



CALAVERAS COUNTY WATER DISTRICT

120 Toma Court • San Andreas, CA 95249 • (209) 754-3543

REQUEST FOR PROPOSALS (RFP)

Electrical Equipment for Hunters Reservoir Raw Water Intake Project (CIP No. 11103)

1. Request for Proposals. Calaveras County Water District (CCWD) is requesting proposals to purchase a main service, motor control center, transformer, and load centers for the Hunters Reservoir pump station as shown in the project design (Attachment A). The District intends to pre-purchase the long lead equipment, including electrical equipment for the construction project. This Request for Proposals (RFP) is for the long lead electrical equipment and is not a bid for construction.

A. Scope and Nature: The District is accepting proposals for supplying a main service, motor control center, transformer, and load centers as provided in the RFP documents.

B. Site and Delivery Address: Hunters Water Treatment Plant, 335 Hunters Dam Road, Avery CA 95224

C. Schedule: The tentative schedule is as follows:

- **Wednesday, July 6, 2022** – Solicit Proposals for Electrical Equipment.
- **Friday, July 22, 2022** – Last day for Request for Information.
- **Monday, August 1, 2022** – Proposal submittals due at 2:00pm.
- **Anticipated Equipment Delivery** – June 2023.

Before submitting a response to this RFP, each proposer shall carefully read and examine all documents associated with this RFP.

Submitted pricing shall be good for 30 calendar days from the proposal due date. Pricing for the equipment shall be secured once District signs and returns the Purchase Order agreement to confirm order.

D. Federal Requirements: This Project is Funded in Part by the United States Federal Emergency Management Agency (FEMA)/Cal-OES. The Project is subject to numerous permits, provisions, and environmental constraints that must be adhered to during course of the work.

This Project includes Federal Domestic Preferences for Procurements, 2 C.F.R. § 200.322. The selected manufacturer shall use products and materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products such as polyvinyl chloride pipe, aggregates such as concrete, glass, optical fiber, and lumber)

Supplier/Contractor is to comply with the Byrd Anti-Lobbying Amendment, 31 § U.S.C. 1352

Supplier/Contractors who apply or bid for an award of \$100,000 or more must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

These certifications are to be made (signed and submitted) in the form of 44 C.F.R. Part 18, Attachment A as shown below.

- E. Proposal Submission:** Three (3) copies of the proposal shall be addressed and delivered in a sealed envelope to Calaveras County Water District, Attention: Kevin Williams, 120 Toma Court, San Andreas, CA 95249. Proposals can be hand delivered on the day of submission or sent via FEDEX inside a separately sealed envelope inside the FEDEX packaging. The District will not accept responsibility for lost, misplaced, or delayed FEDEX packages. **Electronic submission via email will not be accepted.**

Proposals shall include the following:

- **Product Catalog:** General description of equipment selections. Provide elevation drawings, and a complete bill of material. All products shall UL Approved, and metering equipment shall have utility termination and metering approval.
- **Total Cost for Electrical Package:** Includes cost of fabrication and delivery of all equipment to the Project Site. Terms of payment including initial deposit amount should be included.
- **References:** Include names of at least three (3) clients who may be contacted, who purchased similar equipment.
- **Experience:** Provide brief history of the proposing firm and range of services offered and brief history of manufacturer.

- **Proposed Production Schedule:** Including timeframe for equipment fabrication and delivery.
- **Business Information:** Name of Business and Location of all its offices, specifically indicating the principal place of business.
- **Purchase Order Contract:** Form to be signed by District to secure proposal pricing once approved.

F. Detailed Project Description: At a minimum, the following specifications should apply:

- All components manufactured in the United States.
- All proposed equipment shall be by the same manufacturer.
- Meet requirements as described in the Project Plans (Attachment B) and Project Specifications (Attachment C).

For the main service, the following specifications should apply:

- PG&E APPROVED UTILITY TERMINATION AND METERING SECTIONS.
- 800 Amp, 277/480 Volt, 3 phase, 4 wire, 42,000 AIC.
- NEMA 3R enclosure.
- Circuit Breaker 800 Amp, 3 pole with meter.
- ALL BREAKERS SHOWN ON THE PLANS.
- Automatic transfer switch 800A, 480V, 3PH, 4W.
- Electrical busses to be full height. Refer to specifications.

For the motor control center, the following specifications should apply:

- Provide termination section, and all breakers, starters, overloads, etc. shown on the electrical plans.
- Refer to specifications for construction standards.
- NEMA 12 enclosure.
- HMI Displays for starters and VFD's.
- Control Panel A
 - i. NEMA 3R Enclosure
 - ii. Volts: 120/240 Single
 - iii. Single Phase, 3 wire
 - iv. Mounting: In MCC
 - v. With all circuit breakers shown on the plans.
- Control Panel B
 - i. NEMA 3R Enclosure
 - ii. Volts: 120/240 Single
 - iii. Single Phase, 3 wire
 - iv. Mounting: Surface

For the transformer, the following specifications should apply:

- 10KVA
- 480:120/240V
- 1PH
- 3W

For the load centers, the following specifications should apply:

- With ratings and breakers as shown on the electrical plans. Provide copper buss with lockable door. Provide blank covers for spaces not used.

G. Evaluation Criteria and Selection: The District will review all Proposals for cost as well as technical comparisons. The District reserves the right to reject any and all proposals at its discretion, to waive any informality in a proposal, to reject the proposal of any bidder who has been delinquent or unfaithful in any former contract, and to make awards in the interest of the District. The District reserves the right not to purchase the electrical equipment. The District reserves rights to waive formalities and minor irregularities in the proposals received. The anticipated criteria and selection process will take approximately 30 days and the vendor's pricing shall be validate until this time.

H. Contract: The District will enter a contract with the selected Proposer.

I. Attachments:

- Attachment A – Bryd Anti-Lobbying Amendment, 31 § U.S.C. 1352
- Attachment B – 60% Project Plan Set (Electrical Only)
- Attachment C – 60% Electrical Technical Specifications

J. Request for Information: Request for information can be sent to kevinw@ccwd.org. Request for information must be received no later than Friday, July 22, 2022. Responses to request for information will be posted on the District Website.

RECEIPT OF PROPOSALS

Three (3) copies of your proposal shall be delivered to the District on or before August 1, 2022 at 2:00 p.m. local time to the address below:

Calaveras County Water District
120 Toma Court
San Andreas, California 95249
Attn: Kevin Williams

ATTACHMENT A

Contractor is to comply with the Byrd Anti-Lobbying Amendment, 31 § U.S.C. 1352

Contractors who apply or bid for an award of \$100,000 or more must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

These certifications are to be made (signed and submitted) in the form of 44 C.F.R. Part 18, Appendix A as shown below.

Bryd Anti-Lobbying Amendment, 31 § U.S.C. 1352

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersign certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C.Chap. 38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.

Signature of Contractor's Authorized Official

Name and Title of Contractor's Authorized Official

Date

A. Procurement of Recovered Materials, 2 C.F.R. § 200.323

A non-Federal entity that is a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds \$10,000 or the value of the quantity acquired during the preceding fiscal year exceeded \$10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

- (1) In the performance of this contract, the Contractor will make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired either: a) competitively within a timeframe providing for compliance with the contract performance schedule; b) meeting contract performance requirements; or c) at a reasonable price.*
- (2) Information about this requirement, along with a list of EPA designated items, is available at EPA's Comprehensive Procurement Guidelines web site, <https://www.epa.gov/smm/comprehensiveprocurement-guideline-cpg-program>.*
- (3) Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.*

B. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment, 2 C.F.R. § 200.216

Contractor shall comply with Prohibitions on Certain Telecommunications and Video Surveillance Services or Equipment in conformance with 2 C.F.R. §200.216.

C. Domestic Preferences for Procurements, 2 C.F.R. § 200.322.

- (a) As appropriate and to the extent consistent with law, the non-Federal entity should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award.
- (b) For purposes of this section:
 - (1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.
 - (2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

D. Access to Records and Retention,

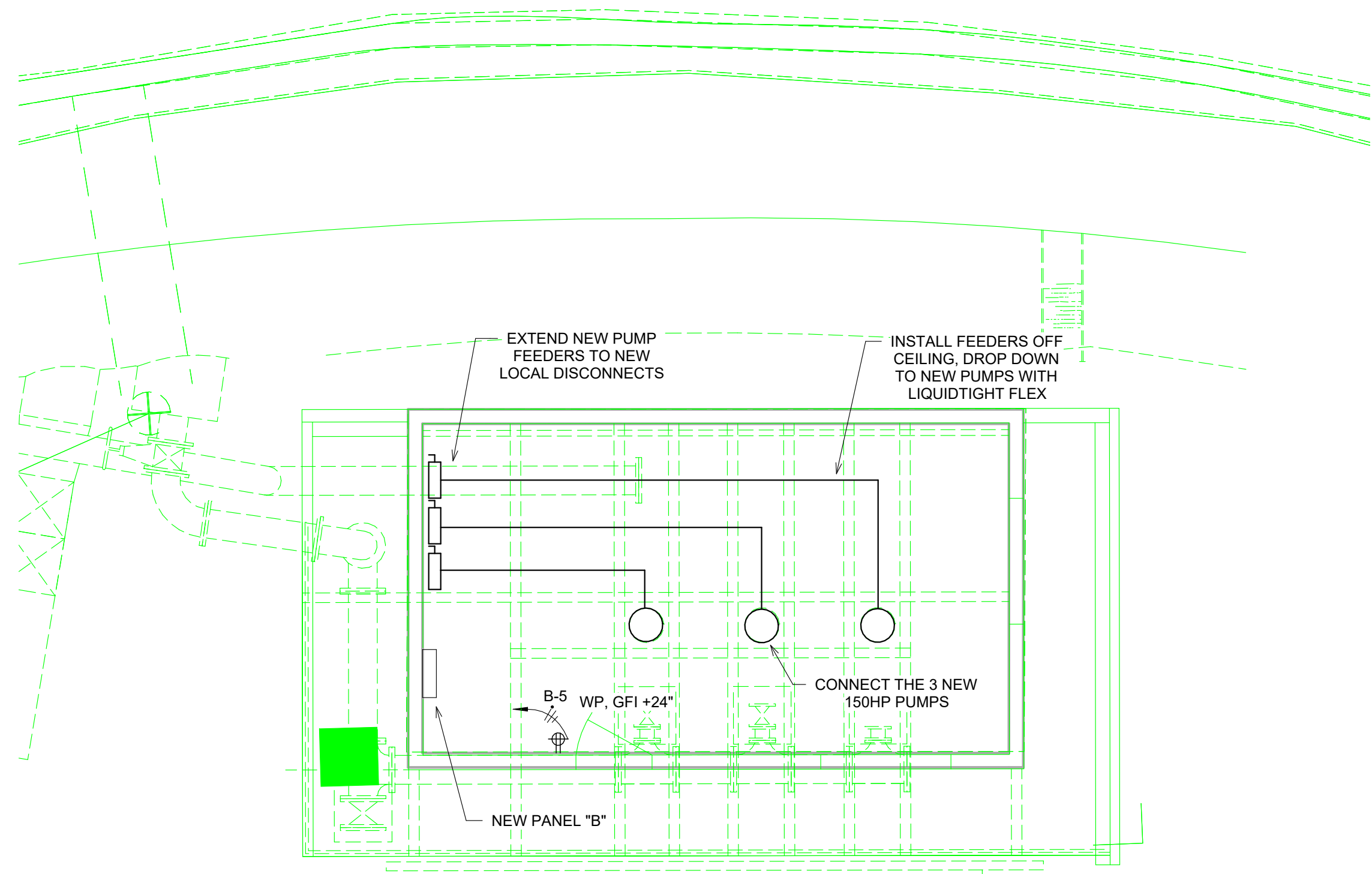
As stipulated in 44 C.F.R. § 13.36(i) (10) – (11), the following access to records and retention requirements apply to this contract and its subcontracts:

- a. The contractor agrees to provide the Calaveras County Water District, Cal-OES, the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts, and transcriptions.*
- b. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.*
- c. The Contractor agrees to provide the FEMA Administrator or his authorized representatives access to construction or other work sites pertaining to the work being completed under the contract.*
- d. The Contractor will retain these records for three years after final payments and all other pending matters are closed.*

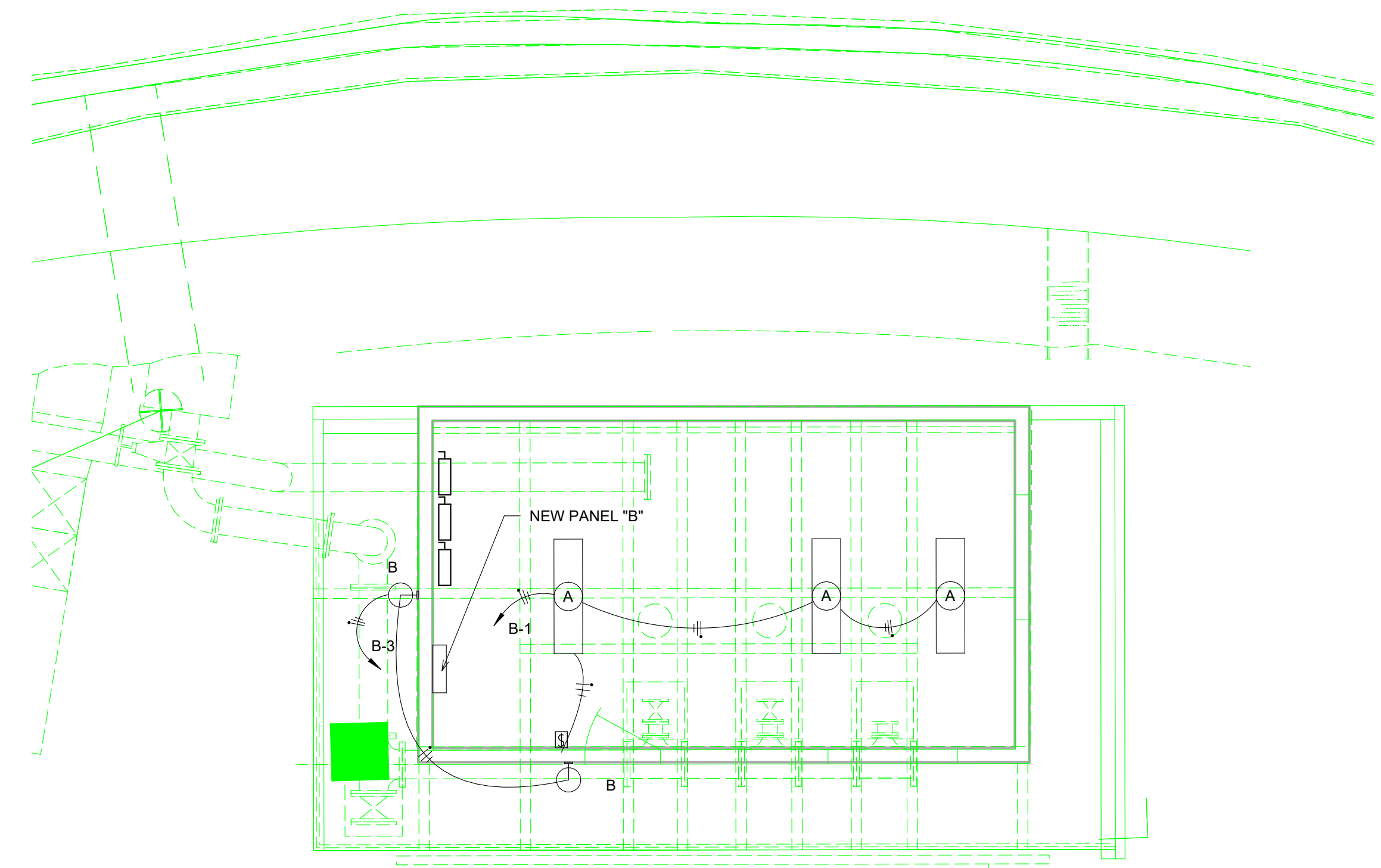
E. Mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub. L. 94-163, 89 Stat. 871)

- a. In accordance with 44 C.F.R. §13.36(i)(13), the Contractor agrees to comply with all mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub. L. 94-163, 89 Stat. 871)*
- b. The Contractor agrees to including paragraph a. above in each third-party subcontract financed in whole or in part with Federal assistance provided by FEMA.*

ATTACHMENT B



- ELECTRICAL DEMOLITION:
- REMOVE ALL ELECTRICAL FROM EXISTING BUILDING INCLUDING CONDUIT, WIRE, CONNECTIONS TO PUMPS, LIGHTS, CONTROLS, ETC.
 - SEAL ALL PENETRATIONS MADE BY THE REMOVAL OF ELECTRICAL



1 PUMP HOUSE
SCALE: 1/4" = 1'-0"

2 PUMP HOUSE LIGHTING
SCALE: 1/4" = 1'-0"

PANEL B

Location: Supply From: PANEL "A"
Mounting: Surface
Enclosure: NEMA 3R

Volts: 120/240 Single
Phases: 1
Wires: 3

A.I.C. Rating: 10,000
Mains Type: MCB
Mains Rating: 60 A
MCB Rating: 60 A

Notes:

| CKT | Circuit Description | Trip | Poles | A | B | Poles | Trip | Circuit Description | CKT |
|-------------|---------------------|------|-------|--------|-------|-------|------|---------------------|------|
| B-1 | LIGHTING | 20 A | 1 | 105 VA | | | | | B-2 |
| B-3 | Lighting | 20 A | 1 | | 40 VA | | | | B-4 |
| B-5 | Receptacle | 20 A | 1 | 180 VA | 0 VA | | 20 A | Spare | B-6 |
| B-7 | | | | 0 VA | 0 VA | | 20 A | Spare | B-8 |
| B-9 | | | | | 0 VA | | 20 A | Spare | B-10 |
| B-11 | | | | | 0 VA | | 20 A | Spare | B-12 |
| Total Load: | | | | 285 VA | 40 VA | | | | |
| Total Amps: | | | | 2 A | 0 A | | | | |

Legend:

FIXTURE SCHEDULE

| Type Mark | Lamp | Description | Manufacturer | Model | Apparent Load |
|-----------|------|--|--------------|-----------------------------|---------------|
| A | LED | 4' LED 4000 LUMEN LED WRAP SURFACE MOUNT FIXTURE, 0-10 V DIMMING DRIVER, UNIVERSAL VOLTAGE | LITHONIA | VAP LED L48 4000L LP840 EZ1 | 35 VA |
| B | LED | SMALL AREA LIGHTING +76" TO BOTTOM, PHOTOCCELL CONTROL | EATON | XTORA 2 PC | 20 VA |



BLACKWATER
CONSULTING ENGINEERS
602 LVELL DRIVE, MODESTO, CA 95356 • PH:209.322.1820

| REV | DATE | DESCRIPTION | APP |
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HUNTER RESERVOIR
RAW WATER INTAKE PROJECT
PUMP HOUSE

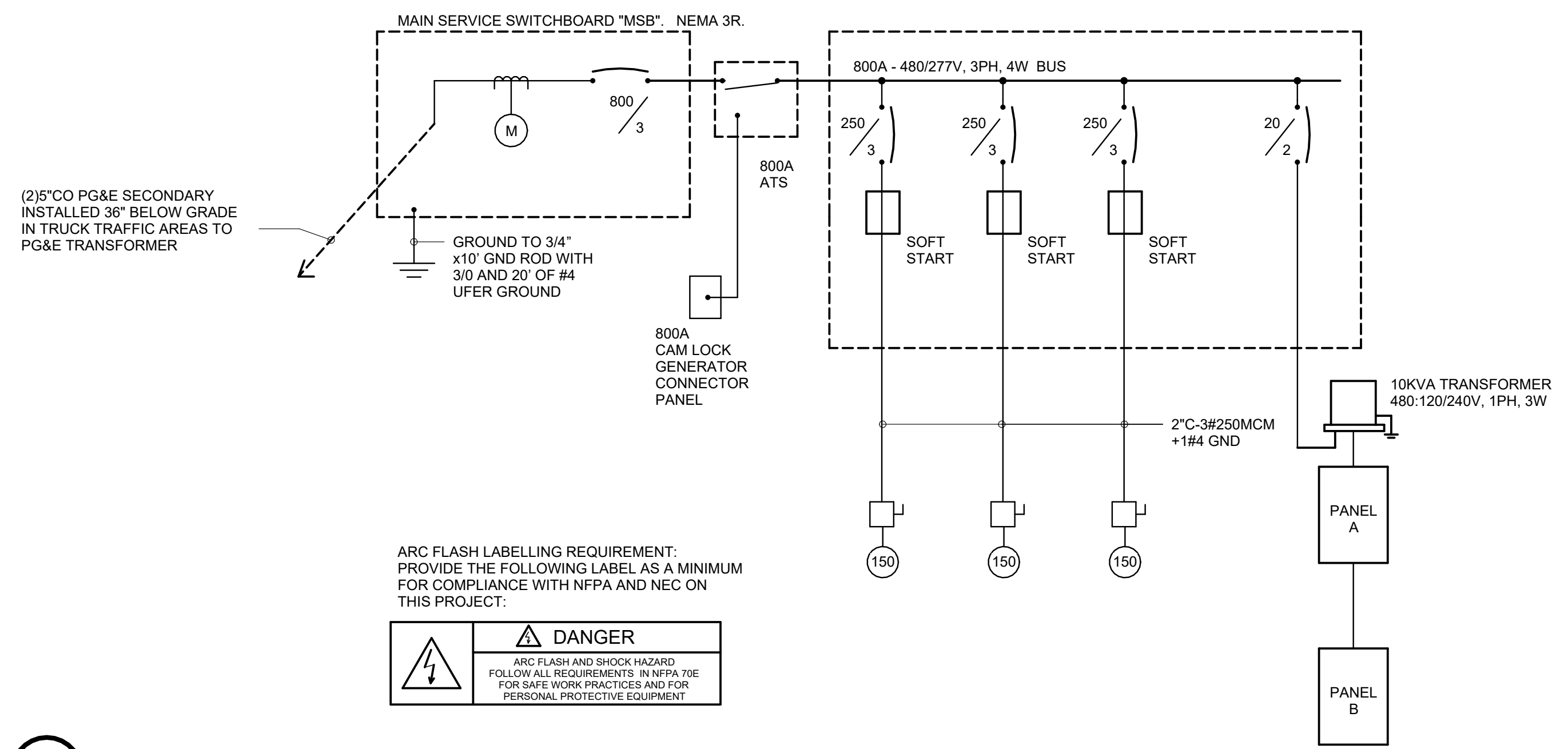
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY
DRAWN BY
RCS
CHECKED BY
RCS
JOB NO.
J22370
DATE
6/17/2022 2:04:37 PM
DRAWING
E3
SHEET NO.
OF XX

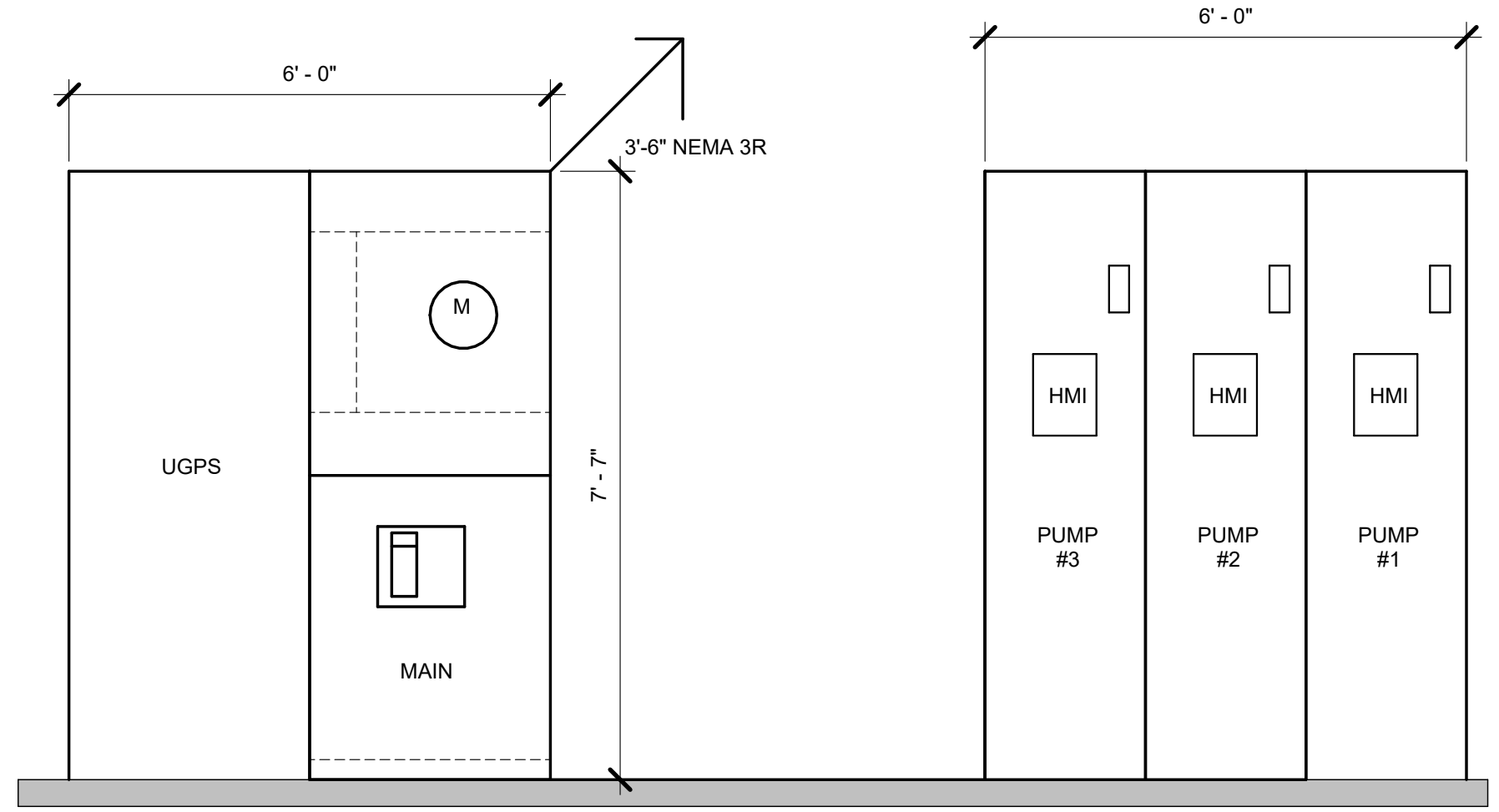


| ELECTRICAL LEGEND | |
|--|--|
| <p>LIGHTING FIXTURES</p> <p>LINEAR FIXTURE SQUARE = RECESSED CIRCLE = SURFACE</p> <p>DOWNLIGHT, SQUARE = RECESSED</p> <p>WALL MOUNT</p> <p>CEILING EXHAUST FAN</p> <p>POLE MOUNT AREA LIGHT</p> | <p>FIXTURE NOTATIONS: A,(b),C-12 FIXTURE TYPE "A", SWITCH "b", CIRCUIT C-12</p> |
| <p>EMERGENCY LIGHTING</p> <p>EXIT SIGN WITH 90 MIN BATTERY BACKUP</p> <p>WALL MOUNT EMERGENCY LIGHT WITH 90 MIN BATTERY BACK</p> <p>EXTERIOR LANDING EMERGENCY LIGHT. CONNECT TO INTERIOR EXIT SIGN FOR POWER.</p> <p>FIXTURES WITH INTEGRAL EMERGENCY BALLAST</p> | |
| <p>BASIC LIGHTING CONTROLS</p> <p>LIGHT SWITCH, +48" TO TOP OF BOX</p> <ul style="list-style-type: none"> D = DIMMER 3 = SWAY P = PILOT SWITCH os = LINE VOLTAGE OCCUPANCY SENSOR T = TIMMER VS = VACANCY SENSOR <p>WALL MOUNT OCCUPANCY SENSOR (LINE VOLTAGE)</p> | |
| <p>TITLE 24 LIGHTING CONTROLS</p> <p>LIGHT SWITCH</p> <p>COMPONENTS OF DIMMING ROOM CONTROLLER</p> <ul style="list-style-type: none"> US = LOW VOLTAGE OCCUPANCY SENSOR (CAT 5 OR AS REQUIRED) DRC = DIMMING ROOM CONTROLLER PE = LOW VOLTAGE DIMMING PHOTOCELL (CAT 5 OR AS REQUIRED) D = LOW VOLTAGE DIMMER (CAT 5 OR AS REQUIRED) R = PLUG LOAD CONTROLLER ADR = AUTOMATIC DEMAND RESPOSNE (FOR BUILDINGS OVER 10,000 SF) <p>NOTES:</p> <ol style="list-style-type: none"> FOR SUBMITTAL INCLUDE FACTORY CONTROL DRAWINGS. CONDUCT A CONTROLS PRE-CONSTRUCTION MEETING WITH CONTROLS STARTUP TEAM. PROVIDE AGENDA AND ATTENDEES AS A SUBMITTAL. INCLUDE DEVICE I.D. TAGS, PROGRAMMING, CABLE ROUTING, PROGRAM AND TIME SCHEDULES AND DATE OF PROGRAMMING AND TESTING. CONTRACTOR TO HAVE SYSTEM FACTORY SUPPORT FOR START UP, PROGRAMMING AND COMMISSIONING. VERIFY OPERATIONAL HOURS WITH OWNER PRIOR TO COMMISSIONING. | |
| <p>ELECTRICAL POWER</p> <p>ALL LINE VOLTAGE WIRING IN CONDUIT, SEE GENERAL NOTES TICKS = # OF #12 WIRE, SHORT = HOT, LONG = NEUTRAL, DOT = GROUND, UNLESS NOTED OTHERWISE</p> <p>120V OUTLET, +18" TO BOTTOM OF BOX</p> <ul style="list-style-type: none"> S = SIGN F = FLOOR GFI = GROUND FAULT INTERUPTER <p>COUNTER OUTLET</p> <p>QUADRUPLEX OUTLET</p> <p>HALF SWITCHED OUTLETS</p> <p>OUTLETS ON EMERGENCY SYSTEMS</p> <p>DUCT SMOKE DETECTOR</p> <p>JUNCTION BOX</p> <p>MOTOR / DISCONNECT</p> <p>PANELBOARD</p> <p>TRANSFORMER / SWITCHBOARD AS NOTED</p> | |
| <p>MOUNTING HEIGHTS</p> <p>FINISHED CEILING</p> <p>AUDIBLE FIRE ALARM APPLIANCE NOT LESS THEN 90" AFF OR AT LEAST 6" BELOW CEILING</p> <p>VISUAL APPLIANCE TO BE NOT LESS THAN 80" AFF MIN. AND NOT MORE THAN 96" AFF TO BOTTOM</p> <p>FIRE ALARM MANUAL PULL STATION SHALL NOT REQUIRE "TIGHT GRASPING, PINCHING OR TWISTING OF THE WRIST"</p> <p>12" TYPICAL</p> <p>SYSTEMS FURNITURE CONNECTIONS +15" TO BOTTOM OF BOXES</p> <p>CONVIENCE OUTLETS, PHONE & DATA OUTLETS, +15" TO BOTTOM OF BOX</p> <p>48" TO TOP OF BOX</p> <p>FINISHED FLOOR</p> <p>THERMOSTAT OR WALL PHONE</p> <p>LIGHT SWITCHES</p> | |

| ELECTRICAL LEGEND | |
|---|---|
| <p>DRAFTING NOTATIONS</p> <p>N## KEY NOTE, SEE SCHEDULE</p> <p>E## EQUIPMENT TAG, SEE SCHEDULE</p> <p>A E-2 REFERENCE TO A DETAIL VIEW "A" ON SHEET E-2</p> <p>NEW ELECTRICAL</p> <p>EXISTING ELECTRICAL OR DEMOLISHED WHERE NOTED</p> <p>(e) (E) EXISTING DEVICE, TO REMAIN IN OPERATION</p> <p>(r) (R) REMOVE DEVICE, KEEP REMAINDER OF CIRCUIT IN OPERATION</p> <p>(RR) REMOVE, RELOCATE AND RECONNECT DEVICE ON EXISTING CIRCUIT, EXTEND CIRCUIT</p> | |
| <p>ONE LINE DIAGRAM</p> <p>BUS / SWITCHBOARD</p> <p>PANEL</p> <p>GROUND</p> <p>METER</p> <p>CURRENT TRANSFORMER</p> <p>POTENTIAL TRANSFORMER</p> <p>DRY TYPE TRANSFORMER</p> <p>MOTOR</p> <p>RELAY</p> <p>CONTACT (OPEN)</p> <p>CONTACT (CLOSED)</p> <p>VARIABLE FREQ. DRIVE</p> <p>MOTOR OVERLOAD HEATER</p> <p>INDICATOR LIGHT (R) RED, (W) WHITE</p> <p>ANTENNA</p> | <p>50/3 CIRCUIT BREAKER 50 AMP RATED, 3 POLE</p> <p>GFI = GROUND FAULT INTERRUPTER AFCI = ARC FAULT CIRCUIT INTERRUPTER</p> <p>DISCONNECT, RATED TO POWER SOURCE VOLTAGE AND AMPERAGE RATING FOR FUSE OR AS NOTED</p> <p>FUSE, SIZE = 60 AMPS</p> <p>AUTOMATIC TRANSFER SWITCH</p> <p>ENGINE DRIVEN GENERATOR RATING AS NOTED AGAINST THE UNIT.</p> <p>DRAW OUT DEVICE</p> <p>ANSI RELAY</p> |



1 ONE LINE DIAGRAM
SCALE: NTS



- NOTES: MAIN SERVICE SWITCHBOARD/MCC
- ALL DIMENSIONS ARE NOMINAL.
 - THE COMPLETE SWITCHBOARD SHALL HAVE A SYMMETRICAL SHORT CIRCUIT RATING EQUAL TO OR GREATER THAN THAT AVAILABLE FROM THE UTILITY COMPANY.
 - MINIMUM INTEGRAL A.I.C. RATING OF SWITCHBOARD AND FEEDER CIRCUIT BREAKERS TO BE 42,000 AMPS.
 - BOLT SECTIONS OF THE SWITCHBOARD TOGETHER WITH 1/2" BOLT AND NUTS AT 4 PLACES PER SECTION.
 - BOLT EACH SECTION OF SWITCHBOARD TO FLOOR WITH (4) 1/2"x3" ANCHOR BOLTS.

2 SERVICE ELEVATION
SCALE: NTS

Know what's below. Call before you dig.

BLACKWATER CONSULTING ENGINEERS
 602 LVELL DRIVE, MODESTO, CA 95356 • PH:209.322.1820

| REV | DATE | DESCRIPTION | APP |
|-----|------|-------------|-----|
| | | | |
| | | | |

HUNTER RESERVOIR RAW WATER INTAKE PROJECT

ELECTRICAL DETAILS

VERIFY SCALES

BAR IS ONE INCH ON ORIGINAL DRAWING

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DESIGNED BY

DRAWN BY
RCS

CHECKED BY
RCS

JOB NO.
J22370

DATE
6/17/2022 2:04:38 PM

DRAWING
E4

SHEET NO.
OF XX

HCS Engineering inc.
50 years

4512 Feather River Dr #F, Stockton, CA 95219
209-478-8270 | www.hcs-eng.com

ATTACHMENT C

SECTION 26 05 00
ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Electrical distribution system and utilization equipment.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding.

1.02 SYSTEM DESCRIPTION

- A. Furnish and install a tested and working electrical system, as indicated on the Drawings and as specified. System includes all items not specifically mentioned in these Specifications or indicated on the Drawings or accepted Shop Drawings, but which are obviously necessary to make a complete working installation and shall be deemed to be included herein.
- B. The Electrical Contractor shall fully investigate the existing pump station and coordinate with PG&E for the connections to the new pump station.
- C. Notify ENGINEER of discrepancies within the Contract Documents and discrepancies between the Contract Documents and actual field conditions.
- D. The Specifications and Drawings indicate or specify minimum sizes of equipment, electric devices, and other components of electrical system, but the Specifications and Drawings do not indicate every offset and fitting, or every structural or mechanical difficulty that may be encountered during the execution of the Work.
- E. Install equipment at locations indicated on the Drawings as closely as field conditions permit. Obtain accepted equipment submittal dimensions prior to installing pads, conduits, and cable trays.
- F. Make minor variations to alignment of equipment and/or installation of raceway systems to avoid conflict with other portions of the Work.
- G. Single Line Diagrams: Single line diagrams indicate circuit voltages for low voltage equipment as follows:
 - 1. Single line diagrams also indicate wire and conduit sizes, circuit protection rating, and other pertinent data. Use single line diagrams to resolve conflicts.
 - 2. When not indicated on the Drawings, provide grounding in accordance with NEC Article 250

26 05 00-1

H. Electrical Utility Services:

1. Provide electrical work in accordance with requirements of the serving utility Pacific Gas & Electric, and local and state inspection authorities. Note that some service requirement details are indicated on the Drawings and are in conformance with the utility's requirements at the time of design.
2. Coordinate and obtain inspections and final installation approval from serving utilities and other authorities having jurisdiction.

1.03 PERFORMANCE REQUIREMENTS

- A. Operate electrical equipment successfully at full-rated load, without failure, at an ambient air temperature of 40 degrees Celsius, and rated for an altitude of 5,000 feet.
- B. Coordination of Electrical Equipment Rating: Verify actual equipment, motor full-load, and locked-rotor current ratings. When providing equipment with different motor full-load and locked-rotor current ratings than indicated on the Drawings, coordinate branch circuit conductor sizes, motor overload protection, motor controllers, control power transformers, and branch circuit overcurrent protection required for equipment provided.
- C. Branch Circuit Conductor Current Carrying Capacity: Minimum 125 percent of the full-load current rating of equipment.
- D. Branch Circuit Conductor Size: Adequate to prevent voltage drop greater than 2 percent from branch circuit protection device to equipment with equipment running at full-load and rated voltage. Include conductor derating in accordance with ambient temperature and conduit fill requirements.
- E. Motor Running Overload Protection Devices:
 1. Rated or selected to trip at no more than the following percent of motor nameplate full-load current rating:
 - a. 125 percent for motors with marked service factor not less than 1.15.
 - b. 125 percent for motors with marked temperature rise not over 40 degrees Celsius.
 - c. 115 percent for all other motors.
 2. Size and provide upon verification of actual motor or nameplate data.
 3. Where power factor correction capacitors are provided on load side of motor running overload protection device, selection or setting shall be based on the improved power factor of motor circuit and not the full-load nameplate current of motors.
- F. Overload Heaters Required for Motors with Temperature Rise of 50 Degrees Celsius: As selected from motor controller manufacturer's overload heater selection tables.
- G. Motor Controller Size: Coordinated with horsepower size of motor.
- H. Motor-Branch-Circuit Short Circuit and Ground Fault Protections Device: Capable of tripping open in 30 seconds or less on locked-rotor current of motor. This device shall also protect the motor-branch-circuit conductors and the motor control apparatus

against overcurrent due to short-circuit or ground faults. Protect motor control circuits with device type specified or as indicated on the Drawings.

1.04 SUBMITTALS

A. Shop Drawings and Product Data:

1. Include data on and details of control devices, fixtures, wire, cables, raceways, and other electrical equipment specified or indicated on the Drawings.

B. Project Record Documents:

1. Submit in accordance with Section 01 77 00 Closeout Procedures. Include drawings of wiring terminations at electrical equipment including, but not limited to:
 - a. Terminal/junction boxes.
 - b. Revised Shop Drawings reflecting modifications made during progress of the Work including testing, and revised Specifications and Drawings with conductors identified identically as on the Specifications and Drawings and accepted Shop Drawings. Updated Shop Drawings shall include all drafting work.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Perform electrical work, including connection to electrical equipment integral with mechanical equipment, in accordance with latest published requirements of the following codes and code/standard making organizations:

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Institute of Electrical and Electronics Engineers (IEEE).
4. Insulated Cable Engineers Association (ICEA).
5. National Electrical Code (NEC).
6. National Electrical Contractors Association (NECA).
7. National Electrical Safety Code (NESC).
8. National Electrical Manufacturers Association (NEMA).
9. National Fire Protection Association (NFPA).
10. State and local codes.
11. California Building Code (CBC).

B. When applicable, materials and equipment used in performance of electrical work shall be listed or labeled by Underwriter's Laboratories or other equivalent, recognized, and independent testing laboratory, for the class of service intended.

C. Manufacturer Qualifications:

1. Low Voltage Equipment: Manufacturer of proposed product with components uniquely selected by engineering review.
 - a. Proprietary bussing and enclosure designs listed by UL in manufacturer's own file for minimum 15 years with satisfactory performance record.
 - b. Capable of providing warranty for assembly when built-up with components from various manufacturers.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Ship electrical panels switchboards, motor control centers, and other electrical distribution equipment in sealed dust and moisture-proof plastic sheet enclosures. Equipment containing dirt, dust, water, grease, rust, or damaged parts or components may be rejected.
- B. Provide for delivery, unloading, transportation, and storage of equipment until installation. Protect electrical and instrumentation equipment and panels from physical and environmental damage. Store and maintain equipment in a weatherproof building until installed.
- C. Store electrical equipment, including motor control centers, instrumentation control panels, and other enclosures that house electronic equipment rated for a specified ambient or environmental temperature range, in air-conditioned buildings to protect equipment from temperatures above 90 degrees Fahrenheit and heated buildings to protect equipment from temperatures below 40 degrees Fahrenheit. Assume liability for the storage facilities or equipment stored therein.
- D. Maintain storage facilities in neat condition with utilities. Maintain stored equipment in same condition as when received.
- E. Provide continuous access for inspection of stored equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

- A. Where it becomes necessary to cut into existing work for the purpose of making electrical installations, use core drills for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the ENGINEER prior to starting the work.

3.02 INSTALLATION

- A. Corrosion Protection:
 - 1. Isolate dissimilar metals, except conduit and conduit fittings, that may come in contact, with neoprene washers, 9 mil polyethylene tape, or gaskets.
 - 2. Restore factory finishes which are damaged or rusted to their original new condition in accordance with manufacturer's instructions.
- B. Install electrical work prior to placing floors and walls. Provide all sleeves and openings through floors and walls required for passage of all conduits and other raceways. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete or water.

- C. Provide all insets and hangers required to support raceways and other electrical equipment. If the inserts, hangers, sleeves, or openings, are improperly placed or installed, do all necessary work to rectify the errors.

3.03 CLEANING

- A. Clean each piece of electrical equipment, both inside and outside, and retouch equipment to match existing paint.

3.04 PROTECTION

- A. Protect products and provide heat to eliminate condensation until acceptance by OWNER.

END OF SECTION

SECTION 26 05 04

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Basic electrical materials and methods.

1.02 REFERENCES

- A. American Society for Testing Materials (ASTM):
 1. A 525 - Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized), by Hot-Dip Process.
- B. National Electrical Manufacturers' Association (NEMA).

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 1. Connections of electrical equipment to supports shall be designed to resist the operating forces plus seismic forces.
 2. Seismic design shall conform to the requirements of Section 01 81 23 Seismic Design Criteria. Calculations shall be by a registered civil or structural engineer in the state where the Project is located.

1.04 SUBMITTALS

- A. Structural calculations for electrical equipment anchorage.
- B. Shop drawings and product data.

1.05 WARRANTY

- A. Submit manufacturer's standard warranty.

1.06 EXTRA MATERIALS

- A. Furnish and install a minimum of 10 percent spare terminal blocks in each terminal/junction box.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Unless specified otherwise indicated on the Drawings, the fabricator of major electrical equipment, such as lighting and distribution panelboards, switchgear, variable frequency drives, and motor control centers, shall also be the manufacturer of the major devices herein.

2.02 MATERIALS

- A. Materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Drawings shall be new and unused, of current manufacture, and of highest grade consistent with the industrial industry standards. Damaged materials, equipment, and parts are not considered to be new and unused and will not be accepted.

2.03 EQUIPMENT

- A. Support Channels: Steel, hot-dip galvanized with G90 coating in accordance with ASTM A 525, or stainless steel.
 - 1. Manufacturers: One of the following or equal:
 - a. Unistrut.
 - b. Superstrut.
 - c. Globe Strut.
- B. Support Channel Bolts, Nuts, and Washers: Stainless steel.
- C. Non-Fused Terminal Blocks: Sized as required for conductors.
 - 1. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Buchanan.
- D. Fused Terminal Blocks: Circuit isolation, fused switch type, sized as required for conductors. Fuse size shall be based upon actual load and conductors to be protected.
 - 1. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Buchanan.
- E. Control Relays:
 - 1. Industrial 600 volt, 10 ampere type with contact arrangement and operating coils of proper voltage as required by control circuit sequence; with minimum of 4 reversible-pole contacts; coils sealed by pressure molding.
 - 2. Non-industrial or plug-in type control relays shall be prohibited unless accepted in writing.
 - 3. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Cutler-Hammer.

- F. Reset Timers and Repeat Cycle Timers:
 - 1. Industrial type; 120 volts alternating current, 60 hertz operating power; 6 amperes minimum at 120 volts alternating current output unless otherwise indicated on the Drawings or specified.
 - 2. In enclosure as indicated on the Drawings or specified; plug-in or non industrial timers shall be prohibited unless accepted in writing.
 - 3. Manufacturers: One of the following or equal:
 - a. Eagle.
 - b. Paragon.

- G. Twenty-Four Hour Timers:
 - 1. Heavy-duty industrial, 120 volts, 60 hertz alternating current operating power, electronic type; 15 amperes at 120 volts alternating current output, single channel type; lithium battery-backed; single pole double throw.
 - 2. In DIN enclosure, plug-in or non-industrial timers shall be prohibited unless accepted in writing.
 - 3. Manufacturers: One of the following or equal:
 - a. Paragon, EC Series
 - b. Tork, equivalent model.

- H. Timing Relays: Heavy-duty industrial, 600 volt, 10 amperes.
 - 1. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Cutler-Hammer.

- I. Nameplates:
 - 1. Type: Black lamicaid with white letters.
 - 2. Fastener: Round head stainless steel screws.

- J. Automatic Equipment and High Voltage Warning Signs:
 - 1. Type: Suitable for exterior use and meeting OSHA regulations.

- K. Underground Hazard Tape: 6 inches wide.
 - 1. Manufacturers: One of the following or equal:
 - a. Panduit.

PART 3 EXECUTION

3.01 GENERAL

- A. Verify dimensions indicated on the Drawings. Actual locations, distances, and levels will be governed by actual field conditions. The CONTRACTOR shall also review information indicated on the Drawings for architectural, structural, yard, mechanical, and other specialties, and the accepted electrical and mechanical shop drawings, and shall adjust his work to conform to all conditions indicated thereon.

- B. Coordinate for consistency lens colors of all pilot lights included in all equipment assemblies specified in Divisions 11 through 16 (subject to ENGINEER'S acceptance).

3.02 EQUIPMENT INSTALLATION

- A. Anchor electrical equipment to building floors, electrical equipment foundations, or other supports by bolts and anchor bolts and studs.
- B. Anchor each piece of electrical equipment with minimum 1/2 inch diameter Type 316 stainless steel bolts, anchor bolts, or studs. Acceptable connectors shall be furnished in each corner of each section of electrical equipment, minimum.
- C. Where plates are embedded in concrete supporting electrical equipment, fasten electrical equipment to the embedded plates with minimum 1/2 inch diameter welded studs. Where required, the number of studs connecting the embedded plates to floors shall be increased as required based upon the calculations of seismic forces in order to resist the forces from the electrical equipment supplied. The additional studs shall be deemed as part of these Contract Documents.

3.03 TORQUING

- A. After installing and before energizing electrical equipment, torque each bolted bus and cable connection in accordance with manufacturer's recommendations with calibrated torque wrenches. Include each bolt at each connection, both factory and field installed, for motor control centers, variable frequency drives, bus ducts, switchgear, switchboards, and other equipment installed.

3.04 CONDUCTOR FASTENERS

- A. Use screw type conductor fasteners and other permanent, such as epoxy conductor adhesives, in junction or pull boxes, termination cabinets, panels, panelboards, switchboards, switchgear, motor control centers, variable frequency drives, or other enclosures containing electrical devices and/or conductors. Do not use glue-on type conductor fasteners.

3.05 SUPPORT CHANNELS

- A. Install channels, as required for support of raceways, cable trays, device enclosures, and other electrical equipment.
- B. Separate iron or steel supports from aluminum with 1/4 inch neoprene or other non-metallic gaskets.
- C. Paint field cuts and scratches of galvanized steel channels with a cold galvanizing spray paint.

3.06 TERMINAL BLOCKS

- A. Furnish and install terminal blocks in control panels, cabinets, terminal/junction boxes, variable frequency drives, motor control centers, switchgear and similar equipment and identify the terminal blocks by numbering and labeling in accordance with

accepted shop drawings. The terminal blocks shall be circuit isolation fused-switch type where indicated on the Drawings and as required.

3.07 ADJUSTING

A. Adjust, set timers and contacts for proper equipment operation.

3.08 DEMONSTRATION

A. Demonstrate operation of equipment.

END OF SECTION

26 05 04-5

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Grounding electrode systems, consisting of concrete encased bare ground conductors and ground rods.
- B. Related Sections:
 - 1. Section 26 07 00 - Electrical Acceptance Testing.

1.02 REFERENCES

- A. National Electrical Code (NEC), Article 250 - Grounding.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Driven Ground Rods:
 - 1. Copper-covered steel.
 - 2. 3/4-inch diameter.
 - 3. 10 feet long, minimum.
- B. Ground Conductor: Bare copper.
- C. Precast Ground Wells:
 - 1. Brooks Products, Inc., valve boxes.
 - 2. Christy, valve boxes.
 - 3. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install concrete encased bare ground conductor in each duct bank. Run grounding electrode system conductors continuously in duct banks, through manholes, handholes, other raceway boxes, and cable tray exteriors. Connect conductors to structure ground ring or grounding system to provide a continuous grounding electrode system.

- B. Bond electrical enclosures, including metallic raceways, panels, switchboards and other similar metallic panels, cases and devices associated with power, instrumentation, and control systems to the grounding electrode system.
- C. Drive ground rods and install grounding conductors prior to construction of concrete slabs and duct banks.
 - 1. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
 - 2. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.
- D. Provide exothermic welded connections for grounding cable to cable and mechanical connections for grounding cable to rods.
- E. When size is not indicated on the Drawings, size grounding conductors in accordance with NEC Table 250-66 and Table 250-122.
- F. Install a green insulated equipment grounding conductor, or multi-conductor cable with integral green insulated grounding conductor, with each feeder and branch circuit from the power source grounding means to the load equipment or device.
- G. Install ground bushings at both ends of rigid conduit runs. Do not use locknuts. Bond ground bushings to the grounding system.
- H. When not indicated on the Drawings, install grounding electrode systems in compliance with NEC 250, Part C.

3.02 FIELD QUALITY CONTROL

- A. Test ground resistance, as specified in Section 26 07 00 Electrical Acceptance Testing, of entire system and at each building/structure where electrical equipment is installed.
- B. Invite ENGINEER to witness ground resistance testing.
- C. Where maximum allowable ground resistance of 5 ohms is exceeded, install additional grounding mats or ground rods until ground resistance is equal to or below maximum allowable ground resistance.

END OF SECTION

26 05 26-2

SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Outlet boxes, device boxes, metallic pull boxes, junction boxes, termination boxes.
 - 2. Concrete pull boxes.
 - 3. Fasteners used with wiring devices.
- B. Related Sections:
 - 1. Section 26 05 04 - Basic Electrical Materials and Methods.

1.02 REFERENCES

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
 - 1. OS1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 2. OS2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- B. National Electrical Code (NEC):
 - 1. Article 370 - Outlet, Device, Pull and Junction Boxes, Conduit Bodies and Fittings.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

- A. Product Data.
- B. Shop Drawings: Include identification and sizes of pull boxes for ENGINEER'S acceptance prior to fabrication and installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Device Boxes, Metallic Pull Boxes and Junction Boxes: One of the following or equal:
 - 1. Crouse-Hinds.
 - 2. Appleton.
 - 3. O-Z/Gedney.

- B. Floor Outlet Boxes with 1 Inch Conduit Knockouts: One of the following or equal:
 - 1. Steel City, 640 Series.
 - 2. Hubbell.
- C. Concrete Pull Boxes with Covers: One of the following or equal:
 - 1. Quickset.
 - 2. Utility Vault Company.

2.02 DEVICE BOXES AND JUNCTION BOXES

- A. Materials: Heavy-duty rigid steel or rigid copper free aluminum, compatible with the location and conduit system being used, unless otherwise specified or indicated on the Drawings.
- B. For Indoor or Non-Corrosive Areas: Provide cast FD type device boxes with epoxy finish, and compatible with the location and conduit system being used.
- C. For Outdoor Locations, Corrosive Areas, or Wet Process Locations: Provide cast FD type boxes with PVC coating for outdoor locations, corrosive areas and wet process locations and compatible with the location and conduit system being used.
- D. Coverplates:
 - 1. Indoor: Provide lighting switch and receptacle boxes of Type 302 stainless steel cover plates with cover gaskets, except where otherwise specified or indicated on the Drawings. Provide other boxes with Type 304 stainless steel cover screws and with cover gaskets.
 - 2. Outdoor and Corrosion Resistant: Provide lighting switch and receptacle boxes, weatherproof with yellow fiberglass lift cover plates with cover gaskets.

2.03 FLOOR OUTLET BOXES

- A. Suitable for receptacles, communications, and data outlets as specified and indicated on the Drawings, complete with gaskets and cover plates.
- B. Dual-gang, heavy-duty cast iron, suitable for wiring devices to be installed to make a complete and operable system and installation.

2.04 CONCRETE PULL BOXES

- A. Precast concrete pull boxes in locations indicated on the Drawings and as required by NEC.
- B. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading.
- C. Minimum 3 feet by 4 feet by depth as necessary for ductbank depth, required with 3/4-inch diameter pulling irons located at each end. Constructed of reinforced Class A concrete.
- D. Identification: Furnish covers with "Electrical" engraved on top side.

2.05 METALLIC PULL BOXES

- A. Boxes for applications in dry and non-corrosive location:
 - 1. Fabricated from 11 gauge (minimum) steel or aluminum, completely weatherproof with gasketed removable covers; compatible with type of conduit systems being used; manufactured, furnished, and installed complete with grounding lug.
- B. Boxes for applications in wet areas, outdoor locations and NEMA 4X designated areas: Fabricated from 11 gauge, 316 stainless steel, with gasketed covers and labeled NEMA 4X.
- C. Boxes in Locations Subject to Flooding, Temporary Submersion, or for Applications in NEMA 6 Designated Areas: Boxes shall be fabricated of cast aluminum, with gasketed cover, stainless steel cover screws, ground flange and listed NEMA 6.

2.06 FASTENERS

- A. Electroplated or stainless steel in boxes with wiring devices.
- B. Screws, Nuts, Bolts, and Other Threaded Fasteners: Stainless Steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Comply with the National Electrical Code.
- B. Terminal blocks installed in junction/terminal boxes as specified in Section 26 05 04 Basic Electrical Materials and Methods.
- C. Install concrete pull boxes on 12 inches of compacted clean aggregate base course as specified in Section 32 11 23 Crushed Aggregate Base Course, and in such a manner that the cover of the pull box will be flush with finish grade.
- D. Provide weatherproof conduit hubs for all conduit connections to metallic pull boxes.
- E. Phosphatize and prime with rust-resistant paint metallic pull box surfaces. Finish shall be 2 coats of ANSI 61 gray enamel paint.
- F. Size pull boxes to meet National Electrical Code requirements and to provide sufficient room for the future conduits and cables indicated on the Drawings.
- G. Furnish and install pull boxes as indicated on the Drawings and as specified. Install additional pull boxes as required to meet cable manufacturer's pulling tension requirements.
- H. Install pull boxes such that access to them is not restricted by obstructions such as pipes, valves, ladders.

- I. Secure metallic pull box covers with Type 316 stainless steel screws or bolts with coated threads.
- J. Provide adequate supporting pillar(s) for boxes to be located above ground or above decks, where there is no structural wall or surface for box mounting.

END OF SECTION

26 05 33-4

SECTION 26 05 33.13

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

B. Conduit Types:

1. Galvanized rigid steel conduit
2. Flexible conduit
3. Polyvinyl chloride-coated rigid steel conduit
4. Rigid nonmetallic polyvinyl chloride conduit.

C. Related Sections:

1. Section 26 05 04 - Basic Electrical Materials and Methods.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. C80.1 - Rigid Steel Conduit, Zinc Coated.

B. Electrical Manufacturers Association (NEMA):

1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

C. National Electrical Code (NEC):

1. Article 348 - Electrical Metallic Tubing.
2. Table 300-5 - Minimum Cover Requirements (0 to 600 volts, Nominal).
3. Article 500 - Hazardous (Classified) Locations.
4. Table 10-4(b) - Minimum Cover Requirements (over 600 volts, Nominal).

D. Underwriters' Laboratories, Inc (UL):

1. JUL 6 - Rigid Metal Conduit.

1.03 SUBMITTALS

A. Product data.

B. Shop Drawings: Installation drawing including individual conduit numbers, routing, conduit sizes, circuit numbers contained in each conduit, and number and size of wires in each conduit.

26 05 33.13-1

PART 2 PRODUCTS

2.01 CONDUIT

- A. Galvanized Rigid Steel Conduit:
 - 1. Domestic raw steel, made smooth, clean, and free of burrs and rough spots to enhance wire pulling; interior and exterior surfaces coated with solid, unbroken layer of zinc; threads hot dip galvanized after cutting; entire surface finish coated with secondary bichromate treatment applied over galvanizing able to extend surface protection and prevent oxidation; threads protected by color coded end caps to provide quick trade size identification.
 - 2. Manufacturers: One of the following or equal:
 - a. LTV Steel Tubular Products Company, Galvite.
 - b. Triangle PWC, Inc.
 - c. Allied Tube and Conduit Corporation.
- B. Liquid-Tight Flexible Conduit: Grounding type, weatherproof, watertight, maximum 60-inch lengths.
 - 1. Manufacturers: One of the following or equal:
 - a. American Brass Company.
 - b. General Electric.
 - 2. Flexible Metal Conduit: Aluminum with minimum trade size of 1/2-inch, maximum length allowed 60 inches.
 - 3. Manufacturers: One of the following or equal:
 - a. ALFLEX
 - b. Allied Tube and Conduit Corporation.
- C. Polyvinyl Chloride-Coated Rigid Steel Conduit:
 - 1. Galvanized rigid steel conduit with coating conforming to ANSI C80.1 and UL 6; bendable without damage to coatings.
 - 2. Manufacturers: One of the following or equal:
 - a. Perma Kote by Robroy Industries.
 - b. OCAL, Inc.
- D. Rigid Nonmetallic Polyvinyl Chloride Conduit:
 - 1. High density, Schedule 40, 90 degrees Celsius, heavy-duty polyvinyl chloride, made from virgin polyvinyl chloride compound; maximum 6 grams per 100 grams smoke emission.
 - 2. Manufacturers: One of the following or equal:
 - a. Carlon.
 - b. Triangle Conduit and Cable.

2.02 RELATED MATERIALS

- A. Couplings, Connectors, and Fittings:
 - 1. Threaded.
 - 2. Manufactured with same materials and process as corresponding conduit.
- B. Condulet Fittings:

1. With wedge nut covers, weathertight when located outdoors or in wet or corrosive locations, matching type for corresponding conduit systems.
 2. Manufacturers: One of the following or equal:
 - a. Crouse-Hinds.
 - b. Appleton.
- C. Galvanized Rigid Steel Conduit Expansion Fittings for Exposed Locations:
1. Manufacturers: One of the following or equal:
 - a. OZ/Gedney, Type AX with jumper.
 - b. Appleton, Type XJ with Jumper.
- D. Galvanized Rigid Steel Conduit Expansion Fittings at Structural Expansion Joints:
1. Manufacturers: One of the following or equal:
 - a. Spring City, Type D.
 - b. Crouse-Hinds, Type D.
- E. Conduit Seals:
1. Manufacturers: One of the following or equal:
 - a. Appleton.
 - b. Crouse-Hinds.
- F. Polyvinyl Chloride-Coated Rigid Steel Conduit Couplings: One provided loose with each length of conduit.
- G. Fasteners for Polyvinyl Chloride-Coated Rigid Steel Conduit: Polyvinyl chloride-coated steel fasteners with Type 316 stainless steel bolts, nuts, and hardware.
- H. Fasteners for Galvanized Rigid Steel Conduit: Galvanized steel fasteners with Type 316 stainless steel bolts, nuts, and hardware.
- I. Conduit Mounting Strut:
1. Type 316 stainless steel for mounting of polyvinyl chloride-coated rigid steel conduit.
 2. Hot-dip galvanized for other conduit types.
- J. Conduit Thruwall Seals:
1. Hot-dip galvanize.
 2. Polyvinyl chloride oversize sleeve.
 3. Manufacturers: One of the following or equal:
 - a. O-Z/Gedney, Type "WSK."

2.03 POLYVINYL CHLORIDE-COATED RIGID STEEL CONDUIT FABRICATION

- A. Coat rigid steel conduit, conduit fittings and hangers with polyvinyl chloride.
- B. Conduit:
1. Ensure that surfaces, including galvanizing, remain intact and undisturbed on both inside and outside of conduit throughout preparation and application processing.
 2. Bond polyvinyl chloride coating to outer surfaces of conduit.

3. Provide bond between polyvinyl chloride coating and conduit surface that is greater than tensile strength of plastic.
 4. Provide minimum 40 mil thick coating on conduit.
 5. Coat interior of conduit and conduit fittings with nominal 2 mil thick corrosion-resistant urethane finish.
 6. Coat threads with clear urethane finish.
- C. Couplings:
1. Bond polyvinyl chloride coating to outer surfaces of couplings.
 2. Extend polyvinyl chloride sleeve equal to outside diameter of uncoated conduit beyond both ends of coupling approximately 1 pipe diameter or 1-1/2 inches, whichever is smaller.
 3. Provide minimum 40 mil thick coatings on couplings and sleeves.
 4. Bond polyvinyl chloride coating to outer surface of conduit bodies and fittings.
 5. Extend polyvinyl chloride sleeves from hubs.
 6. Provide same coating thickness on conduit bodies, fittings, and sleeve walls as on couplings in length and thickness.
 7. Coat covers on conduit bodies on both sides so covers are completely interchangeable.
 8. Coat interior of conduit couplings, sleeves, and conduit bodies with corrosion-resistant urethane finish.
- D. Ensure that inside of conduit bodies remain undisturbed during processing and retain manufacturer's finish.
- E. Polyvinyl Chloride Coated, Mounting Hardware, and Associated Fittings:
1. All mounting hardware and associated fittings shall be polyvinyl chloride coated in accordance with the intent of reference NEMA RN-1.
 2. The polyvinyl chloride exterior coating shall have a normal thickness of 40 mils (.040 inch) except where part configuration or application otherwise dictate.
 3. All fasteners for polyvinyl chloride coated fittings and mounting hardware shall be of the Type 316 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install conduit runs in accordance with schematic representation as indicated on the Drawings and as specified. Modify conduit runs to suit field conditions, as accepted by the ENGINEER.
- B. Install conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings, for circuit numbers indicated on the Drawings.
- C. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends. Make changes in direction with long radius bends or with conduit fittings.

- D. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and not block or interfere with ingress or egress, including equipment removal hatches.
- E. Expose conduit runs in buildings and structures, unless otherwise indicated on the Drawings.
- F. Securely fasten exposed conduits with clamps or straps. Run exposed conduit on walls and ceilings only, parallel to planes of walls or ceilings. Do not run conduit diagonally. Securely fasten exposed polyvinyl chloride-coated rigid steel conduits with Type 316 stainless steel clamps or straps.
- G. Use flexible conduit for short lengths required to facilitate connections between rigid conduit and motors, vibrating equipment, or control equipment.
- H. Support conduit runs on water-bearing walls 1 inch away from wall on an accepted channel. Use hot-dip galvanized steel or stainless-steel channels, consistent with type of conduit being installed. Do not run conduit in water-bearing walls unless otherwise indicated on the Drawings.
- I. Encase underground conduit runs, including conduit runs below slabs-on-grade, in a concrete envelope as specified and indicated on the Drawings.
- J. Install underground installations of direct buried cable, conduit, or other raceways to meet minimum cover requirements of NEC Table 300-5 and Table 710-4(b). Exceed minimum NEC requirements where indicated on the Drawings or specified.
- K. Thoroughly ream conduit after threads have been cut to remove burrs. Seal joints with accepted conductive sealant compound and make watertight. Set up joints tight. Use bushings or conduit fittings at conduit terminations.
- L. Install runs between pull boxes or junction boxes with total bends equaling not more than 270 degrees. Install NEC required pull boxes at locations acceptable to the ENGINEER. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture. Cap spare conduits and provide plastic pulling tape below threaded cap. Provide bonding bushing and bond wire.
- M. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications.
- N. After complete installation of 2 inch and larger conduit runs, snake conduits with conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit. Remove and replace conduits through which mandrel will not pass.
- O. Clean and ensure that new and existing conduit runs are not crushed or creased. Verify internal dimensions of existing conduit prior to installation of conductors. Verify that no foreign objects or obstructions are present in conduit prior to installing conductors.

- P. Install conduit system to provide firm mechanical assemblies with electrical conductivity throughout.
- Q. Install expansion fittings across expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction as indicated on the Drawings.
- R. Install conduits complete between outlets, boxes, and circuit source before conductors are installed.
- S. Install minimum 2-inch ductbank raceways, unless otherwise indicated on the Drawings.
- T. Make ductbank raceway to external conduit size transitions at pullboxes and manholes.
- U. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and pullboxes.
- V. Install conduit thruwall seals where indicated on the Drawings.

3.02 POLYVINYL CHLORIDE-COATED RIGID STEEL

- A. Attach cover to conduit body with Type 316 stainless steel screws.
- B. Where patching is required, apply 40 mil thick polyvinyl chloride coating in accordance with manufacturer's instructions.

3.03 RIGID NONMETALLIC POLYVINYL CHLORIDE

- A. Reinforce encasement as indicated on the Drawings. Install conduit supports at 30 inch intervals.

3.04 SCHEDULES

- A. Conduit Sizes: In accordance with NEC, unless otherwise indicated on the Drawings or specified as follows:
 1. Concealed conduit in partitions or accessible ceilings: Minimum 3/4 inch.
 2. Exposed Conduit: Minimum 3/4 inch.
 3. Rigid Steel Encased In Concrete: Minimum 1 inch.
 4. Rigid Non-Metallic Polyvinyl Chloride Encased In Concrete: Minimum 2 inches.
 5. Direct Buried Conduit Size: Minimum 2 inches.
- B. Conduit Uses and Applications:
 1. Rigid Steel Conduit: Typical, Exposed Conduit Runs in dry and non-corrosive locations, unless otherwise noted.
 2. Liquid Tight Flexible Conduit: final motor and instrument connection in non-hazardous areas.
 3. Polyvinyl Chloride-Coated Rigid Steel Conduit:

- a. Entering or exiting concrete including minimum 12 inches above and below grade or finished floor.
 - b. In exposed outdoor locations.
4. Rigid Nonmetallic Polyvinyl Chloride Conduit: Runs concealed or concrete encased in walls, floors, and underground duct banks.

3.05 FIELD CONDITIONS AND RELATED REQUIREMENTS

- A. Underground water table may be near or above the location of new ductbanks.
- B. CONTRACTOR shall include cost for necessary dewatering, cleaning equipment to perform work in underground ductbanks, pull boxes and manholes, prior to installation of required new conductors.

3.06 RACEWAYS ALLOWANCES

- A. CONTRACTOR shall include allowance of necessary raceways and supports to provide any and all motorized equipment, electrical outlets, fixtures, communication outlets, instruments and devices within 10 linear feet of location shown on the Drawings.
- B. CONTRACTOR shall include allowance of necessary raceways, trench, excavation, backfill, and related materials to provide any and all pull boxes, manholes and ductbanks within 30 linear feet of location shown on the Drawings.
- C. Prior to installation of any raceway or related items identified in paragraphs A and B above, the OWNER shall have the right to make changes related to preferred location, at no additional cost.
- D. CONTRACTOR shall include allowance to provide necessary raceways for all equipment specified, identified in wiring schedules, equipment schedules, panel boards schedules, electrical single line diagrams, block diagrams, process and instrumentation diagrams (P&IDs), fixtures schedules, and devices. Said necessary conduits may not be shown on the plan drawings, but they shall be sized by CONTRACTOR in accordance with requirements specified and the National Electrical Code, and include in this allowance, the raceways necessary for the installation of the conductors and for the complete operation of the included device or equipment.
- E. In addition to the above, include the following allowance for extra items not specified or identified on the documents.
 1. 100 feet of 3/4-inch exposed rigid steel conduit with fittings, and supports, in locations up to 20 feet above finish floor.
 2. 100 feet of 1-inch exposed rigid steel conduit with fittings, and supports, in locations up to 20 feet above finish floor.
 3. 100 of 1-inch PVC coated rigid steel conduit with fittings and supports, in locations up to 20 feet above finish floor.
 4. 100 feet of 2-inch PVC-schedule 40 conduit, encased in concrete, including necessary excavation.

5. 10 equipment terminations with 3/4 inch flexible liquid tight conduit including boxes and fittings.

3.07 RACEWAYS IDENTIFICATION

- A. Each new conduit, new wireway, and new boxes shall be identified by a specific number. The numbering system shall be in accordance with identification named on the Drawings or the process equipment identification. Products for identification of raceways are specified in Section 26 05 53 Electrical Identification.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Identification of electrical conductors, raceways and equipment, and electrical equipment signs.

1.02 REFERENCES

- A. National Electrical Code (NEC):
 1. Article 110–22 - Disconnecting Means.
 2. Article 210–4 - Multiwire Branch Circuits.
 3. Article 200 - Use and Identification of Grounded Conductors.
 4. Article 384 - Switchboards and Panelboards.
 5. Article 300 - Wiring Methods.

1.03 SUBMITTALS

- A. Shop Drawings:
 1. General: Submit shop drawings for electrical equipment room layouts, drawn at a minimum at 1/4 inch = 1 foot, scale.
 2. Cross Reference: Diagram shall carry a uniform and coordinated set of wire numbers and terminal block numbers to permit cross-referencing between the contract document drawings, the drawings prepared by the CONTRACTOR, and equipment O&M Manual Drawings.
 3. Drawing number cross references and continuation references shall also be provided. CONTRACTOR-prepared drawings shall reference applicable CONTRACTOR drawings such as P&IDs, control and logic diagrams, interface wiring diagrams, panel drawings, etc. CONTRACTOR-prepared drawings shall also reference applicable drawings provided by equipment manufacturers.
 4. On any drawing prepared for this project, if a wire, circuit, enclosure, panel, or device is continued on another drawing, the continuation drawing shall be referenced (and vice-versa). Wherever wires are shown connected to terminals, the drawings which show the continuation of the circuits on those terminals must be referenced.
 5. Interconnection Diagrams: Cables shall not be installed into raceways until the wiring interconnection diagrams are reviewed by the DESIGN ENGINEER.
 6. Include tagging system, labels, markers, hazard tape, nameplates, and signs.
- B. Product Data: Include tagging system, labels, markers, and hazard tape.
- C. Project Record Documents:

1. Document wire, cable, and conductor tags, and bundle tags installed in accordance with the Contract Documents.
2. Document installed wire, cable, and conductor tags and bundle tags when not specifically indicated.
3. Indicate on Record Drawings deviations from accepted shop drawing conductor identification.

1.04 QUALITY ASSURANCE

A. Pre-installation Conference:

1. Purpose: To clearly define requirements specified for circuit/cable/conductor identification, hold a meeting including representatives of CONTRACTOR, OWNER, and ENGINEER prior to significant cable or conductor purchase and installation/termination.

PART 2 PRODUCTS

2.01 LABELS

A. Manufacturers: One of the following or equal:

1. Brady.
2. Seton.

B. Type: Sleeve type.

2.02 CONDUCTOR AND CABLE MARKERS

A. Manufacturers: One of the following or equal:

1. Brady.
2. Seton.

B. Type: Slip-on PVC sleeve or strap-on type.

C. Printed using Brady marker "XC PLUS," or equal.

D. Markers used in tunnels or other wet locations shall be on heat-shrinkable marking sleeves.

E. Use self-laminating vinyl on white background for markers within electrical equipment such as panels, termination cabinets, motor control centers.

2.03 RACEWAYS IDENTIFICATION (TAGS)

- ##### A. Conduit numbers shall be pressure stamped into a noncorrosive 2 inch long, 1/2-inch-wide stainless steel tape, Dymo marking system or equal. A tag with number shall be fixed with No. 18 AWG or larger type 304 stainless steel wire, to each conduit segment and at the end of each conduit and within 3 feet of each pull box, panelboard and switchboard.

2.04 NAMEPLATES, LABELS AND SIGNS

- A. Nameplates:
 - 1. Type: Black lamicoid with white letters.
 - 2. Fastener: Round head stainless steel screws.
- B. Automatic Equipment and High Voltage Warning Signs:
 - 1. Type: Suitable for exterior use and meeting OSHA regulations.
- C. Underground Hazard Tape: 6 inches wide.
 - 1. Manufacturers: One of the following or equal:
 - a. Panduit.
 - b. Thomas and Betts.

PART 3 EXECUTION

3.01 CIRCUIT IDENTIFICATION

- A. Identify 3-phase system conductors and cables as Phases A, B, and C and identify 1-phase system conductors and cables at electrical equipment including, but not limited to, switchgear, switchboards, panelboards, motor control centers, and motors.
 - 1. Match OWNER'S existing electrical system identification scheme or meet requirements of the authority responsible for the project.
 - 2. 3-phase 480 Volts AC System Conductors: Phase A, brown; Phase B, orange; Phase C, yellow.
 - 3. Single-Phase Conductors for 120/240 VAC Circuits: Phase A, black; Phase B, red; Phase C, blue.
 - 4. Neutral Conductor: White for 120 VAC and gray for 277 VAC.
 - 5. Insulated Equipment Grounding Conductor: Green.
 - 6. General Purpose AC Control Conductors: Purple.
 - 7. General Purpose DC Control Conductors: Purple with white stripes.
- B. Use color coding and phasing consistent throughout the site. Bus bars at panelboards and motor control centers to be connected Phase A-B-C, top to bottom, or left to right facing connecting lugs.
- C. Conductors Number 2 American Wire Gauge (AWG) and smaller to be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables to be coded by the use of colored tape.
- D. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.
- E. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray or other component of the

raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.

- F. Identify each individual conductor at each termination. This includes such locations as switchgear, switchboards, motor control centers, variable frequency drives, control panels, junction/terminal boxes, all field devices, and all other locations where conductors are terminated. Identify the termination of these conductors in accordance with the accepted shop drawings. Tag conductors with sleeve type labels.
- G. Where more than 1 nominal voltage system exists, identify each ungrounded system conductor by phase and system. Permanently post means of identification at each branch-circuit panelboard, switchboard, switchgear, motor control center, or other type of power distribution equipment.
- H. Include the following minimum information for wire and cable identification.
 - 1. Circuit number or load identification tag number.
 - 2. Origin (from source).
 - 3. Destination (to load).

3.02 NAMEPLATES

- A. Furnish and install nameplates for all electrical equipment indicated on the Drawings or specified.
- B. Each disconnect means for service, feeder, branch, or equipment conductors and pushbutton stations shall have nameplates indicating its purpose or identifying the load.

3.03 AUTOMATIC EQUIPMENT WARNING

- A. Mount permanent warning signs at mechanical equipment which may be started automatically or from remote locations. Fasten warning signs with round head stainless steel screws or bolts, located and mounted in a manner acceptable to ENGINEER.
- B. Place a warning ribbon or other effective means suitable for conditions above ductbank underground installations.
- C. Place warning signs on utilization equipment that has more than one source of power. Provide panel and circuit number of conductor tag of the power source disconnect.
- D. Place warning signs on utilization equipment that has 120 VAC control voltage source used for interlocking. Provide panel, circuit number, and conductor tag of control voltage source disconnect.

END OF SECTION

26 05 53-4

SECTION 26 24 13.13

MOLDED CASE CIRCUIT BREAKER SWITCHBOARD

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: 600 VAC, dead-front type, metal-enclosed molded case circuit breaker switchboards.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. C39.1 - Requirements for Electrical Analog Indicating Instruments.
 - 2. C57.13 - Requirements for Instrument Transformers.
- B. Institute of Electrical and Electronic Engineers (IEEE).
- C. Insulated Cable Engineers' Association (ICEA).
- D. National Electrical Code (NEC):
 - 1. Article 310 - Conductors for General Wiring.
 - 2. Article 384 - Switchboards and Panelboards.
- E. National Electrical Manufacturers' Association (NEMA):
 - 1. PB-2 - Dead-front Distribution Switchboards.
 - 2. SG3 - Low Voltage Power Circuit Breakers.
- F. Underwriters' Laboratories, Inc. (UL):
 - 1. UL 891 - Deadfront Switchboards.
 - 2. UL 489 - Molded Case Circuit Breakers.

1.03 SYSTEM DESCRIPTION

- A. Factory assembled, wired, and tested switchboards, with major components being products of a single manufacturer, including but not limited to, circuit breakers, transformers, instruments, meters, relays, control devices, and other equipment specified herein and indicated on the Drawings.

1.04 SUBMITTALS

- A. Shop Drawings: Submit as a minimum the following information and drawings:
 - 1. Plan, front, and side view drawings including overall dimensions of each switchboard line-up. Identify shipping splits and show conduit stub-up area locations.

2. Internal wiring diagram of each compartment including wiring identification and terminal numbers.
3. Internal compartment-to-compartment interconnection wiring diagrams including wiring identification and terminal numbers.
4. Complete 3 line diagrams for each switchboard line-up. These drawings shall indicate devices comprising the switchboard assembly including, but not limited to, circuit breakers, control power and instrument transformers, meters, relays, and control devices. Clearly indicate electrical ratings of devices on Drawings.
5. Complete bill of material list and equipment data sheets identifying appropriate information specific to the switchboard being supplied.
6. Nameplate schedule.

B. Product data.

1.05 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Enclosure: One of the following or equal:

1. Tesco.
2. Eaton.
3. Square D.

B. Main Circuit Breaker: One of the following or equal:

1. Cutler-Hammer.
2. Square D.

C. Outgoing Feeder Breakers: Molded case; as specified elsewhere in this Section.

2.02 600 VOLTS AC SWITCHBOARDS

A. Furnish and install outdoor dead-front type, low voltage metal-enclosed front- and rear-accessible switchboard.

B. Switchboard and Equipment: Conform to current applicable standards of organizations listed under References.

C. Furnish and install a complete line-up of switchboard and control as detailed herein. Furnish and install devices or accessories not described, but necessary for the proper installation and operation of the equipment.

D. Suitable for use as service entrance equipment in accordance with UL requirements. Complete assembly shall bear a UL label.

E. Rate complete switchboard assembly to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having available

fault current of 42,000 amperes symmetrical at rated voltage. Test switchboard for conformance according to applicable NEMA and UL standards.

- F. Manufacturer of the assembly to be manufacturer of air circuit breakers contained therein.

2.03 VOLTAGE RATINGS

- A. Design and construct switchboard for use on a 480 volt, 3 phase, 3 wire, 60 hertz system with entire assembly suitable for 600 VAC maximum service.

2.04 MAIN BUS

- A. Fabricate main bus of high conductivity, flat, tin plated copper bar having rounded edges suitably braced and supported on high dielectric strength insulators and arranged in the same vertical plane. Buses to have a continuous current-carrying capacity of not less than that specified herein or indicated on the Drawings.
- B. Insulate buses to protect against spread of arcing faults and accidental contact by people or foreign objects. Provide bus joints with Bellville spring type washers.
- C. Mount bus on insulated supports with coordinated dielectric properties, and strength to withstand magnetic stresses developed by fault current equal to 42,000 amperes symmetrical at rated voltage.
- D. Fabricate bus supports from insulation possessing flame-retardant and self-extinguishing, dielectric and anti-hydroscopic properties.

2.05 GROUND BUS

- A. Ground Bus: Tin plated copper bar, 1/4 inch by 1 to 2 inch minimum, extending through all cubicles.
- B. Provide bus joints with Bellville spring type washers.
- C. Ground each housing directly to this bus.
- D. Adequately ground relays by No. 6 American Wire Gauge insulated copper wire.

2.06 STATIONARY STRUCTURE

- A. Utilize construction in formation of housing in order to provide a rigid, self-supporting and self-contained enclosure. Fabricate each stationary structure of heavy, formed, specially smooth and level steel sheets and structural members.
- B. Provide lugs including grounding lugs, suitable for copper cable, of quantity and size as indicated on the Drawings.

- C. After fabrication, bonderize, chemically clean and paint exterior and interior surfaces of the switchboard with a rust inhibiting primer followed by a gray ANSI 61 finish coat or equivalent cathodic electrodeposition epoxy.
- D. Provide bolted removable side and rear covers.
- E. Provide required ventilation at switchboard roof as required.

2.07 MAIN CIRCUIT BREAKER

- A. Circuit Breaker: Molded case;
- B. Rating:
 - 1. Continuous: As indicated on the Drawings.
 - 2. Short Circuit: 42 kA symmetrical.

2.08 OUTGOING FEEDER CIRCUIT BREAKERS

- A. Circuit Breaker: Molded case;
- B. Rating:
 - 1. Continuous: As indicated on the Drawings.
 - 2. Short Circuit: 42 kA symmetrical.

2.09 CURRENT TRANSFORMERS

- A. Ring Type Current Transformers: Dry type, for indoor service, insulated for 600 volts. Design to have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the circuit breaker of the application.

2.10 CONTROL WIRING AND TESTING

- A. Wire and factory test switchboard to satisfy the requirements of the operation described or necessary.
- B. Switchboard Wiring: NEC Type SIS, single-conductor, stranded copper, rated 600 volts bundled and secured with nylon ties. Provide flexible stranding for swinging panels. Minimum wire size: No. 14 for control circuits, and No. 12 for potential and current transformer circuits.
- C. Route outgoing control wires to master terminal blocks with suitable numbering strips numbered in agreement with the manufacturer's detailed wiring diagrams.
- D. Terminate control wiring in molded, screw-type terminal blocks acceptable to ENGINEER. Provide a minimum of 10 percent spare terminal blocks for each circuit breaker and auxiliary compartment. Compression type terminal blocks are not acceptable. Terminal blocks: States Company sliding link Type NT or as accepted by ENGINEER.

- E. Number wiring with shrink-type tag devices at both ends consistent with the manufacturer's detailed wiring diagrams. Duplication of wire numbers and terminal block numbers is not acceptable.

2.11 NAMEPLATES

- A. Provide engraved plastic nameplates to identify switchboard units, door mounted components, and internal components.
- B. Black lamicaid with white letters fastened with round head stainless steel screws, engraved with the circuit number and circuit name consistent with the Drawings.
- C. Label per requirements of NEC, Articles 110-21 and 110-22.

2.12 SWITCHBOARD EQUIPMENT

- A. Provide circuit breaker compartments and auxiliary compartments equipped as previously specified with the following basic equipment:
 - 1. Provide ground bus extending the full length of the switchboard, and firmly secure to each vertical section. Provide lugs for termination of copper ground cable at each end of the bus.
- B. Space Heaters: Fused thermostatically controlled space heater. Utilize tubular type operated at half voltage for long life; 250 volt rated heaters at 120 volt.
- C. Terminations: UL-listed, marked as suitable to accept conductors sized for 90 degrees Centigrade operating temperature in accordance with NEC.

2.13 DESCRIPTION OF SECTIONS

- A. Furnish and install incoming pull section and utility metering section in accordance with the residing utility with service entrance rating.

2.14 ACCESSORIES

- A. Provide the Following Switchboard Accessories:
 - 1. Manual handles for operating circuit breakers.

2.15 WARNING SIGNS

- A. Provide a minimum of two warning signs on the front of the switchboard line-up and two on the back.
 - 1. Red laminated plastic engraved with white letters approximately 1/2 inch high.
 - 2. Signs shall read "DANGER HIGH VOLTAGE."

2.16 SOURCE QUALITY CONTROL

- A. Completely assemble, wire and test switchboard at the factory. Rigid inspections before and after assembly shall assure correctness of design and workmanship.

Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.

- B. After assembly, provide the switchboard with lifting channels having eyebolts for attachment of crane slings to facilitate lifting and handling each shipping-assembly unit. These lifting channels shall be removable after equipment is placed on permanent foundations.
- C. Furnish and install structural mounting channels in accordance with manufacturer's recommendations to provide proper alignment of the units.
- D. Manufacturing facility for switchboard shall be third party certified to ISO 9002. Third party certifier is subject to acceptance of the ENGINEER.

PART 3 EXECUTION

3.01 INSTALLATION

3.02 DEMONSTRATION

- A. Demonstrate operation of equipment.

END OF SECTION

26 24 13.13-6

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Dead-front panelboards, including lighting distribution and control panelboards.
- B. Related Section:
 - 1. Section 01 33 00 - Submittal Procedures.
 - 2. Section 26 05 53 - Electrical Identification.
 - 3. Section 26 28 00 - Low Voltage Circuit Breakers.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
- B. Underwriters' Laboratories, Inc. (UL):
 - 1. UL 67 - Panelboards.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Interrupting Capacity of Device: Equal to available short circuit current at line terminals as determined by CONTRACTOR'S short circuit fault analysis as accepted by ENGINEER, but not less than 22,000 amperes.
- B. Provide main bus rating of panelboards, number of poles, and provisions for number of circuits as indicated on the Drawings.

1.04 SUBMITTALS

- A. Product Data: Include manufacturer's specifications and description.
- B. Shop Drawings: Submit in accordance with Section 01 33 00 Submittal Procedures. Include panelboard layout.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. Square D Company.
 - 3. General Electric Company.

2.02 INTERIOR

- A. Bus: Size main bus bars in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees Centigrade above specified ambient maximum.
 - 1. Tin-plated copper bussing.
- B. Install protective devices such that they can be replaced without disturbing adjacent units.
- C. Number branch circuits and spares as indicated on the Drawings and furnish complete typed circuit schedule in directory cardholder affixed to panel under a transparent cover.
- D. Phase busing shall be full size and height without reduction. Include full size neutral bars with suitable lugs for the maximum number of circuits which can be connected to the panel.
- E. Spares and spaces for future protective devices in panels indicated on the Drawings shall be bussed for panel rating or the main circuit breaker rating.
- F. Provide panels with tin plated copper ground bus separate from neutral bars. Ground bus to have suitable lug for each circuit breaker installed including future circuits.

2.03 ENCLOSURES

- A. Size panelboards sufficiently to provide minimum 4 inches of gutter space on all sides. Doors shall be such that:
 - 1. Live parts shall not be exposed when circuit breakers or switches are put in service.
 - 2. Hinges and latches shall not require tools to operate.
- B. Furnish lock and minimum 2 keys each panelboard. Key all panelboard locks alike.
- C. Enclosure type as indicated on the Drawings. Where not indicated on the Drawings:
 - 1. Indoor Enclosures: NEMA 12.
 - 2. Outdoor Enclosures: NEMA 4X.
- D. Mounting shall be as indicated on the Drawings.

- E. Finish stand alone panelboards with a primer, rust-resistant phosphate undercoat and 2 coats of oven-baked enamel with finish color ANSI 61 gray or a color to be selected by the ENGINEER.
- F. Finish motor control center mounted panelboards to match the MCC finish and color, unless directed otherwise.

2.04 IDENTIFICATION

- A. Label panelboards to indicate use as service entrance equipment where indicated on the Drawings or specified.
- B. Label panelboards with UL short circuit current rating.
- C. Provide each panelboard which is not an integral part of a motor control center with a lamicoid nameplate on outside of door, as specified in Section 26 05 53 Electrical Identification, Electrical Identification.

PART 3 EXECUTION

3.01 INSTALLATION

- A. As indicated on the Drawings, or as required, in a workmanlike manner.

END OF SECTION

SECTION 26 27 16
CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cabinets and enclosures to house electrical controls, instruments, terminal blocks, and similar equipment.
- B. Related Sections:
 - 1. Section 26 05 00 - Electrical Requirements.

1.02 REFERENCES

- A. National Electrical Code (NEC).
- B. National Electrical Manufacturers' Association (NEMA).

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Unless otherwise specified or indicated on the Drawings, enclosures to house electrical controls, instruments, terminal blocks, and similar equipment shall be NEMA 12 for indoor, dry and non-corrosive locations and NEMA 4X for outdoor installations, wet locations and corrosive designated areas and shall be compatible with the conduit system being used.
 - 2. Specific control panel enclosures shall be as specified in Division 13 of these Specifications or as indicated on the Drawings.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 Submittal Procedures.
- B. Submit product data and mounting supports.
- C. Calculations:
 - 1. Conditioning System Sizing: Submit calculations.

1.05 WARRANTY

- A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. NEMA 12 Steel Enclosures: One of the following or equal:
 - 1. Hoffman Engineering Company.
 - 2. Rittal.

- B. NEMA 4X Stainless Steel Enclosures: One of the following or equal:
 - 1. Hoffman Engineering Company.
 - 2. Henessy Products, Inc.
 - 3. Carlon.

- C. Enclosure Air Conditioner: One of the following or equal:
 - 1. Hoffman Engineering Company.

2.02 FABRICATION

- A. NEMA 12 Steel Enclosures:
 - 1. Fabricate enclosures from 14-gauge steel with continuous welded seams.
 - 2. Doors: Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
 - 3. Provide a rolled lip around 3 sides of the door and around all sides of the enclosure opening.
 - 4. Gaskets: Attach gasket with oil-resistant adhesive and hold it in place with steel retaining strips.
 - 5. Provide hasp and staple for padlocking.
 - 6. Provide a print pocket for each enclosure.

- B. NEMA 4X Stainless Steel Enclosures:
 - 1. Provide enclosures that consist of base and cover which shall be of Type 316 stainless steel with minimum thickness of 12 gauge. The enclosures shall be provided with cover hinges to form a weathertight seal between the cabinet and door.

2.03 FINISHES

- A. Steel Enclosures:
 - 1. Do not paint NEMA 4X enclosures. Door fronts shall be ground smooth.
 - a. Print pockets and interior panels shall be steel with a white enamel finish.
 - 2. Provide NEMA 12 and NEMA 4 enclosures with white enamel interior finish: The finish shall be light gray enamel, ANSI 61 exterior, over phosphatized surfaces. Panels shall be white enamel.
 - 3. Special finishes and colors shall be furnished for wet locations.

- B. Other portions of these Contract Documents shall be checked for special conditions.

2.04 ENCLOSURE AIR CONDITIONERS

- A. Provide electrical equipment enclosures with complete air conditioning system as indicated on the Drawings and as specified.
 - 1. Enclosures to be climate controlled, equipped with integral self-contained air conditioning units complete with thermostats.
 - 2. The industrial grade air conditioners to constantly cool and recirculate the internal enclosure air which is kept completely separated from the external, or ambient air (closed-loop system).
 - 3. Provide units suitable for operation in the environment as specified in Section 26 05 00 Electrical Requirements. The units to be complete with all gaskets, mounting hardware, and air inlet filter.
- B. Electrical Requirements:
 - 1. Power supply to the air conditioners to be as indicated on the Drawings.
 - 2. Make adjustments to the power supply circuits (conduits and wires and other components) as necessary to accommodate the air conditioning equipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner. Install in accordance with Section 26 05 04 Basic Electrical Materials and Methods.
- C. Install cabinet fronts plumb.
- D. Top mounted air conditioning units installation shall not allow condensation to damage electrical equipment or enclosure.
- E. Provide size of pull boxes to meet National Electric Code requirements and ample space for conductors and devices.
- F. Provide adequate supports and anchors to resist seismic forces.
- G. Provide adequate supporting pillar(s) for cabinets to be located above decks, above slabs or where there are no structural wall or surface for cabinet mounting.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Wiring devices including the following:
 - 1. Snap switches and toggle switches.
 - 2. Plugs and receptacles.
 - 3. Control and push-button stations.
 - 4. Pilot devices.

1.02 SUBMITTALS

- A. Product Data.

1.03 QUALITY ASSURANCE

- A. Provide industrial grade products for wiring devices. Commercial grade products are not acceptable, unless otherwise specified or indicated on the Drawings.

1.04 WARRANTY

- A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 SNAP OR TOGGLE SWITCHES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. General Electric.
 - 3. Leviton.
 - 4. Bryant.
- B. Number of Poles: As indicated on the Drawings.
- C. Rating: 20 amperes, 125 volt.
- D. Special Switches and Covers: As specified or indicated on the Drawings.

2.02 120 VOLT RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.

2. General Electric.
 3. Leviton.
 4. Bryant.
- B. Duplex Receptacles: 2-pole, 3-wire, grounded, 125 volts, industrial, rated at 20 amperes.
1. Special Receptacles and Covers: As specified in Section 26 05 33 Raceway and Boxes, or as indicated on the Drawings.
- C. Ground Fault Interrupter Receptacles (GFI): Rated at 20 amperes at 125 volts alternating current.

2.03 240 VOLT RECEPTACLES

- A. Manufacturers: One of the following or equal:
1. Hubbell.
 2. General Electric.
 3. Leviton.
 4. Bryant.
- B. Types: Single and 3-phase; suitable for equipment served.
- C. Rating: 20 amperes at 250 volts alternating current, unless otherwise indicated on the Drawings.

2.04 480 VOLT PLUGS AND RECEPTACLES

- A. Manufacturers: One of the following or equal:
1. Killark W Series.
 2. Crouse-Hinds.
 3. Leviton.
 4. Bryant.
- B. Types: Heavy-duty, 3-phase, weather resistant, grounding type, 4-wire, 4-pole device, suitable for equipment served.
- C. Rating: 60 amperes at 480 volts alternating current, unless otherwise indicated on the Drawings or specified.

2.05 DISTRIBUTED CONTROL SYSTEM RECEPTACLES

- A. Manufacturers: One of the following or equal:
1. Hubbell.
 2. Square D Company.
 3. Leviton.
 4. Bryant.
- B. Type: Surge suppression/isolated ground, red, minimum 20 amperes rated at 125 volts alternating current, with gasketed cover plate.

2.06 UNINTERRUPTIBLE POWER SYSTEM RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. Square D Company.
 - 3. Leviton.
 - 4. Bryant.
- B. Type: Surge suppression/isolated ground, red, minimum 20A rated at 125 volts alternating current, with gasketed cover plate.

2.07 LOCAL PUSH-BUTTON MOTOR CONTROL STATIONS

- A. Manufacturers: One of the following or equal:
 - 1. Furnas Electric Company.
 - 2. Square D Company.
 - 3. Allen-Bradley.
 - 4. Siemens.
 - 5. Cutler-Hammer.
 - 6. General Electric.
- B. Types: Heavy-duty, oiltight/watertight.
- C. Components: Selector switches, pilot light, and push buttons.
- D. Enclosures: As follows, unless otherwise indicated on the Drawings or specified:
 - 1. For Nonhazardous Indoor Locations: NEMA 12.
 - 2. For Outdoor Locations: NEMA 4X.
- E. Field Located Maintained Push Buttons: Red mushroom head, push to stop, pull-to-reset, with maintained contacts.

2.08 PILOT DEVICES

- A. Manufacturers: One of the following or equal:
 - 1. Furnas Electric Company.
 - 2. Square D Company.
 - 3. Allen-Bradley.
 - 4. Siemens.
 - 5. Cutler-Hammer.
 - 6. General Electric.
- B. Type: Heavy duty, suitable for mounting in control stations, on switchgear, switchboards, variable frequency drives, motor control centers, control panels, and other electrical equipment.
- C. Components: Oiltight/watertight push buttons, selector switches, pilot light, and incidental items.

- D. Casting: Durable 1 piece with chrome plated octagonal mounting nuts.
- E. Push Buttons: Heavy-duty plastic.
- F. Pilot Light Lenses: Shatter resistant plastic.

2.09 CORD CONNECTOR GRIPS

- A. Non-Hazardous Areas:
 - 1. Manufacturers: One of the following or equal:
 - a. Killark, Series Z.
 - 2. Aluminum cord connector.
 - 3. Stainless steel mesh grip.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install wiring devices in accordance with manufacturer's instructions.
- B. Mount wiring devices as indicated on the Drawings.

3.02 LOCAL PUSH-BUTTON MOTOR CONTROL STATION INSTALLATION

- A. Install Start-Lockout-Stop push-button control stations adjacent to every motor unless otherwise indicated on the Drawings.

3.03 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 26 28 00

LOW VOLTAGE CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Low voltage circuit breakers as indicated on the Drawings and as specified.

1.02 REFERENCES

- A. National Testing
- B. Manufacturers Association (NEMA): Standards Publication No. AB1.
- C. National Electrical Code (NEC): Article 430-52.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Circuit Breakers: Manufacturers: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. General Electric Company.
- B. Motor Circuit Protectors: One of the following manufacturers or equal:
 - 1. Cutler-Hammer.
 - 2. General Electric Company.

2.02 CIRCUIT BREAKERS - LOW VOLTAGE

- A. Circuit Breaker Frame and Trip Ratings: As indicated on the Drawings and coordinated with the ratings of the equipment actually furnished. Modify ratings where necessary to suit this equipment and in accordance with the short circuit fault analysis and protective device coordination study.
- B. Circuit Breakers for Motor Control Centers: As specified and indicated on the Drawings. Where no indication of type is given on the Drawings, the following governs:
 - 1. When an integral part of a UL-listed combination controller: Motor circuit protectors.
 - 2. All other circuit breakers: Molded case circuit breakers.
- C. Provide motor circuit protectors and circuit breakers with non-aluminum line and load terminals suitable for the required conductor type, size, and number of conductors.

D. Panelboard Circuit Breakers: Bolt-in type. Snap-in circuit breakers are not acceptable.

2.03 MOLDED-CASE CIRCUIT BREAKERS

A. Molded-case Circuit Breakers: Ambient compensating which provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Accomplish compensation by a secondary bimetal that will allow the breaker to carry rated current between 25 degrees Centigrade and 50 degrees Centigrade with tripping characteristics which are approximately the same throughout this temperature range.

B. Circuit Breaker Ratings and Modifications: As indicated on the Drawings.

C. On Breakers with Interchangeable, Thermal, Adjustable Magnetic Trip: The accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

D. Circuit Breakers for Mounting in Motor Control Centers or for Separate Mounting: Air-break type, quick-make and quick-break, 600 volt, with number of poles as indicated on the Drawings. Minimum Frame Size: 100 amperes.

1. Provide each breaker pole with inverse time delay and instantaneous circuit protection.

E. Breakers: Operated by a handle and provided with a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents.

1. Tripping Due to Overload, Short Circuit, or Ground Fault: Clearly indicate tripping by the handle automatically assuming a position between the manual ON and OFF positions.
2. Latch Surfaces: Ground and polished.
3. Poles: Constructed so they all open, close and trip simultaneously.
4. Conform to the applicable requirements of NEMA Standard No. AB1.

F. Breakers: Completely enclosed in a molded case.

1. Non-interchangeable Trip Breakers: Sealed covers.
2. Interchangeable Trip Breakers: Sealed trip unit to prevent tampering.
3. Ampere Ratings: Clearly visible.
4. Contacts: Non-welding silver alloy.
5. Arc Extinction: Accomplished by means of arc chutes.

G. Minimum Interrupting Ratings: At least equal to the available short circuit at the line terminals as determined by the CONTRACTOR'S short circuit fault analysis and as accepted by the ENGINEER, but not less than 42,000 RMS amperes.

2.04 MOTOR CIRCUIT PROTECTORS

A. Motor Circuits: Protected by motor circuit protectors, as permitted by Item I below.

- B. Motor Circuit Protectors: Operated by a handle and provided with a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents.
 - 1. Tripping: Clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions.
 - 2. Latch Surfaces: Ground and polished.
 - 3. Poles: Constructed so they all open, close, and trip simultaneously.

- C. Motor Circuit Protectors: Completely enclosed in a molded case.
 - 1. Trip Unit: Sealed to prevent tampering.
 - 2. Ampere Ratings: Clearly visible.
 - 3. Contacts: Non-welding silver alloy.
 - 4. Arc Extinction: Accomplished by means of arc chutes.

- D. Provide each pole of motor circuit protectors with instantaneous short circuit protection by means of a single adjustable magnetic only element. The single adjustment screw is to adjust all poles simultaneously.

- E. Furnish motor circuit protectors with provision for locking the maximum achievable trip setting to values less than maximum obtainable trip setting. Each adjustment typically to have 8 main setting points and mid-setting points following a linear scale so that each point has a significant value within calibration tolerances.

- F. Motor Circuit Protectors: Suitable for use with current limiters, having 100,000 ampere interrupting capacity and a built-in trip indicator, that are fully coordinated with the motor circuit protectors so that the motor circuit protectors will open all 3 phases if the limiter operates.
 - 1. Current limiters shall be so constructed that they can only be replaced by an identical or similar limiter having the same interrupting capacity.

- G. Minimum Interrupting Rating: At least equal to the available short circuit current at the line terminals as determined by the CONTRACTOR'S short circuit fault analysis as accepted by the ENGINEER, but not less than 42,000 RMS amperes.

- H. Motor Circuit Protectors Continuous Current Rating: As specified herein or as indicated on the Drawings.
 - 1. Setting: The motor circuit protectors setting shall be in accordance with the CONTRACTOR'S protective device coordination study as accepted by the ENGINEER and in accordance with the motor circuit protectors manufacturer's recommendation based on motor nameplate current or actual motor current, whichever is larger.

- I. Utilize an instantaneous trip circuit breaker or motor circuit protector only as part of a listed combination motor controller which provides coordinated motor branch-circuit overload, and short-circuit and ground-fault protection in accordance with NEC Article 430-52.

PART 3 EXECUTION (NOT USED)

END OF SECTION

26 28 00-4

SECTION 26 29 10
MOTOR STARTERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Manual starters, magnetic contactors, overload relays, combination starters and related motor controllers.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures.
 - 2. Section 26 05 00 - Electrical Requirements.

1.02 REFERENCES

- A. National Electrical Code (NEC):
 - 1. Article 430 - Motors, Motor Circuits and Controllers.
- B. National Electrical Manufacturers Association (NEMA).

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01 33 00 Submittal Procedures.
- B. Manufacturer's installation instructions.

1.04 WARRANTY

- A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Full Voltage Magnetic Starters: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. Allen-Bradley.
 - 3. Square D Company.
 - 4. ABB

2.02 STARTERS

- A. Suitable for the horsepower ratings specified, and in accordance with NEC Article 430. Motors less than 5 hp to have across the line starters with overloads.

- B. Verify motor ratings and coordinate starter and overload trip ratings with actual horsepower and nameplate current ratings of motors installed.
- C. Magnetic Contactors: Factory adjusted and chatter free.
- D. Overload Relays: Install bimetallic type overload relays in each line conductor as indicated on the Drawings. Provide contacts for remote monitoring of overload status as indicated on the Drawings.
- E. Mount extended overload reset buttons to be accessible for operation without opening door of enclosure. Plastic overload relay reset buttons with plastic operator shafts are unacceptable.
- F. Provide starters Size 2 and larger with arc quenchers on load breaking contacts.
- G. Minimum Size Starter: NEMA Size 1, and not smaller than size indicated on the Drawings.
- H. Provide starters of sufficient size to accommodate motors furnished, including larger starters required for larger motors supplied by CONTRACTOR.
- I. Combination Starters: Furnish complete with a 120-volt control transformer unless otherwise noted.
- J. Control Fuses: Size and furnish as required and where indicated in the schematics.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install per manufacturer requirements. Provide overloads to suit motor nameplate.

3.02 APPLICATION

- A. Supply circuit breaker trip elements and starter overload trip elements to meet above normal ambient temperatures where such conditions are anticipated (subject to ENGINEER'S acceptance).

3.03 DEMONSTRATION

- A. Demonstrate operation of equipment.

3.04 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 26 29 23

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions of the Subcontract apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
 - 1. Variable Frequency Drives.

1.2 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
 - 4. Refer to Division 26 Section "Common Results for Electrical" for codes and standards, and other general requirements.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. NECA "Standard of Installation."
- D. NEMA – National Electrical Manufacturers Association:
 - 1. NEMA ICS 3.1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. Federal Specifications:
 - 1. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
 - 2. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
 - 3. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.

- G. NEMA – National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers.
 - 2. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
 - 3. NEMA KS 1 - Enclosed Switches.

1.3 DEFINITIONS

- A. VFD - Variable Frequency Drive.
- B. The VFD - Applies to VFDs furnished and installed by the Subcontractor.
- C. EMCS - Energy Monitoring and Control System.
- D. FMCS - Facility Monitoring and Control System.

1.4 SYSTEM DESCRIPTION

- A. Furnish and install VFD(s) as indicated on the subcontract drawings and provide wiring and interconnection, and start-up and test services to provide variable speed motor operation.
- B. It is the Subcontractor's responsibility to determine if the existing motor is suitable for operation with VFD control. If not suitable, the Subcontractor shall notify the University Project Manager who may, at his option, furnish new replacement motors which are suitable for the purpose intended. It is the Subcontractor's responsibility to not start or otherwise operate existing motors until it has been determined that they are suitable for operation with VFD control.
- C. The Subcontractor shall furnish and install the VFD as specified, complete with auxiliary components as required to conform with this specification and drawings, including enclosures, transformers, filters, fuses, motor protection, circuit breakers, switches, indicating lights, engraved nameplates, signal transducers, and other components and accessories. The VFD shall be surface mounted in the locations indicated on the drawings.
- D. The Subcontractor shall furnish and install necessary control relays, transducers, power supplies, or other instrumentation equipment within the VFD as required to interface with the Facility [Energy] Monitoring and Control System (FMCS) [(EMCS)] to produce a completely operational system in accordance with these specifications. The instrumentation furnished shall permit the FMCS [EMCS] to control the VFD so as to maintain stable operation at a programmable set point.
- E. The Subcontractor shall provide an enclosure for the VFD. The enclosure shall be ventilated or otherwise adapted to control heat and prevent entrance of moisture, or corrosive or hazardous materials in accordance with the VFD manufacturer's specifications.

- F. The Subcontractor shall provide panel-front manual controls for auto/manual switching of the VFD mode, for adjustment of VFD output in manual mode (10-100 percent speed or 6-60 Hz), and for VFD/bypass operation. In the bypass mode, the VFD shall be electrically isolated from both the input power and the motor load wiring.

1.5 SUBMITTALS

- A. Submit under provisions of Division 26 Section "Common Results for Electrical - Review of Materials" and Division 01 Section "General Requirements."
- B. Pre-Construction Submittals:
 - 1. Submit under provisions of Division 01 Section "General Requirements" for equipment prior to ordering or fabrication. No deviations from the submittals as approved shall be permitted and materials purchased prior to approval shall be at the sole risk of the Subcontractor.
 - 2. All submittal data shall be the same size for groups of information and shall be bound or in a three-ring binder as appropriate. Information shall be indexed and tabbed with reference to the specific section of the specification. Clearly indicate the exact model to be provided for each item.
 - 3. Manufacturer's Installation Instructions: Submit for components being provided under this section. Indicate application conditions and limitations of use stipulated by product testing agency.
 - 4. Labeling: Submit a sample of the proposed labeling method.
 - 5. Shop Drawings: Indicate front and side views of variable frequency drive enclosures with overall dimensions. Include conduit entrance locations and requirements; nameplate legends; electrical characteristics including voltage, frame size and trip ratings; termination numbers and identification of purpose; and time-current curves of equipment and components. Drawings prepared by the Subcontractor shall be developed using the AutoCAD™ computer-aided drafting software. Drawings shall be a maximum ANSI size D.
 - 6. VFD Product Data: Provide complete product data on the variable frequency drive.
- C. Project Record Documents:
 - 1. The construction subcontract drawings shall be submitted with the Subcontractors markings which record the installed conditions from which the University will produce the "as-builts".
 - 2. Additional shop drawings produced by the subcontractor shall be revised to show the "as-built" conditions prior to submittal. Submit as-built shop drawings and copies of computer files developed for this subcontract.
 - 3. Equipment locations: Show actual locations of VFDs.
 - 4. Mounting details: Accurately record mounting details.
 - 5. Software configuration: Submit documentation on the VFD software configuration including the values of parameters and constants, showing both factory settings and modifications for each application.
- D. Operation and Maintenance Data:
 - 1. Maintenance Data: Furnish five (5) original copies and 1 compact disc of recommended maintenance procedures and intervals. Documentation shall include

- manufacturers model number, manufacturer's installation instructions, switch settings, adjustment procedures, inspection period, recommended cleaning methods and materials, testing methods, and calibration tolerances. Include spare parts data listing; source and current prices of replacement parts and supplies.
2. Furnish five (5) hardcopies and one (1) compact disc of as-built drawings which include the elementary and connection diagram. Electronic drawing files shall be in AutoCAD 2008 format.
 3. Warranty: Warranty period shall start at the date the equipment is energized after acceptance by the University. Submit five copies of the warranty certificate.
 4. Name, address, and phone number of the service representative to be called in the event of equipment failure.

1.6 QUALITY ASSURANCE

- A. Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL) as listed in Division 26 Specification "Common Work Results for Electrical."
- B. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.
- C. Manufacturer's Qualifications: Company experienced in manufacturing the products specified in this Section with minimum five (5) years documented product development, testing, and manufacturing experience.
- D. Installer Qualifications: Company experienced in applying the work of this Section with minimum five (5) years documented experience.
 1. The installer shall have a complete sales, installation, and service operation within the area.
 2. Subcontractor must be licensed for C-10 (Electrical) operations.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Division 26 Section "Common Work Results for Electrical".
- B. Care shall be taken to prevent damage to materials and equipment during loading, transporting and unloading. Packaged units shall be delivered in their original crates. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to variable frequency drive components, enclosure, and finish.

1.8 SEQUENCING AND SCHEDULING

- A. Coordination:
 - 1. Coordinate work under provisions of Division 01 Section "General Requirements" and Division 01 Section "Special Procedures."
 - 2. Coordinate installation of system components with other mechanical and electrical systems equipment being interfaced such as motors and motor control centers.
 - 3. Determine required physical distance between The VFD and other work.

1.9 MAINTENANCE

- A. Maintenance Service:
 - 1. Maintenance services shall be provided by the Subcontractor for one (1) year after final system acceptance in accordance with Division 01 Section "General Requirements" without additional cost to the University. These services shall consist of manufacturer's factory-trained representatives providing emergency repair service with on-site response within 24 hours of call, test equipment and hardware necessary for maintenance and repair work and installation of hardware or software modifications designed to improve system performance or eliminate known problems or deficiencies.
 - 2. During the warranty period, provide new or revised documentation showing changes required to solve system problems.
 - 3. Submit written reports on each service or inspection to the LBL Project Manager during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cutler-Hammer.
- B. Allen-Bradley.
- C. Square D Company.
- D. ABB
- E. Substitutions: No substitutes allowed.

2.2 MATERIALS

- A. The VFD shall be new and contained in the original manufacturer's packaging.

- B. Unless approved in writing by the University, the VFD shall have the same manufacturer's model numbers installed in at least ten sites prior to this installation. Sites shall be located in the United States.
- C. The VFD shall be currently under manufacture and shall be expected to have available, for at least ten years after completion of the subcontract, a complete line of spare parts.
- D. The VFD shall be listed as suitable for the purpose specified and shown on the drawings by Underwriters Laboratory (UL), Electronic Testing Laboratories (ETL), or other nationally-recognized testing service certified for testing in accordance with UL standards.

2.3 VARIABLE FREQUENCY DRIVE (VFD)

- A. Horsepower Rating: As scheduled on the drawings, and compatible with the motors to be driven.
- B. Voltage Rating: As scheduled on the drawings.
- C. Remote Control and Feedback Terminals: Provide for Class 2 wiring terminations to accept a dry contact closure for external start/stop control, a 0-10Vdc analog input signal for external control of speed from 0-60 Hz, a 0-10Vdc output signal to provide frequency feedback, and an alarm dry contact output.
- D. The VFD shall incorporate a disconnect switch sensing function. This sensing function shall allow the VFD to shut down normally when a power disconnect switch located between the VFD and the associated motor is opened during operation.
- E. Enclosure: ANSI/NEMA ICS 6; Type NEMA 1.
- F. Upon a fault detection and VFD trip, the alarm contact shall open on the VFD, for external connection and remote indication, to signify a fault condition (contact rating of 0.5 amps resistive at 120 VAC).

PART 3 - EXECUTION

3.1 VFD INSTALLATION

- A. Install VFD equipment in accordance with manufacturer's instructions.
- B. The VFD shall be totally enclosed in either wall-mounted or free-standing enclosures as specified elsewhere, NEMA 1, 4 or 12 if installed indoors, NEMA 4 or 12 if installed outdoors.
- C. VFD Data: Provide neatly typed label on each variable frequency drive enclosure identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

- D. The VFD shall be located as shown on the drawings. The VFD shall be wall mounted or furnished with steel freestanding panels, as appropriate to the location and as specified.
- E. Freestanding panels shall be securely anchored to the floor with steel bolts, the number and size of which shall be consistent with the size and weight of the enclosure, and consistent with seismic restraint requirements for seismic zone 4.
- F. Wall mounted panels shall be secured to structural walls with steel bolts, the number and size of which shall be consistent with the size and weight of the enclosure, and consistent with seismic restraint requirements for the location.
- G. Installations shall meet the applicable requirements for seismic restraints as required by codes and standards. Enclosures shall be located so as to provide ready access to controls and displays, and to allow full, unimpeded opening of doors and covers. Access and clearance shall conform the requirements of the National Electrical Code, Article 110, and OSHA. Installations shall be subject to University's approval as to location, mounting, and wiring.
- H. For retrofit applications, remove the existing motor starter, and install the VFD between the existing circuit breaker and the motor disconnect switch, where existing, so that the motor disconnect switch can still be used to isolate the motor.
- I. VFD power output wiring shall not be installed in conduit with wiring for the VFD input wiring or other load. If existing wiring is in conduit with other wiring, then Subcontractor shall locate VFD appropriately and install new conduit and wiring for the VFD output to the motor.
- J. VFD power and signal wiring shall be installed in appropriate metallic electrical conduit and raceways, which shall be suitably grounded for VFD installations and the VFD manufacturer's recommendations. Flexible conduit is specifically prohibited.
- K. The Subcontractor shall verify, prior to installing conduits, the free clearance in front of the VFD enclosure will extend out a minimum of 42 inches (10767 mm), and be at least 30 inches (762 mm) wide. Working clearances shall comply with NEC 110-26. VFD shall not intrude on codes-required access to, or clearances of, other electrical equipment.
- L. Where a Subcontractor elects to provide and install a VFD with a horsepower rating in excess of the specified or scheduled rating, circuit conductors and conduit sizes shall be increased as necessary to comply with NEC 430-2.

3.2 TESTING

- A. The Subcontractor shall provide labor and equipment necessary to perform a comprehensive acceptance test of the VFD under the supervision of the University. The Subcontractor shall contact the University to schedule the testing at least two (2) weeks prior to the time at which the system will be prepared to undergo the tests. Acceptance testing shall be in accordance with manufacturer's written start-up and testing instructions.

- B. The Subcontractor shall provide labor and equipment necessary to perform operational testing shall in coordination with specification section Division 25 Section "Integrated Automation Facility Controls".

END OF SECTION 262923

26 29 23-8

SECTION 26 05 21
WIRES AND CABLES
600 VOLT OR LESS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. 600 Volt Class wire and cable.
 - 2. Instrumentation Class wire and cable.
 - 3. Fire Alarm wire and cable.
 - 4. Communication wire and cable.

- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes.
 - 2. Section 26 05 33.13 - Conduits.
 - 3. Section 26 05 53 - Electrical Identification.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B 3 - Standard Specification for Soft or Annealed Copper Wire.
 - 2. B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

- B. Insulated Cable Engineers Association (ICEA).

- C. National Electrical Code (NEC):
 - 1. Article 250 - Grounding.
 - 2. Article 310 - Conductors for General Wiring.
 - 3. Article 760 - Fire Alarm Systems.

- D. Underwriters' Laboratories, Inc., (UL):
 - 1. UL 1277 Subject - Electrical Power and Control Tray Cables with Optional Optical-fiber Members.

1.03 SUBMITTALS

- A. Shop Drawings: Show splice locations. Submit cable pulling calculations for all cable feeder larger than 2/0 AWG and pulling lengths longer than 200 feet. Submit cable pulling calculations for all conductor runs longer than 400 feet.

- B. Product Data: Include wires, cables, pulling compounds, and splicing materials.

1.04 QUALITY ASSURANCE

- A. Conform to ASTM and ICEA standards.
- B. Furnish mechanical conductor connector and heat-shrink type insulation by same manufacturer.

PART 2 PRODUCTS

2.01 WIRE AND CABLE MATERIALS

- A. Conductors: ASTM B 8, soft drawn copper, maximum 12 months old, minimum 97 percent conductivity. American Wire Gauge (AWG) sizes as indicated on the Drawings, Class B or C stranded.
- B. Insulation Thickness: Minimum specified by NEC Article 310.
- C. Conductor Sizes: As indicated on wiring schedules and Drawings.

2.02 600-VOLT CLASS CABLE

- A. Power Wire and Cable:
 - 1. Manufacturers: One of the following or equal:
 - a. Okonite Company.
 - b. BICC Cable.
 - c. Rockbestos Company.
 - d. Rome Cable Corporation.
- B. Control Wire and Cable:
 - 1. Manufacturers: One of the following or equal:
 - a. Okonite Company.
 - b. BICC Cable.
 - c. Rockbestos Company.
 - d. Rome Cable Corporation.
- C. Insulation for Individual Wires or Multiple Conductor Cable for Power and Control Circuits:
 - 1. Type XHHW-2 insulation to be used in all locations.
- D. Jackets for Multiple Conductor Cable for Power and Control Circuits: Type CPE.
- E. Multi-Conductor Cable Insulated Grounding Conductors:
 - 1. Color: Integral green.
 - 2. Sizes: In accordance with NEC 250-122.
- F. Solid-conductor wire, Number 12 AWG and smaller, may be used only for lighting and receptacle circuits.

2.03 INSTRUMENTATION CLASS CABLE

- A. Single Pair or Triad Applications:
 - 1. Manufacturers: One of the following or equal:
 - a. The Okonite Company, Okoseal-N Type P-OS.
 - b. Equivalent manufactured by Cooper Industries, Belden Wire and Cable Division.
- B. Multiple Pair or Triad Applications:
 - 1. Manufacturers: One of the following or equal:
 - a. The Okonite Company, Okoseal-N Type SP-OS.
 - b. Equivalent manufactured by Cooper Industries, Belden Wire and Cable Division.
- C. Approved for cable tray installation in accordance with the National Electrical Code.
- D. Number of Individually Shielded, Twisted Pairs and Triads: As indicated on the Drawings or as necessary for the application.
- E. Voltage Rating: 600 volts.
- F. Cable Type: TC.
- G. Temperature Rating: 90 degrees Celsius dry location, 75 degrees Celsius wet location.
- H. Conductors: Bare, soft annealed copper in accordance with ASTM B 3, Class B, 7 strand concentric in accordance with ASTM B 8.
- I. Conductor Insulation: Flame-retardant polyvinyl chloride, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness, 90 degrees Celsius temperature rating in accordance with Underwriters' Laboratory Subject 1277.
- J. Color Code: Provide conductor color code as specified in Section 26 05 53 Electrical Identification.
- K. Single Pair or Triad Shielding:
 - 1. Group Shielding: Minimum 1.35 mil double-faced aluminum/synthetic polymer-backed tape overlapped to provide 100 percent coverage.
 - 2. Drain Wire: 7-strand tinned copper drain wire, 2 sizes smaller than conductor.
- L. Multiple Pair or Triad Shielding:
 - 1. Group Shield: 1.35 mil aluminum-polyester tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, 2 sizes smaller than conductor. Completely isolate group shields from each other.
 - 2. Cable Shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, same size as conductors.

- M. Jacket: Black, flame-retardant in accordance with Underwriter's Laboratory Subject 1277, 90 degrees Celsius temperature rating, rip cord laid longitudinally under jacket to facilitate removal.
- N. Conductor Size: Number 16 AWG minimum unless otherwise indicated on the Drawings.
- O. Numerically identify one conductor within each pair and triad.

2.04 RELATED MATERIALS

- A. Splicing Material:
 - 1. In conformance with ANSI C119.1, IEEE 383, and ICEA 5-19-81.
 - 2. Manufacturers: One of the following or equal:
 - a. Elastimold.
 - b. Thomas-Betts.
 - c. Raychem, FCSM Series.
- B. Wire Nuts:
 - 1. Rated 600 volt with live-spring feature for tight fitting connections.
 - 2. Manufacturers: One of the following or equal:
 - a. 3M.
 - b. Thomas and Betts.
- C. Junction Boxes and Terminal Cabinets: As specified in Section 26 05 33 Raceway and Boxes.
- D. Pulling Compound: As recommended by conductor manufacturer.

2.05 WIRE AND CABLE FABRICATION

- A. Permanently mark American Wire Gauge (AWG) size, grade of insulation, voltage, and manufacturer's name on outer covering at maximum 24 inch intervals.
- B. Identify and mark conductors in accordance with NEC Article 310.
- C. Color code wire and cable as specified in Section 26 05 53 Electrical Identification.
 - 1. Integrally color insulation for Number 2 AWG and smaller.
 - 2. Wrap colored tape around cable larger than Number 2 AWG.
- D. Fabricate cable ends with provisions for field testing.

2.06 SOURCE QUALITY CONTROL

- A. Test full lengths in accordance with ASTM and ICEA Standards.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install continuous circuit conductors from source to load without splices or terminations in intermediate manholes or pull boxes, except for Number 10 AWG and smaller conductors for lighting and receptacles.
- B. Splices:
 - 1. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths, install and label junction boxes for power conductors or termination cabinets for control and instrument conductors.
 - 2. Power and control conductors routed in common raceways may be spliced in common junction boxes.
 - 3. Install NEMA 4X junction and terminal boxes in wet and outdoor locations. Clearly label junction and terminal boxes containing splices with the word "SPLICE."
 - 4. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
- C. Properly coat wires and cables with pulling compound before pulling into conduits and prevent mechanical damage to conductors during installation.

3.02 600-VOLT CLASS CABLE

- A. Size power conductors in accordance with National Electrical Code when sizes are not indicated on the Drawings.
- B. Install minimum Number 12 AWG wiring for power circuits unless otherwise specified or indicated on the Drawings, and minimum Number 14 AWG for control wiring unless otherwise specified.
- C. Install minimum 14 AWG for internal panel control wiring with type MTW or SIS insulation.
- D. Do not exceed cable manufacturer's pulling tension and side-wall pressures.
- E. Terminations and Splices (600 Volt or Less):
 - 1. Terminations: Terminate control and instrument conductors in terminal boxes in accordance with Section 26 05 33 Raceway and Boxes.
 - 2. Splicing: Join conductors mechanically with splice connectors and install heat-shrink type insulation. Splice conductors in accordance with manufacturer's instructions. Make waterproof heat shrink type splices in wet and below grade locations.
 - 3. Splice or weld grounding conductors of different sizes.
 - 4. Conductor Number 10 AWG and smaller for lighting and receptacle circuits may be spliced in junction boxes with wire nuts.

- F. All conductors of size No. 1/0 AWG and smaller for installation in cable trays and continuing without splices via other conduits; they shall be of the multi-conductor type with overall jacket.

3.03 INSTRUMENTATION CLASS CABLE

- A. Install instrumentation class cables in separate raceway systems.
 - 1. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
 - 2. Install cable without splices between instruments or between field devices and instrument enclosures or panels.
- B. Do not make intermediate terminations, except in designated terminal boxes indicated on the Drawings.
- C. Ground cable shields at only one location, typically at panels, not at field instruments.

3.04 SIGNAL CABLE AND CONDUIT INSTALLATION

- A. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

3.05 FIELD QUALITY CONTROL

- A. Grounding

3.06 FIELD CONDITIONS AND RELATED REQUIREMENTS

- A. Existing underground water table is near or above the location for new ductbanks.
- B. Existing underground pull boxes, handholes, ductbanks, and manholes contain excessive amounts of water, conductors and debris.
- C. CONTRACTOR shall include cost for necessary dewatering, equipment cost to identify raceways, and cleaning equipment to perform the work required for new underground ductbanks, manholes and pull boxes.
- D. CONTRACTOR shall include necessary cost to clean all underground ductbanks and pull boxes prior to installation of required new conductors.

3.07 WIRING ALLOWANCES

- A. CONTRACTOR shall include allowance of necessary conductors and termination to provide any and all motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of location shown on the Drawings.
- B. CONTRACTOR shall include allowance of necessary conductors and related materials to provide any and all pull boxes, manholes and ductbanks within 20 linear feet of location shown on the Drawings.

- C. Prior installation of any raceway or related items identified in paragraphs A and B above, the OWNER shall have the right to make changes related to preferred location, at no additional cost.
- D. CONTRACTOR shall include allowance to provide necessary conductors for all equipment specified, identified in wiring/raceway schedules, equipment schedules, panelboards schedules, electrical single line diagrams, block diagrams, process and instrumentation diagrams (P&IDs), fixture schedules, and devices. Said necessary conductors may not be shown on the plan drawings, but they shall be sized by CONTRACTOR in accordance with requirements of the National Electrical Code, and included in this allowance if the conductor are necessary for the complete operation of the included device or equipment.
- E. Include cost allowance to provide the following wiring for potential extra items not included in contact documents:
 - 1. 500 linear feet of No. 12 AWG-XHHW-2 copper single conductor for installation in conduit.
 - 2. 300 linear feet of No. 14 AWG-XHHW-2 for installation in conduit.
 - 3. 100 linear feet of No. 16 AWG shielded one pair cable for installation in conduit.
 - 4. 500 linear feet of No. 12-2 w/Ground AWG-XHHW-2 with jacket for installation in conduit.

END OF SECTION

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