at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least five times greater than the specified accuracy of the instrument being calibrated. Such test instruments shall have accuracies traceable to the National Bureau of Standards, as applicable. Provide a written report to the Owner on each instrument certifying that it has been calibrated to its published specified accuracy. This report shall include a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerances,

defects noted, correction action required, and apply to instrument calibration sticker with date after calibration correction made.

F. System Validation

Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each instrumentation system to verify that each system is operational and performing its intended function within system tolerance. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output. Validate each system by simulating inputs at the first element in loop (i.e., sensor) of 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span, or on/off and verifying loop output devices (i.e., recorder, indicator, alarm, etc., except controllers). During system validation, make provisional settings on levels, alarms, etc. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.

Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation. Test equipment for this function shall be as specified under "Instrument Calibration."

Immediately correct all defects and malfunctions disclosed by the tests. Use new parts and materials as required and approved and retest. Provide a report certifying completion of validation of each instrument system. This report shall indicate calculated system tolerances, verification that the system meets these tolerances, and any provisional setting made to the devices.

G. Final Operational Testing and Acceptance

Upon completion of instrument calibration and system validation, test all systems under process conditions. The intent of this test is to demonstrate and verify the operational inter-relationship of the instrumentation systems. This testing shall include, but not be limited to, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and/or mechanical equipment. The Contractor shall furnish the test procedure checklist to the Owner for review and acceptance 5 days prior to any scheduled tests. The procedure will include all operational features in the system.

Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing. Upon completion of final operational testing, submit a certified report indicating that total ICM system meets all the functional requirements specified herein. The Owner shall countersign this report and it shall constitute final acceptance of the ICM system.

Testing shall be observed by the Owner. Notify the Owner in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon completion of this test, the ICM system supplier shall begin or have begun plant start-up.

Demonstrate that instruction manuals for the PLC are consistent with the latest version of programming utilized for final acceptance testing.

H. Start-Up Assistance

Provide the services of a factory trained and field experienced instrumentation engineer to assist the Owner's personnel during start-up of the plant process. Purpose of this assistance is to provide support in making final adjustments of settings on the instrument systems.

I. Instruction of the Owner's Personnel

Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training of the Owner's designated personnel in the operation of each instrument system. This training shall be for the time period of 24 hours and shall be performed separately and after start-up has been finalized. The training shall be coordinated by the inspector at a time designated by the inspector. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the system descriptions and operation and maintenance manuals as required under these Specifications. If requested by the Owner, the ICM provider shall delete all programs from the PLC, reinstall all programs to the PLC with an ICM supplied portable computer, and demonstrate that the facilities are operating as intended.

3.02 SYSTEM DESCRIPTION

A. General

The supplier of other equipment and sub-systems shall be aware of the scope of the ICM system in order to ensure compatibility with all electrical controls and interface with the PLC and OIT. The electrical equipment is specified in Division 16. All I/O functions and status indicators shall be capable of being transmitted to the Owner's SCADA system. Installation, testing, calibrations, validation, startup and instructions shall be in accordance with the requirements as specified in this section and other applicable sections.

B. Local Automatic Control

1. Automatic Operation

The PLC shall be programmed to provide operations as described in Section 17100, General Operations.

2. Remote Monitoring and Control

The system supplier shall demonstrate that the PLC is capable of outputting status conditions to the Owner's SCADA system. The PLC shall be capable of receiving program or set point changes from the central SCADA.

3. Local PLC Programming

The facility PLC shall be capable of being programmed utilizing an IBM (or compatible) personal computer.

4. Operator Interface Terminal (OIT)

The OIT shall be programmed by the ICM supplier to provide functionality as described in Section 17100, General Operations.

3.03 SOFTWARE DOCUMENTATION

Prior to any on-site Engineer witness testing, the instrument contractor shall furnish complete software documentation in type written form including the following:

- A. Narrative description of control logic and station operation including alarms and fail mode operation.
- B. Lists of the following with functional description and PLC internal addresses:
 - 1. Analog inputs
 - 2. Analog outputs
 - 3. Digital inputs
 - 4. Digital outputs
 - 5. Pulse inputs
 - 6. Internal relays
 - 7. Internal registers and initial value
 - 8. Internal timers and initial value
 - 9. Alarm setpoints and rung number
 - 10. Adjustable parameters
- C. Complete ladder diagram of program.
- D. System block diagram showing interface and terminal numbers.

At the close of the project, the ICM shall provide on CD-ROM the final program complete with program installation instructions and associated software to reinstall the program.

3.04 SEQUENCE OF WORK

- A. The Contractor and system supplier will reference the sequence of events and project phase scheduling requirements. Restrictions and coordination shall be conformed to without variation without a written approval from the Owner's chief inspector operation manager. All phase testing, operation and installation acceptance require on-site testing. Final test of all the improvements at the project final acceptance shall be provided as stated in these Specifications.

END OF SECTION

SECTION 17100: GENERAL OPERATIONS

PART 1 - GENERAL

1.01 DESIGN INTENT

- A. The proposed project includes the installation of seven (7) new slant intake wells to provide seawater to the Desalination Plant.
- B. The wells will be connected to local Programmable Logic Controllers (PLC's). The electrical and control equipment, which includes the PLC, Variable Frequency Drives (VFD's) and electrical switchboards will be located inside prefabricated electrical enclosures located adjacent to the well heads.
- C. The Slant Well Intake System will contain seven (7) submersible slant well pumps and motors. Each pump has a 250 HP, NEMA rated premium efficiency motor controlled by a VFD.

1.02 PROCESS FACILITIES

- A. The following are the main components of the slant wells:
 - 1. Submersible Well Pump and Motor (**P-101, P-201, P-202, P-301, P-401, P-501, P-502**)
 - 2. Motor Variable Frequency Drive (**VFD-101, VFD-201, VFD-202, VFD-301, VFD-401, VFD-501, VFD-502**)
 - 3. Level Transducer (**LIT-0101, LIT-0101A, LIT-0201, LIT-0201A, LIT-0202, LIT-0202A, LIT-0301, LIT-0301A, LIT-0401, LIT-0401A, LIT-0501, LIT-0501A, LIT-0502, LIT-0502A**)
 - 4. Pressure Transducer (**PIT-0101, PIT-0201, PIT-0202, PIT-0301, PIT-0401, PIT-0501, PIT-0502**)
 - 5. System Pressure Transducer (**PIT-0700**)
 - 6. Discharge Flow meter (**FIT-0101, FIT-0201, FIT-0202, FIT-0301, FIT-0401, FIT-0501, FIT-0502**)
 - 7. Pump to Waste Valve (**PTW-0111, PTW-0211, PTW-0212, PTW-0311, PTW-0411, PTW-0511, PTW-0512**)
- B. Submersible Slant Well Pump and Motor (**P-101, P-201, P-202, P-301, P-401, P-501, P-502**)
 - 1. The Slant Well raw water is discharged to a below grade header through individual discharge pipes in each well casing. Each Slant well discharge pipe has a separate flow meter. The below grade header discharges into the raw water intake pipe for the Desalination Plant.

- C. Level Transducer (**LIT-0101, LIT-0101A, LIT-0201, LIT-0201A, LIT-0202, LIT-0202A, LIT-0301, LIT-0301A, LIT-0401, LIT-0401A, LIT-0501, LIT-0501A, LIT-0502, LIT-0502A**)
 - 1. Level transducers are mounted at the top of each well casing and extend down into each well casing. The level transducers will monitor the depth of seawater in each casing and shall provide a 4-20mA signal input to the well control panel. Each well contains second transducer as a backup.

- D. Pump to Waste Valve (**PTW-0111, PTW-0211, PTW-0212, PTW-0311, PTW-0411, PTW-0511, PTW-0512**)
 - 1. Each well is equipped with a PTW valve to eliminate starting and stopping surges caused by the pump and to maintain a minimum back pressure during pump-to-waste cycle. The pump is started with the valve in an open position. The initial water is flushed through the PTW valve and into the on-site waste basin for a settable amount of time. Once the PTW set time has elapsed, the PTW valve will slowly close. The PTW valve is equipped with limit switches to indicate fully open and fully closed positions.

- E. Discharge Flow meter (**FIT-0101, FIT-0201, FIT-0202, FIT-0301, FIT-0401, FIT-0501, FIT-0502**)
 - 1. A flow meter is located on the well discharge line. The FIT shall provide a 4-20mA signal input to the well control panel.

1.03 CONTROL SYSTEM EQUIPMENT

A. Local PLC

The Slant Wells will have a local PLC. All individual control devices will be connected to the PLC, so that all functions can be controlled, adjusted, and monitored by the PLC. The PLC shall be programmed to allow control adjustment at the Operator Interface Terminal (OIT) so operations personnel can adjust set points without requiring reprogramming of the PLC.

B. Remote SCADA System Control

The Slant Wells will be monitored and controlled remotely by the Desalination Plant Control System. The detailed control strategy will be developed by the SCADA Integrator of the Desalination Plant Control System.

1.04 SYSTEM OPERATION

- A. The well motor VFD is equipped with an HOA switch and will be able to fully operate in either automatic or hand mode.

- B. In Automatic mode, each well will be called to operate from the Desalination Plant SCADA.

- C. In Hand mode, the well will continue to run until shutdown by putting the switch in Off or by a fault condition.

1.05 SURGE TANK

- A. The Surge Tank water levels shall be provided with a differential pressure type level transmitter to monitor the surge tank water level.

1.06 INFORMATION TO BE TRANSMITTED TO THE SCADA MONITORING SYSTEM

- A. The following shall be available to transmit from the well PLC to SCADA system:
 - 1. Discharge Flow Rate as measured by flow meter (each well).
 - 2. Pump Status (each well)
 - 3. Pump speed in
 - 4. Pump speed out
 - 5. Pump start/stop
 - 6. Water Level (each well)
 - 7. Well Alarms (each well)
 - 8. Well HOA status (each well)
 - 9. Intrusion (each well)
 - 10. Pump discharge pressures (each well)
 - 11. System pressure
 - 12. Surge Tank level (each tank)
 - 13. PTW valve status
 - 14. PTW valve open/close

1.07 PARAMETERS MONITORED AT WELL OIT

- A. Discharge flow rate
- B. Totalized discharge flow (Well 101)
- C. Pump status
- D. Pump speed in
- E. Pump speed out
- F. Well water level
- G. Pump discharge pressure
- H. Check valve position

- I. PTW status
- J. Alarms
- K. Pump discharge and system pressures
- L. Intrusion

1.08 ALARM CONDITIONS

- A. PTW Valve Fault
- B. Pump Fault
- C. Starter Fault
- D. High Pressure Shutdown
- E. High Temperature Shutdown
- F. Enclosure Intrusion

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 17210: MAGNETIC FLOWMETERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

Contractor shall furnish and install magnetic flowmeters and all appurtenant materials and equipment. Magnetic flowmeters shall be suitable for the services listed, complete and operable in accordance with requirements of the Contract Documents and in conformance with the manufacturer's recommendations.

1.2 PROJECT SPECIFIC REQUIREMENTS

Contractor shall furnish and install magnetic flowmeter(s) as shown on the Drawings and as specified herein.

1.3 RELATED SECTIONS

A. The Contract Documents are a single integrated document, and as such all Specification Sections apply. It is the responsibility of the Contractor and its subcontractors to review all sections and ensure a complete and coordinated project.

B. Related Specification Sections include, but are not limited to, the following:

1. Division 15 – Mechanical
2. Division 16 – Electrical
3. Division 17 – Instrumentation and Controls

1.4 SUBMITTALS

All submittals shall be in accordance with the General Conditions and requirements specified herein.

A. Shop Drawings

Contractor shall prepare and submit complete and organized information, drawings, and technical data for all equipment and components. All drawings shall be legible and reduced to a maximum size of 11" x 17" for inclusion within the submittal. Shop drawings shall include, but not be limited to, the following:

1. Detailed Bill of Materials for all equipment and components, listing: manufacturer's name, quantity, size, description, and part number.

2. Manufacturer's product literature, specifications, performance capabilities, features and accessories, materials of construction, illustrations, and data in sufficient detail to demonstrate compliance with Specification requirements. Manufacturer's literature and data shall be marked to clearly delineate all applicable information and crossing out all inapplicable information.
3. Dimensional drawings for each meter size.
4. Electrical wiring schematics for flow sensor and signal converter/transmitter. Interconnection wiring diagrams between signal converters/transmitters and related equipment and materials.
5. Diagrams showing meter grounding recommendations and grounding conductor/connection requirements (conductor size and connection type), including: connection from meter terminal box or signal converter (if integrally mounted) to grounding ring(s), connection between grounding rings, and connection from grounding rings to ground rod.
6. Meter cable product data sheets.
7. Manufacturer's application performance guarantee for each meter location, and recommendations for installation at each location.

B. Operation and Maintenance Manual

Contractor shall submit a detailed Operation and Maintenance Manual for all equipment and components specified herein and incorporated into the Work. Operation and maintenance manuals shall include, but not be limited to, the following:

1. Equipment Performance Data and Drawings
 - a. Detailed Bill of Materials for all equipment and components, listing: manufacturer's name, quantity, size, description, and catalog/part number.
 - b. Manufacturer's product literature, specifications, performance capabilities, features and accessories, materials of construction, and illustrations.
 - c. Dimensional drawings for each meter size.

- d. Electrical wiring schematics for flow sensor and signal converter/transmitter. Interconnection wiring diagrams between signal converters/transmitters and related equipment and materials.
2. Equipment Installation Requirements
- a. Complete, detailed installation instructions for all equipment and components.
3. Equipment Operation Data
- a. Complete and detailed operating instructions, including operator interface menus, programming, and setup parameters.
 - b. Printed list of all final setup parameters for each flowmeter, including factory settings and any field modifications to factory settings.
4. Equipment Service and Maintenance Data
- a. Maintenance data shall include all information and instructions required by OWNERS personnel to keep equipment properly cleaned and adjusted so that it functions economically throughout its full design life.
 - b. Unloading, handling, and long-term storage requirements.
 - c. Explanation with illustrations as necessary for each maintenance task.
 - d. Recommended schedule of maintenance tasks.
 - e. Troubleshooting instructions.
 - f. List of maintenance tools and equipment.
 - g. Recommended spare parts list.
 - h. Name, address and phone number of manufacturer and manufacturer's local service representative.
 - i. Manufacturer's Warranty
 - j. Provide a signed written certification report with the Final

Operation and Maintenance Manuals, certifying that the magnetic flowmeters have been properly installed, calibrated and adjusted, and are suitable for satisfactory continuous operation under varying operating conditions, and meet all requirements specified in the Contract Documents.

1.5 COORDINATION

Flowmeters and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers and manufacturers under other sections of these Specifications and where applicable, with related existing equipment. All flowmeter and control devices shall be applied in full conformity with the Construction Drawings and Specifications, and with the instructions and recommendations of the flowmeter manufacturer and the related equipment manufacturer.

Related equipment and materials may include, but not be limited to: valve actuators, chemical feed equipment, analytical measuring devices, supervisory control equipment (SCADA), telemetry, conduit, cable, and piping, as described in other Sections associated with the project and shown on the Drawings.

Interconnection wiring diagrams shall be prepared between the related equipment and the equipment furnished under this Section. Interconnection wiring shall provide all functions specified herein and/or shown on the Drawings.

PART 2 - MATERIALS

2.1 GENERAL

The magnetic flowmeter shall consist of a flow sensor and a signal converter/transmitter. The flow sensor shall utilize Faraday's Law of Electromagnetic Induction, to produce an electrical voltage that is proportional to the velocity of the flow of liquid through the sensor. The signal converter/transmitter shall be micro-processor based. Unless specified otherwise, the signal converter/transmitter shall be remote mounted.

2.2 FLOW SENSOR

- A. Each flow sensor shall be provided with a flanged end flow tube and a non-conductive liner suitable for the liquid (seawater) being metered. Unless specified otherwise, the flow tube shall be constructed of Type 316 stainless steel with stainless steel flanged ends. Where the design pressure is 150 psi or less, Flanges shall be ANSI/AWWA C207 Class D, ANSI B16.1 125-lb class, or ANSI B16.5 150-lb class for meter sizes up to 24". Flow sensors exposed to water with a chlorine concentration of

10 ppm or greater, such as recycled water, shall be provided with Teflon liner material.

- B. The field coils of the flow sensor shall be supplied with a precisely adjusted bi-polar direct current. Coil drive power shall be supplied by the signal converter/transmitter. The output signal from the flow sensor shall be fed through cable to the signal converter/transmitter. There shall be no electronic components in the flow sensor.
- C. The flow sensor coil enclosure and cable connection housing shall be epoxy coated steel or epoxy coated aluminum. Plastic housings will not be acceptable.
- D. Flow sensors shall be weatherproof NEMA 4X at a minimum. Meters installed underground or in a below grade vault shall be manufactured to NEMA 6P standards to enable the meter to be submerged up to 30 feet for 48 hours and up to 10 feet with continuous submersion. Meters rated NEMA 6P shall have remote transmitters in separate NEMA 4X enclosures. The interconnecting cables shall be installed at the factory and the termination box filled with a non-setting, transparent potting material.
- E. When installed in metallic piping, the flow sensor shall be provided with integral grounding electrodes. When installed in lined or non-metallic piping, the flow sensor shall be provided with Type 316 stainless steel grounding rings (grounding electrodes will not be acceptable).
- F. Flow sensor grounding electrode and sensing electrode material shall be compatible with the process fluid. Unless specified otherwise, electrodes shall be constructed of Type 316 stainless steel.
- G. Unless specified otherwise, the flow sensor lining material shall be neoprene, EPDM, or BUNA. Accuracy shall not be affected by cuts or scratches in the flow sensor liner.
- H. The flow sensor shall be provided with multiple sensing electrodes to accurately measure mean velocity. The flow sensor shall be capable of accurately measuring slurries and water with entrained air. Accuracy of the flowmeter system shall be $\pm 0.2\%$ of rate. Accuracy shall be traceable to the US National Institute of Standards and Technology (NIST) and shall be guaranteed on-site for applications such as seawater, drinking water, raw sewage, and similar media, even with a permanent coating of raw sewage or similar on the electrodes. A NIST traceable calibration certificate shall be provided with each flowmeter.
- I. The flow sensor shall incorporate an empty pipe detection feature, which

shall cause the meter to register zero flow when the sensor is not full.

- J. Unless specified otherwise, the flow sensor shall be rated for a minimum working pressure of 60 psig (maximum 150 psi).
- K. The flow sensor shall be suitable for operating temperatures ranging from -4°F to +122°F (minimum).

2.3 SIGNAL CONVERTER/TRANSMITTER

- A. Unless specified otherwise, the signal converter/transmitter shall be remote mounted from the flow sensor. Where special signal cable is required and recommended by the manufacturer, the cable shall be supplied by the meter manufacturer. Supplier shall confirm the length and installation requirements. Where signal converter/transmitter location is not shown on the Drawings, each flowmeter shall be furnished with a minimum of 200 feet of signal cable.
- B. The signal converter/transmitter shall be suitable for outdoor exposure and shall be rated NEMA 4X.
- C. The signal converter/transmitter shall be provided with an alphanumeric, 3-line, 16-character (minimum), backlit display to indicate flow rate, totalized values, settings, and faults. Unless specified otherwise, the display shall indicate flow in gallons per minute and total flow in acre feet. All programming shall be accomplished through an integral keypad or touch screen operation and all programming shall be protected by a user-defined password. The signal converter/transmitter shall be provided with a fault and status log.
- D. The signal converter shall be coordinated with the flow sensor selection for accurate measurements.
- E. The signal converter/transmitter shall be capable of measuring bi-directional flow and shall have three separate totalizers.
- F. The signal converter/transmitter shall operate on 120V, 60 Hz supply power.
- G. The signal converter/transmitter shall produce a 4-20 mA DC output signal, linear to flow. Output shall be selectable as unidirectional or bi-directional. In addition, the signal converter/transmitter shall provide a digital scaled pulse output for external display/recording of flow rate or total flow.
- H. Where indicated on the Drawings the signal converter/transmitter shall be

provided with a positive zero circuit to register zero flow when pumping units are not operating. A closed external dry contact (generated by pump "off" or other similar equipment control signal) input to the signal converter/transmitter shall drive the meter output to zero.

- I. The signal converter/transmitter shall be suitable for operation in ambient temperatures ranging from -4°F to +140°F (minimum).
- J. Where located indoors, the signal converter/transmitter shall be wall mounted or flush panel door mounted as indicated on the Drawings.
- K. Where located outdoors, signal converter/transmitter shall be suitable for mounting inside a NEMA 4X stainless steel enclosure, Hoffman, or equal. The stainless-steel enclosure shall be provided with a swing-out door panel and back panel. The signal converter/transmitter shall be flush mounted on the swing-out door panel or back panel mounted with a cut-out in the swing-out door panel for the display. The enclosure shall be provided with side mounted air supply fan, side mounted louvered and filtered air supply and exhaust openings, 120V supply power circuit breaker for the signal converter and air supply fan, and fuses for each.
- L. The signal converter/transmitter shall be capable of verifying the performance of the measuring system in the field without removing the meter tube from the process. The field verification feature shall be integral to the signal converter/transmitter and shall be capable of continuously monitoring electronic parameters within the flow meter and signal converter/transmitter. If any value deviates from an acceptable range, the signal converter/transmitter shall acknowledge the event and a relay shall be activated. A summary report of the verification shall be downloadable directly through the service port of the signal converter/transmitter or while logged onto the manufacturer's webserver for an Ethernet/IP capable signal converter/transmitter. The integral verification system shall be Endress+Hauser Heartbeat Technology, or equal.
- M. Where specified, local service communication with the meter shall be capable via a RJ-45 port and an Ethernet cable regardless of the output. The signal converter/transmitter shall have integral webserver capabilities with a unique IP address.

2.4 MANUFACTURERS

Magnetic flowmeters and manufacturers shall be as follows (no substitutes):

Rosemount 8732EMT, as manufactured by Emerson or approved equal. Unless specified otherwise, the signal converter/transmitter shall be provided with the

following input/output signal capabilities: HART/4-20 mA; frequency, relay, and status input (flexible module); and Ethernet/IP.

Model numbers supplied herein are provided for information purposes only, to assist Contractor in selecting equipment that conforms to the Specification and Drawing requirements. In case of any conflict between model numbers provided and the descriptive requirements specified herein, the descriptive requirements shall govern.

Manufacturers shall modify or supplement standard equipment to provide all features and capabilities specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of magnetic flowmeters and signal converters/transmitters shall be in accordance with manufacturer's written instructions.
- B. Wiring between flow sensors and remote mounted signal converters shall be supplied by the meter manufacturer.
- C. All magnetic flowmeters shall be grounded per manufacturer's requirements. Contractor shall coordinate grounding between signal converter, flow sensor, grounding rings, and ground rod to ensure compliance with the manufacturer's recommended grounding procedures. Prior to start up, manufacturer shall provide written certification that the meter installation is in accordance with their requirements, including grounding.
- D. Unless specified or shown otherwise, outdoor signal converters/transmitters shall be remote mounted within NEMA 4X stainless steel enclosures. The enclosures shall be mounted on stanchions adjacent to the respective meters.

3.2 MANUFACTURER'S WARRANTY

Manufacturer shall guarantee all equipment against defects in material and workmanship for a period of two years from date of project acceptance. During the warranty period, manufacturer shall provide all labor and material required to repair or replace defective equipment at no cost to the District.

*****END OF SECTION*****