

ADDENDUM NO. 1

TO THE
RAW WATER LINE REPLACEMENT PROJECT (Project WTR-00016)
FOR
THE CITY OF FORT BRAGG, CA

This addendum shall be considered part of the contract documents and shall be acknowledged by the bidder in his/her Cover Letter.

The cost of meeting the requirements herein shall be included in the bid prices for the respective items of work, or in related items of work if no specific item is specified. No additional compensation will be allowed.

This addendum makes the following changes to the contract documents:

<u>Item</u>	<u>Page or Drawing</u>	<u>Description</u>
1.	General Explanation	<ul style="list-style-type: none">• Replace 480/277V, 100 A, 3 phase Metering Panel with 120/240V, 400 A, 1 phase Metering Switchboard.• Add 50 KVA 240-480V, 1 phase Step Up Transformer, and 150 A Disconnect Switch, and 480 V, 1-phase to 3-phase Phase Convertor.• Locate above equipment on housekeeping pad atop a slab on grade, and on stanchions as noted on Drawings.
2.	Drawings	Replace the following Drawings: <ul style="list-style-type: none">• GE3• E1• E2• E3• E7
3.	Specifications	Replace the following Specification Sections: <ul style="list-style-type: none">• Table of Contents• 26 05 00• 26 05 26• 26 05 33• 26 05 43• 26 05 73• 26 08 00• 26 24 13• 26 27 26

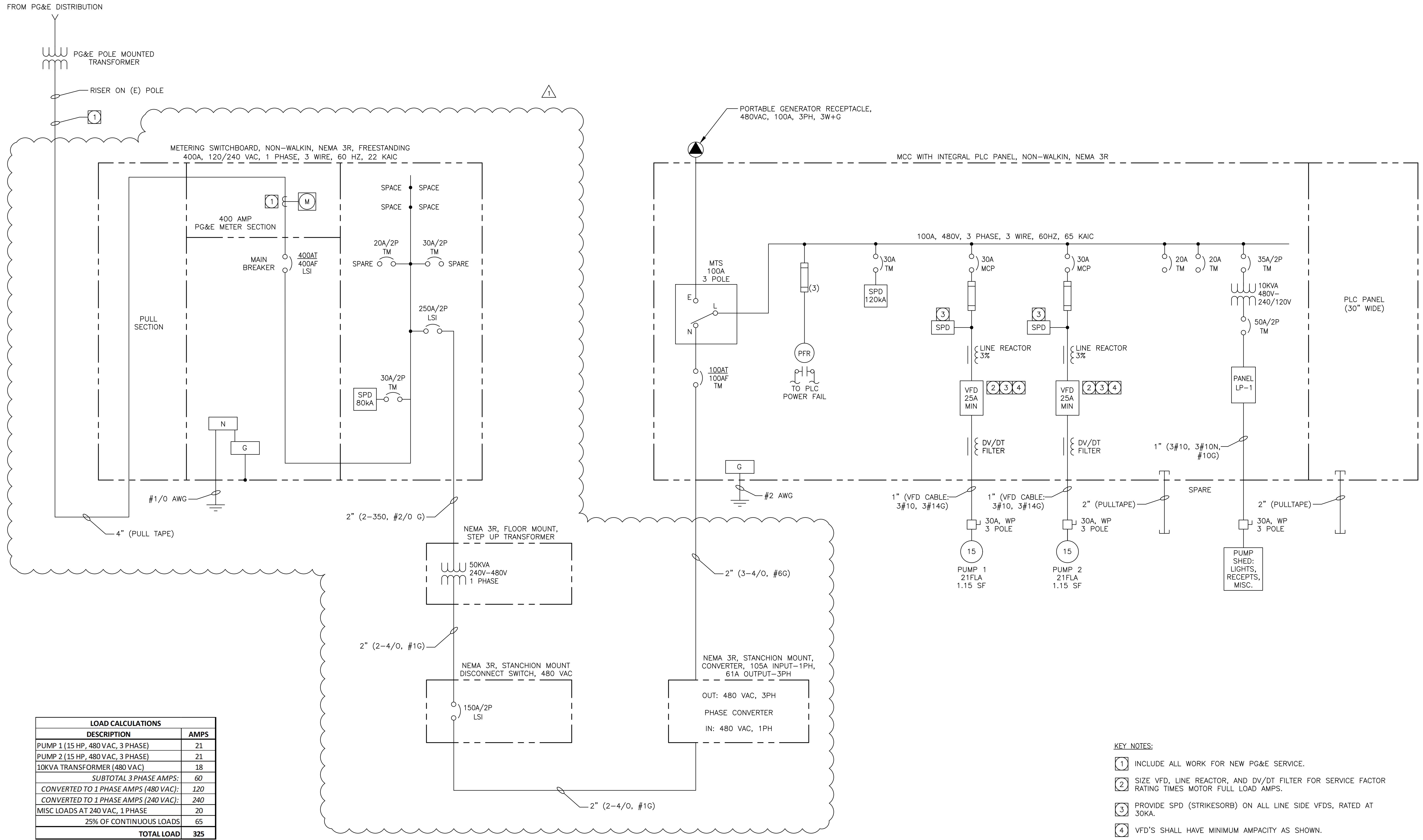
<u>Item</u>	<u>Page or Drawing</u>	<u>Description</u>
4.	Pre-Bid Meeting Question 1	Question 1: Will the City locate the existing pipeline in Segment 2? Answer 1: The City will not locate the existing pipeline in any portion of the project. The existing pipeline must be located and protected by the Contractor.
5.	Pre-Bid Meeting Question 2	Question 2: How should the Contractor restore and leave the surface in Segment 3 in the Timber Harvest Plan shown on Sheet C11? Answer 2: The Contractor will restore the ground surface in this area to pre-construction conditions. No additional improvements are required in this area.
6.	General Provisions, Section 3.9	Replace General Provisions, Section 3.9 with the following text: 3.9 Construction Staking. The Contractor is responsible for all required construction surveying, including staking, as described in Specification Section 01 70 00 and other technical specifications.

The changes detailed in this Addendum No. 1 are hereby made part of the Contract Documents titled Raw Water Line Replacement Project, dated November, 2023.



Date: December 19, 2023

Chad R. Coleman, P.E.
Coleman Engineering, Inc.



LOAD CALCULATIONS	
DESCRIPTION	AMPS
PUMP 1 (15 HP, 480 VAC, 3 PHASE)	21
PUMP 2 (15 HP, 480 VAC, 3 PHASE)	21
10KVA TRANSFORMER (480 VAC)	18
SUBTOTAL 3 PHASE AMPS:	60
CONVERTED TO 1 PHASE AMPS (480 VAC):	120
CONVERTED TO 1 PHASE AMPS (240 VAC):	240
MISC LOADS AT 240 VAC, 1 PHASE	20
25% OF CONTINUOUS LOADS	65
TOTAL LOAD	325

- KEY NOTES:**
- 1 INCLUDE ALL WORK FOR NEW PG&E SERVICE.
 - 2 SIZE VFD, LINE REACTOR, AND DV/DT FILTER FOR SERVICE FACTOR RATING TIMES MOTOR FULL LOAD AMPS.
 - 3 PROVIDE SPD (STRIKESORB) ON ALL LINE SIDE VFDs, RATED AT 30KA.
 - 4 VFD'S SHALL HAVE MINIMUM AMPACITY AS SHOWN.

11/27/23 S:\PROJECTS\FB18-001 - RAW WATER LINE REPLACEMENT PROJECT\LOADS\REVISIONS 2-5 FULL SET\1 - SINGLE LINE DIAGRAM, LOAD CALCULATIONS.DWG

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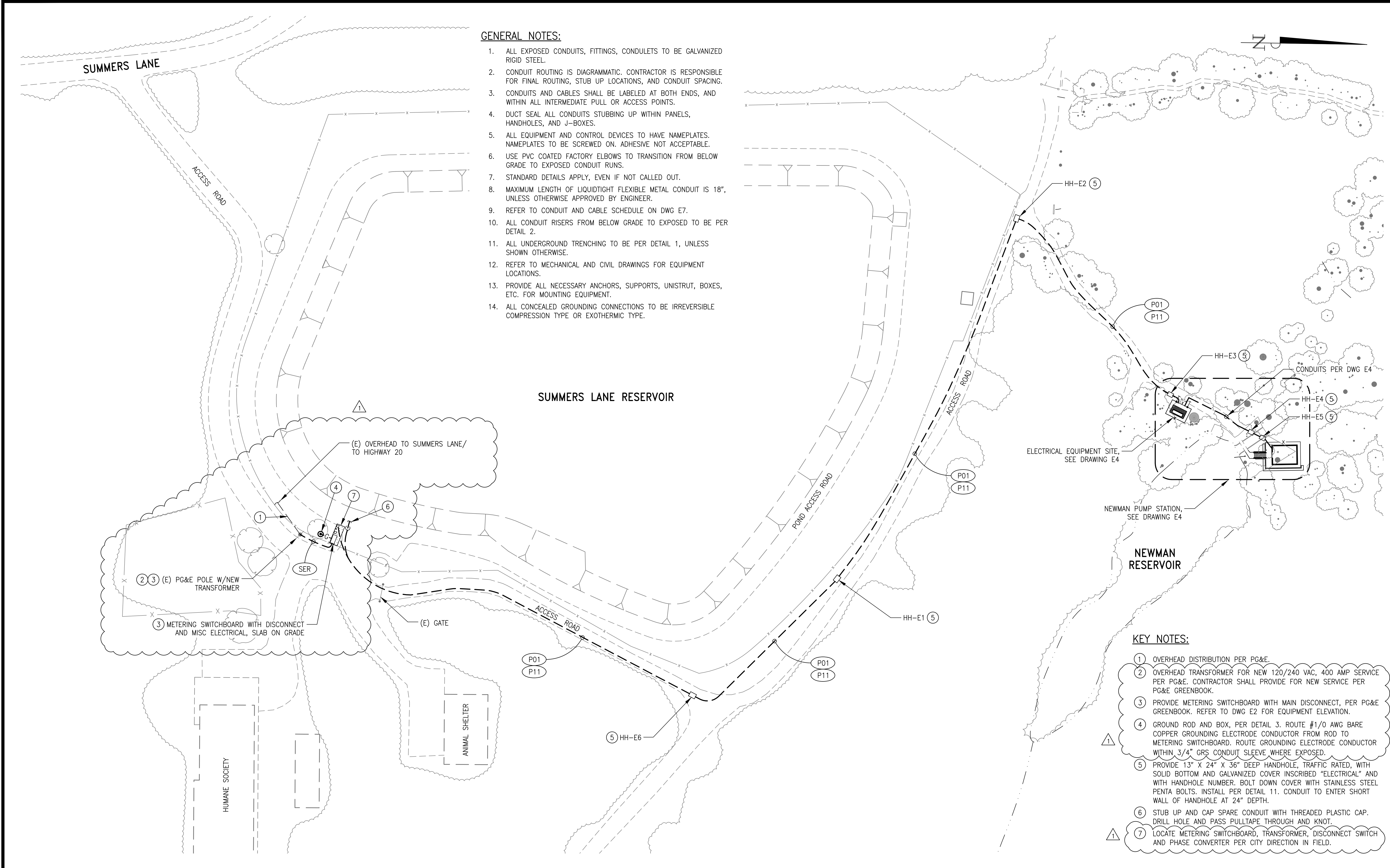
GENERAL NOTES:

1. ALL EXPOSED CONDUITS, FITTINGS, CONDULETS TO BE GALVANIZED RIGID STEEL.
2. CONDUIT ROUTING IS DIAGRAMMATIC. CONTRACTOR IS RESPONSIBLE FOR FINAL ROUTING, STUB UP LOCATIONS, AND CONDUIT SPACING.
3. CONDUITS AND CABLES SHALL BE LABELED AT BOTH ENDS, AND WITHIN ALL INTERMEDIATE PULL OR ACCESS POINTS.
4. DUCT SEAL ALL CONDUITS STUBBING UP WITHIN PANELS, HANDHOLES, AND J-BOXES.
5. ALL EQUIPMENT AND CONTROL DEVICES TO HAVE NAMEPLATES. NAMEPLATES TO BE SCREWED ON. ADHESIVE NOT ACCEPTABLE.
6. USE PVC COATED FACTORY ELBOWS TO TRANSITION FROM BELOW GRADE TO EXPOSED CONDUIT RUNS.
7. STANDARD DETAILS APPLY, EVEN IF NOT CALLED OUT.
8. MAXIMUM LENGTH OF LIQUIDTIGHT FLEXIBLE METAL CONDUIT IS 18", UNLESS OTHERWISE APPROVED BY ENGINEER.
9. REFER TO CONDUIT AND CABLE SCHEDULE ON DWG E7.
10. ALL CONDUIT RISERS FROM BELOW GRADE TO EXPOSED TO BE PER DETAIL 2.
11. ALL UNDERGROUND TRENCHING TO BE PER DETAIL 1, UNLESS SHOWN OTHERWISE.
12. REFER TO MECHANICAL AND CIVIL DRAWINGS FOR EQUIPMENT LOCATIONS.
13. PROVIDE ALL NECESSARY ANCHORS, SUPPORTS, UNISTRUT, BOXES, ETC. FOR MOUNTING EQUIPMENT.
14. ALL CONCEALED GROUNDING CONNECTIONS TO BE IRREVERSIBLE COMPRESSION TYPE OR EXOTHERMIC TYPE.

SUMMERS LANE RESERVOIR

KEY NOTES:

- 1 OVERHEAD DISTRIBUTION PER PG&E.
- 2 OVERHEAD TRANSFORMER FOR NEW 120/240 VAC, 400 AMP SERVICE PER PG&E. CONTRACTOR SHALL PROVIDE FOR NEW SERVICE PER PG&E GREENBOOK.
- 3 PROVIDE METERING SWITCHBOARD WITH MAIN DISCONNECT, PER PG&E GREENBOOK. REFER TO DWG E2 FOR EQUIPMENT ELEVATION.
- 4 GROUND ROD AND BOX, PER DETAIL 3. ROUTE #1/0 AWG BARE COPPER GROUNDING ELECTRODE CONDUCTOR FROM ROD TO METERING SWITCHBOARD. ROUTE GROUNDING ELECTRODE CONDUCTOR WITHIN 3/4" GRS CONDUIT SLEEVE WHERE EXPOSED.
- 5 PROVIDE 13" X 24" X 36" DEEP HANDHOLE, TRAFFIC RATED, WITH SOLID BOTTOM AND GALVANIZED COVER INSCRIBED "ELECTRICAL" AND WITH HANDHOLE NUMBER. BOLT DOWN COVER WITH STAINLESS STEEL PENTA BOLTS. INSTALL PER DETAIL 11. CONDUIT TO ENTER SHORT WALL OF HANDHOLE AT 24" DEPTH.
- 6 STUB UP AND CAP SPARE CONDUIT WITH THREADED PLASTIC CAP. DRILL HOLE AND PASS PULLTAPE THROUGH AND KNOT.
- 7 LOCATE METERING SWITCHBOARD, TRANSFORMER, DISCONNECT SWITCH AND PHASE CONVERTER PER CITY DIRECTION IN FIELD.



11/27/23 S:\PROJECTS\FIBER-001 - RAW WATER LINE REPLACEMENT PROJECT\CADD\SEGMENTS 2-5 FULL SERVICES - OVERALL SITE PLAN.DWG

J Calton Engineering



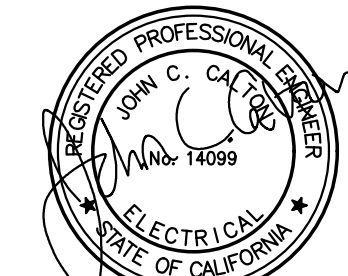
BAR IS ONE INCH AT FULL SCALE
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RAW WATER LINE REPLACEMENT PROJECT
OVERALL ELECTRICAL SITE PLAN
 CITY OF FORT BRAGG CALIFORNIA

DESIGNED UNDER THE DIRECTION OF:

JOHN C. CALTON No. 14099 - REGISTRATION EXPIRES 06-30-23	10/6/23
DESIGN: JCC	DATE: 10/6/23
DRAWN: WCJ	DATE: 10/6/23
CHECKED: JCC	DATE: 10/6/23



SCALE
1"=40'
 DRAWING NUMBER
E3
 SHEET NUMBER
59 OF 68 SHEETS

CONDUIT AND CABLE SCHEDULE					
CONDUIT		CABLE SIZE AND QUANTITIES	FROM	TO	REMARKS
NO.	SIZE				
P01	2"	3-#4/0, #6G	PHASE CONVERTER (OUTPUT)	MCC - MAIN BREAKER	480 VAC POWER, VIA HANDHOLES
P02	1"	VFD CABLE (3-#10, 3-#14G)	MCC - PUMP 1 VFD	DISCONNECT SWITCH - PUMP 1	480 VAC POWER
P03	1"	VFD CABLE (3-#10, 3-#14G)	MCC - PUMP 2 VFD	DISCONNECT SWITCH - PUMP 1	480 VAC POWER
P04	1"	3-#10, 3-#10N, #10G	MCC - LP-1 - CKT 2,4,6	NEWMAN PS - 3 POLE DISC SWITCH	120 VAC: MAGMETER, LIGHTS, RECEPTS
P05	3/4"	#10, #10N, #10G	NEWMAN PS - 3 POLE DISC SWITCH	NEWMAN PS - MAGMETER	120 VAC: PS MAGMETER
P06	3/4"	#10, #10N, #10G	NEWMAN PS - 3 POLE DISC SWITCH	NEWMAN PS - LIGHT SWITCH	120 VAC: LIGHTS
P07	3/4"	#10, #10N, #10G	NEWMAN PS - 3 POLE DISC SWITCH	NEWMAN PS - RECEPTACLES	120 VAC: RECEPTS
P10	1"	PULLTAPE	MCC - BREAKER SECTION	NEWMAN PS	STUB IN NEWMAN PS AND CAP
P11	2"	PULLTAPE	STUB UP AT METERING, CAP	MCC - PLC PANEL	SPARE CONDUIT, VIA HANDHOLES
SER	4"	PULLTAPE	PG&E POLE	METERING SWITCHBOARD	PROVIDE CONDUIT AND RISER
P21	2 1/2"	2-#350, #2/0G	SWITCHBOARD 250A BREAKER	50 KVA TRANSFORMER	240 VAC, 1 PHASE
P22	2"	2-#4/0, #1G	50 KVA TRANSFORMER	150A DISCONNECT SWITCH	480 VAC, 1 PHASE
P23	2"	2-#4/0, #1G	150A DISCONNECT SWITCH	PHASE CONVERTER (INPUT)	480 VAC, 1 PHASE

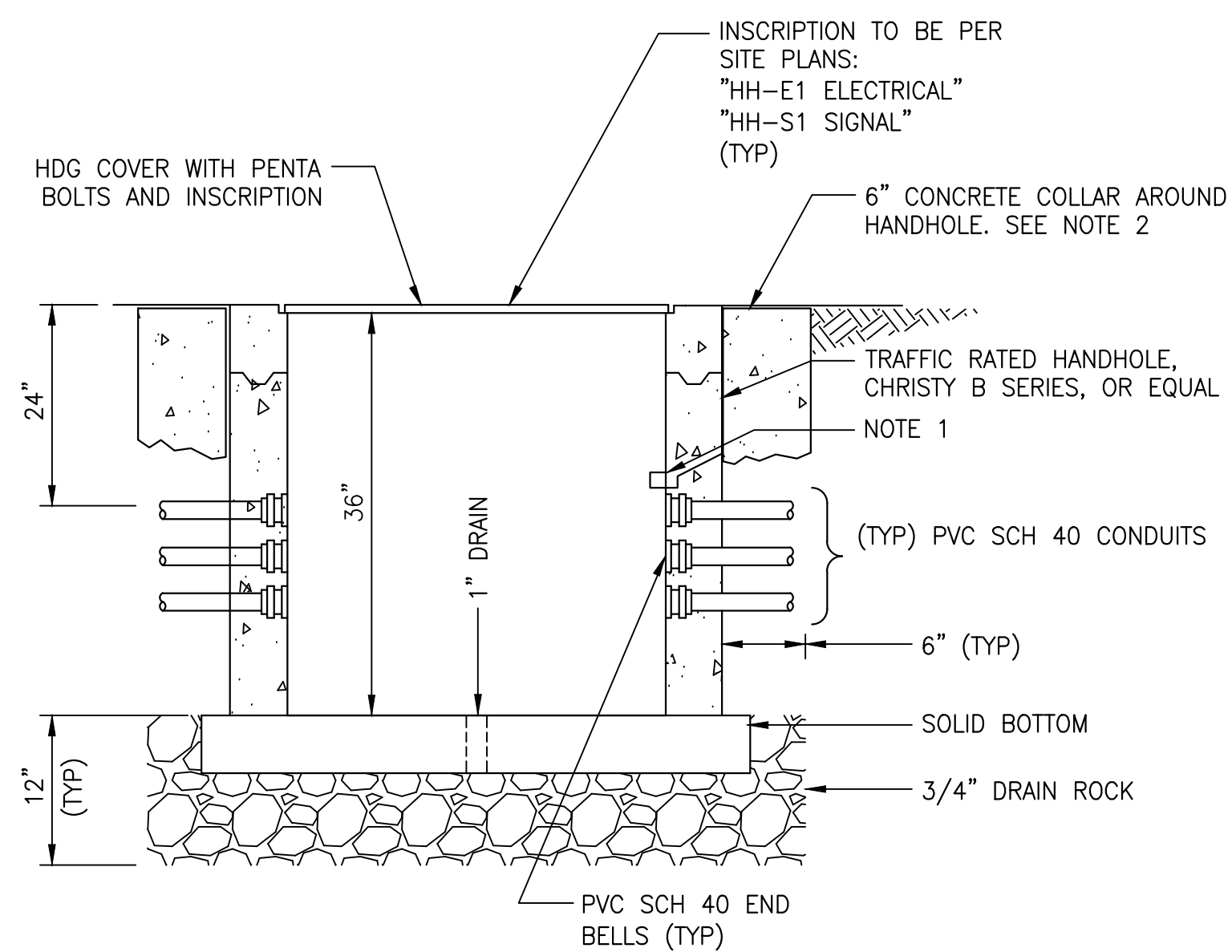
CONDUIT AND CABLE SCHEDULE					
CONDUIT		CABLE SIZE AND QUANTITIES	FROM	TO	REMARKS
NO.	SIZE				
C01	1"	10-#14, #14G	MCC - PUMP 1 VFD	PUMP 1 - OT&SF, E-STOP, PSHH	120 VAC CONTROLS, 4 SPARES
C02	1"	10-#14, #14G	MCC - PUMP 2 VFD	PUMP 2 - OT&SF, E-STOP, PSHH	120 VAC CONTROLS, 4 SPARES
S01	1 1/2"	3-#16 TWSP, 6-#14, #14G	MCC - PLC PANEL	NEWMAN PS - SIGNAL J-BOX	ANALOG AND DC SIGNALS, SPARES
S02	1/2"	2-#14, #14G	NEWMAN PS - SIGNAL J-BOX	NEWMAN PS - INTRUSION SWITCH	INTRUSION ALARM
S03	3/4"	#16 TWSP, #14G	NEWMAN PS - SIGNAL J-BOX	NEWMAN PS - MAGMETER	MAGMETER FLOW SIGNAL
S04	2"	COAXIAL CABLE	MCC - PLC PANEL	ANTENNA MAST, STUB UP 10'	ATTACH TO ANTENNA
S05	1"	LEVEL MANU CABLE	MCC - PLC PANEL	LEVEL TRANSDUCER	
S10	1"	PULLTAPE	MCC - PLC PANEL	NEWMAN PS	STUB IN NEWMAN PS AND CAP

NOTES:
1. CONDUIT SIZES SHOWN ARE MINIMUM. CONTRACTOR TO CONFIRM BASED ON SUPPLIED CABLE DIAMETERS AND NEC ALLOWED CONDUIT FILL.

FIXTURE SCHEDULE					
TYPE	VAC	DESCRIPTION	LAMPS	MOUNTING	MANUFACTURER / MODEL NO.
A	120	LED STRIP LIGHT, VAPOR TIGHT, IN POLYCARBONATE HOUSING, 48" LONG. UL LISTED FOR WET LOCATIONS. PROVIDE WITH HIGH EFFICIENCY LEDS. SUITABLE FOR SURFACE MOUNTING, WITH WET LOCATION FITTINGS AT BOTH ENDS. PROVIDE WITH SWITCHABLE LUMENS OUTPUT AND COLOR TEMPERATURES. NO CONTROLS REQUIRED.	LED 24-42 WATTS 3000-4800 LUMENS	SURFACE MOUNT	FIXTURE: LITHONIA CSVT-L48-ALO3-MVOLT-SWWW3-80CRI-WLFEND2.
B	120	LED EMERGENCY LIGHTING UNIT WITH 90 MINUTES OF ILLUMINATION. THERMOPLASTIC HOUSING WITH TEST SWITCH, LITHIUM-IRON PHOSPHATE BATTERIES, TWO LED LAMPS FOR 640 LUMENS. MULTIVOLT. 5000K. PROVIDE WITH SELF DIAGNOSTICS, FAILURE INDICATION. UL LISTED.	LED TWO 6.6 WATT LAMPS, 640 LUMENS	WALL MOUNT	FIXTURE: LITHONIA ELM4L-UVOLT-LTP-SDRT
C	120	LED WALL SCONCE FIXTURE, ENCLOSED AND GASKETED. WALL MOUNTED. LONG LIFE LEDS, 100,000 HOURS, 3000K COLOR, TYPE IV DISTRIBUTION. MOTION AND AMBIENT SENSOR CONTROLS. DARK BRONZE FINISH. UL LISTED FOR WET LOCATIONS.	LED 20 WATT 2053 LUMENS	WALL MOUNT	FIXTURE: LITHONIA WRW-LED-P1-30K-SR4-MVOLT-PIR-DDBXD

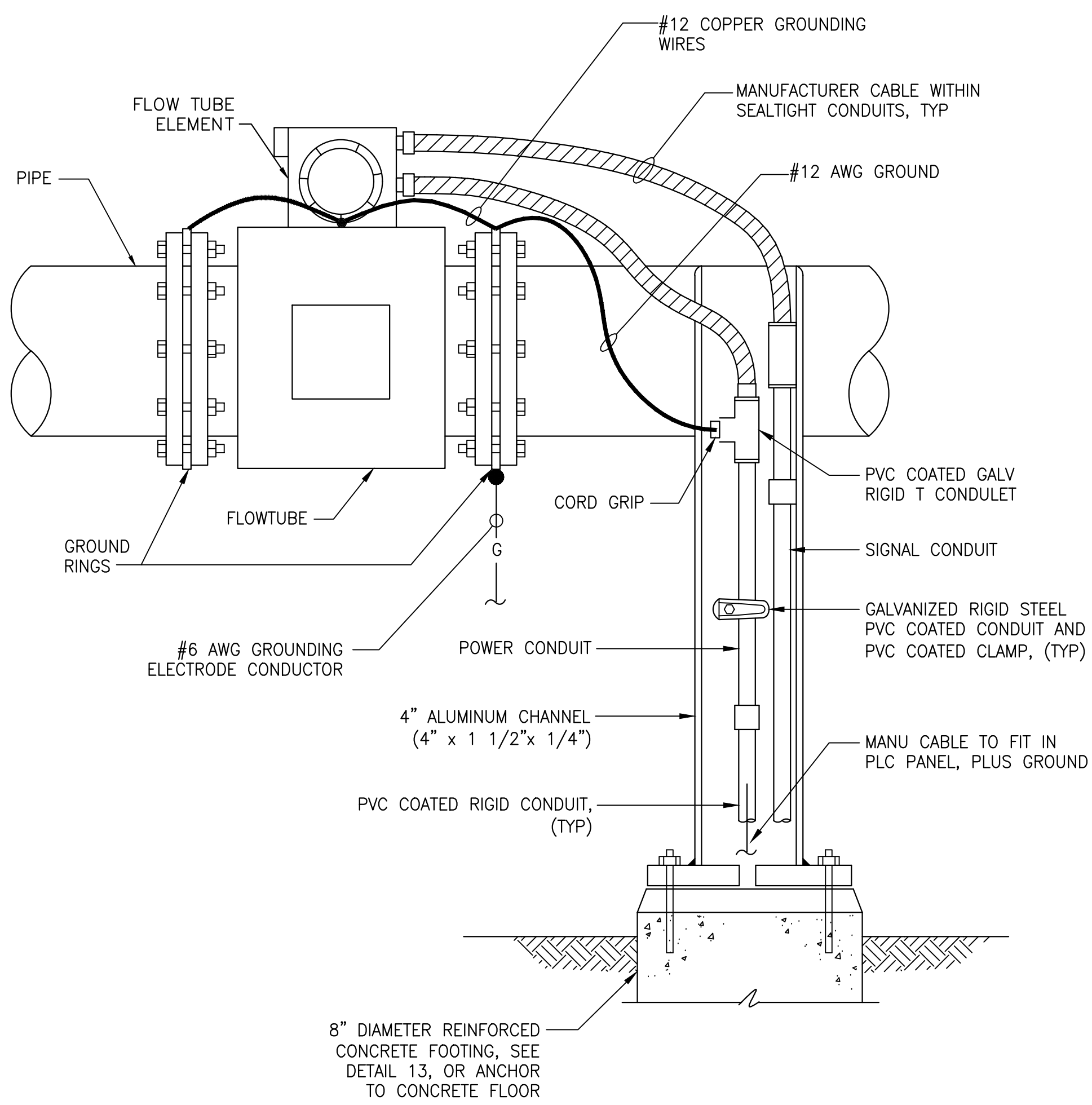
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		BAR IS ONE INCH AT FULL SCALE IF NOT ONE INCH ON THIS SHEET SCALE ACCORDINGLY	NO.	REVISIONS	BY	APP	DATE	RAW WATER LINE REPLACEMENT PROJECT CONDUIT AND CABLE AND FIXTURE SCHEDULES CITY OF FORT BRAGG CALIFORNIA	DESIGNED UNDER THE DIRECTION OF: JOHN C. CALTON No. 14099 - REGISTRATION EXPIRES 06-30-23 DATE: 10/6/23		SCALE NO SCALE
			ADDENDUM NO.1 JC 11/28/23	DESIGN: JCC DATE: 10/6/23 DRAWN: WCJ DATE: 10/6/23 CHECKED: JCC DATE: 10/6/23	DRAWING NUMBER E7 SHEET NUMBER 63 OF 68 SHEETS						

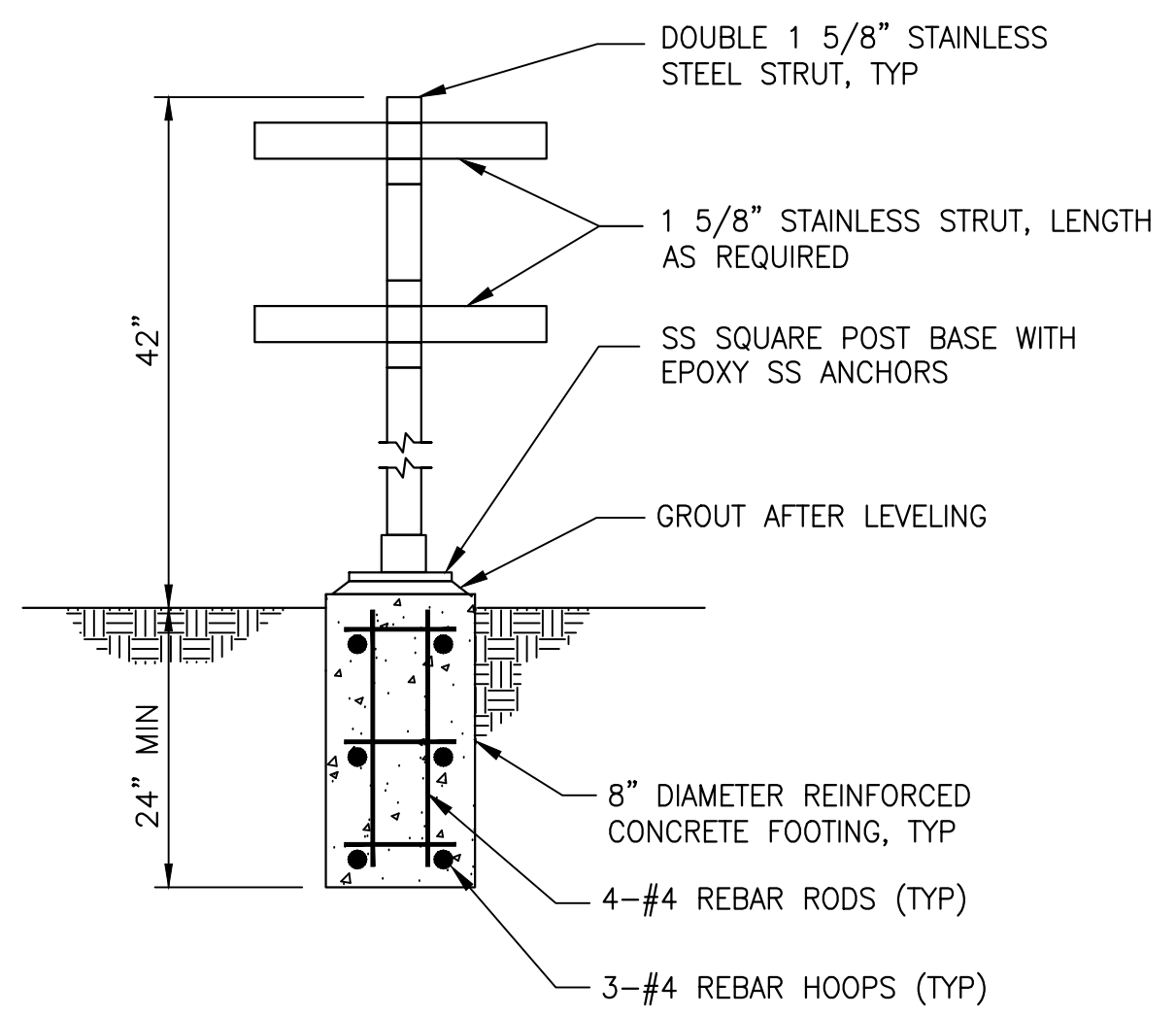


- INSCRIPTION TO BE PER SITE PLANS:
"HH-E1 ELECTRICAL"
"HH-S1 SIGNAL"
(TYP)
- TRAFFIC RATED HANDHOLE, CHRISTY B SERIES, OR EQUAL
NOTE 1
- (TYP) PVC SCH 40 CONDUITS
- 6" (TYP)
- SOLID BOTTOM
- 3/4" DRAIN ROCK
- PVC SCH 40 END BELLS (TYP)
- NOTES:
1. PROVIDE AND INSTALL EPOXY CEMENT PHENOLIC TAG, INSCRIBED WITH CONDUIT NUMBER, ABOVE EACH CONDUIT, OR CABLE TIE TO CONDUIT.
 2. INSTALL TRAFFIC RATED HANDHOLE WITH 6" CONCRETE COLLAR. REFER TO CHRISTY CONCRETE TRAFFIC RATED INSTALLATION GUIDE. PROVIDE 1" DRAIN IN BOTTOM SLAB.
 3. LABEL CABLES WITH ENGRAVED PHENOLICS PER SPECIFICATIONS.

PRE-CAST HANDHOLE DETAIL (11)

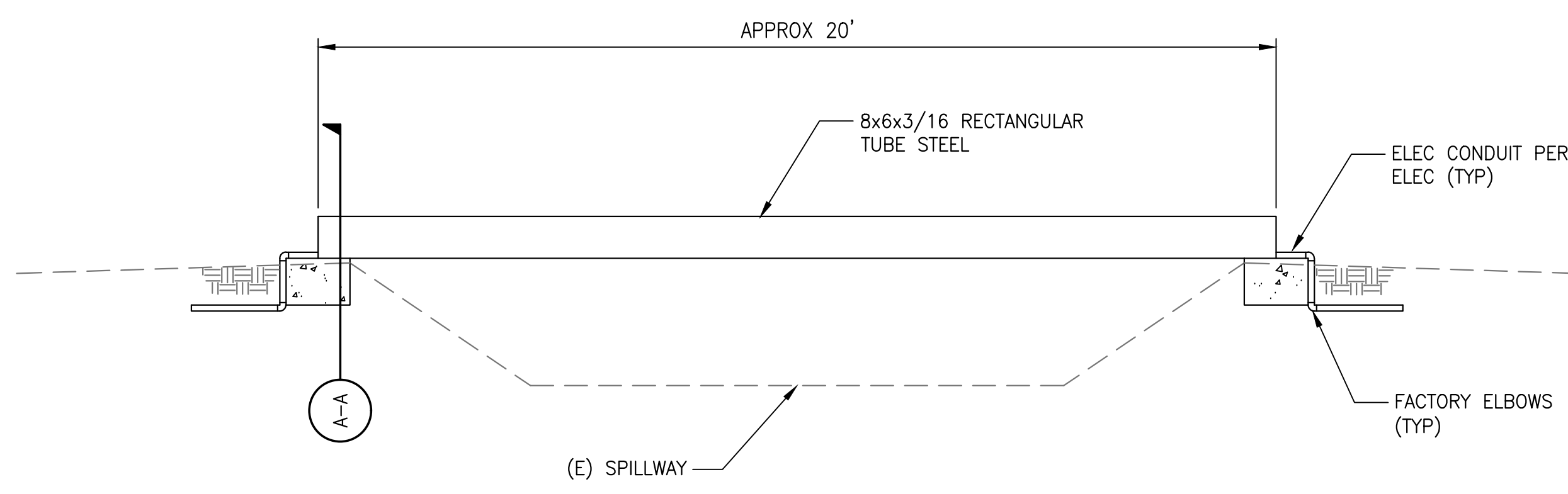


FLOWMETER WIRING DETAIL (12)



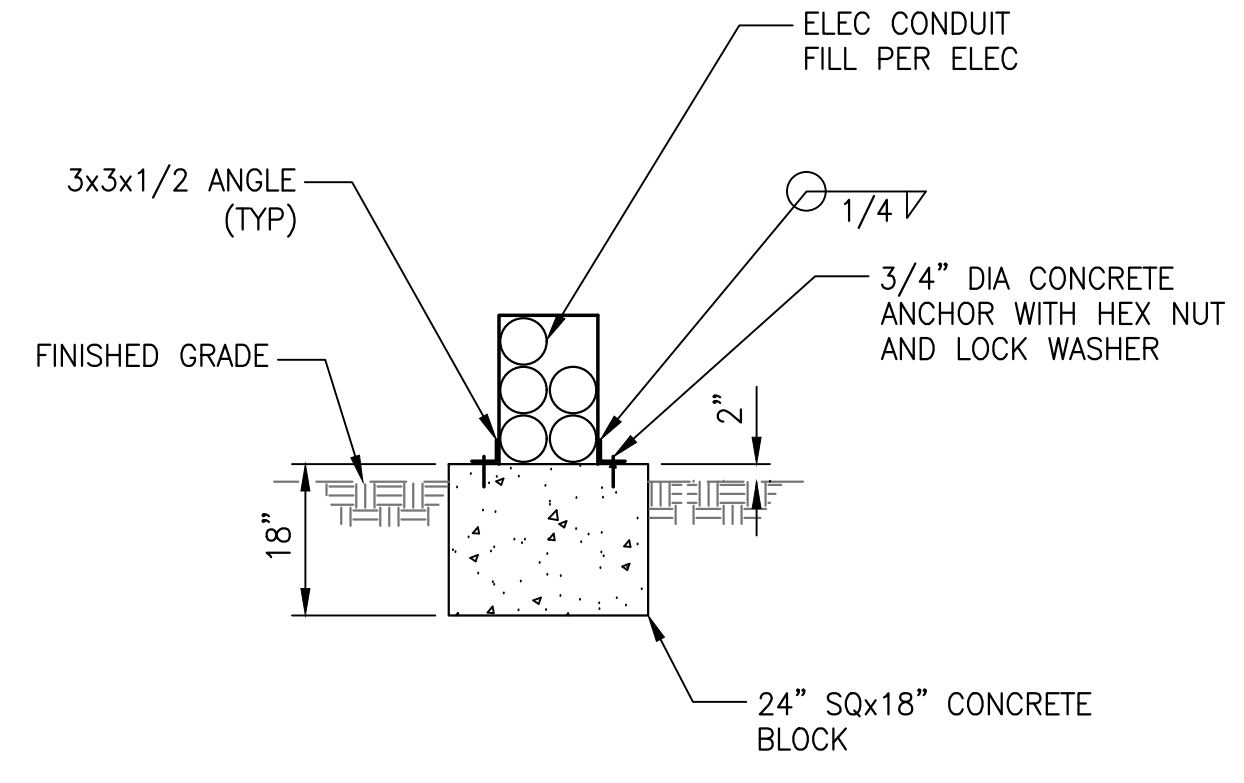
- NOTES:
1. ALL STRUT AND HARDWARE SHALL BE TYPE 316 STAINLESS STEEL.

SINGLE STANCHION DETAIL (13)

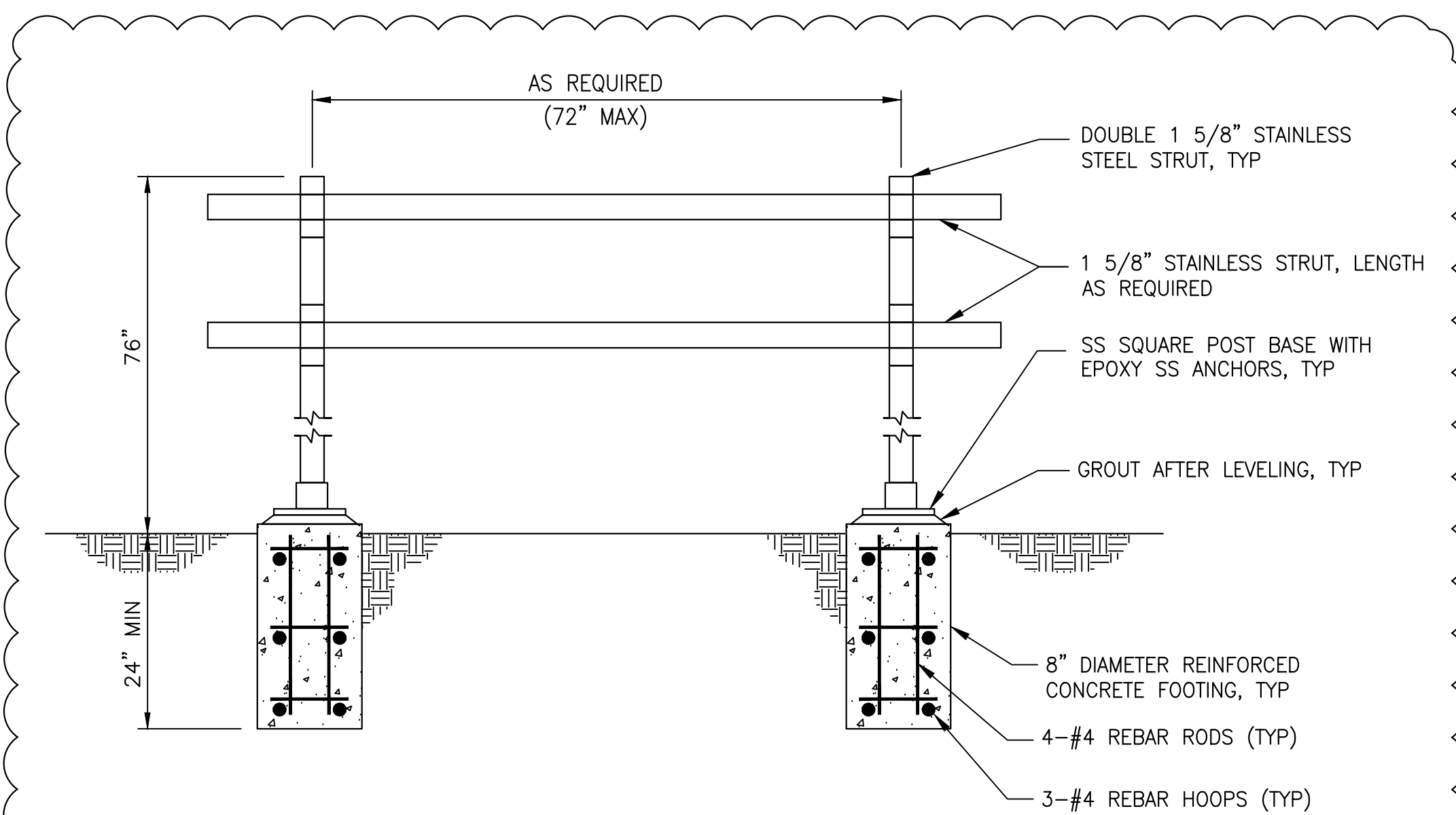


- NOTES:
1. COAT TUBE STEEL AND ANGLES PER SPECIFICATIONS.
 2. PROVIDE ONE GUARD POST EACH END. FIELD LOCATE TO PROTECT EXPOSED CONDUIT.

ELECTRICAL CONDUIT STREAM CROSSING (14)



SECTION A-A



- NOTES:
1. ALL STRUT AND HARDWARE SHALL BE TYPE 316 STAINLESS STEEL.

DOUBLE STANCHION DETAIL (15)

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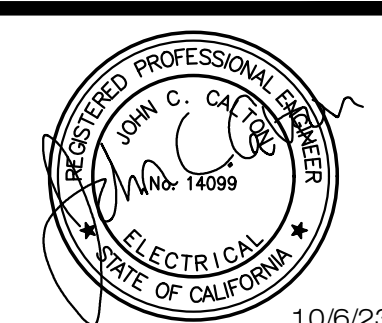
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RAW WATER LINE REPLACEMENT PROJECT
DETAILS - SHEET 2 OF 4
 CITY OF FORT BRAGG CALIFORNIA

DESIGNED UNDER THE DIRECTION OF:
 JOHN C. CALTON
 No. 14099 - REGISTRATION EXPIRES 06-30-23
 DATE: 10/6/23
 DESIGN: JCC DATE: 10/6/23
 DRAWN: WCJ DATE: 10/6/23
 CHECKED: JCC DATE: 10/6/23



SCALE
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 DRAWING NUMBER
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 SHEET NUMBER
 54 OF 68 SHEETS

**TECHNICAL SPECIFICATIONS FOR
CITY OF FORT BRAGG, CALIFORNIA
RAW WATER LINE REPLACEMENT PROJECT, SEGMENTS 2 – 5
CITY PROJECT No. 2019-02**

Division 01 – General

Section 01 10 00	Summary
Section 01 20 00	Price and Payment Procedures
Section 01 25 00	Substitution Procedures
Section 01 30 00	Administrative Requirements
Section 01 32 16	Construction Progress Schedule
Section 01 33 00	Submittal Procedures
Section 01 40 00	Quality Requirements
Section 01 50 00	Temporary Facilities and Controls
Section 01 60 00	Product Requirements
Section 01 70 00	Execution and Closeout Requirements
Section 01 74 19	Construction Waste Management
Section 01 91 00	Commissioning

Division 02 – Existing Conditions

Section 02 41 16	Structure Demolition
Section 02 82 13	Asbestos Abatement for Utilities

Division 03 – Concrete

Section 03 10 00	Concrete Forming and Accessories
Section 03 20 00	Concrete Reinforcing

Section 03 30 00 Cast-in-Place Concrete
Section 03 60 00 Grouting

Division 5 – Metals

Section 05 52 00 Metal Railings

Division 6 – Wood, Plastics and Composites

Section 06 10 00 Rough Carpentry
Section 06 17 53 Wood Trusses
Section 06 20 00 Finish Carpentry

Division 7 – Roofing, Waterproofing and Insulation

Section 07 03 11 Fiber Glass Based Asphalt Shingles
Section 07 06 00 Flashing
Section 07 21 03 Batt and Blanket Insulation
Section 07 46 46 Siding
Section 07 92 00 Sealants and Caulking

Division 8 – Windows and Doors

Section 08 11 00 Metal Doors and Frames
Section 08 31 13 Horizontal Access Doors
Section 08 71 00 Door Hardware

Division 09 – Finishes

Section 09 90 00 Painting and Coating

Division 26 – Electrical

Section 26 05 00 Electrical Work – General

Section 26 05 19 Wires and Cables

Section 26 05 26 Grounding

Section 26 05 33 Electrical Raceway Systems

Section 26 05 43 Underground Raceway Systems

Section 26 05 73 Protective Device Studies

Section 26 08 00 Electrical Testing

Section 26 24 13 ~~480V Metering Panel~~Metering Switchboard

Section 26 24 19 Low Voltage Motor Control Center

Section 26 27 26 Wiring Devices

Section 26 29 13 Local Control Stations

Section 26 50 00 Lighting

Division 31 – Earthwork

Section 31 05 13 Soils for Earthwork

Section 31 05 16 Aggregates for Earthwork

Section 31 10 00 Site Clearing

Section 31 22 13 Rough Grading

Section 31 23 16 Excavation

Section 31 23 16.13 Trenching

Section 31 23 19 Dewatering

Section 31 23 23 Fill

Division 32 – Exterior Improvements

Section 32 12 16 Asphalt Paving

Section 32 92 19 Seeding

Division 33 – Utilities

Section 33 05 05.31 Hydrostatic Testing

Section 33 05 07 Trenchless Installation of Utility Piping

Section 33 05 09.33 Thrust Restraint for Utility Piping

Section 33 05 63 Concrete Vaults and Chambers

Section 33 14 13 Public Water Utility Distribution Piping

Section 33 14 19 Valves and Hydrants for Water Utility Service

Division 40 – Process interconnections

Section 40 90 00 Process Control and Instrumentation Systems

Section 40 91 00 Process Measurement Devices

Section 40 95 13 Process Control Panels and Hardware

Division 43 – Process gas and liquid handling, purification and storage equipment

Section 43 23 31.23 Overhung Close-Coupled Vertical End Suction Pumps

SECTION 26 05 00 – ELECTRICAL WORK, GENERAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide electrical work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section apply to all sections in Division 26, except as indicated otherwise. The work of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. The Contractor's attention is directed to the requirement for proper coordination of the work of this Section with the work of equipment specifications, the work of Division 40.
- C. All concrete, excavation, backfill, and steel reinforcement work required for encasement, installation, or construction of the work of the various sections of Division 26 is included as a part of the work under the respective sections, including ductbanks, handholes, slabs on grade, housekeeping pads, antenna mast, and equipment stanchion supports.
- D. Contractor shall provide all utility work shown on Contract Drawings, Utility Drawings, and per Pacific Gas and Electric's (PG&E) Greenbook, Specifications and Standards. The Contractor is responsible for coordination with, and obtaining permits and inspections, as required by PG&E. Work includes, but is not limited to, as applicable: ~~service pole and weatherhead with cables, riser and secondary conduit, Metering panel~~ Switchboard with main disconnect, all as applicable to utility design drawings and PG&E standards. Contractor to coordinate with PG&E for required inspections. Owner is coordinating with PG&E for ~~overhead line extension, and three phase, 480/277 VAC~~ 120/240 VAC service near the Summer Lane Reservoir for the Newman Pump Station project.
- E. Contractor shall provide lighting, receptacles, and controls for heaters and fans within outdoor electrical equipment. Motor Control Centers (MCC) shall be NEMA 3R rated, painted steel, non-walk-in exterior enclosures with sloped roof. Equipment will sit on housekeeping pads integral to slabs on grade. Slabs on grade shall be sized with minimum 48" clearance of concrete slab, measured from front edge of housekeeping pad, and 6" from pad on sides and back for anchoring clearances.
- F. Contractor shall provide PLC Panel, integral to MCC line up. Contractor shall provide programmable logic controller (PLC), operator interface terminal (OIT), radio, antenna, antenna mast, and coaxial antenna cable, for remote communication systems. Programming of the PLC and OIT and radios shall be provided by Contractor. Refer to

Control Descriptions. Antenna mounting heights shall be per radio path study. Contractor shall install and orient antenna.

- G. Contactor shall provide electrical work at the Newman Pump Station including: flowmeters, Newman Reservoir level system, pressure lighting and receptacles, pump disconnects, high pressure switches, for a complete and operable pumping system.
- H. Owner shall provide programming at Owner's existing Supervisory Control and Data Acquisition (SCADA) system, outside of this contract. Contractor shall provide support for field testing of PLC and OIT logic, and for verification of inputs and outputs from the PLC and OIT back to Owner's SCADA system. Contractor to coordinate with Owner for scheduling of PLC and OIT and SCADA testing. Contractor to include one day at site for such testing on the schedule.
- I. The Contractor shall coordinate location of antenna mast in field with Owner. Contractor shall provide, install, connect, and orient antennas per Owner's radio path study. Contractor to include in bid scope to move antenna mast 10' in any direction from where shown on Contract Drawings, as no additional cost to Owner.
- J. Contractor is responsible for daily redlining of drawings. Redlined drawings subject to review by Owner and Engineer.
- K. Electrical equipment shall not be energized until sequence steps 1 through 6 of Section 260573 Paragraph 3.1.C, are completed and approved by Owner and Engineer.
- ~~K.~~L. Contractor shall provide electrical work for Metering Switchboard distribution section, Step Up Transformer, Circuit Breaker Disconnect Switch, and Phase Converter. Provide all stanchions required. Provide slab on grade with integral housekeeping pad.

1.2 APPLICABLE CODES, STANDARDS, PERMITS, AND REQUIREMENTS

- A. Perform all work; furnish, install, and test all materials and equipment in full accordance with the latest applicable editions, rules, regulations, requirements, and specifications of the following:
 - 1. Title 8, Subchapter 5, California Administrative Code – Electrical Safety Orders.
 - 2. Local Laws and Ordinances.
 - 3. State and Federal Laws.
 - 4. Local and State Fire Marshal.
 - 5. Underwriters' Laboratories (UL).
 - 6. National Electrical Safety Code (NEC).
 - 7. American National Standards Institute (ANSI).
 - 8. National Electrical Manufacturer's Association (NEMA).
 - 9. National Electrical Contractors' Association (NECA) Standard of Installation.

10. Institute of Electrical and Electronics Engineers (IEEE).
11. Insulated Cable Engineers Association (ICEA).
12. Occupational Safety and Health Act (OSHA).
13. National Electrical Testing Association (NETA).
14. American Society for Testing and Materials (ASTM).
15. National Fire Protection Association (NFPA).
16. National Electrical Code (NEC).
17. California Electrical Code (CEC).
18. Pacific Gas and Electric Company (PG&E).
19. City of Fort Bragg (Owner, City).

- B. All electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL), or by an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.
- C. Installation of electrical equipment and materials shall comply with Occupational Safety and Health Administration (OSHA) Safety and Health Standards, state building standards, and applicable local codes and regulations.
- D. Where the requirements of the specifications conflict with UL, National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), or other applicable standards, the more stringent requirements shall govern as approved by the local authority having jurisdiction. Conflicts that may exist between the above items will be resolved at the discretion of the Engineer at no extra cost by the Contractor.
- E. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.
- F. Obtain all permits and pay all fees required by any governmental agency or utility having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction. PG&E fees will be paid by the Owner.

1.3 SIGNAGE

- A. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal, state, OSHA, and NEC requirements. The Contractor shall provide the following signage at a minimum, unless otherwise stated in individual

equipment specifications sections. Nameplates and Warning Signs shall be screwed on with stainless steel screws. Arc Flash Labels may be adhesive.

1. Arc Flash Labels – Provide Arc Flash labels as required per NEC Article 110.16 and these Specifications. Inscribe the Arc Flash label with the maximum available fault current at Metering Panel-Switchboard main breaker, including date of calculation, per NEC Article 110.24. Provide Arc Flash label at MCC main breaker. Provide Arc Flash labels at each motor starter section and lighting panelboard main breaker. Adhesive arc flash labels are acceptable. Arc flash labels shall be durable materials and rated for outdoor, marine environments.
2. Local Disconnect Switches – Each local disconnect switch, shall include engraved phenolic, marked to indicate its voltage, number of phases, source, and equipment served (description and tag number as applicable). Phenolic nameplates to have minimum ¼-inch lettering, black engraved to white core, and attached with stainless steel screws.
3. Equipment Nameplates – Provide engraved phenolic equipment nameplates on all electrical and instrumentation equipment. Nameplate to be inscribed with equipment name and equipment tag number, at a minimum. Submit listing of equipment nameplates complete with inscriptions for review. Phenolic nameplates to have minimum ¼-inch lettering, black engraved to white core, and attached with stainless steel screws, unless shown otherwise.
4. Warning Signs:
 - a. Provide electrical shock hazard signs on the exterior doors of the Metering Panel-Switchboard, Step UP Transformer, Circuit Breaker Disconnect Switch, Phase Converter, and MCC enclosures.

1.4 PERMITS AND INSPECTION

- A. Permits shall be obtained and inspection fees shall be paid by Contractor as applicable.
- B. Contractor shall coordinate with serving electrical utility (PG&E) for required inspections and approvals.

1.5 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. Before submitting a bid, visit the sites and determine conditions at the sites and at all existing structures in order to become familiar with all existing conditions and electrical systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the Contractor's failure to fulfill this requirement.
- B. Protect all existing aboveground and underground utilities during construction. Pay for all repairs without increase in Contract cost should damage to underground utilities

occur during construction. This includes the existing underground conduit system for the Summers Lake Reservoir shed.

- C. Replace existing surface (asphalt, concrete) in kind where work is performed, unless Contract Drawings show otherwise.
- D. Coordinate location of Newman Reservoir level system with the Owner.

1.6 RESPONSIBILITY

- A. The Contractor shall be responsible for:
 - 1. Complete electrical system that is functionally operational in accordance with the intent of these Contract Documents. This includes demolition, procurement, installation, testing, start-up, and training.
 - 2. Coordinating the details of facility and process equipment layouts and construction for all Specification Divisions which affect the work covered under Divisions 26 and 40.
 - 3. Coordinate, provide and install all PG&E utility requirements for new electrical services.
 - 4. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
 - 5. Coordination with other Divisions for equipment electrical, wiring and cable requirements.
 - 6. Satisfying all requirements of Owner's standards.
 - 7. PLC's and OIT's and radios programming and configuration and field testing, plus verification of PLC input and output points back to Owner's SCADA system. ~~(typical of all three sites), and AWPF SCADA system (Willowbrook Site).~~
 - 8. Coordination with the Owner to provide complete work as described in Specifications and shown on Drawings and attachments. This includes coordination with Owner's SCADA programmer and Contractor's PLC and OIT and radio programmer.
 - 9. Submit to the Owner a complete copy of red line as-builts every month after the Notice to Proceed date for Owner information and review in accordance with the Record Drawing requirements.

1.7 INTENT OF DRAWINGS

- A. The Contract Drawings indicate the extent, general location, and arrangement of equipment. Ductbank and conduit runs are diagrammatic and may not show the exact locations for installation. The Contractor shall verify the locations of conduit stub-ups based upon conduit entry space of equipment furnished from the manufacturer's certified shop drawings and by inspection of the actual equipment to be installed. Coordinate with serving utilities and Owner for exact location of substructures, or point

of interconnections. Include in bid all costs to modify locations shown on Drawings by ten feet in any direction.

- B. In general, where the background on Contract Drawings has been screened, the area screened is work other than electrical, unless otherwise noted. Work under Division 26 and 40 is shown heavier for contrast.
- C. Standard details are typical for all locations which apply, regardless of whether a callout is shown on the Drawing.
- D. Electrical design is based on minimum horsepower and current ratings. If the manufacturer and/or the Contractor provides equipment with a larger horsepower or current rating, the Contractor shall be responsible for making all necessary changes to accommodate the larger unit, with the approval of the Engineer. Contractor shall pay for all such changes, including engineering design by a professional electrical engineer currently registered in the state of California. Contractor to provide conduits with sufficient dimensions, per NEC, for conduits filled with manufacturer cables.
- E. Number and size of wires which shall be installed in runs of conduit where not shown on the Contract Drawings shall be determined from the one-line, schematics, connection, interconnection, and control diagrams of actual equipment furnished. Cable quantity and size and type shall be based on submitted and approved Interconnect Diagram, refer to Division 40 for Interconnect Diagram requirements.
- F. Final layout of panels, equipment, lights, etc. shall be approved by Owner and Engineer in field prior to construction. The Contractor shall make an appointment with the Owner and Engineer to review such locations and shall not commence construction until the locations have been approved by the Owner and Engineer. A minimum of three working days is required to schedule review.

1.8 CONTRACTOR SUBMITTALS

- A. General
 - 1. Submittals shall be specific for each facility.
 - 2. Provide manufacturers' descriptive information and shop drawings for all equipment, material, and devices furnished under Divisions 26 and 40, including raceway routing drawings, schematic (elementary) diagrams, equipment dimensional drawings, interconnection and connection diagrams, grounding diagrams, catalog cut sheet information, and calculations in accordance with Specifications. Device designations and symbols for schematic (elementary) connection or interconnection diagrams shall conform to the latest edition of NEMA ICS 1.

3. Provide separate submittals for the following equipment: Metering Panel Switchboard with Main Disconnect, Step Up Transformer, Circuit Breaker Disconnect Switch, Phase Converter, Motor Control Center with integral PLC Panel, Interconnect Drawings, Protective Device Studies, disconnect switches, conduits, cables, light system and fixtures, wiring devices, grounding system components, and instrumentation. Prepare separate submittals for Protective Device Studies, and Electrical Testing. Submittals shall be per Specification Section.
4. Submit complete electrical drawings for all equipment furnished in accordance with other Divisions that interface with electrical equipment. These drawings shall contain panel elevation, bill of materials, control schematic diagrams (complete with terminal numbers, device names, field equipment descriptions and tag numbers, cable colors, ladder rung numbers, etc.) to provide complete identification of the circuits and provide coordination between the equipment. Both AutoCAD and PDF-type files are required for submitted drawings.
5. Check submittals for proper number of copies, adequate identification, correctness and compliance with Drawings and Specifications, and initial all copies indicating this has been done.
6. If the equipment installed during construction is not the exact same equipment that was approved by the Engineer before construction, then the Contractor shall resubmit all documentation related to the installed equipment as required herein for the Engineer's approval.
7. Review of submittal information by the Engineer shall not relieve the Contractor from responsibility for deviations from Contract Drawings and Specifications, unless Contractor has received written approval from the Engineer for specific deviations at the time of the submission request. Review of submittal information shall not relieve the Contractor from responsibility for errors and omissions in shop drawings or literature.
8. Manufacturer's standardized schematic diagrams will not be acceptable.
9. Catalog cut sheets shall be highlighted to designate the exact model number of proposed equipment. Cross out all non-applicable equipment on submitted sheets.
10. Submit understanding of Control Descriptions, and color OIT screens in hard copy (PDF) format.
11. Operation and Maintenance (O&M) Manuals per Specification. Provide with completed O&M Manual Review Checklist Form (attached). Provide minimum of four hard copies and one electronic copy of all Division 26 O&M Manuals, unless noted otherwise.

B. Submit certified shop drawings and diagrams as follows:

1. Layouts indicating conformity with space requirements, including front and rear access requirements.
2. Detailed anchoring requirements, including stamped and signed seismic calculations confirming anchor type, size and depth.

3. Assembly drawings in sufficient detail to identify every part of the specified equipment, including bills of material.
 4. General dimension, outline, and panel, cubicle, and structure layout drawings showing the principal dimensions of the equipment, the location of all devices therein, and the size of electrical conduit windows and cable connections. Include front, rear, side elevations and top view. Include front and rear access requirements. Provide finish and materials, temperature limitations, and grounding requirements. Provide nameplate inscription schedule. Provide manufacturer anchoring requirements to confirm seismic results and equipment weights.
 5. In AutoCAD format and PDF format, submit the following: Single Line Drawings, Equipment Elevation Drawings, Schematic Diagrams, Interconnection Drawings, PLC Panel Drawings. Drawings shall be 11 inches x 17 inches. Submit drawings in PDF format and AutoCAD format.
 6. Installation details for the following: Conduit Crossings at the Spillway, Newman Reservoir level transducer with stilling well, both flowmeters, and discharge high pressure switches.
- C. Submit manufacturer's certified shop drawings and information on the following:
1. Metering Panel Switchboard with Main Disconnect including all components.
 2. Submit proof of PG&E approval of Metering Panel Switchboard, including metering sections and installed equipment and distribution section.
 3. Step Up Transformer
 4. Circuit Breaker Disconnect Switch
 - 2-5. Phase Converter
 - 3-6. Motor Control Center including all components.
 - 4-7. PLC Panel (integral to MCC) including all components, PLC, OIT, and radio hardware.
 - 5-8. Motor Disconnect Switches, 3 pole switch at pump station.
 - 6-9. In addition to submittals for the specific items mentioned above, furnish shop drawings and catalog cut information on the following items:
 - a. Conduits, fittings, device boxes.
 - b. Warning tape and pull tape.
 - c. Lighting fixtures
 - d. Antenna mast, and reinforced concrete base design.
 - e. Handholes.
 - f. Wires, cables, grounding conductors.
 - g. Wiring devices (switches and receptacles).
 - h. Tagging and labeling materials, with inscriptions, for conduits, cables, instruments, panels, switches, and equipment.
 - i. Protective Device Studies: Arc Flash, Short Circuit, Coordination.
 - j. Grounding system components.

- k. Submit hardcopy of all Contractor configurations of equipment. This applies to VFD configurations, instrumentation settings and calibrations, and all other configured devices.
 - l. Instrument installation details for: both magmeters, pressure switches, Newman Reservoir level system.
 - m. Testing Procedures, and Certified Results for: Factory Acceptance Testing (FAT), Pre-Demonstration start-up, Demonstration Testing.
 - n. Submit NETA Testing agency, NETA testing procedures, and certified NETA testing results stamped by California professional engineer, for approval.
 - o. Equipment as listed in individual specification sections.
- D. Seismic
- 1. Submit proof of compliance that the following electrical equipment items are seismically anchored: MCC with PLC Panel. Proof of compliance shall include complete anchorage details coordinated with equipment mounting provisions showing weights, calculations, anchoring points, anchor bolts size and type, and any special considerations. Proof of compliance for each listed piece of equipment is to be prepared, stamped and signed by a licensed structural engineer in the state of California. Listing is not inclusive and is applicable for all electrical equipment 400 pounds and greater that is floor-mounted, and equipment 50 pounds and greater that is wall-mounted.
- E. Operation and Maintenance Manuals shall be submitted per Specifications. Include completed O&M Manual Review Checklist with each O&M Manual submittal. Refer to O&M Manual Review Checklist at end of this Section.

1.9 AREA DESIGNATIONS

- A. General
- 1. Raceway system enclosures shall comply with Sections 260533 and 260543.
 - 2. Electric work specifically indicated in sections within any Division of the Specifications shall comply with those requirements.
 - 3. Other electrical work not included in 1.10.A.1 and 1.10.A.2 shall comply with this Paragraph 1.10.A.3.
 - a. The following (Table 1) lists the type of electrical equipment and materials to be used based on applied area, unless shown otherwise on Contract Drawings.

Table 1					
Electrical Equipment and Materials					
Applied Area Classification	Enclosure, Pullbox or J-Box NEMA Rating	Device Box or Small Enclosure	Strut and Mounting Hardware	Exposed Conduit System	Concrete Encased Conduit System
Interior Damp	NEMA 4/3R	Cast Steel	316 stainless steel struts, and stainless steel hardware	Galvanized Rigid Steel	PVC Sch 40 with PVC boxes
Exterior Wet	NEMA 4X 316 stainless steel, unless noted otherwise	PVC coated cast steel	316 stainless steel struts, and stainless steel hardware	PVC coated galvanized rigid steel conduits and fittings	PVC Sch 40 conduits and fittings

b. The following (Table 2) identifies area classification.

Table 2		
Areas Classifications By Building/Facility and Room		
Building/Facility	Room	Area Classification
Pump Station	Interior	Interior Damp
General Site	All exterior Site Areas not otherwise designated	Exterior Wet

B. Material Requirements

1. NEMA 3R enclosures shall be painted steel, ANSI 61, unless noted otherwise.
2. Notes on Contract Drawings takes precedence over material requirements in Table 1.

1.10 TESTS

- A. The Contractor shall be responsible for all factory and field tests required by specifications in Divisions 26 and 40, and by the Engineer and Owner and other authorities having jurisdiction. The Contractor shall furnish all necessary testing

equipment and pay all costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

- B. Factory Acceptance Testing (FAT), NETA Testing, Pre-Demonstration Testing and Demonstration Testing shall be per Specifications and performed by Contractor via submitted and approved procedures. Submit results. Include certified results with O&M submittal. PLC Panel FAT shall include verification of Contractor's programming for PLC, OIT, and radio configuration.
- C. Factory Acceptance Testing shall take place within 250 miles of project site. If Factory Acceptance Testing is greater than 250 miles, Contractor shall reimburse Owner and Engineer for travel and lodging expenses for four people at no extra cost to the Owner.
- D. Any equipment or material which fails a test shall be removed and replaced at no additional cost to the Owner.
- E. Submit all test forms for approval four weeks prior to testing.
- F. Provide a minimum of two weeks notification of Field Tests to the Engineer. Field Tests shall be witnessed and signed off by the Engineer in order to be considered valid. Any test results without the Engineer's signature are considered invalid.
- G. NETA testing to be performed prior to energizing equipment. NETA testing on Metering Panel/Switchboard (main breaker and grounding system) shall be completed prior to letter of acceptance of PG&E metering section by inspector to PG&E to set meter and energize.

1.11 TEMPORARY LIGHTING

- A. The Contractor shall provide temporary lighting for all trades. The average lighting level (foot-candle) shall meet OSHA and CAL-OSHA.

1.12 DEFINITIONS (APPLICABLE TO SPECIFICATIONS AND DRAWINGS)

- A. Above Grade – Not buried in ground and not embedded in concrete slab on ground.
- B. Below Grade – Buried in ground and below floor slab as applicable, and not embedded in concrete slab on ground.
- C. Certified: – Confirmed to be accurate, or as represented, or as meeting standards.

- D. Concealed – Inside building above grade and located within walls, furred spaces, crawl spaces, attics, above suspended ceiling, etc. In general, any item not visible or directly accessible.
- E. Connect – Complete hookup of item with required services, including conduits, wires, and other accessories.
- F. Exposed – Either visible or subject to mechanical or weather damage, indoor or outdoor. In general, any item that is directly accessible without removing walls, panels, ceilings or other parts of structure.
- G. Underground – Buried in ground, including under building slabs.
- H. Wiring – Electrical conduit, raceway, conductors and connections.

1.13 WARRANTY

- A. The warranty for all provided equipment shall be not less than two years after approved and witnessed startup and receipt of approved as-built drawings and O&M Manuals, or Owner beneficial use, whichever is later. Warranty shall include all costs for repairs, parts, travel and living expenses, and labor. This warranty, provided by the Contractor, shall cover all equipment, including but not limited to: Metering Panel Switchboard, Step Up Transformer, Circuit Breaker Disconnect Switch, Phase Converter, MCC and integral PLC Panel complete, wires and cables, miscellaneous control panels, motors, controls, and instrumentation (flowmeters, switches, level measuring system).
- B. Contractor is responsible to reimburse Owner for all materials, labor, and indirect costs incurred by Owner to support warranty repairs.

PART 2 PART 2 PRODUCTS

2.1 GENERAL

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the work shall be products of the same manufacturer. All equipment and materials shall be of industrial grade standard of construction.
- B. Where a NEMA enclosure type is indicated in a non-hazardous location, the Contractor shall utilize that type of enclosure, despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.

- C. All equipment shall be NEMA rated and UL listed. IEC rated equipment will not be allowed.
- D. All equipment shall be rated for, and include surface protection, as applicable for marine environment.

2.2 MOUNTING HARDWARE

- A. Miscellaneous Hardware
 - 1. All nuts, bolts, and washers shall be 316 stainless steel.
 - 2. Strut materials, including all bases, brackets, angles, etc., shall be per Table 1 above.
 - 3. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Where ends are exposed from cutting, coat ends of strut with zinc rich galvanizing compound.
 - 4. Anchors for attaching equipment to concrete walls, slabs, and housekeeping pads shall be 316 stainless steel chemical (epoxy) anchors unless Contract Drawing details call for cast in place anchorage. Anchor size and embedment requirements shall be per approved seismic calculations.

2.3 ELECTRICAL IDENTIFICATION

- A. Contractor is responsible to submit list of electrical equipment with associated tag inscription and tag materials for approval by Owner and Engineer.
- B. All conduits, cables, and individual wires shall be labeled. Power wiring insulation shall be color coded. All terminal blocks shall be labeled.
- C. All equipment, control devices, and panels shall include nameplate with description and tag number.

2.4 EQUIPMENT FINISH

- A. Provide equipment with manufacturers, standard finish application system with ANSI 61, light grey color, except for outdoor equipment and panels which shall be colored as specified. Some exterior equipment shall have further finish applied, refer to individual specifications.
- B. Equipment finish shall be suitable for marine environment.

2.5 EQUIPMENT RATINGS

- A. Provide equipment and devices capable of continuous operation within an ambient temperature range of 0° C to 40° C. Equipment must be capable of proper operation at rated output continuously in this ambient temperature range in direct sun.
- B. Provide any additional equipment such as enclosures, sunshades, heaters, ventilation fans, removable filtered louvers, and cooling equipment, so that this performance requirement can be met.
- C. Equipment to be rated for elevation installed, roughly 500' above sea level.

PART 3 PART 3 EXECUTION

3.1 GENERAL

- A. Incidentals: The Contractor shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.
- B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of lighting, receptacles, conduit runs, equipment, and other items. Exact locations shall be determined by the Contractor in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions.
 - 1. Where "home runs" are shown, the Contractor shall route the conduits in accordance with the indicated installation requirements. Routings shall be below grade unless otherwise indicated.
 - 2. All conduit and equipment shall be installed in such a manner as to avoid all obstructions, maximize working clearances, and keep passageways clear. Lighting pole locations shall be adjusted to avoid obstructions.
 - 3. No conduits shall be routed within the wall of the Pump Station. All conduits to be routed exposed on the interior, or under the slab, not through the slab.
- C. Workmanship: All materials and equipment shall be installed in strict accordance with the printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

- D. Protection of Equipment and Materials: The Contractor shall fully protect all materials and equipment against damage from any cause. 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, dust, dirt, plaster, or paint. All moving parts shall be kept clean and dry. The Contractor shall replace or refinish all damaged materials or equipment, including face plates of panels, at no additional expense to the Owner.
- E. Cap and label all spare conduits. Include pull tape in all spare conduits and conduits designated for future equipment. Pull tape to extend through plastic threaded conduit cap, and knotted.

3.2 CONCRETE SLAB ON GRADE

- A. Concrete slab on grade shall be provided for electrical equipment. Free-standing electrical equipment shall be anchored to housekeeping pad which are integral to slab on grade. Slab on grade shall be four inches above the surrounding grade and extend 6" from equipment sides and back of installed equipment and 48" in front. Housekeeping pads shall extend approximately 2" above slab on grade, and be 2" larger than installed equipment on all sides.

3.3 EQUIPMENT ANCHORING

- A. Floor-supported, wall-mounted, or ceiling-hung equipment and conduits shall be anchored in place by methods that will meet project seismic requirements. Wall or stanchion mounted panels, that weigh more than 200 pounds, shall be provided with fabricated steel support pedestals.
- B. Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the work of this Contract. Such recommendations shall be submitted as shop drawings.

3.4 EQUIPMENT IDENTIFICATION

- A. General: Equipment and Devices shall be Identified as Follows:
 - 1. Nameplates shall be provided for all equipment and instruments. Equipment description and equipment tag number (as assigned by Contractor and/or noted on Drawings), and electrical power source shall be utilized on all nameplates. If no tag number is given, the Contractor shall assign and submit a number for approval.
 - 2. All conduits and cables shall be labeled. It is the Contractor's responsibility to provide conduit tag, cable tag and wire tag label inscriptions. If no tag number is given, the Contractor shall assign and submit a number for approval.

3. The Contractor shall furnish typewritten circuit directories for panelboard; the circuit directory shall accurately reflect the load description connected to each circuit.

3.5 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut, drill, or notch any structural member or building surface without the specific approval of the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Use skilled craftsmen of the trades involved.
- B. Where core drill through existing below grade concrete wall, provide water tight mechanical seal fitting on interior or accessible side and grout pack void on exterior or concealed side.

3.6 LOAD BALANCE

- A. The Contract Drawings and Specifications indicate circuiting to electrical loads and distribution equipment. Balance electrical load between phases as nearly as possible on panelboard.

3.7 MOTOR ROTATION

- A. After final service connections are made, check and correct the rotation of all motors.
- B. Coordinate rotation checks with the Engineer and supplier responsible for the driven equipment for their witnessing.

3.8 CLEANING AND TOUCHUP PAINTING

- A. Keep the premises free from an accumulation of waste material or rubbish. Upon completion of the work, remove all materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.
- B. The interior of all electrical equipment and panels and enclosures, including windings of dry type transformers, shall be vacuumed and wiped free of dust just before final

acceptance. Shutting off equipment to clean and wipe down shall be done at times as approved by the Engineer.

- C. Wipe down exterior of all conduits and lighting fixtures and poles.

3.9 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer and Owner or their representatives.
- B. Correct the work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.

3.10 OPERATION AND MAINTENANCE MANUALS

- A. Provide Operation and Maintenance Manuals in hard cover, 3-ring binders, separately bound volumes, number as required to accommodate material 8½-inch x 11-inch for text and 11-inch x 17-inch half-sized drawings and also in accordance with provisions of specifications. Provide the number of copies specified. Electrical and Instrumentation O&Ms shall include the following as a minimum:
 1. Operation, maintenance, recommended spare parts, and renewal parts information for all equipment furnished under this Section.
 2. Provide separate O&M Manual for each specification section.
 3. Set of complete, final, as-reviewed and accepted manufacturers or vendors descriptive information.
 4. As-built electric schematics, equipment, elevations, layouts, and installation drawings showing equipment as it was actually installed and connected. Provide PDF and AutoCAD formats on portable USB drive within O&Ms.
 5. Index of all equipment suppliers with a list of current names, addresses, and telephone numbers of those who should be contacted for service, information, and assistance.
 6. All factory and field test results.
 7. Instrument calibration ISA data sheets.
 8. Information listed under individual specification submittal requirements.
 9. Complete facility Interconnection Diagrams for all equipment except lighting and receptacles. Show field wiring from equipment origin numbered terminal to destination numbered terminal in block diagram format. Include wire labels, cable labels, conduit numbers, handholes, junction boxes, etc.
 10. Use only clean, legible material.
 11. Submit material to the Engineer for review prior to delivery of the final Operation and Maintenance Manuals to the Owner. O&M Manuals to be approved prior to

start of Demonstration Period and 30 days prior to training. Make additions or changes required by the reviewer.

12. Electronic versions of programming files for PLCs, and OITs.
13. Completed O&M Manual Review Checklist form. Checklist attached.
14. O&M Manuals shall be approved and supplied before training can begin. Include training materials within O&M Manual.

3.11 RECORD DRAWINGS

- A. Provide number sets of full-sized marked-up as-built Contract Drawings in accordance with specifications. Show all departures from original Drawings, underground cable, conduit, or duct runs dimensioned from established building lines, and all electrical work revisions. As-built drawings shall be initialed by the Engineer prior to submission for drafting. Obtain new, clean sets of Contract Drawings for as-built production after each as-built submittal. Contractor shall pay all costs for as-built drawing reproduction.

3.12 SERVICE CONTINUITY, START-UP AND SHUTDOWNS

- A. Make no outages without the prior written authorization of the Owner and Engineer. Include all costs for temporary wiring and overtime work required in the contract price. Remove all temporary wiring at the completion of the work.
- B. Shutdowns, tie-ins, and startups shall be scheduled two weeks in advance, upon approval from the Owner and the Engineer. Schedule of shutdowns and startups shall be limited between Tuesday and Thursday from 9:00 a.m. to 3:00 p.m., unless prior approval has been given from the Owner and the Engineer.

3.13 TESTING

- A. Contractor shall submit testing procedures for Engineer and Owner review a minimum of two weeks prior to testing.
- B. A representative from the Engineer or Owner must be present for all testing. Any unwitnessed testing is not valid. Contractor shall provide a minimum of three working days notification for testing.
- C. Any remedial action due to testing failure and re-testing shall be at the Contractor's expense.
- D. A manufacturer's representative shall be present for all equipment initial start-up and field testing.

- E. All testing shall be witnessed by the Engineer and/or Owner. All testing sheets shall be signed off by the Engineer and/or Owner to be considered valid. Refer to Specifications for further testing requirements.
- F. Contractor shall perform miscellaneous electrical testing and provide results to third party NETA testing organization for evaluation and inclusion in testing submittal.
 - 1. Miscellaneous Testing to Include:
 - a. Cable megger
 - b. Wiring Devices: Demonstrate that circuits are powered by named breaker per Panelboard schedule and drawings.
 - c. VFDs shall be tested by MCC supplier, not part of NETA testing organization scope.
- G. Pre-Demonstration period for electrical work shall include Factory Acceptance Testing, Manufacturer certification, Instrumentation Supplier certification, NETA Field Testing, equipment start-up, instrumentation simulation, PLC and OIT programming and operation, approval of electrical and instrumentation O&M Manuals, and electrical and instrumentation training. Perform Pre-Demonstration Testing prior to start up testing and Demonstration period.
- H. Demonstration period for electrical work shall include 7-day functional testing of facilities, and Contractor field instructions.

3.14 O&M MANUAL REVIEW CHECKLIST

- A. Contractor and Manufacturer's Representative to complete one Checklist form per manufacturer equipment O&M submittal. Checklist form provided on following pages.

END OF SECTION

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SECTION 26 05 26 – GROUNDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 260500 – Electrical Work, General apply to this Section.
- C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.
- D. The grounding system is intended to provide a low resistance path to earth ground. Acceptable ground system resistance is 5 ohms or less.
- E. Coordinate, provide and install grounding system at the ~~Metering Panel~~Metering Switchboard. Provide utility grounding and bonding systems per PG&E Greenbook requirements.
- F. Provide grounding to magmeter flow tubes by connecting grounding electrode conductor to ground rings and bonding to magmeter body, and also grounding of pressure transmitters, per Contract Drawings and manufacturer requirements.
- G. Bond transformer neutrals to grounding electrode conductor directly, as well as provide supply side bonding jumper between neutral and transformer equipment ground.
- G.H. Provide grounding system at Phase Converter per manufacturer recommendations.
Provide grounding system at Step Up Transformer and Circuit Breaker Disconnect Switch.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Contractor shall submit Shop Drawings in accordance with Specifications and Section 260500 – Electrical Work, General.
- B. Shop Drawings: Manufacturer's product information for connections, clamps, and grounding system components, showing compliance with the requirements of this Section.

PART 2 PART 2 PRODUCTS

2.1 GENERAL

- A. All components of the grounding electrode system shall be manufactured in accordance with American National Standards Institute (ANSI)/UL 467 – Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code (NEC) Article 250 and local codes. The minimum size shall be as outlined in National Electrical Code.
- B. There shall be an equipment grounding conductor in each raceway, even if not called for on Contract Drawing Conduit and Cable Schedule, except conduits with manufacturer power cables.

2.2 GROUNDING ELECTRODE SYSTEM

- A. Grounding electrode conductors shall be bare annealed stranded copper conductors suitable for direct burial. Conductors shall be #4/0, unless indicated otherwise. Refer to Section 260519 – Wires and Cables, for grounding electrode conductor specifications.
- B. Ground rods shall be copper-clad steel, 3/4-inch diameter and 10 feet long conforming to UL 467. Electrolyte copper 10 mils thick shall be mechanically bonded to the rigid steel core. Ground rod to grounding electrode conductor connections shall be exothermic weld, or irreversible compression connection.
- C. Exothermic connections shall consist of a molecular weld utilizing the reaction of copper oxide and aluminum powder in a semi-permanent graphite mold. Exothermic connectors shall be as manufactured by Erico Products Cadweld, Thermoweld, or approved equal.
- D. Irreversible compression connectors shall be Burndy HYGROUND, or approved equal.

2.3 GROUND ROD BOXES

- A. Boxes shall be precast, high density, reinforced concrete, traffic rated, measuring a 10-inch interior diameter at the top and 12 inches deep. Covers shall be cast iron, and include special marking: "GROUND".
- B. Boxes and covers shall be manufactured by Christy Concrete G03, or approved equal.

PART 3 PART 3 EXECUTION

3.1 GROUNDING

- A. General: When sizes are not specifically indicated on the Contract Drawings, grounding cable shall be sized by the Contractor in accordance with all applicable code requirements. The location of ground rods shall be as indicated. The lengths of rods forming an individual ground array shall be equal and shall be of the quantity required to obtain a ground resistance of no more than five ohms. Measured resistance may be required to be less than five ohms where specific code or utility requirements apply. The grounding system shall be in strict accordance with Article 250 of the NEC.
- B. Install grounding systems for electrical utility service per latest PG&E Greenbook.
- C. Equipment Grounding System: Ground continuity throughout the facility shall be maintained by means of equipment grounding conductor run in all conduits. Equipment grounding conductors which are run in conduit shall be insulated copper conductors, sized in accordance with the NEC, or the Contract Drawings, whichever is larger. Equipment grounding conductors shall meet the specification requirements of Section 260519 – Wires and Cables.
 - 1. Make connections of any equipment grounding conductors to motors 10 hp and above, or circuits 20 amps or above, by a solderless terminal and a 5/16-inch minimum bolt tapped to the motor frame or equipment housing. Ground connections to smaller motors or equipment may be made by fastening the terminal to a connection box.
 - 2. Connect junction boxes and wiring device boxes to the equipment grounding system with a 3/8-inch machine screw.
 - 3. Insulated throat grounding fittings shall be employed for all equipment grounding connections. Route equipment grounding conductor through insulated throat grounding fitting, or bond fitting to equipment ground bus with same size jumper.
 - 4. Completely remove all paint, dirt, or other surface coverings at equipment grounding conductor connection point, if no ground bus provided, so that good metal-to-metal contact is made.
 - 5. Bond doors of MCC, PLC Panel, and panels, to equipment ground bus, with #12 AWG equipment grounding conductor. Attach with mechanical means.
- D. Grounding Electrode System: The Contractor shall install the grounding electrode conductor system, with all required components in strict accordance with National Electrical Code Article 250 and the Contract Drawings.
 - 1. Connections to grounding electrodes conductors shall be exothermic or irreversible compression type where concealed or below grade, and shall be bolted mechanical lug type connector where exposed and above grade or within ground well. Bolted connectors shall be assembled wrench tight to manufacturer's requirements.

2. Grounding electrode conductors that make up the ground grid, shall have a minimum buried depth of 36 inches below finished grade.
 3. Provide ufer ground within concrete slabs on grade, even if not shown on Contract Drawings. Provide minimum of twenty feet of #2 AWG grounding electrode conductor within middle third of slab. Connect both ends to MCC ground bus.
 4. Bond all exposed structural members, fences, antenna masts, and metallic enclosures of electrical equipment to ground grid, even if not shown on Contract Drawings. This including fences and gates (two places with #2 AWG grounding electrode conductor). Provide such connections even if not shown on Contract Drawings. Connections to fences and gates shall be mechanical type.
 5. Unless otherwise indicated on the Contract Drawings, the ground connections from the grounding electrode system to the equipment shall be the following: No. 4/0 AWG for equipment rated 480 Volts; No. 2 AWG for equipment rated 240 volts and to fencing and gates; and No. 6 for 120-volt equipment and instrumentation.
 6. Route all exposed (above ground) grounding electrode conductors within galvanized rigid steel conduit sleeve, from 24" below grade. Include threaded conduit bushing at exposed conduit end.
 7. Main bonding jumper and system bonding jumpers shall be sized as shown and, if not shown, shall be sized per the requirements of National Electrical Code Article 250.
 8. Bond neutral at ~~Metering Panel~~Metering Switchboard, and dry type transformer neutral in MCC, to equipment ground bus, and also bond neutral directly to the grounding electrode conductor that is routed from the ground grid. Each neutral to have two grounding electrode conductor connections, one to ground bus and one to ground grid.
 9. In ground rod boxes, install ground rods with end minimum six inches above drain rock, with connection of grounding electrode conductor fully visible and accessible from top.
- 9-10. Provide grounding system to Step Up Transformer and Circuit Breaker Disconnect Switch from grounding electrode system, to equipment ground bar or bus. Provide grounding system to Phase Converter from grounding electrode system to equipment, per manufacturer recommendations.

E. Shield Grounding

1. Shielded instrumentation cable shall be grounded at one end only; at the PLC Panel or receiving end of the signal.
2. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire. The connection to the ground shall be accomplished with a No. 12 green insulated conductor to the panel ground bus.

- F. Provide UFER ground at each light pole and antenna mast base. UFER ground to be #4 AWG bare copper grounding electrode conductor, minimum 20' long, coiled and cast as part of concrete base. Connect #4 AWG grounding electrode conductor to ground lug within pole.

3.2 FIELD TESTS

- A. All grounding systems shall be installed complete prior to field testing.
- B. All field tests to be witnessed and signed off by the Engineer.
- C. In the Engineer's presence, test the ground resistance of the grounding system using the Institute of Electrical and Electronics Engineers (IEEE) "Fall of Potential Method." Test grounds at ~~Metering Panel~~Metering Switchboard ground bus, MCC ground bus and Pump No. 2 motor casing. Total of three ground tests.
- D. Test all ground fault interrupter (GFCI) receptacles and/or GFCI circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
- E. Provide copies of reports of all grounding system tests for inclusion in Operation and Maintenance Manuals and for review by the Engineer.
- F. Refer to Specification 260800 – Electrical Testing for further testing requirements.
- G. Grounding tests shall be completed and approved prior to energizing electrical equipment.

END OF SECTION

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SECTION 26 05 33 – ELECTRICAL RACEWAY SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.
- B. The requirements of Section 260500 – Electrical Work, General apply to this Section.
- C. The Contractor shall provide electrical raceway systems sized for submitted and approved cables, including vendor supplied cables, based on the National Electrical Code or as shown on Contract Drawings, whichever is larger.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Contractor shall submit Shop Drawings in accordance with Specifications and Section 260500 – Electrical Work, General.
- B. Shop Drawings: Complete catalog cuts of all raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.
- C. Conduit Tags: Submit tag materials, and listing of inscriptions, for approval.
- D. Submit dimensioned Installation Detail of conduit crossing at spillway.

1.3 QUALITY ASSURANCE

- A. Seismic Design Requirements: All raceway systems to be furnished under this Section shall be designed and constructed to meet the seismic requirements of these Specifications.

PART 2 PART 2 PRODUCTS

2.1 GENERAL

- A. Pull and junction boxes, fittings, and other indicated enclosures which are dedicated to the raceway system, shall comply with the requirements of this Section.
- B. Set screw type couplings, bushings, elbows, nipples and other fittings are not allowed.

- C. No conduit shall be smaller than 3/4-inch. All underground conduits shall be a minimum of 1-inch.
- D. Conduits containing manufacturer cables shall be sized based on approved manufacturer cable at minimum 40-percent fill, unless approved by the Engineer.
- E. No conduits shall be routed within the wall of the Pump Station. All conduits to be routed exposed on the interior, or under the slab, not through the slab.

2.2 CONDUITS

- A. Rigid Galvanized Steel (RGS) Conduit
 - 1. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.
 - 2. Rigid steel conduit and all appurtenances shall be manufactured in accordance with ANSI C80.1 – Rigid Steel Conduit, Zinc Coated, and UL-6.
 - 3. Manufacturers, or approved equal:
 - a. Allied Conduit
 - b. Western Tube and Conduit
- B. Rigid Non-Metallic (PVC) Conduit
 - 1. Rigid non-metallic conduit shall be Schedule 40 PVC, sunlight resistant, UL listed for concrete encasement. Conduit shall have factory-formed bell on one end.
 - 2. Rigid PVC conduit shall be manufactured in accordance with NEMA TC-2 – Electrical Plastic Tubing and Conduit, and UL-651 – Standard for Rigid Non-metallic Conduit standards.
 - 3. Conduit shall be marked for use with conductors having 90° C insulation.
 - 4. Manufacturers, or approved equal:
 - a. Carlon Plus Rigid PVC
 - b. PW Pipe
- C. Rigid PVC Coated Galvanized Steel (PVC RGS) Conduit
 - 1. The conduit, prior to PVC coating, shall meet the requirements for RGS conduit above.
 - 2. A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating.
 - 3. PVC coating thickness shall be not less than 40 mils. Interior coating shall be minimum 2 mil urethane. All male threads on conduit, elbows and nipples shall be protected by urethane coating.
 - 4. PVC RGS shall be manufactured in accordance with the following standards:
 - a. UL-6
 - b. ANSI C80.1

- c. NEMA RN1 – PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - d. Federal Specification WW-C-581E.
 - 5. Conduits shall be suitable for conductors with 75° C insulation.
 - 6. Manufacturers:
 - a. Robroy Plasti-Bond Red
 - b. T&B OCAL-Blue Double-Coat
 - c. Perma-Cote Industries Supreme Conduit
- D. Liquidtight Flexible Metal Conduit
 - 1. Liquidtight flexible metal conduit shall be constructed of a flexible galvanized metal core with a sunlight resistant thermoplastic outer jacket.
 - 2. Liquidtight flexible metal conduit shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.
 - 3. Conduits shall have insulated throat and stainless steel sealing O-ring.
 - 4. Manufacturers, or approved equal:
 - a. Anaconda, "Sealtite" Type UA
 - b. Electriflex, "Liquatite" Type LA
- E. Electrical Metallic Tubing and Intermediate Metallic Conduit, and associated type fittings and connectors, will not be accepted.
- F. Provide conduit or riser for secondary electrical service as required by PG&E. Refer to PG&E Greenbook for requirements.

2.3 FITTINGS AND CONDUIT BODIES

- A. General
 - 1. All cast and malleable iron fittings for use with metallic conduit shall be the threaded type with five full threads.
 - 2. All fittings and conduit bodies shall have neoprene gaskets and non-magnetic stainless steel screws. All covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be allowed.
 - 3. Conduit, fittings, and conduit bodies in hazardous locations shall be suitable for the Class and Division indicated.
 - 4. Provide Form 8 conduit bodies only. Form 7 conduit bodies are not acceptable.
- B. Fittings and Conduit Bodies for Rigid Galvanized Steel Conduit
 - 1. Use insulated throat grounding bushings for all rigid steel conduit ends. Bushings shall be threaded zinc-plated malleable iron grounding bushings with bonding screw and insulated throat rated for 150 degrees C. Acceptable products include: Thomas

- & Betts Grounding and Bonding Bushings, OZ Gedney Type BLG, Appleton Threaded Grounding Bushings, or approved equal.
2. Watertight hubs for rigid steel conduit shall be male thread type zinc-plated malleable iron with recessed "O" ring sea, insulated throat and ground bonding locknut. Acceptable products: OZ Gedney Type CHM-T, Myers STG series, or approved equal.
 3. For conduit bodies for rigid steel conduit sized as required by the NEC, use cast iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets. Acceptable products include: Crouse-Hinds Form 8 threaded condulets, OZ Gedney Form 8 threaded conduit bodies, or approved equal.
- C. Fittings for Liquidtight Flexible Metal Conduit
1. Liquidtight flexible metal conduit fittings shall have cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and o-ring seals around the conduit and box connection and insulated throat. Straight, 45 degree and 90 degree fittings shall be used where applicable.
- D. Fittings for PVC Schedule 40 Conduits
1. All fittings for use with rigid non-metallic conduit shall be PVC, solvent welded type.
 2. Provide all welding solvent as required for installation of non-metallic conduit and fittings.
 3. Manufacturers, or approved equal:
 - a. Carlon
 - b. Crouse-Hinds
- E. Fittings and Conduit Bodies for PVC Coated Rigid Steel Conduit
1. Use insulated throat grounding bushings for PVC Coated Rigid Steel conduit. Provide threaded zinc-plated malleable iron grounding bushings with bonding screw and insulated throat rated for 150° C. Acceptable products include: Thomas & Betts Grounding and Bonding Bushings, OZ Gedney Type BLG, Appleton Threaded Grounding Bushings, or approved equal.
 2. Watertight and corrosion resistant hubs for PVC Coated Rigid Steel conduit shall have a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves. Acceptable products include: Robroy Plasti-Bond Red Type ST Hub, Perma-Cote Industries Supreme Type ST Hub, T&B OCAL-Blue Double-Coat Type ST Hub, or approved equal.
 3. For conduit bodies for use with PVC Coated Rigid Steel conduit, sized as required by the NEC, use cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating and nominal 2 mil internal urethane coating, and pressure sealing sleeves on all conduit openings. Acceptable products include: Robroy Plasti-Bond Red Form 8 Conduit Bodies, T&B OCAL-Blue Double-Coat Form 8

Conduit Bodies, Perma-Cote Industries Supreme Form 8 Conduit Bodies, or approved equal.

2.4 JUNCTION AND PULL BOXES

- A. Junction and pull boxes shall be provided by the Contractor as required to make the installation in accordance with NEC. Size junction and pull boxes in accordance with the NEC for the number of conductors enclosed in the box.
- B. Where outlet boxes are used as junction or pull boxes, use materials as specified in Section 262726 – Wiring Devices.
- C. Where boxes larger than outlet or device boxes are required for junction of pull boxes, provide the following:
 - 1. Furnish 14-gauge or 16-gauge 316 stainless steel enclosures with continuously welded seams, continuous door hinge, external fast operating clamp cover, external mounting feet, oil-resistant gasket and adhesive. NEMA rating per Section 260500 – Electrical Work, General. Acceptable products include: Hoffman Bulletin A51S Boxes, or approved equal.

2.5 CONDUIT TAGS

- A. Provide permanent, 316 stainless steel, 2-inch diameter conduit tags with conduit number laser engraved onto the tag. Conduit tag letters and numbers shall be 1/2-inch minimum.
- B. Conduit tags in underground installations, including within handholes, shall be 2” diameter black phenolic tags, with 1/2-inch lettering engraved to white core.

2.6 SUPPORTS AND FITTINGS

- A. Strut and mounting hardware shall be per Table 1 in Section 260500 – Electrical Work, General.
- B. Strut and mounting hardware shall be sized to meet seismic requirements.
- C. 316 stainless steel strut and mounting hardware; all supports and fittings shall be of same material as conduit, including pipe straps, clamp back spacers, beam clamps, and other supports and fittings. For example, if conduits are PVC coated galvanized rigid steel, all conduit clamp back spacers shall be PVC coated galvanized rigid steel. Bolts and hardware shall be stainless steel.
- D. Acceptable products include: Unistrut, B-Line, Power Strut, or approved equal.

2.7 CONDUIT PENETRATION SEALS AND SLEEVES

- A. Conduit penetration seals shall be a modular, mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the opening. The elastomeric element shall be sized and selected per the manufacturer's recommendations and shall be suitable for use in standard service applications.
- B. Sleeves shall be the thermoplastic type with water stops, suitable for poured wall construction.
- C. Conduit penetration seals and sleeves shall be complete assemblies supplied by a single manufacturer.
- D. Acceptable products include: Thunderline Corporation Link-Seal and Plastic Sleeves, Calpico Inc. Pipe Linx and Plastic Sleeves, or approved equal.

2.8 DUCT SEAL

- A. Duct seal shall be a non-hardening compound designed as a waterstop and moisture barrier for sealing the annular space between conduit and electrical conductors and cables.
- B. Acceptable products include: O-Z Gedney DUX, or approved equal.

2.9 PULL TAPE

- A. Pull tape shall be 1/2-inch in width, suitable for 1,250 pounds of pull strength.
- B. Acceptable products include: Neptco Muletape WP1250P, or approved equal.

PART 3 PART 3 EXECUTION

3.1 GENERAL

- A. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.
- B. Raceway sizes shown on Drawings are minimum dimensions based on designed equipment. Contractor to provide conduits as shown or larger based on submitted and approved equipment; at no extra cost to the Owner.

- C. No conduits shall be routed within slab on grade. Conduits shall be routed under the slab and footing and stubbed through the slab.
- D. Underground conduits shall be installed per Section 260543 – Underground Raceway Systems.
- E. Where raceways are indicated but routing is not shown, such as home runs or on conduit schedules; raceway routing shall be the Contractor's choice and in strict accordance with the NEC.
- F. Routings shall be adjusted to avoid obstructions. Coordinate with all other trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be at no extra cost to the Owner.
- G. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.
- H. Provide all necessary sleeves and chases required where conduits pass through poured walls; otherwise provide mechanical seals on the interior and grout pack the exterior to seal all openings and finish to match adjacent surfaces.
- I. Provide all raceways as required by PG&E for electrical service, per PG&E Greenbook.
- J. Support
 - 1. Support raceways at intervals not exceeding NEC requirements unless otherwise indicated.
 - 2. Support all raceways from structural members only. Do not support from pipe hangers or rods or another conduit.
 - 3. Support flexible metal conduit with conduit clamps, per NEC, except where the flexible metal conduit length is less than two feet in length.
- K. Bends
 - 1. Make changes in the direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible; but, where necessary, make with an acceptable hickey or conduit bending machine.
 - 2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.
 - 3. For PVC Schedule 40 conduits, use factory made elbows for all bends 30 degrees or larger.

4. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.
- L. Insulated Throat Grounding Bushings and Conduit to Enclosure Connections
 1. Where conduit enters metal enclosure, install an insulated throat grounding bushing on the end of each conduit. For all other areas install insulated throat grounding hub, unless threaded connection. Install a bonding jumper from the bushing to equipment ground bus or ground pad, or route equipment grounding conductor through bushing ground. Interconnection of bonding jumpers from each conduit grounding bushing to the equipment ground bus or ground pad is acceptable. If neither a ground bus or ground pad exists, connect the bonding jumper to the metallic enclosure with a bolted-lug connection.
 2. All NEMA 3R/4 enclosures without integral watertight hubs shall be connected with insulated throat grounding hubs. The conduit connections shall maintain the integrity of the enclosure NEMA rating. Liquid-tight PVC jacketed flexible metal conduit connections shall be corrosive resistant, watertight hub.
 - M. PVC Schedule 40 Conduit: Solvent weld PVC conduit joints with solvent recommended by the conduit manufacturer. Follow manufacturer's solvent welding instructions and provide watertight joints. Use acceptable PVC terminal adapters when joining PVC conduit to metallic fittings. Use acceptable PVC female adapters when joining PVC conduit to PVC coated rigid steel conduit.
 - N. PVC Coated Rigid Steel Conduit: Install in strict accordance with the manufacturer's instructions. Touch up any damage to the coating with conduit manufacturer acceptable patching compound. PVC boot shall cover all threads. Leave no metallic threads uncovered. Clean field threads with solvent and coat with urethane touch-up.
 - O. Penetrations
 1. Conduits shall not be cast as part of cast-in-place structures. Cast-in-place structures shall include sleeves, and conduits shall pass through the sleeves to penetrate the structures. Coordinate sleeve installation with structural work.
 - P. Install duct seal in all conduits that are routed below grade, at Metering Panel, Metering Switchboard, Step Up Transformer, Circuit Breaker Disconnect, Phase Converter, MCC, Motor Terminal Boxes, handholes, disconnect switches, and conduits connected to field instruments.

3.2 CONDUIT

- A. All exposed conduit shall be as noted in Area Designations per Section 260500 – Electrical Work, General.

- B. PVC coated RGS elbow and PVC coated RGS conduit for vertical run, shall be utilized for transition from underground concrete ductbank to exposed conduit riser. Conduit shall emerge from the ductbank perpendicular to the surface whenever possible. Extend PVC coated rigid steel conduit up to a minimum of 24 inches above the finished grade, or completely to the electrical enclosure if the enclosure is less than 54 inches above the finished grade.
- C. Exposed conduits shall be 3/4-inch minimum trade size. Below grade conduits shall one-inch minimum trade size, unless shown otherwise.
- D. All threads shall be coated with a conductive lubricant before assembly. Acceptable products include: Appleton Type TLC, Thomas & Better KOPR-Shield, or approved equal.
- E. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. All conduits shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduits to prevent wrench marks on the conduits. Conduits with wrench marks shall be replaced at no additional cost.

3.3 REQUIRED RACEWAY TYPE FOR SPECIAL LOCATIONS AND INSTALLATION METHOD

- A. Final Connection to Certain Equipment: Make final connection to pressure transmitters, flow meters, pressure switches, valve actuators, and other equipment where flexible connection is required, to facilitate removal or adjustment of equipment with liquidtight flexible metal conduit. Liquidtight flexible metal conduit shall be of 12-inch minimum to 24-inch maximum lengths, unless otherwise approved by the Engineer or as noted on Contract Drawing.

3.4 PREPARATION FOR PULLING IN CONDUCTORS

- A. Ream all raceways, remove burrs, and clean raceway interiors. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals.
- B. Pull a bristle brush and then mandrel through each raceway to remove any debris and clean raceway prior to pulling conductors. The diameter of the mandrel shall be approximately 1/4-inch less than the raceway inside diameter, through each raceway. For conduits one inch and less, pull a rag through to clean and remove debris prior to pulling conductors.
- C. For all raceways which contain less than 50 percent of the NEC allowed fill, install a pull tape along with the conductors.

3.5 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty raceway. Provide a removal cap over each end of empty raceways. Provide a pull tape in each empty raceway.

3.6 JUNCTION AND PULL BOXES

- A. Where indicated on the Contract Drawings, and where necessary, redirect multiple conduit and cable runs and provide and install appropriately-sized junction boxes. Furnish and install pull boxes where necessary in the raceway system to facilitate conductor installation.
- B. Make all boxes accessible. Do not install boxes in finished areas unless accepted in writing by the Engineer. Mount all boxes plumb and level.
- C. PVC coated conduit bodies (condulets) may be used for junction or pull boxes as long as sized for installation.

3.7 ELECTRICAL CONTINUITY

- A. The entire electrical raceway system shall form a continuous metallic electrical conductor from the service point to every outlet and shall be grounded by connection to the main service ground.
- B. Rigid steel conduits shall have threads coated with conductive sealant before screwing into fittings.
- C. An equipment grounding conductor shall be installed in all conduits. Conduits shall not be substituted for the grounding wire. Bond together the conduit system, enclosures, grounding system, and equipment bus bars.

3.8 CONDUIT IDENTIFICATION

- A. All conduits shall be identified with minimum of two tags, one at each end. In addition, all conduits shall be tagged at intermediate pull points like handholes or pull boxes. Use correct type of tag based on installed location. Tags shall be inscribed as designated on the Contract Drawing Conduit and Cable Schedule and per approved Interconnect Diagrams.
- B. Exposed and Above Grade Conduits: Attach stamped stainless steel tags to conduits with 316 stainless steel tie wire at end of the conduit.

- C. Below Grade Conduits: black phenolic conduit tags shall be applied with epoxy to the wall of the handhole above the conduit entrance, or attached to conduit with black nylon cable tie if conduit is accessible.
- D. Conduits shall be tagged prior to Field Testing.

END OF SECTION

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SECTION 26 05 43 – UNDERGROUND RACEWAY SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide underground raceway systems, complete and in place, in accordance with the Contract Documents.
- B. The requirements of Section 260500 – Electrical Work, General apply to this Section.
- C. The Contractor shall provide underground raceway systems sized for submitted and approved cables, including vendor supplied cables, or ultimate equipment size, or as shown on Contract Drawings, whichever is larger. Conduit sizes shall be as required by National Electrical Code.
- D. Contractor to provide handholes as required for cable pulling means, even if not shown on Contract Drawings as dependent on Contractor's routing. Handholes shall be sized per NEC requirements.
- E. Refer to Section 260533 – Electrical Raceway Systems for conduit tag requirements.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Contractor shall submit Shop Drawings in accordance with Specifications and Section 260500 – Electrical Work, General.
- B. Shop Drawings: Complete catalog cuts of all underground raceway systems, including handholes, conduits, ductbanks, trenches, etc.
- C. Provide surveyed as-built drawings of all installed ductbanks providing top-of-ductbank elevation, ductbank width, handholes, and routing. Include cross-section information for all ductbank sections.

PART 2 PART 2 PRODUCTS

2.1 GENERAL

- A. Handholes, underground conduits and fittings which are dedicated to the underground raceway system, shall comply with the requirements of this Section.
- B. No conduits shall be routed within the wall of the Pump Station. All conduits to be routed exposed on the interior, or under the slab, not through the slab.

2.2 HANDHOLES

- A. Handholes and special marking covers shall be designed for AASHTO M309 H-20 traffic loading. Boxes shall include extensions for interior dimension shown on Contract Drawings. Handhole covers shall be checker plate, hot-dip galvanized after fabrication and provided with security "Penta" style, stainless steel bolts. Coat bolts with Tripac 2000 Blue coating system, or approved equal.
- B. Handholes shall have identification letters one-inch high and 3/4-inch wide minimum, indicating "ELECTRIC" or "SIGNAL", as applicable, plus handhole identification number, "HH-E1" for example, as shown on Contract Drawings. Electric handholes are all handholes with AC voltage cables. Signal handholes are all handholes with DC voltage cables.
- C. Acceptable products include: Christy Concrete B1017, B1324, H20 rated handholes with extensions, checker plated hot dipped galvanized covers, solid bottoms, and coated stainless steel security bolts, or equal. Size as noted on Contract Drawings. Provide with identification lettering and inscribed handhole tag number inscribed on hot dipped galvanized cover.

2.3 CONDUITS, CONCRETE CAP, AND DUCTBANK SPACERS

- A. Underground conduits shall be Schedule 40 PVC, except where conduit transition from horizontal to vertical, or through structure walls, when it will be PVC coated rigid steel. Refer to Section 260533 – Electrical Raceway Systems for conduit specifications. Provide end bells on all PVC Schedule 40 conduit ends. Provide insulated throat grounding bushings on all PVC coated rigid conduit ends.
- B. Concrete cap shall be minimum 2000 psi, red colored, concrete.
- C. Install conduit spacers in ductbanks, where four or more conduits are provided. Conduit spacers shall be Carlon Snap-Loc Spacers, or equal, with minimum 1-1/2" duct separation and installed at five foot on center intervals. Provide 3" separation between the power, or control conduits ("P", or "C") and the signal conduits ("S").

2.4 WARNING TAPE

- A. Provide heavy-gauge, red, non-adhesive polyethylene tape of six-inch minimum width, four-mil nominal thickness, with black lettering, for use in trenches containing electric circuits. Use tape with the following printed warning: "CAUTION-ELECTRIC LINE BURIED BELOW".
- B. Acceptable products include: Harris Industries, Inc. Underground Tape Catalog No. UT-29, or equal.

2.5 CONDUIT PENETRATION SEALS AND SLEEVES

- A. Conduit penetration seals shall be a modular, mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the opening. The elastomeric element shall be sized and selected per the manufacturer's recommendations and shall be suitable for use in standard service applications.
- B. Sleeves shall be the thermoplastic type with water stops, suitable for poured wall construction.
- C. Conduit penetration seals and sleeves shall be complete assemblies supplied by a single manufacturer.
- D. Acceptable products include: Thunderline Corporation Link-Seal and Plastic Sleeves, Calpico Inc. Pipe Linx and Plastic Sleeves, or equal.

2.6 DUCT SEAL

- A. Duct seal shall be a non-hardening compound designed as a waterstop and moisture barrier for sealing the annular space between conduit and electrical conductors and cables.
- B. Acceptable products include: O-Z Gedney DUX, or equal.

2.7 GROUND ROD BOXES

- A. Refer to Section 260526 – Grounding for ground rod boxes.

PART 3 EXECUTION

3.1 GENERAL

- A. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.
- B. Raceway sizes shown on Drawings are minimum dimensions based on designed equipment. Contractor to provide conduits as shown or larger based on submitted and approved equipment; at no extra cost to the Owner.
- C. No conduits shall be routed within slabs on grade. Conduits shall be routed under the slab and footing and stubbed through the slab.

- D. All conduits located underground in ductbanks or trenches shall be concrete capped. Include ductbanks with 1-1/2" conduit spacers at five foot on center intervals.
- E. Do not backfill ductbanks until they have been inspected by the Engineer.
- F. Warning Tapes: Bury warning tapes approximately 12 inches above top-of-conduits in all underground conduit runs or duct banks. Align parallel to and within six inches of the centerline of runs that are 12 inches wide or less. Provide two rows of tape and align parallel to and within six inches of the centerline of each side of runs that are more than 12 inches wide.
- G. Install duct seal in all conduits that are routed below grade, at Metering Panel, Metering Switchboard, Step Up Transformer, Circuit Breaker Disconnect Switch, Phase Converter, MCC, Motor Terminal Box, disconnect switches, handholes, and conduits connected to field instruments.
- H. Bypass Flowtube: route conduits with flowmeter manufacturer cables 2" inside vault. Install insulated throat bushing on conduit end and route manufacturer cables to flow tube. Provide cord grip fittings on flow tube cable entries. Installation shall be rated for NEMA 6 submergence.

3.2 TRENCHING

- A. Verify the location of all existing cables, conduits, piping, and other equipment in or near the areas to be trenched, prior to starting trenching. Repair any equipment damaged during trenching. Call an Underground Service firm before trenching. Trenches shall not be left unattended unless the area is fenced or barricaded to restrict entry to the area.

3.3 DUCTBANKS AND TRENCHING

- A. Separation and Support
 1. Separate parallel runs of four or more raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install conduit spacers at intervals of five feet.
 2. Support raceways installed in fill areas to prevent accidental bending until backfilling is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.
 3. Provide 6" separation between power and control conduits and signal conduits.
- B. Arrangement and Routing

1. Arrange multiple conduit runs substantially in accordance with any details shown on the drawings.
2. Make minor changes in the location or cross-section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown on submitted and approved layout drawings because of conditions not discoverable prior to digging of trenches, refer the condition to the Engineer for instructions before further work is done. Determine exact alignment and depth as required to avoid other utilities.
3. Where other utility piping systems are encountered or being installed along a raceway route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Engineer for instructions before further work is done.
4. Ductbank and trenching alignments shown on Drawings are diagrammatic. Actual alignments shall contain no sharp bends and shall be installed with minimum radius bends as required in the NEC or installed cable, whichever requires a larger radius bend.
5. Provide bell-ends on all PVC conduits entering handholes.

C. Concrete Cap and Backfill

1. Cap all underground conduits with 4-inches of concrete cap. Concrete to be red colored, 2000 PSI minimum.
2. Backfill material above concrete cap, may be selected from the excavated material if it contains no particles larger than three inches in diameter and is free from roots or debris. Imported material meeting these same requirements may be used in lieu of material from the excavation. Compact backfill in maximum 12-inch layers to at least 95 percent of the maximum density at optimum moisture content as determined by AASHTO T 180.

3.4 HANDHOLES

- A. Provide excavation, backfilling, compaction and grading, etc., in accordance with requirements specified in Contract Documents and manufacturer requirements for traffic rated handholes. Refer to Oldcastle Christy Concrete Traffic Rated Installation Guide for installation details
- B. Do not install handholes until final conduit grading, including field changes necessitated by underground interferences, has been determined. Set frames just above final grade so that the site drains away from the handholes.
- C. Make the installation so that raceways enter handholes at nearly right angles and as near as possible to one end of a wall, unless otherwise indicated.

- D. Provide for over-excavation of the handhole foundation area and furnish minimum of one-foot depth of 3/4-inch drain rock 12-inches below the handhole base, and 6-inch wide concrete collar on all sides down to top of bottom handhole slab.
- E. Bolt down covers with stainless steel Penta bolts. Provide anti-seize coating on Penta bolts.

3.5 CONDUIT IDENTIFICATION

- A. Refer to Section 260533 – Electrical Raceway Systems for conduit tag specification.
- B. All conduits shall be identified with minimum of two tags, one at each end. In addition, all conduits shall be tagged at intermediate pull points like handholes and pull boxes and junction boxes. Use correct type of tag based on installed location. Tags shall be inscribed as designated on the Contract Drawing Conduit and Cable Schedule and per approved Interconnect Diagrams.
- C. All underground conduits shall be tagged within handholes, and where stub up into equipment.
- D. Exposed and Above Grade Conduits: Attach stainless steel tags to conduits with 316 stainless steel tie wire at end of the conduit.
- E. Below Grade Conduits: black phenolic conduit tags shall be applied with epoxy to the wall of the handhole, above the conduit entrance, or attached to conduit with black nylon cable tie if conduit is accessible.
- F. Conduits shall be tagged prior to Field Testing.

3.6 PREPARATION FOR PULLING IN CONDUCTORS

- A. Ream all raceways, remove burrs, and clean raceway interiors. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals.
- B. Pull a bristle brush and then a mandrel through each raceway to remove any debris and clean the raceway prior to pulling conductors. Mandrel diameter shall be approximately 1/4-inch less than the raceway inside diameter, through each raceway. For conduits of one inch and less, pull a rag through to swab clean and remove debris prior to pulling the conductors.
- C. For all raceways which contain less than 50 percent of the NEC allowed fill, install a pull tape along with the conductors.
- D. Provide phenolic tags on cables, attached with nylon tie wires inside the handholes.

3.7 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify them with conduit tags at each end and at any intermediate pull point of each such empty raceway. Provide a removal cap over each end of empty raceways. Provide a pull tape in each empty raceway.

3.8 TRENCH SETTLING

- A. If, at any time during a period of one year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, the Engineer may notify the Contractor to immediately provide additional fill and to make such repairs or replacements in paving, planting, or structures, as may be deemed necessary at the Contractor's expense.

END OF SECTION

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SECTION 26 05 73 – PROTECTIVE DEVICE STUDIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall perform the following four studies for the electrical power system in accordance with the Contract Documents: Short Circuit Studies (Preliminary and Final versions), Arc Flash Study, and Protective Device Coordination Study.
- B. The studies shall cover the maximum available ~~3~~Single and Three Phase Faults and line-to-ground faults to calculate minimum equipment ratings, to establish personnel protective wear, and to coordinate over-current settings and ground-fault settings for proper coordination and protection. The studies shall include all portions of the electrical distribution system for normal utility power source down to and including the 120/240V lighting panelboard main breaker. Studies shall include 120/240 VAC single phase service from PG&E, and via Phase Converter, the 480 VAC three phase feeder to MCC and on to lighting panelboard.
- C. It is the responsibility of the Contractor to obtain from PG&E the information required to perform all of the studies. The Contractor shall contact PG&E and obtain the short circuit contribution and impedance values in writing for the facility that is needed for these studies and submit to the Engineer.
- D. It is the responsibility of the Contractor to obtain from appropriate vendors the information required to perform all the studies. The Contractor shall contact the protective device manufacturers and obtain the ratings and time current curves for all protective devices including fuses, circuit breakers, motor circuit protectors, relays and overload protective elements.
- E. A Preliminary Short Circuit Study shall be prepared and submitted early in the project to verify the suitability of submitted equipment's short circuit and arc flash ratings, and allow for Engineer review. The Contractor shall use the first named supplier for the Preliminary Short Circuit Study. The Contractor may estimate cable lengths for the Preliminary Short Circuit Study.
- F. The Contractor shall perform all needed field investigation and inspections to properly identify equipment including motors and transformers and any appropriate settings and nameplate data to get the correct information to work with including impedance values, voltage ratings, base kVA ratings, cable lengths, and/or current ratings for Final studies submittal. The Contractor shall perform all needed field investigation and inspections to

properly identify all cable and wire sizes, types, sizes and materials for use in the Final and Record set of studies.

- G. The Protective Device Coordination Study shall be submitted and approved prior to Field Testing. Device settings shall be verified during the Field Testing.
- H. The Arc Flash Study shall be submitted and approved prior to energizing and any Field Testing. Arc Flash labels must be installed prior to energizing equipment. Refer to Section 260500 – Electrical Work, General for additional warning label and signage requirements.
- I. After the facilities are built and operating, all comments on the studies and studied equipment shall be addressed and all corrections made to input data and the three studies submittals for Record Set. The Record Set of the studies shall include all calculations rerun, coordination plots remade, copies of arc flash labels, tabulations corrected, and reports adjusted reflecting the post Field Tested as-built equipment with as left settings. Provide electronic files of study from SKM or ETAP software to the Owner. Submit per O&M Manual guidelines per Contract Specifications.

1.2 QUALIFICATIONS

- A. Studies shall utilize the latest SKM or ETAP software for making ~~3~~Single and Three Phase Fault duty calculations.
- B. The Preliminary, Final and Record Set of studies shall be thoroughly reviewed, stamped and signed by an electrical engineer who is registered in the state of California, who has experience performing short circuit and coordination studies, and who directly supervised the collection of information, the creation of the studies and the furnishing of reports.

1.3 CONTRACTOR SUBMITTALS

- A. Studies shall be submitted and approved prior to final project acceptance in accordance with Specifications and Section 260500 – Electric Work, General.
- B. Preliminary Short Circuit Study shall be submitted and approved prior to approval of any electrical equipment and vendor panels.
- C. Copy of Arc Flash labels inscriptions with a description of the installed location. Labels shall meet OSHA, ANSI, NFPA, NEC, and Owner requirements.
- D. The protective device studies, reports, settings, calculations, plots and tabulations shall be performed, including two rounds of submittals (Final and Record Set), in addition to the Preliminary Study to allow approval of distribution equipment short circuit

protective devices. The Final Studies (after the Preliminary Study) as a part of normal construction, setup and startup of the facilities to be approved prior to Field Testing. The Record Set with the O&M Manual submittal process as a separate submittal after all comments, corrections, updated input data, and as left settings have been inserted into the software programs to produce an as-built set of studies, reports, settings, calculations, labels, plots and tabulations.

- E. Provide a portable USB thumb drive with the Record Set of studies, reports, single line, calculations, plots, protective device settings, and tabulations utilizing SKM or ETAP software. Also include the original source format of input data used as direct input to the selected software to perform the calculations, generate the reports, generate the tabulations, plot the curves and graphs, and list the device settings for the as-built facilities.

1.4 SERVICES OF MANUFACTURERS

- A. Contractor shall furnish the services of a third party InterNational Electrical Testing Association (NETA) testing firm to set all over-current protective devices. This shall include circuit breaker trip unit settings, motor solid state starter settings, motor solid state overload settings, and as recommended in the protective device coordination study. Refer to Section 260800 – Electrical Testing.

PART 2 PART 2 PRODUCTS (NOT USED)

PART 3 PART 3 EXECUTION

3.1 GENERAL

- A. The study shall include single-line and impedance diagrams of the power system. This diagram shall identify all components considered in the study and the ratings of all power devices, including transformers, circuit breakers, relays, fuses, busses, and cables. The resistance and reactance of all cables shall be identified in the impedance diagram. The study shall contain all written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.
- B. The study shall include all protective devices and feeders included under this Contract. The PG&E short circuit information and overcurrent protective device and ground fault protective device shall be used as a fixed reference and starting point for these studies.
- C. The work shall be performed in the following sequence:
 - 1. A Preliminary Short Circuit Study, approved by the Owner and the Engineer.

2. Submit electrical equipment with short circuit rating greater than maximum available fault current per Preliminary Short Circuit Study.
3. Final Protective Device Studies submitted: Short Circuit Study, Arc Flash Study, and Protective Device Coordination Study, approved by the Owner and the Engineer.
4. Set all adjustable protective devices.
5. Install approved arc flash labels on equipment.
6. Provide Electrical Testing per Section 260800 – Electrical Testing.
7. Energize equipment. Equipment shall not be energized until Sequence Steps 1 through 6 above are completed and approved by the Owner and the Engineer.
8. Provide further testing including, but not limited to manufacturer recommended field testing, Pre Demonstration testing, Demonstration 7-day functional testing, and as required by the Specifications.
9. Update and replace arc flash labels on equipment if protective device settings are modified during testing and start-up phase.
10. Complete Record Set of Protective Device Studies, approved by the Owner and the Engineer.

3.2 SHORT CIRCUIT STUDY

- A. The Short Circuit Study shall be performed with the aid of a digital computer program, and shall be in accordance with:
 1. ANSI/IEEE 141 – Recommended Practice for Electrical Power Distribution for Industrial Plants
 2. ANSI/IEEE 242 – Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems
 3. ANSI/IEEE C 37.13 – Low-Voltage AC Power Circuit Breakers Used in Enclosures
- B. The Short Circuit Study shall be performed to determine the adequacy of circuit breakers, molded case switches, and fuses. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the Engineer's attention.
- C. Do not utilize series-rated circuit breakers to meet short circuit requirements for this project. Devices shall be fully rated to withstand available fault currents.
- D. The Contractor shall as-built the Short Circuit Study and rerun and adjust all the reports, calculations, device settings and output tabulations for all the protective devices reflecting the as-built facilities after all corrections have been inserted into the input data and all previous comments have been addressed.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

- A. A Protective Device Coordination Study shall be performed to provide the necessary calculations required to select protective device settings.
- B. As a minimum, the time/current coordination curves for the power distribution system shall include the following on 5-cycle log-log graph paper:
 - 1. Time/current curves for each protective relay, circuit breaker, or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and tap and time dial settings shall be specified. Provide individual curves for each feeder unless identical to others.
 - 2. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Engineer shall be notified as to the cause. Recommendations shall be included for alternate methods that would improve selectivity.
 - 3. Time/current curves and points for cable and equipment damage.
 - 4. Circuit interrupting device operating and interrupting times.
 - 5. Indicate maximum fault values on the graph.
 - 6. Sketch of bus and breaker arrangement.
 - 7. Magnetizing inrush points of transformers.
 - 8. Thermal limits of dry type and liquid insulated transformers. (American National Standards Institute (ANSI) damage curve).
- C. The Contractor shall indicate suggested changes to the protection scheme or settings that will result in improved system reliability, and safety.
- D. All restrictions of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.
- E. The Contractor shall as-build the Protective Device Coordination Study, rerun and adjust all the reports and calculations, and plot the final curves for all the protective devices reflecting the as-built facilities after all corrections have been inserted into the input data and all previous comments have been addressed.

3.4 ARC FLASH STUDY

- A. The Arc Flash Study shall be performed with the aid of a digital computer program to cover the whole power distribution system. The Arc Flash Study shall calculate, determine and report the "Arc Flash Boundary" incident energy at 18 inches expressed in cal/sq-cm, voltage shock hazard, limited shock approach boundary, restricted shock approach boundary, prohibited shock approach boundary and "Personal Protective Equipment" (PPE) level. The Arc Flash Study shall calculate and determine these items

for electrical equipment in the power distribution system study. The Arc Flash Study shall be performed in conjunction with short circuit calculations and protective device coordination. The Arc Flash Study shall be done for worst-case analysis, considering minimum/maximum utility fault current and with motors either on or off. All calculation shall be performed in accordance with IEEE 1584. The use of thumb rules is not acceptable in place of a calculated value as shown in IEEE 1584. The Arc Flash Study shall be in accordance with the latest version of:

1. NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces
2. IEEE 1584 – Institute of Electrical and Electronics Engineers (IEEE) guide for performing Arc Flash Hazard Calculations
3. OSHA (29 CFR PART 1910) – Occupational Safety and Health Standards for General Industry
4. ANSI Z535.1 – Safety Color Code
5. ANSI Z535.3 – Criteria for Safety Symbols
6. ANSI Z535.4 – Product Safety Signs and Labels

- B. The study shall determine and report the following: The recommended values for the “Arc Flash Boundary” incident energy at 18 inches expressed in cal/sq-cm, voltage shock hazard, limited shock approach boundary, restricted shock approach boundary, prohibited shock approach boundary and PPE levels, based on the Arc Flash Study results. These results shall be tabulated with all identified equipment or short circuit interrupting items in the short circuit and coordination study.
- C. Provide arc flash calculations for main breaker at ~~Metering Panel~~Metering Switchboard. Apply arc flash labels that include calculations on the ~~Metering Panel~~Metering Switchboard near the main breaker, and on the exterior of the ~~Metering Panel~~Metering Switchboard enclosure. Include arc flash labels on the Circuit Breaker Disconnect Switch, MCC near the main breaker, and each individual MCC vertical section, and on the exterior of the MCC enclosure near the doors, as applicable to arc flash information based on equipment within. Each ~~Metering Panel~~Metering Switchboard exterior door and each MCC exterior door shall have an arc flash label, with matching label on the interior dead front.
- D. The study shall recommend the Personal Protective Equipment (PPE) that the Owner should maintain for standard maintenance and operations expected to be conducted for this electrical system. The study shall recommend the safety label design that should be posted on electrical equipment. The study shall recommend the specific information that should be typewritten as part of the safety label. Label information shall also be coordinated with Owner requirements during submittal period. These recommendations shall be based on the National Electrical Code (NEC) requirements, Occupational Safety and Health Administration (OSHA) standards, and National Fire Protection Association (NFPA) recommended practices. The Contractor shall furnish and

install the field markings required by the NEC for Flash Protection on all power distribution equipment. The field marking shall be the approved recommended safety label.

- E. The Contractor shall as-build the Arc Flash Study and rerun and adjust all the reports, calculations, and adjust the PPE recommendation reflecting the as-built facilities after all corrections have been inserted into the input data and all previous comments have been addressed.

3.5 RECORD SET

- A. The results of the power system studies shall be summarized in a Record Set. Submittal shall follow guidelines of O&M Manual and as described below. The Record Set shall include the following:
 1. Single-line diagram with field measured 480V cable lengths.
 2. Impedance diagram for Single and Three ~~3~~-Phase Faults.
 3. Impedance diagram for line to ground faults.
 4. Tabulation of all protective devices for 3-Phase Faults, which shall be identified on the single line diagram.
 5. Tabulation of all protective devices for line to ground faults, which shall be identified on the single line diagram.
 6. Time/current coordination curves for 3-Phase Fault protective settings.
 7. Time/current coordination curves for line to ground fault protective settings.
 8. Computerized 3-Phase Fault current calculations.
 9. Computerized line to ground fault current calculations.
 10. Recommended settings to achieve < 8 cal/sq-cm; or specific recommendations on how to mitigate all locations to < 8 cal/sq-cm.
 11. Transformer energization inrush points plotted on the associated time current protective curves
 12. Motor starting inrush current plotted on the associated time current protective curves.
 13. Sensing instrumentation, condition, and connections, as applicable, for each study.
 14. Arc Flash Study report including tabulations, label design and recommendations.
 15. Tabulation of all power distribution measuring, control, monitoring, and setup device settings.
 16. Specific recommendations shall include how to potentially reduce the arc-flash incident-energy levels for each location having more than 8 cal/sq-cm present. Include a budgetary estimate for implementing any proposed change.
- B. The Record Set shall include information concerning the computer program used for the study and also shall include a general discussion of the procedure, items, and data considered in preparing the study.

- C. The Record Set shall include portable USB thumb drive as well as hard paper copy form of all input data, all calculation reports, all plotted curves, all drawings, all output data, and all device settings in tabulated organized form. The Contractor shall submit the final SKM or ETAP model with scenarios in original source format on the USB Drive that can be utilized by the Owner.

END OF SECTION

SECTION 26 08 00 – ELECTRICAL TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies the work necessary to test, commission and demonstrate that the electrical work and equipment satisfies the criteria of these specification, InterNational Electric Testing Association's (NETA) latest Acceptance Testing Specifications, and also functions as required by the Contract Documents.
- B. Electrical Testing shall be completed by NETA certified testing agency. Results shall be reviewed and stamped by registered California professional electrical engineer, employed by the NETA testing agency. Stamped results shall be submitted, for approval by Engineer, prior to energizing any equipment. Unstamped and unsigned results that are submitted shall be returned without review.
- C. Electrical equipment shall not be energized until sequence steps 1 through 6 of Section 260573, Paragraph 3.1.C are completed and approved by Owner and Engineer.

1.2 GENERAL

- A. The work of this Section includes furnishing the labor, equipment, and power required to support the testing specified in this and other sections of the Specification. Electrical testing specified in Division 26 and functional testing of all power and controls not tested under Division 40 shall be completed before commencement of start-up testing. This scope of work may require the Contractor to activate circuits, shutdown circuits, run equipment, take electrical measurements, replace blown fuses, install temporary jumpers, etc.
- B. The Contractor shall provide support to disconnect and reconnect cables, portable power source, and perform any other functions required to test electrical equipment at no extra cost to the Owner. The Contractor is responsible for all work, equipment damage, power interruptions and schedule delays caused by the testing agency.
- C. Electrical tests shall be performed by third party, NETA certified, testing agency hired by the Contractor. Testing Agency shall meet the qualifications of this Section. All electrical testing shall be witnessed by the Owner and Engineer to be considered valid. All equipment that has successfully been tested shall include testing agency sticker with date of test and initials of tester.
- D. All electrical testing performed per this Section shall be done during Pre Demonstration period. Refer to Specifications on facility startup for further testing requirements.

1.3 SUBMITTALS

- A. Submit testing forms for approval. Testing forms shall be based on InterNational Electric Testing Association's (NETA) latest Acceptance Testing Specifications procedures, having space for a sign-off (tester and witness), pass/fail status, and a data field for each line item covered by NETA's Acceptance Testing Specifications latest edition.
- B. Stamped and signed results of all testing shall be submitted to the Engineer prior to final project acceptance. Results to be included as part of final O&M Manuals. Results shall describe test conditions, weather (including temperature and humidity), test date, duration of test, test equipment, tested equipment, testing technician, "as found" and "as-left" results, expected results, actual results, pass/fail status based on listed testing standards and a registered Professional Engineers stamp and signature; registered in Electrical Engineering in the state of California.
- C. Testing agency engineer to submit confirmation that "equipment is ready to be energized". Confirmation shall be on company letterhead with name, signature and stamp of responsible Professional Engineer of NETA testing agency.

1.4 TESTING AGENCY QUALIFICATION

- A. NETA testing shall be performed by a separate and independent subcontractor who has been regularly engaged in the testing of equipment for a period of at least five (5) years. All testing shall be conducted under the direct supervision of an electrical engineer, registered in the state of California. This registered electrical engineer will prepare and sign test reports with values, recommendations, comments, pass/fail status, as well as ready for energization confirmation letter.
- B. Testing equipment required to conduct the specified tests shall be furnished by the NETA testing agency. Testing equipment shall be in good working condition and comply with the requirements of this Specification and applicable industry standards.
- C. Testing equipment shall have valid calibration sticker.
- D. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and latest NETA Acceptance Testing Specifications. All testing shall be done in the presence of the Engineer, and forms shall include space for Engineer sign-off at time of test. Test shall be giving a PASS/FAIL grade at time of test by certified NETA tester.
- E. NETA testing agency shall be Associated Power Solutions, or approved equal.
- F. The NETA testing agency shall be responsible for testing, and verification of results of Contractor performed testing, of equipment listed below:

- ~~1.~~ Metering Panel/Metering Switchboard and Motor Control Center: Including bus, grounding, breakers (all mains and breakers 100 amps and above), transformers, and panelboards.
- ~~2.~~ Step Up Transformer
- ~~4-3.~~ Circuit Breaker Disconnect Switch
- ~~2-4.~~ Cables – shall be tested by Contractor after pulling and prior to termination. Refer to Section 260519 – Wires and Cables. Testing organization is responsible to review results, provide pass/fail evaluation and include results submittal.
- ~~3-5.~~ Electric Motors (10 hp and up). May be performed by pump supplier.
- ~~4-6.~~ Grounding System.
- ~~5-7.~~ Miscellaneous Testing – shall be performed by Contractor.

1.5 NETA FIELD TESTING

- A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere:
1. ~~Metering Panel/Metering Switchboard~~:
 - a. Perform Field Testing per NETA Acceptance Testing Specifications on: ~~Metering Panel/Metering Switchboard~~ including main circuit breaker, 250 amp circuit breaker, bus, and grounding system.
 2. Motor Control Center:
 - a. Perform Field Testing per NETA Acceptance Testing Specifications on: MCC including bus, main circuit breaker, circuit breakers 100 amps and above, panelboard main breaker, motor circuit protectors 50 amps and above, panelboard, dry type transformer, and grounding system.
 - b. Perform manufacturer recommended Field Testing on: VFD's. Manufacturer or MCC supplier shall field test and configure the VFD's.
 - ~~3.~~ Step Up Transformer:
 - a. Perform Field Testing per NETA Acceptance Testing Specifications.
 - ~~4.~~ Circuit Breaker Disconnect Switch:
 - a. Perform Field Testing per NETA Acceptance Testing Specifications.
 - ~~3-5.~~ Cables – to be performed by Contractor:
 - a. Perform Field Testing per NETA Acceptance Testing Specifications.
 - b. Refer to Section 260519 – Wires and Cables for additional testing.
 - ~~4-6.~~ Electric Motors (10 hp and up) – may be performed by pump supplier.
 - a. Perform Field Testing per NETA Acceptance Testing Specifications and pump motor manufacturer standard field testing procedures.
 - ~~5-7.~~ Grounding System:
 - a. Perform Field Testing per NETA Acceptance Testing Specifications.
 - b. Test Grounding System at ~~Metering Panel/Metering Switchboard~~ ground bus, and at MCC ground bus and at Pump No. 2 casing.
 - ~~6-8.~~ Miscellaneous Testing– to be performed by Contractor:

- a. Refer to Section 260500 – Electrical Work, General.

1.6 TESTING SEQUENCE

- A. Refer to Section 260573 Paragraph 3.01.C for sequence.
- B. ~~Metering Panel~~Metering Switchboard and connected grounding system, shall be successfully NETA tested prior to PG&E setting meter and prior to energizing.

PART 2 PART 2 PRODUCTS (NOT USED)

PART 3 PART 3 EXECUTION

3.1 TESTING

- A. All testing shall be witnessed and signed-off by the Owner and the Engineer to be considered valid. Each test sheet must be signed-off prior to submittal.
- B. After equipment is tested and approved, testing organization shall apply sticker on equipment noting date of test and initial of tester.
- C. Pre-Demonstration period shall include all NETA Field Testing, and manufacturer recommended testing and testing requirements listed in equipment specification sections.

END OF SECTION

SECTION 26 24 13 – ~~480V METERING PANEL~~METERING SWITCHBOARD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide the ~~Metering Panel~~Metering Switchboard, complete and operable, in accordance with the Contract Documents. ~~Metering Panel~~Metering Switchboard shall be NEMA 3R, painted steel exterior enclosure, ~~freestanding, NEMA 3R,~~ with main disconnect ~~and suitable for pole mounting~~and distribution section with internal surge protection device (SPD).
- B. The pull section and metering section of the ~~Metering Panel~~Metering Switchboard shall meet PG&E service meter requirements for ampacity as shown on the Contract Drawings, ~~480/277~~120/240 VAC, ~~single~~three phase, ~~four~~three wire, 60 Hz service. Refer to PG&E Greenbook. ~~Metering Panel~~Metering Switchboard submittal drawings shall be approved by PG&E prior to work. Provide submittal with listing of applicable EUSERC numbers for PG&E review.
- C. The requirements of Section 260500 – Electrical Work, General, apply to the Work of this Section.
- D. Provide arc flash labels and maximum available fault current (with date) on the ~~Metering Panel~~Metering Switchboard main circuit breaker. Provide nameplates, warning labels, and arc flash labels, on the ~~Metering Panel~~Metering Switchboard, both on exterior doors and matching label on interior dead front doors. Provide additional electrical hazard warning signs on exterior doors of Panel enclosure. Refer to Section 260500 – Electrical Work, General for additional warning labels and signage requirements.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Contractor shall submit Shop Drawings in accordance with Specifications and Section 260500 – Electrical Work, General.
- B. Shop Drawings for ~~Metering Panel~~Metering Switchboards:
 - 1. Enclosure National Electrical Manufacturers Association (NEMA) rating
 - 2. Bus ampacity, voltage rating and interrupting capacity. Include materials of construction.
 - 3. Ground bus size and material of construction.
 - 4. Conduit entrance provisions for ~~top~~bottom feed and bottom load conduits.
 - 5. Utility incoming line entry provision (~~bottom~~top) for ~~Metering Panel~~Metering Switchboard pull section and into metering section.

6. Metering sections, and equipment per PG&E and EUSERC standards. Submit proof of approval by PG&E to Engineer.
7. Nameplate schedule.
- ~~8.~~ 8. Main circuit breaker type, frame and electronic trip unit.
- ~~8-9.~~ 8-9. Distribution section with surge protection device (SPD) and circuit breakers with trip types and sizes per Contract Drawings.
- ~~9-10.~~ 9-10. Schematics Drawings and Elevation Drawings.
- ~~10-11.~~ 10-11. Short circuit rating of the complete assembly.
- ~~11-12.~~ 11-12. Factory Test procedures and certified results.

- C. Operation and Maintenance Manuals: The Contractor shall submit Operation and Maintenance Manuals per Specifications. Refer to Section 260500 – Electrical Work, General for O&M Manual requirements.

1.3 APPLICABLE CODES AND REQUIREMENTS

- A. As specified in Section 260500 – Electrical Work, General.

1.4 MAINTENANCE AND GUARANTEE, WARRANTY

- A. After completion the Contractor shall furnish to the Owner the supplier's written guarantees, that the systems will operate within the published accuracies and ranges and meet these Specifications.
- B. The Contractor shall also furnish the manufacturer's warranties as published in its literature, and submit within the O&M Manuals.
- C. The warranty for all provided equipment shall be not less than two years after initial startup or Owner beneficial use, whichever is later, and shall include all costs for repairs, parts, travel and living expenses, and labor.

PART 2 PRODUCTS

2.1 GENERAL

- A. ~~Metering Panel~~Metering Switchboard shall be rated for minimum 2265k AICS.
- B. ~~Metering Panel~~Metering Switchboard including all components shall be rated for 40° Celsius at full load. Panel and components shall be rated for marine environment.
- C. ~~Metering Panel~~Metering Switchboard wiring shall be labeled, color coded, and furnished per applicable codes and standards requirements.

- D. ~~Metering Panel~~Metering Switchboard shall be products of Eaton, Millbank, or approved equal, with exterior NEMA 3R, painted steel, non walk-in freestanding enclosure. Enclosure painting (coating) system shall be suitable and provide protection for marine environment. Exterior paint color shall be ANSI 61.

2.2 ~~METERING PANEL~~METERING SWITCHBOARD DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

- A. ~~Metering Panel~~Metering Switchboard shall be ~~600~~240-volt class suitable for operation on a ~~single~~three-phase, ~~four~~three-wire, and 60-Hz system.
- B. ~~Metering Panel~~Metering Switchboard shall receive power from PG&E service, ~~three single~~ phase, ~~three four~~ wire system. ~~Metering Panel~~Metering Switchboard shall include provision for termination of the incoming neutral conductor in conformance to NEC requirements for service entrance. ~~Hence load connection between Metering Panel and MCC shall be 480 VAC, three phase, three wire, plus ground.~~
- C. ~~Metering Panel~~Metering Switchboard exterior enclosure shall be NEMA 3R painted steel, ANSI 61. Exterior door shall be padlockable at main disconnect breaker.
- D. Size and Arrangement
1. ~~Metering Panel~~Metering Switchboard shall contain PG&E incoming pull section, meters and test switches, all as required by PG&E and EUSERC.
 2. ~~Metering Panel~~Metering Switchboard shall contain the main circuit breaker with ~~thermal~~electronic trip.
 - ~~2-3.~~ Distribution section of Metering Switchboard shall contain internal SPD and circuit breakers per Contract Drawings.
- E. Enclosure
1. Structural members shall be fabricated of not less than 12-gauge steel and side and top panels and doors shall be not less than 14-gauge steel.
 2. Provide screwed nameplates on all sections.

2.3 MAIN CIRCUIT BREAKER

- A. Main circuit breaker shall be molded case with electronic trip element. Main circuit breaker shall be Eaton Series C K-Frame Type KD with electronic unit, or approved equal. The interrupting capacity shall be a minimum of 22,000 RMS symmetrical amperes at operating voltage.
- B. Provide breaker with load side cable lugs as required per Contract Drawings.

2.32.4 MAIN-DISTRIBUTION SECTION SPD AND CIRCUIT BREAKERS

- A. Surge protection device (SPD) shall be rated for 80 KA and be internal to the Metering Switchboard, with circuit breaker protection. Provide with alarm and counter. SPD shall be Eaton SPD Series, or equal.
- A.B. Main-Distribution section circuit breakers shall be molded case with thermal trip element, unless shown otherwise. ~~Main circuit~~ Circuit breakers shall be Eaton Series C F-Frame Type HFD-FD with thermal unit, or approved equal. The interrupting capacity shall be a minimum of 6522,000 RMS symmetrical amperes at operating voltage.
- C. Distribution Section 250 amp circuit breaker feeding the Step Up Transformer, shall be molded case with electronic trip element. 250 amp circuit breaker shall be Eaton Series C K-Frame Type KD with electronic unit, or approved equal. The interrupting capacity shall be a minimum of 22,000 RMS symmetrical amperes at operating voltage.
- B.D. Provide breakers with load side cable lugs as required per Contract Drawings.

PART 3 PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall install ~~Metering Panel~~ Metering Switchboards in accordance with supplier's published instructions conforming to these Contract Documents.
- B. ~~Metering Panel~~ Metering Switchboards shall be handled carefully to avoid damage to components, enclosure, and finish. Damage shall be repaired before installation.

3.2 INSTALLATION

- A. ~~Metering Panel~~ Metering Switchboards shall be installed on ~~pole~~ housekeeping pad and slab on grade, anchored per manufacturer recommendations. Provide 48" of concrete slab on grade in front of housekeeping pad. Installation shall be per PG&E Greenbook.
- B. The Contractor shall:
1. Torque all bus bar bolts to supplier's recommendations; tighten all sheet metal and structure assembly bolts.
 2. After equipment is installed, touch up scratches and verify that nameplate, and other identification is accurate.
 3. Install duct seal within conduit stubbing up within ~~Metering Panel~~ Metering Switchboard.
 4. After equipment is installed, touch up scratches and verify that nameplate, and other identification is accurate.

3.3 FIELD TESTS AND CERTIFICATION

- A. Visual and mechanical inspection after installation shall include:
 - 1. Inspect for physical damage, proper anchorage and grounding.
 - 2. Check tightness of bolted connections.
- B. Provide NETA field testing as outlined in Specification 260800 - Electrical Testing.
- C. All testing shall be witnessed by the Engineer and/or Owner. All testing sheets shall be signed off by the Engineer and/or Owner to be considered valid.
- D. Refer to Specifications on facility start up for further testing requirements.
- E. Pre-Demonstration period for ~~Metering Panel~~Metering Switchboard testing shall include NETA Field Testing, equipment start-up, and approval of O&M Manuals.

END OF SECTION

SECTION 26 27 26 – WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide wiring devices, complete and operable, in accordance with the Contract Documents.
- B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.
- B.C. Work includes the following equipment: Step Up Transformer, Circuit Breaker Disconnect Switch, and Phase Converter.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Contractor shall submit Shop Drawings in accordance with Specifications and Section 260500 – Electrical Work, General.
- B. Shop Drawings
 - 1. Complete catalog cuts of equipment, with enclosures, covers, and appurtenances, marked to clearly identify proposed materials.
 - 2. Shop drawings for Disconnect Switches, Step Up Transformer, Circuit Breaker Disconnect Switch, and Phase Converter including dimensions, materials, nameplates, installation details, ratings and voltages and phases.
 - 3. Documentation showing that proposed materials comply with the requirements of NEC and UL.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices shall carry the UL label.

2.2 LIGHTING SWITCHES

- A. Light switches shall be heavy duty, industrial, toggle type, 20-amp, 125 VAC-rated, self-grounding, and back and side wired. Light switch handles shall be brown. Contact arm spring and terminal plate shall be copper alloy. Contact points shall be silver cadmium

oxide. Ground terminal shall be nickel-plated steel with brass screw. Switches shall conform to UL 20. Provide single and three way switches as required.

- B. Acceptable products: Hubbell 1221B, Hubbell 1223B, or approved equal.

2.3 GENERAL PURPOSE RECEPTACLES

- A. Duplex receptacles shall be 125 VAC, 20 amperes, polarized three-wire type, NEMA 5-20R conforming to UL 498. Receptacles shall be brown. Receptacles shall conform to UL 498. External wiring shall be provided by side mounted terminal screws. Acceptable products: Hubbell 5362B, or approved equal.
- B. Ground-fault circuit interrupting receptacles (GFCIs) shall be installed at outdoor locations. GFCIs shall be rated 125 V, 20 amperes NEMA 5-20R, conforming to UL 498 and UL 943, and brown. Acceptable products: Hubbell GF-5362SG, or approved equal.

2.4 OUTLET AND DEVICE BOXES

- A. Outlet and Device boxes are specified in Section 260533 – Electrical Raceway Systems.

2.5 DEVICE COVERS

- A. While in use covers shall be UL listed, NEMA 3R, metallic, neoprene gaskets, heavy duty, deep depth, lockable type. While in use covers shall be TayMac #MX3200, or approved equal.

2.6 NAMEPLATES

- A. Provide nameplates on switches, motor switches, and receptacles wall plates stating panelboard (or lighting control panel) and circuit number feeds to the device. For example, a receptacle nameplate may be inscribed "LP-1, Circuit 3".

2.7 PUMP STATION INTRUSION SWITCHES

- A. Provide industrial grade, encapsulated SPDT magnetic contact switch. Switch shall be NEMA 3R, with mounting brackets as required. Switch to include stainless steel flexible conduit, 3' long. Gap distance to make, up to 3". Housing to be anodized aluminum or stainless steel.
- B. Intrusion switch shall be GE Sentrol 2507A, or approved equal.

2.8 NON-FUSED PUMP DISCONNECT SWITCHES

- A. Provide disconnect switches in NEMA rated enclosures as specified in Section 26 05 00 – Electrical Work. Provide switches that can be locked in the “OFF” position. Interlock enclosure and switches to prevent opening the cover with the switch in the “ON” position. Provide switches which are quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type, having external marking clearly indicating “ON” and “OFF” positions. Furnish switches meeting the requirements of NEMA KS 1. Provide switches suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity. Switches shall be rated for 15 hp, or 30 amps, whichever is greater.
- B. Provide disconnect switches with factory installed, engraved, laminated nameplates (black background with white lettering) citing the name of the equipment serving.
- C. Acceptable Products: Eaton Heavy Duty Safety Switches, or approved equal.

2.9 PUMP STATION - 3 POLE DISCONNECT SWITCH

- A. Provide 3 Pole disconnect switch to disconnect the three 120 VAC circuits coming into the Pump Station. Switch shall be rated 30 amps.
- B. Provide disconnect switches with factory installed, engraved, laminated nameplates (black background with white lettering) citing the name of the equipment serving.
- C. Acceptable Products: Eaton Heavy Duty Safety Switch, or approved equal.

2.10 PUMP STATION – SIGNAL J-BOX

- A. Signal J-Box shall be NEMA 12, painted steel, fully hinged, padlockable handle, back panel, grounding lug, and minimum 6” H x 16” W x 6” D (or as required based on installed conduit dimensions and per NEC requirements), connectors, and splices.
- B. Signal J-Box shall be Hoffman Products Bulletin A51SE with back panel, or approved equal.

2.11 STEP UP TRANSFORMER

- A. Step Up Transformer shall be NEMA 3R, 50 KVA, 240 VAC single phase input to 480 VAC single phase output. The transformer shall be dry-type, designed, manufactured, and tested in accordance with the latest applicable standards of ANSI and NEMA. Transformer shall be UL-listed and bear the UL label. Transformer shall be noise isolating type with shield between primary and secondary windings. Provide with copper windings. 220° C insulation system based upon 150° C rise. Provide with vibration

isolation pads. Transformer shall have four 2½-percent taps, two above and two below primary. Transformer shall be suitable for concrete pad mounting.

B. Step Up Transformer shall be Eaton, or approved equal.

2.12 CIRCUIT BREAKER DISCONNECT SWITCH

A. Circuit Breaker Disconnect Switch shall be NEMA 3R type enclosure, painted steel, with 150 amp circuit breaker with electronic trip unit, 480 VAC rated. Switch shall be padlockable in the off position. Enclosure shall be suitable for stanchion mounting.

B. 150 amp circuit breaker shall be Eaton Series C K-Frame Type KD with electronic unit, or approved equal. The interrupting capacity shall be a minimum of 22,000 RMS symmetrical amperes at operating voltage. Provide breaker with cable lugs as required per Contract Drawings

C. Circuit Breaker Disconnect Switch shall be Eaton, or approved equal.

2.13 PHASE CONVERTER

A. Phase Converter shall be NEMA 3R, 480 VAC single phase input (105 amps) to 480 VAC three phase output (61 amps) and rated for 50.7 KVA output. Enclosure shall be suitable for stanchion mounting. Phase Converter shall be 98.7% efficient at full load, voltage balance within 2%.

B. Phase Converter shall be Phase Technologies Phase Perfect PT Series #PT440, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. Perform work in accordance with the National Electrical Code (NEC).

B. Outdoor receptacles shall be GFCI type, with while in use covers.

~~B.C.~~ Install Step Up Transformer, Circuit Breaker Disconnect Switch, and Phase Converter per manufacturer recommendations, and as shown on Contract Drawings.

3.2 CONNECTION

A. Rigidly attach wiring devices in accordance with manufacturer instructions.

- B. Securely fasten nameplates using epoxy glue centered under or on the device, unless otherwise indicated.

3.3 GROUNDING

- A. Ground all devices, including switches and receptacles, in accordance with NEC and Section 260526 – Grounding.
- B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.
- C. Ground flush receptacles and their metal plates through positive ground connections to the outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to the outlet box and grounding system at all times.
- D. Exterior receptacles shall be 24” above grade, unless shown otherwise.

3.4 FIELD TESTING

- A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 260800 – Electrical Testing.
- B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.
- C. Wiring devices testing shall be completed during Pre Demonstration period.
- D. Set taps on Step Up Transformer primary as required for 480 VAC output.
- E. Configure the Phase Converter as required for 480 single phase input and 480 VAC three phase output, and per manufacturer based on installed requirements.

END OF SECTION