

EMERALD COAST UTILITIES AUTHORITY
INTERIM LIFT STATION DESIGN AND TECHNICAL STANDARDS

REVISED MAY 2013



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DESIGN STANDARDS

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SECTION 575 - WASTEWATER LIFT STATIONS AND FORCE MAINS

PART 1: GENERAL

1.1 PURPOSE

Lift stations shall be provided at any point in a proposed sewage collection system where the upstream gravity collection system cannot be physically connected to the existing collection system in a manner to permit gravity flow. System extensions shall be designed to avoid lift stations as much as possible.

- A. In general, lift stations may lift flows to a higher elevation, transport flow horizontally or combine lifting and horizontal transport.
- B. In general, lift stations shall utilize submersible pumps placed in a below-ground wet well, unless otherwise noted.

1.2 LOCATION AND DESIGN

Lift station location and design capacity shall be compatible with the ECUA Collection System Master Plan. Lift stations shall be designed to operate effectively at initial flows as well as at ultimate design flows. To that end, each lift station design must address several interrelated elements including, but not limited to:

- A. Wet well size (diameter and depth)
- B. Force main size and lift station piping
- C. Pump and control selection
- D. Flow quantity and lift station appurtenances

1.3 CALCULATIONS

Lift station design calculations submitted to ECUA for approval shall include all design considerations and assumptions. (See Lift Station Design Worksheet, pages 575.6 and 575.7)

PART 2: REFERENCE STANDARDS - See Section 570 – Sanitary Sewer Collection System, Part 2**PART 3: DESIGN FLOWS**

3.1 FLOW REQUIREMENTS

Lift station design flow requirements shall be developed in accordance with Section 570-Sanitary Sewer Collection System, Part 3 of ECUA's Engineering Manual. In addition, flows shall be estimated for each of the following conditions:

- A. Peak hourly flow for initial, intermediate, and ultimate periods

- B. Average flow for initial, intermediate, and ultimate periods
- C. Minimum flow for initial, intermediate, and ultimate periods

PART 4: DESIGN PARAMETERS AND FUNCTIONAL CRITERIA

4.1 LIFT STATION SITING

Lift station shall be located so as to permit sewage collection by means of gravity flow from the largest feasible drainage area. Consideration may be given to locating lift stations to permit continuing future downstream gravity sewer system development where possible and consistent with ECUA's Collection System Master Plan.

- A. General Location: Lift station top elevation shall be above the 100 year flood level as designated by FEMA Flood Maps. In no case should the lift station be placed in an area subject to prolonged periods of flooding. In no case shall the lift station parcel be subject to prolonged periods of flooding.
- B. Access: Lift station access shall be readily accessible to maintenance vehicles at all times. Parcels not fronting on public rights-of-way shall be provided with a dedicated access easement at least 20 feet in width and with adequate provisions for turn-around and gate access. Driveways shall be 12 feet wide minimum and paved with asphalt and capable of supporting H-20 traffic loading.
- C. Parcel Requirements: The lift station site shall be 50 feet in width and 50 feet in depth, at a minimum. A larger parcel may be required if necessary to accommodate additional equipment or access. Title to the lift station site shall be conveyed to ECUA in accordance with ECUA policy. The site shall be fenced in accordance with ECUA requirements unless specifically exempted. The parcel and any associated access driveways shall be designed to permit proper drainage away from the lift station.
- D. Other Considerations: The lift station electrical power service shall be three phase. The potable water service shall be 2-inch in diameter with a backflow preventer and 1 ½ -inch meter.

4.2 FUNCTIONAL CRITERIA

- A. Redundancy: Lift stations shall contain a minimum of 2 pumps with each pump capable of pumping a minimum 250 gallons per minute or peak hourly flow, whichever is greater based on the design point using the calculated system head curve. Peak hourly flow shall be determined using the curve or formula in Appendix E-2 (page 575.9).
- B. Wet Well Sizing: Wet well volume shall be calculated based on the projected ultimate peak flows with consideration for initial peak flows, or a peak hourly flow rate of 250 gallons per minute (62.5 gpm, average daily flow using a 4.0 peaking factor), whichever is greater.

1. Minimum liquid level in the wet well shall be 2 feet above the top of the pumps minimum or in accordance with the manufacturer's requirements for the pump selected, whichever is greater.
 2. Cycle time, to pump down and refill, shall be not less than 10 minutes nor more than 15 minutes at 1/2 peak hourly flow.
 3. The spacing between 'lead pump on' and 'lead pump off' shall be a minimum of 2 feet. Levels will be field adjusted to match calculations.
 4. The spacing between 'lead pump on' and 'lag pump on' shall be a minimum of 1 foot.
 5. The high level alarm shall be set not less than 1 foot above 'lag pump on', and at sufficient depth to provide a minimum of 30 minutes storage, calculated at average flow, below the lowest influent line.
- C. Velocities: The lift station discharge force main (riser piping) velocity at the initial pumping rate shall be not less than 5 fps. The velocity in the discharge force main (riser piping) at the design pumping rate shall be not more than 10 fps. If flow monitoring is required, the riser piping velocity shall be maintained through the flow meter. The force main velocity in the remaining parts of the proposed transmission system (downstream of the the above-grade plug valves or flow meter) shall not be less than 2.5 fps at the initial peak hourly design pumping rate.
- D. Downstream Impacts: Engineer shall coordinate with ECUA Engineering staff to analyze downstream capacities. ECUA staff will assist the engineer to the extent possible with the analyses noted below.
- a. When the force main will manifold into an existing force main the impact on that line and all existing pump stations that utilize that line must be evaluated by the Engineer and ECUA staff.
 - b. When the force main could either discharge to an existing lift station or manifold into that station's force main, an analysis shall be made to determine which alternative is in the best long-term interest of ECUA.
- E. System Head: Calculate system head: static, friction and velocity. Select pumps. (See Worksheet, pages 575.6 and 575.7). Pump curves shall show range and efficiencies, horsepower draw, and shall include the system curve(s) at the initial, intermediate, and ultimate design periods. The maximum system pressure shall not exceed 60 psi (138 feet of head).

4.3

WET WELL DESIGN

The minimum wet well size shall be 8-feet in diameter. The wet well shall be sized by determining the combination of diameter and depth most suitable to handle the intended maximum design capacity with adequate provision for emergency storage.

- A. Elevations: Based on location constraints, functional criteria, and the approximate wet well size, the following design elements shall be established:
1. Ground elevation at wet well.
 2. Lowest influent elevation of gravity system.
 3. "High level alarm" elevation.
 4. "2nd Lag pump on" elevation (for triplex lift stations).
 5. "Lag pump on" elevation.
 6. "Lead pump on" elevation.
 7. "All pumps off" elevation.
 8. Wet well bottom elevation.
- B. Future Needs: When the wet well and force main are oversized for future requirements, the station piping, electrical service, and controls shall be sized accordingly. When it is anticipated that a third pump is to be installed in the future, the station shall be designed to accommodate through-wall piping in the wet well top, a manifold into the discharge force main, and appropriate equipment in the control panel.
- C. Optimization: Compute design elements for larger and/or smaller diameter wet wells, then select optimum size to meet initial and future demands. Wet well sizing, force main sizing and pump selection may require several iterations to arrive at optimum design for sound economic selection over the proposed design period.

PART 5: DETAIL SPECIFICATIONS FOR WET WELL, PUMPS AND CONTROLS

(See Section 02575)

PART 6: APPURTENANCES

6.1 FENCING

The lift station site shall be fenced in accordance with ECUA specifications unless specifically waived by ECUA's Engineer.

- A. The fence shall enclose an area sufficient to protect the lift station and all appurtenances. Minimum size of parcel shall be 50' by 50'.
- B. The electric supply meter shall be outside the fence or located so as to be read without entering the fence.
- C. See Section 02830 for specifications.

6.2 BYPASS PUMPING

Emergency bypass piping with plug valve and quick-connect coupling shall be the same size (up to 8-inch diameter) as the station piping, and shall be located within the valving area as shown on ECUA's Standard Lift Station Detail Sheet.

6.3 EMERGENCY POWER

Standby emergency power will be required as follows:

- A. Lift stations that discharge through a 12-inch diameter or larger piping shall require an on-site emergency generator suitably located and wired for automatic transfer. Generator will be of sufficient size to run all of the station equipment. For duplex lift stations, the generator must be sized to run two pumps at a time. For triplex lift stations, the generator must be sized to run the remaining pump(s) with the largest pump out of service.
- B. All lift stations shall be equipped with a manual transfer switch for connecting a portable generator. Engineer shall coordinate with ECUA to determine the best location for the additional manual transfer switch for lift stations that require an automatic transfer switch (ATS),

6.4 FLOW MEASUREMENT

Flow measuring devices shall be provided with lift stations that have a design flow of 1,200 gpm or greater. Flow measurement device shall have instantaneous, totalizing, and recording capabilities.

6.5 CHEMICAL FEED EQUIPMENT

Chemical feed equipment may be required at lift stations or elsewhere in the collection system if conditions may develop causing generation of hydrogen sulfide and other gases. If chemical feed equipment is not required initially, access must be provided for possible future use.

LIFT STATION DESIGN - WORKSHEET

Project Name: _____

Date: _____

Project Location: _____

By: _____

REQUIRED CALCULATIONS FOR WET WELL DESIGN:

1. Estimate average daily flow (ADF):

Initial (first year) $(\text{ERC} + \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{240}{1440} = \text{gpm}$

Intermediate (this project) $(\text{ERC} + \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{240}{1440} = \text{gpm}$

Ultimate (build-out of lift station coverage area) $(\text{ERC} + \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{240}{1440} = \text{gpm}$

Note: 1 ERC = 240 gpm

2. Select appropriate peaking factor (see Appendix E-2, page 575.9) and determine Design Peak Flow:

Initial Avg. X _____ Peak = _____ gpm

Intermediate Avg. X _____ Peak = _____ gpm

Ultimate Avg. X _____ Peak = _____ gpm

3. Primary Operating Volume in gallons for a minimum cycle time of 12 minutes will be 3 X the pumping rate in gallons per minute. Note: The spacing between 'lead pump on' and 'lead pump off' shall be a minimum of 2 feet. Levels will be field adjusted to match calculations.

Compute for Initial and Ultimate conditions.

4. Compute Primary Operating Range = Vol. required divided by Vol. per vertical foot. Compute for Initial, Intermediate, and Ultimate conditions.
5. Calculate Emergency Storage Time (see paragraph 4.2, B.5, page 575.3).
6. Calculate Emergency Storage Volume = Emergency Storage Time X QAV. Calculate for Initial and Ultimate Flow conditions. The minimum emergency storage volume shall be 1,880 gallons (5-feet of additional depth for 8-foot diameter wet well).
7. Calculate Alarm Time Range = Alarm Volume divided by volume per vertical foot.
8. Identify the lowest discharge (or spill) point assuming lift station has failed and system is surcharging.
9. Establish critical pump control elevations.

10. Check Flotation: Total weight - buoyancy force x 1.2 must be positive.

REQUIRED CALCULATION FOR FORCE MAIN DESIGN:

Compute System Curve

TDH shall be evaluated separately for discharge elevation and elevation of high points of the force main, and for initial and aged "C" factors. The typical "C" factors for PVC for initial and aged conditions shall be 140 and 100, respectively. Other "C" factors may be utilized as necessary when analyzing piping of various materials (e.g. ductile iron).

Static Head High Point ____ or Discharge Elevation ____ - Pump Off ____ = ____ ft.

Pump Selection:

| PERIOD | PUMP | | | MOTOR | | | | PERFORMANCE | | |
|--------------|------|-------|----------|-------|----|-----|-------|-------------|-----|--------|
| | MAKE | MODEL | IMPELLER | MODEL | HP | RPM | ELEC. | GPM | TDH | EFFIC. |
| Initial | | | | | | | | | | |
| Intermediate | | | | | | | | | | |
| Ultimate | | | | | | | | | | |

APPENDIX E-1**LIFT STATION DESIGN
REFERENCE DATA***Capacity of Force Mains at Given Velocity $Q = AV$ gpm*

| VELOCITY fps | FORCE MAINS - NOMINAL SIZE - INCHES DIAMETER | | | | | | | | | | |
|-----------------|--|-----|-----|-----|------|------|------|------|------|------|-------|
| | 2" | 3" | 4" | 6" | 8" | 10" | 12" | 14" | 16" | 20" | 24" |
| 2 | 20 | 40 | 80 | 180 | 310 | 490 | 700 | 960 | 1250 | 1960 | 2820 |
| 2.5 | 25 | 60 | 100 | 220 | 390 | 610 | 880 | 1200 | 1570 | 2450 | 3520 |
| 3 | 30 | 70 | 120 | 260 | 470 | 730 | 1060 | 1440 | 1880 | 2940 | 4230 |
| 4 | 40 | 90 | 160 | 350 | 630 | 980 | 1410 | 1920 | 2510 | 3910 | 5640 |
| 5 | 50 | 110 | 200 | 440 | 780 | 1220 | 1760 | 2400 | 3130 | 4890 | 7050 |
| 6 | 60 | 130 | 230 | 530 | 940 | 1470 | 2110 | 2880 | 3760 | 5870 | 8460 |
| 7 | 70 | 150 | 270 | 620 | 1100 | 1710 | 2470 | 3360 | 4380 | 6850 | 9860 |
| 8 | 80 | 180 | 310 | 700 | 1250 | 1960 | 2820 | 3840 | 5010 | 7830 | 11270 |
| 9 | 90 | 200 | 350 | 790 | 1410 | 2200 | 3170 | 4320 | 5640 | 8810 | 12680 |
| 10 | 100 | 220 | 390 | 880 | 1570 | 2450 | 3520 | 4800 | 6260 | 9790 | 14090 |

(for friction losses and full chart see Appendix E-3, page 575.10)

| PIPE VOLUME (Gal/100 FT): | | | | | | | | | | | | |
|---------------------------|----|----|----|-----|-----|-----|-----|-----|------|------|------|------|
| Diam. | 2" | 3" | 4" | 6" | 8" | 10" | 12" | 14" | 16" | 20" | 24" | 36" |
| Vol. | 19 | 42 | 70 | 153 | 259 | 405 | 573 | 800 | 1044 | 1632 | 2350 | 5284 |

Manhole or Wet Well Volume per Vertical Foot in Gallons

| DIAMETER (FT) | 4 | 5 | 6 | 8* | 10 | 12 | 14 |
|---------------|------|-------|-------|-------|-------|-------|--------|
| VOL. (GAL) | 94.0 | 147.0 | 211.5 | 376.0 | 587.5 | 846.0 | 1151.5 |

*(adjust for reduced diameters for sidewall taper at bottom)*** smallest wet well diameter allowed for lift stations*

APPENDIX E-3

FRICITION LOSS PER 100 FEET LENGTH OF PIPE. BASED ON HAZEN-WILLIAMS FORMULA USING "C" FACTOR OF 140. SIZES OF STANDARD PIPE IN INCHES.

| Flowrate (gallons/min) | 1/2-inch | | 3/4-inch | | 1-inch | | 1 1/4-inch | | 1 1/2-inch | | 2-inch | | 2 1/2-inch | | 3-inch | | 4-inch | | 5-inch | | 6-inch | | | | | |
|---------------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|-------|-------|-------|------|
| | Velocity (feet/sec) | Loss (ft/100 ft) | | | | |
| 2 | 2.11 | 4.07 | 1.20 | 1.03 | 0.74 | 0.32 | 0.43 | 0.08 | 0.32 | 0.04 | 0.19 | 0.01 | 0.13 | 0.00 | 0.09 | 0.00 | 0.05 | 0.00 | 0.03 | 0.00 | 0.02 | 0.00 | | | | |
| 4 | 4.23 | 14.69 | 2.41 | 3.73 | 1.49 | 1.15 | 0.86 | 0.30 | 0.63 | 0.14 | 0.38 | 0.04 | 0.27 | 0.02 | 0.17 | 0.01 | 0.10 | 0.00 | 0.06 | 0.00 | 0.04 | 0.00 | | | | |
| 6 | 6.34 | 31.13 | 3.61 | 7.91 | 2.23 | 2.44 | 1.29 | 0.64 | 0.95 | 0.30 | 0.57 | 0.09 | 0.40 | 0.04 | 0.26 | 0.01 | 0.15 | 0.00 | 0.10 | 0.00 | 0.07 | 0.00 | | | | |
| 8 | 8.46 | 53.04 | 4.82 | 13.48 | 2.97 | 4.16 | 1.72 | 1.10 | 1.26 | 0.52 | 0.77 | 0.15 | 0.54 | 0.06 | 0.35 | 0.02 | 0.20 | 0.01 | 0.13 | 0.00 | 0.09 | 0.00 | | | | |
| 10 | 10.57 | 80.18 | 6.02 | 20.38 | 3.71 | 6.29 | 2.15 | 1.66 | 1.58 | 0.78 | 0.96 | 0.23 | 0.67 | 0.10 | 0.43 | 0.03 | 0.25 | 0.01 | 0.16 | 0.00 | 0.11 | 0.00 | | | | |
| 12 | 12.69 | 112.38 | 7.22 | 28.56 | 4.46 | 8.82 | 2.58 | 2.32 | 1.89 | 1.10 | 1.15 | 0.33 | 0.80 | 0.14 | 0.52 | 0.05 | 0.30 | 0.01 | 0.19 | 0.00 | 0.13 | 0.00 | | | | |
| 15 | 15.86 | 169.89 | 9.03 | 43.18 | 5.57 | 13.34 | 3.22 | 3.51 | 2.37 | 1.66 | 1.44 | 0.49 | 1.01 | 0.21 | 0.65 | 0.07 | 0.38 | 0.02 | 0.24 | 0.01 | 0.17 | 0.00 | | | | |
| 18 | 19.03 | 238.13 | 10.84 | 60.52 | 6.69 | 18.70 | 3.86 | 4.92 | 2.84 | 2.33 | 1.72 | 0.69 | 1.21 | 0.29 | 0.78 | 0.10 | 0.45 | 0.03 | 0.29 | 0.01 | 0.20 | 0.00 | | | | |
| 20 | | | 12.04 | 73.56 | 7.43 | 22.72 | 4.29 | 5.98 | 3.15 | 2.83 | 1.91 | 0.84 | 1.34 | 0.35 | 0.87 | 0.12 | 0.50 | 0.03 | 0.32 | 0.01 | 0.22 | 0.00 | | | | |
| 25 | | | 15.05 | 111.20 | 9.29 | 34.35 | 5.37 | 9.05 | 3.94 | 4.27 | 2.39 | 1.27 | 1.68 | 0.53 | 1.09 | 0.19 | 0.63 | 0.05 | 0.40 | 0.02 | 0.28 | 0.01 | | | | |
| 30 | | | 18.06 | 155.86 | 11.14 | 48.15 | 6.44 | 12.68 | 4.73 | 5.99 | 2.87 | 1.78 | 2.01 | 0.75 | 1.30 | 0.26 | 0.76 | 0.07 | 0.48 | 0.02 | 0.33 | 0.01 | | | | |
| 35 | | | | | 13.00 | 64.06 | 7.51 | 16.87 | 5.52 | 7.97 | 3.35 | 2.36 | 2.35 | 1.00 | 1.52 | 0.35 | 0.88 | 0.09 | 0.56 | 0.03 | 0.39 | 0.01 | | | | |
| 40 | | | | | 14.86 | 82.03 | 8.59 | 21.60 | 6.31 | 10.20 | 3.83 | 3.03 | 2.68 | 1.27 | 1.74 | 0.44 | 1.01 | 0.12 | 0.64 | 0.04 | 0.44 | 0.02 | | | | |
| 45 | | | | | 16.72 | 102.03 | 9.66 | 26.87 | 7.10 | 12.69 | 4.31 | 3.76 | 3.02 | 1.58 | 1.95 | 0.55 | 1.13 | 0.15 | 0.72 | 0.05 | 0.50 | 0.02 | | | | |
| 50 | | | | | | | 10.73 | 32.66 | 7.88 | 15.43 | 4.78 | 4.57 | 3.35 | 1.93 | 2.17 | 0.67 | 1.26 | 0.18 | 0.80 | 0.06 | 0.56 | 0.02 | | | | |
| 60 | | | | | | | 12.88 | 45.77 | 9.46 | 21.62 | 5.74 | 6.41 | 4.02 | 2.70 | 2.61 | 0.94 | 1.51 | 0.25 | 0.96 | 0.08 | 0.67 | 0.03 | | | | |
| 70 | | | | | | | 15.02 | 60.90 | 11.04 | 28.77 | 6.70 | 8.53 | 4.69 | 3.59 | 3.04 | 1.25 | 1.77 | 0.33 | 1.12 | 0.11 | 0.78 | 0.05 | | | | |
| 80 | | | | | | | 17.17 | 77.98 | 12.62 | 36.84 | 7.65 | 10.92 | 5.36 | 4.60 | 3.47 | 1.60 | 2.02 | 0.43 | 1.28 | 0.14 | 0.89 | 0.06 | | | | |
| 90 | | | | | | | 19.32 | 96.99 | 14.19 | 45.81 | 8.61 | 13.58 | 6.03 | 5.72 | 3.91 | 1.99 | 2.27 | 0.53 | 1.44 | 0.18 | 1.00 | 0.07 | | | | |
| 100 | | | | | | | | | 15.77 | 55.69 | 9.57 | 16.51 | 6.71 | 6.95 | 4.34 | 2.42 | 2.52 | 0.64 | 1.60 | 0.21 | 1.11 | 0.09 | | | | |
| 110 | | | | | | | | | 17.35 | 66.44 | 10.52 | 19.70 | 7.38 | 8.30 | 4.78 | 2.88 | 2.77 | 0.77 | 1.77 | 0.26 | 1.22 | 0.10 | | | | |
| 120 | | | | | | | | | 18.92 | 78.05 | 11.48 | 23.14 | 8.05 | 9.75 | 5.21 | 3.39 | 3.03 | 0.90 | 1.93 | 0.30 | 1.33 | 0.12 | | | | |
| 130 | | | | | | | | | 20.50 | 90.53 | 12.44 | 26.84 | 8.72 | 11.31 | 5.65 | 3.93 | 3.28 | 1.05 | 2.09 | 0.35 | 1.44 | 0.14 | | | | |
| 140 | | | | | | | | | | | 13.39 | 30.79 | 9.39 | 12.97 | 6.08 | 4.51 | 3.53 | 1.20 | 2.25 | 0.40 | 1.56 | 0.16 | | | | |
| 150 | | | | | | | | | | | 14.35 | 34.99 | 10.06 | 14.74 | 6.51 | 5.12 | 3.78 | 1.37 | 2.41 | 0.45 | 1.67 | 0.19 | | | | |
| 160 | | | | | | | | | | | 15.31 | 39.43 | 10.73 | 16.61 | 6.95 | 5.77 | 4.04 | 1.54 | 2.57 | 0.51 | 1.78 | 0.21 | | | | |
| 170 | | | | | | | | | | | 16.26 | 44.11 | 11.40 | 18.58 | 7.38 | 6.46 | 4.29 | 1.72 | 2.73 | 0.57 | 1.89 | 0.23 | | | | |
| 180 | | | | | | | | | | | 17.22 | 49.04 | 12.07 | 20.65 | 7.82 | 7.18 | 4.54 | 1.91 | 2.89 | 0.64 | 2.00 | 0.26 | | | | |
| 190 | | | | | | | | | | | 18.18 | 54.20 | 12.74 | 22.83 | 8.25 | 7.93 | 4.79 | 2.11 | 3.05 | 0.70 | 2.11 | 0.29 | | | | |
| 200 | | | | | | | | | | | 19.13 | 59.60 | 13.41 | 25.10 | 8.69 | 8.73 | 5.04 | 2.33 | 3.21 | 0.77 | 2.22 | 0.32 | | | | |
| 225 | | | | | | | | | | | 21.53 | 74.13 | 15.09 | 31.22 | 9.77 | 10.85 | 5.67 | 2.89 | 3.61 | 0.96 | 2.50 | 0.39 | | | | |
| 250 | | | | | | | | | | | 23.92 | 90.11 | 16.76 | 37.95 | 10.86 | 13.19 | 6.30 | 3.52 | 4.01 | 1.17 | 2.78 | 0.48 | | | | |
| 275 | | | | | | | | | | | | | | | | | 18.44 | 45.28 | 11.94 | 15.74 | 6.94 | 4.19 | 4.41 | 1.40 | 3.06 | 0.57 |
| 300 | | | | | | | | | | | | | | | | | 20.12 | 53.20 | 13.03 | 18.49 | 7.57 | 4.93 | 4.81 | 1.64 | 3.33 | 0.67 |
| 325 | | | | | | | | | | | | | | | | | | | 14.11 | 21.44 | 8.20 | 5.72 | 5.22 | 1.90 | 3.61 | 0.78 |
| 350 | | | | | | | | | | | | | | | | | | | 15.20 | 24.60 | 8.83 | 6.56 | 5.62 | 2.18 | 3.89 | 0.89 |
| 375 | | | | | | | | | | | | | | | | | | | 16.29 | 27.95 | 9.46 | 7.45 | 6.02 | 2.48 | 4.17 | 1.01 |
| 400 | | | | | | | | | | | | | | | | | | | 17.37 | 31.50 | 10.09 | 8.40 | 6.42 | 2.80 | 4.44 | 1.14 |
| 425 | | | | | | | | | | | | | | | | | | | 18.46 | 35.24 | 10.72 | 9.39 | 6.82 | 3.13 | 4.72 | 1.28 |
| 450 | | | | | | | | | | | | | | | | | | | 19.54 | 39.18 | 11.35 | 10.44 | 7.22 | 3.48 | 5.00 | 1.42 |
| 475 | | | | | | | | | | | | | | | | | | | 20.63 | 43.30 | 11.98 | 11.54 | 7.62 | 3.84 | 5.28 | 1.57 |
| 500 | | | | | | | | | | | | | | | | | | | 12.61 | 12.69 | 8.02 | 4.23 | 5.56 | 4.17 | 1.73 | |
| 600 | | | | | | | | | | | | | | | | | | | 15.13 | 17.79 | 9.63 | 5.92 | 6.67 | 6.67 | 2.42 | |
| 700 | | | | | | | | | | | | | | | | | | | 17.65 | 23.67 | 11.23 | 7.88 | 7.78 | 7.78 | 3.22 | |
| 800 | | | | | | | | | | | | | | | | | | | 20.18 | 30.31 | 12.84 | 10.09 | 8.89 | 8.89 | 4.13 | |
| 900 | | | | | | | | | | | | | | | | | | | | | 14.44 | 12.55 | 10.00 | 5.13 | | |
| 1000 | | | | | | | | | | | | | | | | | | | | | 16.05 | 15.26 | 11.11 | 6.24 | | |
| 1100 | | | | | | | | | | | | | | | | | | | | | 17.65 | 18.20 | 12.22 | 7.44 | | |
| 1200 | | | | | | | | | | | | | | | | | | | | | 19.26 | 21.38 | 13.33 | 8.75 | | |
| 1300 | | | | | | | | | | | | | | | | | | | | | 20.86 | 24.80 | 14.45 | 10.14 | | |
| 1400 | | | | | | | | | | | | | | | | | | | | | | | | 15.56 | 11.64 | |
| 1500 | | | | | | | | | | | | | | | | | | | | | | | | 16.67 | 13.22 | |
| 1600 | | | | | | | | | | | | | | | | | | | | | | | | 17.78 | 14.90 | |
| 1700 | | | | | | | | | | | | | | | | | | | | | | | | 18.89 | 16.67 | |
| 1800 | | | | | | | | | | | | | | | | | | | | | | | | 20.00 | 18.53 | |
| 1900 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2000 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2100 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2200 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2300 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2400 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2500 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2750 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3000 | | | | | | | | | | | | | | | | | | | | | | | | | | |

| "C" Factor: | Multiply Loss By: |
|-------------|-------------------|
| 130 | 1.15 |
| 120 | 1.33 |
| 110 | 1.56 |
| 100 | 1.86 |

02575 - WASTEWATER LIFT STATIONPART 1: GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, test and place in operation the sewage pumping station shown on the approved drawings and specified hereinafter. All applicable sections of the ECUA Water and Sewer Standards shall be considered part of this work. All references to Industry Standards (ASTM, ANSI, etc.) shall be to the latest revision unless otherwise stated. Only those materials included in the ECUA Water and Sewer Standards Manual, (including, but not limited to, submersible pumps, VFD equipment and control panels), shall be installed. All materials shall be new unless specifically called for otherwise. All structures, pumps and panels shall require a complete shop drawing submittal for ECUA's review and approval.

1.2 SUBMITTALS

- A. Actual catalog data, brochures and descriptive literature will be required for wet well, pumps, piping, valves, and rebar spacing at a minimum as specified herein. The wet well manufacturer shall provide up-lift calculations (signed and sealed by a Florida Registered Professional Engineer) for the wet well. Groundwater level shall be assumed to be at grade unless specific geotechnical exploration indicates the groundwater level should be assumed at a lower elevation. However, in no case shall the groundwater elevation be considered at lower than one-half the depth of the wet well.
- B. Submit under provisions of the General Provisions.
1. The Contractor installing all work shall review and approve all shop drawings prior to submittal to the Engineer for review. As part of the review, the contractor shall certify the following and include this statement on each submittal:
- a. I hereby certify that the equipment and devices shown and marked in this submittal are in compliance with the contract drawing and specifications, can be installed in the allocated space, will be stored in accordance with the manufacturer's recommendation and is submitted for approval.

Certified by: _____ Date: _____

- C. Submit six (6) sets of shop drawings and product data grouped to include complete submittal of related systems, products, and accessories in a single submittal. No lift station work may be performed until shop drawings are approved. Submit Shop Drawings on the following systems as grouped below:
1. Wet Well
 - a. Flotation Calculations (Signed and Sealed by Florida Registered P.E.)
 - b. Base Thickness and Compaction Requirements
 - c. Pipe Invert Elevations
 - d. Pump Mounting Base
 - e. Warranty Information
 - f. Aluminum Hatches and Locations
 - g. Safety Grating
 - h. Orientation Diagram
 2. Concrete Rebar Spacing Drawings
 - a. Lift Station Base and Top Slabs
 - b. Generator Slab
 - c. SCADA Antenna Base
 - d. Control Panel Base
 - e. Concrete Pipe Supports
 3. Submersible Pumps
 - a. Pump Curve (Variable Speed and Fixed Speed)
 - b. NPSH Curves
 - c. Horsepower Curves
 - d. Efficiency Curves
 - e. Pump Efficiency (Pump and Motor Efficiency Provided Separately)\
 - f. Pump Cables
 - g. Pump Materials
 - h. Base Elbow
 - i. Guide Rail System
 - j. Lifting Bales
 4. Piping and Appurtenances
 - a. Plug Valves
 - b. Check Valves
 - c. Backflow Prevention Device
 - d. Stainless Steel Riser Piping and Fittings
 - e. Pipe Bracing
 - f. Float Hangar Rod Assembly
 - g. Floats
 - h. Level Transducer
 - i. Flow Meter (if applicable)
 - j. Pressure Transmitter
 - k. Air Release Valves
 - l. Pipe Supports and Location Schematic

- 5. Miscellaneous Mechanical Equipment
 - a. Miscellaneous Mechanical Parts

D. Mark dimensions and values in units to match those specified.

1.3 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Excavation, Backfilling and Compaction: Section 02221
- B. Water Distribution Lines/Service Lines: Section 02556
- C. Gravity Sanitary Sewer: Section 02570
- D. Sanitary Force Main: Section 02576
- E. Fiberglass Wet Well: Section 02577
- F. Fencing: Section 02830
- G. Cast-in-Place Concrete: Section 03300
- H. Electrical - Sections 16010-16050

1.4 QUALITY ASSURANCES

Comply with the latest published editions of AWWA and ASTM Standards

- A. AWWA C515 - Gate Valves for Water & Sewerage Systems
- B. AWWA C509 - Swing Check Valves for Waterworks
- C. AWWA C151 - Ductile Iron Pipe
- D. ASTM A746 - Ductile Iron Pipe
- E. ASTM C478 - Concrete Pipe Manholes
- F. ASTM D2241 - Poly Plastic Pipe
- G. ASTM F477 - Elastomeric Seals for Plastic Pipe

PART 2 - WARRANTY

2.1 CONTRACTOR WARRANTY

- A. The Contractor shall supply to ECUA a two (2) year unconditional warranty after final acceptance or any designated portion thereof. The warranty shall include materials and installation and shall constitute complete replacement and delivery to the site of materials and installation of same to replace defective materials or defective workmanship with new materials/workmanship conforming to the specifications.

2.2 FIBERGLASS WET WELL MANUFACTURER WARRANTY

- A. The fiberglass wet well manufacturer shall warrant the wet well against defects for at least twenty (20) years after final acceptance of the lift station by

ECUA for operation and maintenance. Defects are defined as cracking, delamination or leaking. The warranty shall require the manufacturer to supply all necessary labor, materials, and equipment to repair defects to satisfaction of ECUA. The Contractor and/or manufacturer shall not make any exemption or exception to the above stated conditions or warranty.

2.3 PUMP MANUFACTURER WARRANTY

- A. The manufacturer shall warrant to ECUA for permanent installation in municipal sewage service submersible pump and motor against defects in materials and workmanship including normal wear and tear to the following parts for a period of 5 years after final acceptance of the lift station, mechanical seals, bearings, shafts, motor electrical cables and motor stators.
- B. The warranty shall include no less than 100% coverage for original equipment manufactured (OEM) parts and in-shop labor for pump/motor repairs for the full 5 years at NO COST to ECUA. This warranty shall not apply to parts that fail due to abuse, neglect, mishandling, or acts of God.
- C. Verification of guarantees of performance and warranty certificate shall be indicated in the shop drawing submittal and in the operation and maintenance manuals and disks (Adobe Acrobat or Microsoft Word).
- D. The pump distributor shall employ and make available proficient manufacturer-authorized service technicians to perform service calls to pumps supplied to ECUA. Service personnel shall adhere to all ECUA Safety Rules & Regulations and be trained and certified for confined space entries and carry liability and workers compensation insurance.
- E. During the warranty period, the pump distributor shall, at no cost to ECUA, repair the subject pump. The location address, contact names, phone numbers, (including emergency, mobile, etc.) and fax numbers of the manufacturer-authorized warehouse and warranty service center shall be indicated in the shop drawing submittal and in the operation and maintenance manuals and disks (Adobe Acrobat or Microsoft Word).

PART 3 - GENERAL REQUIREMENTS

3.1 PROJECT SCHEDULE AND COOPERATION

- A. The project schedule shall be established on the basis of working a normal work schedule including five days per week, single shift, eight hours per day or four days per week, single shift, ten hours per day, except for ECUA recognized holidays. Unless approved otherwise by ECUA, normal or general

items of work such as setting wet well, field pump test, density testing and final inspections, shall be scheduled during the normal work schedule. Due to operational and manpower limitations on the ECUA systems, ECUA may require the contractor to perform work outside of the normal work schedule. These operational and manpower limitations, including but not limited to, tie-in work (cut-in work or other work) and other phases of the work which may impact the continued (non-interruptible) service to existing ECUA customers. The contractor shall plan and anticipate the cost impact of these systems limitations and provide such work or services at no additional cost to ECUA. Unless approved otherwise, an ECUA representative shall be present to observe the excavated area prior to setting (installing) the wet well. The date and time for setting (installing) the pre-cast or fiberglass wet well shall be reviewed and approved by ECUA, prior to the actual work.

3.2 AS-BUILT DRAWINGS

- A. As-built drawings are required on all sewer, force main and pump station projects, including projects for ECUA, City of Pensacola, Escambia County, DOT, private developments, and other Authorities, etc. As-built drawings shall be reviewed and approved by ECUA. The cost to provide as-built drawings shall be included as part of the related work requirements or general conditions for the utility work. **Contractor shall submit “As Built” drawings and operation and maintenance manuals before lift station start-up, no exceptions.**

3.4 WORKMANSHIP

- A. Materials: All work shall be constructed in accordance with the drawings and specifications. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor with no additional compensation.
1. All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified.
 2. Unless indicated otherwise on the drawings, all metal components in the wet well, with the exception of pumps and motors shall be 316 stainless steel as specified herein or on the plans.
 3. The pumps, motors and guide rail system shall be supplied by the pump supplier to ensure unit compatibility.
 4. Station piping shall conform to ECUA Water and Sewer Standards. Specifically, station piping shall be as follows:
 - a) Piping within the wet well shall be flanged schedule 10 316 stainless steel, (intermediate joints shall be welded). Fittings within the wet well shall be flanged 316 stainless steel. All nuts, bolts and accessories within the wet well shall be 316 stainless steel.

- b) Pipe and fittings outside of the wet well and above ground shall be 316 stainless steel (flanged, schedule 10). All fabricated fittings shall be constructed to ANSI dimensions. If a spool piece is required, the length of the “run” or “through” dimension of a standard tee fitting of equal diameter to facilitate emergency replacement. Any variance shall be pre-approved by ECUA prior to installation. All bolts, washers and nuts shall be 316 stainless steel and shall be coated with “Never Seize” anit-sieze compound.
- c) Force main piping below ground, outside of the wet well shall be in accordance with Section 02576 – Sanitary Sewer Force Mains of this standards manual.
- d) Minimum wet well size shall be 8 foot diameter. A 12 foot diameter wet well (minimum) shall be utilized in cases where the pump discharge piping (in the wet well) is 10-inch diameter or larger.

3.5 REFERENCE POINTS AND LAYOUT

- A. The Contractor shall be responsible for setting all grade stakes, lines and levels. The Contractor or Contractor’s Surveyor will provide centerline of construction and will establish a bench mark. Any reference points, points of intersection, property corners, or bench marks, which are disturbed during construction, shall be restored by a Land Surveyor registered to practice in the State of Florida, and all costs thereof shall be borne by the Contractor. The Contractor shall assume all responsibility for the correctness of the grade and alignment stakes.

PART 4 - SUBMERSIBLE PUMPS

4.1 OPERATING CONDITIONS AND UNIT SIZES

- A. Operating conditions and unit sizes shall be as shown on the drawings. The pump design operating conditions shall be within 10% +/- of the best efficiency point, unless otherwise approved by ECUA. When possible, the pump selection shall initially operate near and to the right of the best efficiency point (BEP).

4.2 SHOP DRAWINGS AND PUMP TAGS

- A. Prior to commencing the pumping station installation and/or the furnishing of replacement pumps, the pump vendor shall submit for approval, detailed and dimensioned shop drawings for pumps including factory curves of identical model pumps provided to ECUA. The pump vendor shall furnish and deliver at the time of acceptance for use of the lift station and/or of the replacement pump(s) by ECUA, 3 compact disks (Adobe Acrobat, Microsoft Word or

Excel) and 6 manuals containing Operation & Maintenance data and motor and pump nameplate data (including serial numbers) for each pump supplied. The pump vendor shall provide a stainless steel or aluminum placard or tag which indicates all operating conditions of the pumps, including name plate data, impeller size and part number, design flow, TDH, and other pump related data. The tag shall be placed (with adhesive) inside the front panel of the pump control panel or as directed by ECUA.

4.3 PUMP EQUIPMENT:

- A. Pumping equipment shall be premium quality submersible non-clog pumps for sewage service. Pumps shall be as listed in **Table 1: ECUA Pump Selection Chart** provided at the end of this section. Submersible pumps shall be complete with a submersible electric motor, floor-mounted discharge base and elbow, guide rails, motor electrical cable (minimum 50 feet in length) to connect at the control panel, disconnect, or junction box (no splicing allowed) and all other appurtenances specified or otherwise required for proper operation. Supplied pump cables are not to be trimmed without prior authorization and, if trimming is allowed, must be witnessed by ECUA Lift Station Maintenance Staff.

4.4 GENERAL

- A. Equipment furnished and installed shall be fabricated, assembled, erected and placed in proper operating condition in full accordance with approved drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer, unless exceptions are noted and approved by ECUA. A letter from the pump manufacturer must be included in the submittal stating compliance to project specifications. Maximum motor horsepower shall be non-overloading over the entire length of the pump curve unless otherwise noted and approved.

4.5 SERVICE CONDITIONS:

- A. Pump performance shall be stable and free from cavitations and excessive vibration and noise throughout the specified operating head range at minimum suction submergence. Pump shall be designed so that reverse rotation at rated head will not cause damage to any component. Pump manufacturer shall supply a registered engineer to witness the pump tests and sign and seal the Certified Hydraulic Institute test reports.

4.6 MATERIALS

- A. Major pump components shall be of gray cast iron unless otherwise noted. The Contractor/Developer shall furnish a spare pump impeller, volute, wear rings, wear plate, seals, and all other necessary maintenance parts for each installed pump specified. The spare pump impeller shall not be trimmed. The spare parts shall be delivered to ECUA in a storage box made with pressure treated wood and marked with the lift station number and applicable pump model on all visible sides. As an alternate, the Contractor/Developer may supply a complete single spare pump in lieu of the various spare parts listed above.

4.7 SOLIDS HANDLING PUMP CONSTRUCTION

- A. Impeller: The impeller casing shall have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The impeller shall be a semi-open or enclosed one-piece casting and must pass a minimum 3-inch solid sphere. Vortex impellers may be used with prior authorization from ECUA staff on a case-by-case basis. The interior water passages shall have uniform sections and smooth surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft by means of a key and self-locking bolt or nut. All interior surfaces of the wet end (impeller, volute and back plate) shall be coated with Belzona 1321 Ceramic S-metal or preapproved equal. Hardened metallurgy may be required in sewer collection areas that are known to have a high grit content. Coatings shall be applied in accordance with coating manufacturer's recommendations.
- B. Mechanical Seals (Upper and Lower Seals): Pumps shall have mechanical seals, which shall require neither maintenance nor adjustment and shall be readily accessible for inspection and replacement. The seals shall not rely upon the pumped media for lubrication and shall not be damaged if the pump is run un-submerged for extended periods while pumping under load. Mechanical seals shall be solid hard faced, (not laminated type). The bottom and top seals shall be silicon carbide.
- C. Mating Surfaces: All mating surfaces (pump assembly), of major components shall be machined and fitted with o-rings where watertight sealing is required.
- D. Wear Rings: Impeller and volute must have stainless steel wear ring system (except vortex impellers). Impeller wear ring shall be 300 series Brinnell hardness, minimum, and volute wear ring shall be 400 series Brinnell hardness, minimum. Wear rings may not be required if hardened metallurgy components are utilized.

- E. Discharge Base and Elbow: The pump manufacturer shall furnish a discharge base and discharge elbow for the pump supplied. The base shall be sufficiently rigid to firmly support the guide rails, discharge piping and pump under all operating conditions. The base shall be suitable for bolting to the floor, (bolting to the pump mounting bracket, see details on drawings), of the wet well. All bolts shall be supplied with a fender and lock washer. The face of the discharge elbow inlet flange shall make contact with the face of the pump discharge nozzle flange. The pump and motor assembly shall be a “quick disconnect” type connected to and supported by the discharge base and guide rails allowing the pump to be removed from the wet well and replaced without the need for unbolting any flange or requiring personnel to enter the wet well. Pump shall be provided with a sealing flange and guide rail sliding bracket. The bracket shall be designed to obtain a leak proof seal between flange faces as final alignment of the pump occurs in the connected position. The bracket shall maintain proper contact and a suitably sealed connection between flange faces under all operating conditions. Metal to metal mating surfaces are unacceptable.
- F. Motors: The pump shall be driven by a totally submersible electric motor rated for service utilizing an adjustable-speed drive (VFD). Pump motor shall be of sufficient horsepower as to be non-overloading over the entire length of the pump curve. The stator housing shall be a watertight casing. Motor insulation shall be moisture resistant, Class H, at a minimum. Motor shall be NEMA Design B for continuous duty at 40 degree C ambient temperature and designed for at least 10 starts per hour. All motors shall be 3 phase unless preapproved by ECUA. Motor bearings shall be anti-friction, permanently lubricated type. Motor shall be oil-cooled and designed to operate in a totally or partially submerged condition without damage to the motor. Pump cable assembly shall bear a permanently embossed code or legend indicating the cable is suitable for submerged and hazardous duty use. Cable sizing shall conform to NEC requirements. The cable shall enter the pump(s) through a heavy-duty stainless steel assembly with grommet. An epoxy seal system shall be provided to this cable entrance assembly to achieve water tightness. The system used shall ensure a watertight submersible seal. Cable shall terminate in a junction chamber. Junction chamber shall be sealed from the motor by a compression seal and epoxy dam system. All motors shall be explosion proof. Provide motors that are FM or UL listed for use in Class I Division 1 Groups C&D hazardous locations as defined by the National Electric Code.
- G. Balance: All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as possible. Excessive vibration shall be sufficient cause for rejection of the equipment. The pump impellers shall be re-balanced after being trimmed and coated.

4.8 GUIDE RAILS

- A. Pump shall be equipped with two guide rails (no cable wire assembly). Guide rails shall be schedule 40 pipe, minimum, a minimum of 2-inches in diameter and sized to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to the access hatch cover at the top of the wet well. Intermediate rail braces shall be provided and evenly spaced for wet wells greater than 15 feet in depth. Braces secured to the discharge piping shall not be accepted. Guide rails and brackets shall be 316 stainless steel, no exceptions.
- B. Pump removal shall be facilitated by a lifting bale only, no chains or cables are allowed unless specifically noted by ECUA. Lifting bales shall be stainless steel and shall be easily “hooked” from the top of the wet well. Lifting bale shall be designed for the full weight of the pump with a safety factor of 1.6.

4.10 INSTALLATION

- A. Pump discharge base shall be leveled, plumbed and aligned into position to fit connecting piping. The discharge base shall be solidly secured to the wet well floor using the pump mounting plate and appropriately sized 316 stainless steel anchors. This work shall be inspected by ECUA prior to any liquid being allowed into the wet well. After final alignment and bolting, pump discharge base and all connections shall be inspected. If any movement or opening of any joints is observed, any and all piping, including pump discharge base, shall be corrected.

PART 5 - FRAME AND COVERS

- A. Access frame and covers shall be suitable size for pumping units furnished and shall be constructed of skid-proof aluminum with a minimum load rating of 300 lbs. /sq. ft. or H-20 traffic loading when called for on the drawings. Frame and covers shall be furnished complete with stainless steel staple assembly (not recessed) for the locking mechanism, hold-open device, upper guide holder and cable holder. Access covers shall be hinged to open as indicated on the drawings. Hatches shall be sized to provide a 4-inch minimum clearance between hatch and pump volute (measured from all sides and includes the pump and rail system). Hatches shall be gasketed to minimize water intrusion and odors, with drain piping.
- B. All hinges, fasteners and miscellaneous hardware shall be 316 stainless steel. For tamper proof and security purposes, the hinges shall be bolted to the door(s) with stainless steel carriage bolts and nuts. The nuts shall be welded to

the bolts on both the door(s) and frame. ECUA will provide pad locks, as required. Locks shall be easily accessed, no slam-lock-type locking mechanisms will be allowed.

PART 6 - VALVES

6.1. GENERAL

- A. The contractor shall furnish and install check valves, plug valves, and appurtenances as shown on the drawings and as specified in the ECUA Water and Sewer Standards Manual.
- B. The coating system for the valves and appurtenances (as needed) shall be manufactured by Sherman Williams. Surface Preparation shall be based on the guidelines set forth by the Society for Protective Coatings (SSPC) as follows: 1.) *New Materials* - SP6, Commercial Blast, or 2.) *Refurbishing Existing Piping, Valves, and Appurtenances* - SP6, Commercial Blast or SP10, Near White Metal depending on level of corrosion and paint damage.

| Level | Paint | Dry Film Thickness (Microns) |
|--------------|---------------|------------------------------|
| Primer | Macropoxy 646 | 6-9 |
| Intermediate | Macropoxy 646 | 6-9 |
| Top | Acrolon 218 | 2-4 |

In addition, the surface preparation requirements shall be field verified by ECUA Maintenance or Engineering Representatives.

- C. Unless otherwise noted, painting system shall be applied in accordance with manufacturers recommendations.

Color selection shall be in accordance with ECUA Standards. Any variance from these standards must be approved by ECUA Engineering staff prior to application.

6.2. CHECK VALVES (LEVER & WEIGHT STYLE)

- A. Check valves shall conform to the requirements of AWWA C508. Check valves larger than 2-inch nominal size shall be iron body with stainless steel bolts and nuts, flanged ends, 316 stainless steel shaft connected to a steel outside lever and weight, swing-type with straight-away passageway of full pipe area. The valve shall have renewable bronze seat ring and rubber-faced disc. Check valves shall be 150 psi working pressure. All interior and exterior ferrous surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

6.3 PLUG VALVES (ABOVE GROUND ONLY)

- A. Plug valves shall be of the non-lubricated, 100 percent port eccentric type with resilient faced plugs with flanged ends, furnished with all necessary joint materials. Valves are to be rated for 150 psi (non-shock working pressure), cast-iron body, nickel seat, and hard rubber Hycar coated plug with a flushing port. Valves shall be installed with the seat on the downstream side of the flow path, to provide a positive seal when closed. Valve shall include hand-wheels for operation. Valves shall be as manufactured by Dezurik or approved equal. Unless otherwise approved by ECUA, plug valves will not be allowed in direct bury applications. Direct bury valves shall be resilient seated gate valves as specified in Section 02576 – Sanitary Sewer Force Mains of the specifications. All interior and exterior ferrous surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

PART 7 - TESTING

7.1 PUMP FACTORY TESTS

- A. The pump manufacturer shall perform the following tests on each pump prior to shipment. Pump test report must be provided to Engineer prior to pump installation.
1. Megger the pump motor and cable for insulation breaks or moisture intrusion.
 2. Prior to submergence, run pump dry “bump” and check for correct rotation.
 3. Pump shall be run continuously for 30 minutes in a submerged condition, with a minimum submergence of 10 feet.
 4. Vibration shall not exceed 10 mm/s (RMS) when measured at the main bearing nearest to the impeller.
 5. Pump shall be removed from test tank, meggered immediately for moisture and all seals checked for water intrusion.
 6. Pumps shall be operated at a minimum of 6 points to establish the hydraulic curve. Variable speed pumps shall be reduced in speed in increments of 200 rpm down to the minimum speed and operated at a minimum of 6 points to establish the hydraulic curves for each of the speeds. KW input shall be monitored and recorded. One test point shall be performed with discharge valve closed. Pumps shall develop appropriate capacity and head within Hydraulic Institute Standards without excessive noise or cavitations.

7. For pumps less than 100 HP, the pump supplier shall submit copies of certified Hydraulic Institute test reports including factory pump curves for each pump (s) provided to ECUA.
8. For pumps 100 HP and greater, the above certified pump performance test (at a minimum) must be completed on each actual pump supplied. An ECUA representative(s) may be required to witness the certified test (ECUA's travel expenses by ECUA).

7.2. FIELD ACCEPTANCE TESTING

- A. Pre-Final Inspection: Prior to final inspection, the Contractor shall conduct a pre-final site inspection (including energizing each pump), in the presence of an ECUA representative. Any deficiencies noted at this time shall be corrected prior to scheduling of the final inspection.
- B. Final Inspection:
 1. The Contractor shall be responsible for conducting the following field acceptance tests and start-up procedures in the presence of a ECUA representative. The Contractor shall notify ECUA, the Engineer and the pump manufacturer's representative 48 hours prior to the proposed start-up. The time and date of this final inspection shall be scheduled by ECUA. The Contractor shall furnish all labor, piping, equipment, water and materials required to perform the acceptance testing. The Contractor shall ensure the force main is full of water prior to the pump test. The pumps shall not be field tested by recirculating water through the wet well.
 2. The Contractor shall demonstrate that the pump mounting and guide rail systems are fully operational. The Contractor shall remove and reinstall the pumps in the presence of the ECUA representative, prior to conducting the performance test.
 - a. Prior to acceptance, as part of the final inspection, and prior to placing the station in operation, the Contractor shall conduct a pump performance test. Pumps shall operate according to the operating conditions indicated on the drawings without excessive vibration or overheating. Testing shall be performed using clean water. The Contractor shall supply water at its own expense to perform the required testing. Pumping rates shall be determined by pumping a calculated volume of water in a specified time interval. Head and flow conditions shall be measured and recorded. Water levels during testing shall fall within the pump control levels shown on the drawings. Amperage draws shall be

monitored to determine effectiveness and efficiency of equipment. The test shall be repeated until satisfactory results are obtained. The test results shall be recorded on the Pump Test Report sheet included in the appendix section herein. Test reports shall include a minimum of three (3) points on the factory curve provided in the field at start-up. Pump test data will include the factory curve and the start-up curve. If the Contractor is unable to demonstrate to ECUA that the pumping unit performs satisfactorily, the unit shall be rejected. The Contractor shall then remove and replace the defective unit at its own expense. Satisfactory performance includes, but is not limited to, the following:

- b. Pumps shall deliver rated GPM at rated TDH.
- c. Running amperage shall be noted and recorded on each leg of power cord while pump is operating under full load.
- d. All self test trip relays shall demonstrate ability to simulate a fault condition. All test results shall be recorded on the pump test report and be submitted to the Engineer.
- e. Unless otherwise allowed by ECUA, pumps shall operate within 5 % of the approved, certified, head-capacity curve.
- f. Following performance testing, pumps shall be meggered for pump-moisture intrusion.

PART 8 - WASHDOWN STATION

8.1. WATER SERVICE PIPING

- A. Water service piping shall be 2-inch diameter (minimum). Water meter, shall be 1 1/2-inch diameter (minimum) and will be supplied and set by ECUA unless otherwise noted. Materials and installation shall meet ECUA's standards for typical water service construction unless otherwise noted or water service provided by a utility other than ECUA.

8.2. BACKFLOW PREVENTOR

- A. The Contractor shall furnish and install a 2-inch diameter (minimum) reduced pressure backflow preventer which meets the requirements of ECUA's Cross Connection Control Policy (see details on drawings).

8.3. WATER SERVICE & METER

- A. The Contractor shall secure the water meter by filling out an ECUA water meter application. There is no fee for a water service for an ECUA Standard Lift station. The Contractor shall install the meter box and service in accordance with all applicable ECUA Standard Details and Specifications and

ECUA will install the meter. If ECUA is not the provider of water service, the Contractor/Developer shall be responsible for all installation fees, including but not limited to permitting and tap fees. The Contractor shall be responsible for the cost of all water used during construction and testing. The water service will then be transferred to ECUA upon final acceptance of the pump station.

PART 9 - PERMITS

- A. The Contractor shall secure and pay for all plumbing, electrical, right-of-way and other required permits and make application for electric and water meter. The Contractor shall be responsible for all costs associated with utilities used during construction and testing of the lift station.

PART 10 - OPERATION AND MAINTENANCE MANUALS

10.1 GENERAL

- A. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. Summary: This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Maintenance manuals for the care and maintenance of products, materials, finishes and systems and equipment.
- C. Submittals:
 - 1. Initial Submittal: Submit 1 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Engineer will return one copy of draft and mark whether general scope and content of manual are acceptable.
 - 2. Final Submittal: Submit three copies of each manual in final form at least 15 days before final inspection. Engineer will return copy with comments within 15 days after final inspection.
 - a. Correct or modify each manual to comply with Engineer's comments. Submit six (6) copies of each

corrected manual within 15 days of receipt of Engineer's comments.

- D. Coordination: Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

10.2 PRODUCTS

A. Operation and Maintenance Documentation Directory

1. Organization: Include a section in the directory for each of the following:
 - a) List of documents.
 - b) List of systems.
 - c) List of equipment.
 - d) Table of contents.
2. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
3. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
4. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
5. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

B. MANUALS, GENERAL

1. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - a) Title page.
 - b) Table of contents.
 - c) Manual contents.

2. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - a) Subject matter included in manual.
 - b) Name and address of Project.
 - c) Name and address of Owner.
 - d) Date of submittal.
 - e) Name, address, and telephone number of Contractor.
 - f) Name and address of Engineer.
 - g) Cross-reference to related systems in other operation and maintenance manuals.

3. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - a) If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

4. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 - a) Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch(215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets. Maximum binder size shall be 3-inches in thickness.
 - b) Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - c) Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 - d) Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - e) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - f) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual.

- g) At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- 5. Descriptions: Include the following:
 - a) Product name and model number.
 - b) Manufacturer's name.
 - c) Equipment identification with serial number of each component.
 - d) Equipment function.
 - e) Operating characteristics.
 - f) Limiting conditions.
 - g) Performance curves.
 - h) Engineering data and tests.
 - i) Complete nomenclature and number of replacement parts.
 - j) Copy of pump data plate.
 - 6. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 - 7. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - a) Include procedures to follow and required notifications for warranty claims.

10.3 EXECUTION

- A. Manual Preparation: Operation and Maintenance Documentation
Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. **Manufacturers' Data:** Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. **Drawings:** Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

EMERALD COAST UTILITIES AUTHORITY
SUBMERSIBLE SEWAGE PUMP SELECTION CHART

REV. 5/30/2013 by SNH

| Horsepower | 15 HP and Below | 16-40 HP | 41 HP and Above |
|--|--|--|--|
| RPM | 1200 or 1800 | 1200 or 1800 | 900, 1200, or 1800 ⁴ |
| Pump Type | Submersible Centrifugal Non-clog or Vortex ¹ | Submersible Centrifugal Non-clog or Vortex ¹ | Submersible Centrifugal Non-clog or Vortex ¹ |
| Power Control | FVNR Starters | FVNR Starters (<20HP) VFD/Soft Start (≥ 20HP) | VFD |
| Pump Manufacturer Warranty (100%) | 5 year, See Spec. | 5 year, See Spec. | 5 year, See Spec. |
| Minimum Pump Efficiency | 60% ² | 60% ² | 60% ² |
| Motor Insulation Class | Class H | Class H | Class H |
| Mechanical Seal Type - Pump Side | Silicon Carbide/Silicon Carbide | Silicon Carbide/Silicon Carbide | Silicon Carbide/Silicon Carbide |
| Mechanical Seal Type - Bearing Side | Carbon/Silicon Carbide | Carbon/Silicon Carbide | Carbon/Silicon Carbide |
| Bearings | 40,000 hours min. | 40,000 hours min. | 40,000 hours min. |
| Impeller Wear Ring ³ | Stainless Steel/ 300 Series Brinnell Hardness | Stainless Steel/ 300 Series Brinnell Hardness | Stainless Steel/ 300 Series Brinnell Hardness |
| Volute Wear Ring ³ | Stainless Steel/ 400 Series Brinnell Hardness | Stainless Steel/ 400 Series Brinnell Hardness | Stainless Steel/ 400 Series Brinnell Hardness |
| Removal Method/ Material | 2-inch Guide Rails Sch. 40, 316 S.S. | 2-inch Guide Rails Sch. 40, 316 S.S. | Based on Pump Size 2- inch, Sch. 40 min., 316 S.S. |
| Seal Availability | 2 Business Days | 5 Business Days | TBD Based on Size of Pump |
| Impeller Availability | 2 Business Days | 5 Business Days | TBD Based on Size of Pump |
| Shaft | 440 Stainless Steel | 440 Stainless Steel | 440 Stainless Steel |
| Approved Manufacturer⁵ | EMU | EMU | EMU |
| | Fairbanks Morse | Fairbanks Morse | Fairbanks Morse |
| | Hydromatic | Hydromatic | KSB |
| | KSB | KSB | |

1 - Pump selection shall be determined at ECUA's discretion depending on application.

2 - Minimum pump efficiency requirement is for non-clog pumps and may be waived by ECUA on a case by case basis. ECUA project specific requirements shall be shown on Contract Drawings or in Section 02575 of the Contract Specifications

3 - Hardened metalurgy may be required in some locations, primarily where high grit is anticipated (i.e. Pensacola Beach and Perdido Key)

4 - 1800 rpm allowed on pump motors less than 61 horsepower only.

5 - Engineer shall evaluate each approved pump manufacturer and provide ECUA with his/her selection for each. If a pump selection is not available for a manufacturer, Engineer shall provide documentation from pump vendor. Engineer shall obtain ECUA's concurrence prior to final pump selection and power control options during review of permit application or review of construction drawings. A pre-submittal meeting with ECUA is mandatory.

SECTION 02577 - FIBERGLASS WET WELL

PART 1 - GENERAL

1.1 DESIGN

- A. The fiberglass wet well shall be designed (signed and sealed) by a Florida Professional Engineer. Wet well weight and soil pressure on concrete base collar may be used to calculate down forces, but pump and piping weights shall not be used. Assume groundwater is at grade. A factor of safety of 1.2, minimum, must be used in anti-flotation calculations. The design shall include the operating conditions as noted on the drawings, a 12 inch minimum thick concrete base inside the wet well, a 12 inch minimum thick outside the wet well reinforced concrete hold-down base which extends 12-inches (minimum) beyond the outside of the wet well, a 10-inch (minimum) thick reinforced concrete top slab, pump access frame and cover and other standard wet well features as shown on the drawings. Pumps shall be anchored to a mounting plate (see details on the drawings). The complete design (signed and sealed by a Florida Professional Engineer) must be submitted in the form of a shop drawing for ECUA's review and approval. Fiberglass reinforced polyester wet wells shall be manufactured from commercial grade unsaturated polyester resin with fiberglass reinforcements. Unless approved otherwise by ECUA, the wet well shall be a one piece unit. Wet wells shall be manufactured by LFM, CSI, Xerxes or AFE.

1.2 MATERIALS

- A. Resin: The resins used shall be commercial grade unsaturated polyester resins.
- B. Reinforcing Materials: The reinforcing materials shall be a commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcements and the resin.
- C. Surfacing Materials: If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.
- D. Fillers and Additives: Fillers, when used, shall be inert to the environment and wet well construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

1.3 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Excavation, Backfilling and Compaction: Section 02221
- B. Water Distribution Lines/Service Lines: Section 02556

- C. Gravity Sanitary Sewer: Section 02570
- D. Sanitary Force Main: Section 02576
- E. Wastewater Lift Station: Section 02575
- F. Fencing: Section 02830
- G. Cast-in-Place Concrete: Section 03300
- H. Electrical - Sections 16010-16050

1.4 QUALITY ASSURANCES

Comply with the latest published editions of AWWA and ASTM Standards

- A. ASTM D883: Standard Terminology Related to Plastics
- B. ASTM D3299: Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
- C. ASTM D3753: Standard Specifications for Glass-Fiber-Reinforced Polyester Manholes and Wet Wells
- D. ANSI / AWWA D120-09: AWWA Standard for Thermosetting Fiberglass-Reinforced Plastic Tanks

1.5 FABRICATION

- A. Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.
- B. Interior Surface: The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted if they are less than 3/4 inch in diameter and less than 1/16 inch deep.
- C. Defects Not Permitted:
 - Exposed fibers: glass fibers not wet out with resin.
 - Resin runs: runs of resin and sand on the surface.
 - Dry areas: areas with glass not wet out with resin.
 - Delamination: separation in the laminate.
 - Blisters: light colored areas larger than 1/2 inch in diameter.
 - Crazing: cracks caused by sharp objects.
 - Pits or Voids: air pockets.
 - Wrinkles: smooth irregularities in the surface.
 - Sharp Projection: fiber or resin projections necessitating gloves for handling.
- D. Installation of Brackets: Manufacturer or manufacturer certified field personnel shall glass in all stainless steel fasteners and brackets, discharge piping brackets, etc. Manufacturer of wet well shall be responsible for integrity of all field glassing.

- E. Markings: Each wetwell shall have wetwell data integrated into fiberglass and affixed to top inside and top outside walls. Data required includes manufacturer’s name, ASTM designation, production and/or serial number, production date, length and diameter, and warranty length. Product data shall not be written in ink or paint. Production/serial numbers shall be kept on file by manufacturer for a minimum of 20 years and shall be accompanied by project data for future reference and recall.

The following is an example:

ABC Manufacturing
 ASTM D3753
 Serial # ABC20083461
 Production date: October 22, 2008
 Depth = 22’
 Diameter = 10’
 20 Year Warranty

1.6 PHYSICAL REQUIREMENTS

- A. Load Rating: The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lbs when tested in accordance with ASTM 3753, Section 8, test methods D 790 and D 695. To establish this rating the complete wet well shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.
- B. Stiffness: The wet well cylinder shall have a minimum pipe-stiffness value as shown in Table 1 (at a minimum) when tested in accordance with ASTM D3757, Section 8.

Table 1 - Stiffness Requirements:

| Length - Ft. | F/AY - PSI |
|---------------------|-------------------|
| 10 to 20 | 2.01 |
| 21 to 30 | 3.02 |
| 31 to 40 | 5.24 |

Physical Properties :

| | Hoop Direction | Axial Direction |
|------------------------------------|-----------------------|------------------------|
| a. Tensile Strength (psi) | 18,000 | 5,000 |
| b. Tensile Modules (psi) | 0.8×10^6 | 0.7×10^6 |
| c. Flexural Strength (psi) | 26,000 | 4,500 |
| d. Flexural Modules (psi) | | |
| (no ribs - 48", 60", 72") (psi) | 1.4×10^6 | 0.7×10^6 |
| (with ribs - 96", 144") (psi) | 0.7×10^6 | 0.7×10^6 |

1.7 FIBERGLASS CONSTRUCTION METHODS

- A. Handling: The wet well shall not be dropped or impacted. Wet wells shall be chocked if stored horizontally. If wet wells must be moved by rolling, the ground transverses shall be smooth and free of rocks, debris, etc. FRP wet wells may be lifted by the installation of three lifting lugs as specified by the manufacturer on the outside surface near the top or by a sling or "choker" connection around the center. Use of chains or cables in contact with the wet well surface is prohibited. Wet wells may be lifted horizontally using one support point.
- B. Wet Well Installation: Bottom of excavation should be compacted to 95% Standard Proctor Density. Pour reinforced concrete base a minimum of one foot deep and at least two feet in diameter larger than the fiberglass wet well outside diameter. As soon as the concrete has set-up enough to support the fiberglass wet well, lower the wet well into place. (Wet wells with fiberglass bottoms, should have rebar inserted into bottom reinforcement.) Pour a minimum of one foot of reinforced concrete on the inside, also a minimum of one foot deep and two feet from the fiberglass wet well wall on the outside of the fiberglass wet well. Insert "RAMNEK" type sealant on the outside of the fiberglass wet well around the bottom where the fiberglass and concrete come together.
- C. Wet Well Cutouts: Cutouts in wet well wall should be made with proper cutting tools such as jigsaw or hole saw. Do not use axe or other impact-type tools.
- D. Pipe Installation: Discharge wall penetrations are to have sleeves large enough to accept O.D. of pipe discharge flange. All discharge sleeves shall be sealed via a gas tight-water tight Link Seal system or approved equal. Influent pipe connections shall be made with an NPC Kor-N-Seal Boot with stainless steel band or approved equal.

1.8 DESIGN FEATURES

- A. Top Slab Support: Pour reinforced concrete slab support a minimum of two feet outside of fiberglass wet well wall and minimum of six inches thick.
- B. Design: Fiberglass wet well system to be designed, signed and sealed by a Professional Engineer registered in the State of Florida. Resistance to floatation and traffic or pedestrian loading requirements shall be addressed in the design.
- C. Wet Well Top: Wet well top shall be concrete and designed for 300 PSf or H-2O Traffic loading as noted on the drawings. Hatches shall be as specified in this specification and as detailed on the contract drawings. Bottom of top slab and around side of hatch opening shall be fiberglass lined and shall meet all the requirements of this specification.

1.9 WARRANTY

- A. The fiberglass manufacturer shall warrant the fiberglass wet well against defects for at least twenty (20) years after the date of acceptance by ECUA. Defects are defined as cracking, delaminating, or leaking. The warranty shall require the manufacturer to supply all necessary labor, materials, and equipment to repair defects to the satisfaction of ECUA. The Contractor and/or manufacturer shall not make any exemption or exception to the above stated conditions or warranty. Manufacturer's recommended installation procedures to assure 20-year warranty provided to ECUA to be included in submittal package.

PART 2 - EXCAVATION

2.1 GENERAL

- A. The limit of excavation shall be such to allow for placing and removing forms, installing sheeting, shoring, bracing, etc. The Contractor shall pile excavated material in a manner that will not endanger the work and will avoid obstructing sidewalks, driveways, power poles, etc. Drainage shall be kept clear.

2.2 VERTICAL SIDES (SHEETING, SHORING AND BRACING)

- A. When necessary to protect existing or proposed structures or other improvements, the Contractor shall maintain vertical sides of the excavation. The limit shall not exceed three feet outside the footing on a vertical plane parallel to the footing except where specifically approved otherwise by the Engineer. The Contractor shall provide and install any sheeting, shoring, and bracing as necessary to provide a safe work area as required protecting workers, structures, equipment, power design and adequacy of all sheeting, shoring, and bracing. For excavations deeper than 20 vertical feet, which utilize sheeting, shoring or bracing, the sheeting, shoring and bracing plan shall be

designed by a Florida Professional Engineer, (signed and sealed). This plan shall be submitted to ECUA for review and approval, prior to construction. The construction of sheeting, shoring and bracing shall be in accordance with the approved plan. All major field modifications shall be approved by the Professional Engineer. The sheeting, shoring, and bracing shall be removed as the excavation is backfilled in such manner as to prevent injurious caving. Excavation shall meet the Florida Trench Safety Act (an OSHA requirement) and OSHA Excavation Standards (29 CFR subpart P 1926.650) at a minimum.

2.3 SLOPING SIDES

- A. Where sufficient space is available, the Contractor shall be allowed to back slope the sides of the excavation. The back slope shall be such that the excavation shall be safe from caving. The type of material being excavated shall govern the back slope used, but in any case the back slope shall be no steeper than 1 foot horizontal to 1 foot vertical without sheeting or shoring.

2.4 DE-WATERING

- A. The Contractor shall keep excavation free from water by use of cofferdams, bailing, pumping, well pointing, or any combination as the particular situation may warrant. All de-watering devices shall be installed in such a manner as to provide clearance for construction, removal of forms, and inspection of exterior of form work. It is the intent of these specifications that the foundation be placed on a firm dry bed. The foundation bed shall be kept in a de-watered condition a sufficient period of time to ensure the safety of the structure. The excavation shall be protected from excessive rainfall, drainage and drying. The excavation shall be inspected and approved by ECUA's representative before work on the structure is started. It is the intent of these specifications that the Contractor provides a relatively smooth, firm foundation bed for footing and slabs that bear directly on the undisturbed earth without additional cost, regardless of the soil conditions encountered. The Engineer will be the sole judge as to whether these conditions have been met.

2.5 UNAUTHORIZED EXCAVATION

- A. Excavation for slabs, footings, etc., that bear on earth shall not be carried below the elevation shown on the drawings. In the event the excavation is carried on below the indicated elevation, the Contractor shall bring the slab, footing etc., to the required grade by filling with concrete having a minimum compressive strength of at least 3,000 PSI at 28 days.

PART 3 - BACKFILL

3.1 BACKFILL MATERIAL

- A. Unless shown otherwise on the drawings, suitable soil (A-3 sand only, no clay or rocks larger than 3/4" size) shall be used for backfill around the wet well for a distance of two feet from the outside surface and extending from bottom of the excavation to the bottom of the top slab. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by the Engineer. Backfill material shall be free of vegetation or other extraneous material. Excavation materials which are to be used for fill or backfill may be stockpiled on site. Top soil should be stockpiled separately and used for finish grading around the structure.

3.2 SCHEDULE OF BACKFILLING

- A. The Contractor may begin backfilling of wet well as soon as the concrete has been allowed to cure and the forms removed.

3.3 BACKFILL

- A. Backfill shall be placed in layers of not more than 12 loose measure inches and mechanically tamped to at least 95% Standard Proctor Density. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the structure.

16010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE

- A. This scope covers the furnishing, installation, testing, adjusting and placing in operation all electrical equipment, devices, facilities, materials, and auxiliary items necessary for the complete and successful operation of all electrical equipment as herein described, shown on the plans, or deemed necessary for the completion of the electrical portion of the project. It is the intent of DIVISION 16 to outline the electrical requirements of the contract in order to provide the information necessary for the construction of a fully operational system as shown on the plans and as herein described. A comprehensive electrical scope of work is as follows:
 - 1. Power/Electrical System
 - 2. Lighting System
 - 3. Control System
 - 4. Instrumentation System
 - 5. Utility Work
 - 6. Connection of Electrically Powered Mechanical Equipment
 - 7. Temporary Construction Power
 - 8. All Incidentals Necessary for a Complete and Fully Operational Electrical System.

1.3 DEFINITIONS

- A. LED: Light Emitting Diode.

1.4 WORKING CLEARANCES

- A. Working clearances around equipment requiring electrical services shall be verified by Contractor to comply with Code requirements. Should there be apparent violations of clearances; the Contractor shall notify the OWNER before proceeding with connection or placing of equipment.
- B. In the case of circuit breakers, safety switches and other equipment requiring wire and cable terminations, the Contractor shall ascertain that lug sizes and wiring gutters or

space allowed for proper accommodation and termination of the wires and cables are adequate.

1.5 WORKMANSHIP

- A. Workmanship under this Division shall be accomplished by persons skilled in the performance of the required task. All work shall be done in keeping with conventions of the trade. Work of this Division shall be closely coordinated with work of other trades to avoid conflict and interference.

1.6 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Electrical equipment shall be protected by the weather, especially from water dripping or splashing upon it, at all times during shipment, storage and after installation. Should any apparatus be subjected to possible injury by water, it shall be thoroughly dried out and put through a dielectric test, at the expense of the contractor, to ascertain the suitability of this apparatus. The results of the test shall be submitted to the Engineer and if the apparatus is found to be unsuitable, the contractor shall replace it without additional cost to the Owner.

1.7 UTILITIES

- A. The Contractor shall provide a fully operational electrical service as described in the plans.
 - 1. Coordinate with the utility company for the services and install the service in accordance with their requirements, regulations and recommendations.

1.8 GUARANTEE

- A. Contractor shall guarantee all lighting fixture drivers and LEDs for a period of one (5) years after the lift station is in service. Guarantee shall include material and labor for replacing drivers and LEDs or associated LED bar.
- B. The Contractor shall guarantee all other electrical systems, materials and workmanship to be free from defects for a period of one (1) year from the date of final acceptance. He shall correct all defects arising within this period upon notification by the Owner, without additional compensation.
- C. It is understood that the rights and benefits given the Owner by the guarantees found in the technical specifications are in addition to and not in derogation of any rights or benefits found in the special and general provisions of the contract.

1.9 TEMPORARY DURING CONSTRUCTION

- A. It shall be the responsibility of the Contractor to provide and maintain adequate temporary lighting at all times during construction, so that the various other trades can accomplish their work in a flawless manner. All utility installation costs and monthly bills shall be included as part of the responsibility.

1.10 MATERIAL STANDARDS

- A. Material shall be new and comply with standards of Underwriters' Laboratories, Inc., where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, IPCEA or other publications referenced.

1.11 TEST EQUIPMENT

- A. The contractor shall provide all test equipment and supplies deemed necessary by the Owner or Engineer at no extra cost to the Owner. These supplies shall include but not be limited to the following: volt meters, amp meters, light meters, fuel, generator load banks, watt meters, harmonic distortion test equipment, thermal image camera, high pot test equipment, power quality analyzers, and oscilloscopes.

1.12 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code
- B. ANSIC2 – National Electrical Safety Code
- C. EPA – Environmental Protection Agency
- D. FDEP – Florida Department of Environmental Protection
- E. NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- F. NEMA – National Electrical Manufacturer's Association.
- G. NFPA – National Fire Protection Association
- H. IEEE – The Institute of Electrical and Electronics Engineers
- I. IESNA – The Illuminating Engineering Society of North America
- J. NETA – International Electrical Testing Association
- K. UL – Underwriters' Laboratories

- L. Recommended Standards for Water Works and Wastewater Facilities as published by Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers.

1.13 SUBMITTAL

- A. Submit under provisions of the General Provisions.
 - 1. The Contractor installing all Electrical work shall review and approve all electrical shop drawings prior to submittal to the Engineer for review. As part of the review, the installer shall certify the following:
 - a. I hereby certify that the equipment and devices shown and marked in this submittal is in compliance with the contract drawing and specifications, can be installed in the allocated space, will be stored in accordance with the manufacturers recommendation, will be installed per NEC, and is submitted for approval.

Certified by: _____ Date: _____

- B. Submit shop drawings and product data grouped to include complete submittal of related systems, products, and accessories in a single submittal. No electrical work may be performed until shop drawings are approved. Submit Shop Drawings on the Following Systems as Grouped Below:
 - 1. Power/Electrical System
 - a. Conduit and Conduit Fittings
 - b. Wire/Conductors
 - c. Pull Boxes
 - d. Control Panel Layouts
 - e. Support Racks Materials
 - f. Conduit Support Systems
 - g. Transformers
 - h. Surge Protection Devices
 - 2. Generator Equipment
 - a. Generator
 - b. Generator Enclosure
 - c. Fuel System Tank & Piping
 - d. Transfer Switches
 - 3. Lighting System
 - a. All Light Fixtures
 - b. Site Poles & Foundations
 - 4. Control System
 - a. Control Panels
 - b. Generator Receptacle
 - c. Circuit Breakers
 - d. Across-The-Line Starters
 - e. Fuses
 - f. Power Distribution Blocks

- g. Surge Protection Devices
 - h. 24VDC Power Supplies
 - i. Batteries
 - j. Converters
 - k. PLC
 - l. Software
 - m. HMI
 - n. I/O Racks
 - o. Relays
 - p. Intrinsically Safe Barrier Relays
 - q. Seal Fail Relays
 - r. Pressure Transducers
 - s. Float Switches
 - t. Momentary Push Buttons
 - u. Hand-Off-Automatic Selectors
 - v. On-Off Selectors
 - w. Limit Switches
 - x. Alarm Lights
 - y. Wiring Devices
 - z. Control Point-to-Point Drawings
 - aa. Conductors with Color Indications
 - bb. Radio
 - cc. Conduit Penetration Areas
 - dd. Air Break Seal System
 - 5. Miscellaneous Electrical Equipment
 - a. Miscellaneous Electrical Parts
 - 6. Drawings
 - a. Coordination drawing of All Electrical Items in relation to Site
 - b. Conduit layout drawings
 - c. Conduit penetration locations into wet well
- C. Mark dimensions and values in units to match those specified.

1.14 REGULATORY REQUIREMENTS

- 1. Obtain permits, and request inspections from authority having jurisdiction.
- 2. References listed.

1.15 FINAL INSPECTION AND TESTING

- A. After the electrical installation is complete, the CONTRACTOR shall deliver to the ENGINEER and OWNER the following information with his request for final inspection.
 - 1. One set of contract drawings marked to show all significant changes in equipment ratings and locations, alterations in locations of conduit runs, or of any data differing from the contract drawings.

2. Certificates of final inspection from local Authority Having Jurisdiction.
3. A tabulation of all motors listing their respective manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating.

B. The electrical work shall be thoroughly tested to demonstrate that the entire system is in proper working order and in accordance with the plans and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. Contractor may be required during final inspection, at the request of the Engineer or Owner to furnish test instruments for use during the testing.

1.16 STAFFING

- A. The electrical contractor shall provide a “Master Electrician” who has been deemed a “Master Electrician” by exam through the State of Florida, or any other Florida County Permitting Authority as the Electrical Superintendent for the project. The Electrical Superintendent shall be on the project site any time any electrical work is performed by the contractor.
- B. In addition, the contractor shall provide one Journeyman electrician for every four electrical helpers used on the project site.
- C. The electrical contractor is required and expected to read all other equipment specifications contained in these documents and provide all required power and control conductors required by said equipment to allow them to function as described.

1.17 AS-BUILT DRAWINGS

- A. The contractor shall provide detailed as-built drawings for the project indicating all power wiring. (All Drawings shall be delivered to the Owner in an AutoCAD 2007 Format.)
- B. The As-Built drawings shall include detailed drawings of all underground conduit, above ground conduit, control panels, and control drawings.
- C. The Owner will provide electronic copies of all drawings in the plans set on a CD for use by the contractor.

END OF SECTION 16010

16050 - BASIC ELECTRICAL MATERIALS AND MEETHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Common electrical installation requirements.
 - 3. Concrete equipment bases.
 - 4. Touch-up paint.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings detailing fabrication and installation of supports and anchorage for electrical items.
- C. Samples of color, lettering style, and other graphic representation required for each identification product for Project.
- D. Coordination Drawings for electrical installation.
 - 1. Prepare Coordination Drawings according to "Submittals" to a 1/4-inch-equals-1-foot (1:50) scale or larger. Detail major elements, components, and systems of electrical equipment and materials in relation to each other and to other systems and installations. Indicate locations and space requirements for installation, access, and working clearance. Show where sequence and coordination of installations are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following:

- a. Provisions for scheduling, sequencing, moving, and positioning equipment to the site during construction.
- b. Plans, elevations, and details, including the following:
 - 1) Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - 2) Sizes and locations of required concrete pads and bases.
 - 3) Cross section of underground ducts at all pipe crossings showing clearance.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 2. To allow right of way for piping and conduit installed at required slope.
 - 3. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70 for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate electrical equipment installation with other components.
- B. Arrange for chases, slots, and openings in structures during progress of construction to allow for electrical installations.
- C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.
- E. Coordinate connecting electrical service to components furnished under other Sections.

PART 2 - PRODUCTS

2.1 CONCRETE EQUIPMENT BASES

- A. Forms and Reinforcing Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

2.2 TOUCH-UP PAINT

- A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. For Non-equipment Surfaces: Matching type and color of undamaged, existing adjacent finish.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for rack mounted items and lighting fixture for pole mounted items fixtures.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- D. Install items level, plumb, and parallel and perpendicular to other systems and components, except where otherwise indicated.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 TOUCH-UP PAINTING

- A. Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3.3 CUTTING AND PATCHING

- A. Drill slabs and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces.
- C. Concrete Slabs: Core-drill holes or form openings.

END OF SECTION 16050

SECTION 16055 - OVERCURRENT PROTECTIVE DEVICE COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

- A. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- B. Qualification Data: For coordination-study specialist.
- C. Submittals: Submittals shall be in paper and electronic forms.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report (breaker curves in color).
 - 4. Provide Electronic Study for Engineer and Owner Review.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state of Florida, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Product: Subject to compliance with requirements, provide by one of the following:
 - 1. SKM Systems Analysis, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 16 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Control panel ampacity and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Control Panel.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.

2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 3. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 and IEEE242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.

- F. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 16055

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16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Overhead-lines grounding.
 - 2. Underground distribution grounding.
 - 3. Ground to grounding counterpoise.
 - 4. Grounding to piping.
 - 5. Grounding to rebar within slab / top of lift station.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Ground counterpoise.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in operation and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at ground rings and grounding connections for separately derived systems based on NETA MTS and NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. No. 4 AWG minimum, soft-drawn copper.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4 inch in diameter by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for overhead would poles, and stranded conductors for all other conductors, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

- A. Comply with IEEE C2 grounding requirements.
- B. Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install welded connectors for underground connections and connections to rods.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

- B. Retain and edit paragraph below to exceed NFPA 70 requirements. If concrete pad is for equipment to be supplied by utility company, revise to comply with utility company's grounding standards or delete and detail on Drawings.
- C. Pad-Mounted Transformers: Concrete pad for equipment to be supplied by utility company; grounding shall comply with utility company's grounding standards

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing rod or damaging rod coating.
 - 2. For grounding electrode counterpoise system, install three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from service equipment to main metal water service into lift station. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Grounding for Top of Lift Station: Install a driven ground rod at base at distances not more than 60 feet apart, as measured around perimeter. Provide a minimum of 1 for each separated slab.
- F. Grounding for Slabs - Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
1. Control Panel: 3 ohm(s).
 2. Pad-Mounted Equipment: 5 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. RMC: Rigid metal conduit.
- B. RNC: Rigid Non-metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Equipment support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of equipment supports. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- B. Conduit and Cable Support Devices: Stainless Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to slab surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.

PART 3 - EXECUTION

3.1 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to rack structural elements by the following methods unless otherwise indicated by code:
 - 1. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 2. To Light Steel: Sheet metal screws.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.2 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

END OF SECTION 16073

16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Identification for raceway.
 2. Identification for conductors and communication and control cable.
 3. Underground-line warning tape.
 4. Warning labels and signs.
 5. Instruction signs.
 6. Equipment identification labels.
 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring

diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 - PRODUCTS

2.1 RACEWAY CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.

- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD – WEAR PROTECTIVE GEAR PRIOR TO OPENING PANEL DOOR."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb, minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
 - 1. Exterior Ferrous Metal:
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A: Identify with weatherproof, orange self-adhesive vinyl label rated for exterior use.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, weatherproof, self-adhesive vinyl label rated for exterior use:
 - 1. Electrical Supervisory System: Green and blue.
 - 2. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in pull and junction boxes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than two branch circuits in the same junction or pull box, use. Identify each ungrounded conductor according to source and circuit number.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarms, control, signal, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, and control wiring. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance

Manual. Apply labels to disconnect switches and protection equipment and control panels.

1. Labeling Instructions:
 - a. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
2. Equipment to Be Labeled:
 - a. Control panel sections with access doors.
 - b. Disconnect switches.
 - c. Motor starters.
 - d. Push-button stations.
 - e. Power transfer equipment.
 - f. Contactors.
 - g. Power-generating units.
 - h. Monitoring and control equipment.
 - i. Uninterruptible power supply equipment.
 - j. Terminals for signal and control functions.
 - k. Miscellaneous equipment and devices located within control panel.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.
- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded conductors.
 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 2. Colors for 240-208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red (Orange for 240V Stinger Leg).
 - c. Phase C: Blue.
 3. Colors for 480/277-V Circuits:

- a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made, and for a minimum width of 2 inches. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 - I. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION 16075

16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wires and cables rated 600 V and less.
 - 2. Connectors and terminations rated 600 V and less.
- B. Restrictions:
 - 1. All wire/cable runs of any type must be continuous. Splices are expressly prohibited.

1.3 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene rubber.
- B. FVR: Full-Voltage Starter.
- C. RVSS: Reduced-Voltage Soft Starter.
- D. TSP: Twisted Shielded Pair
- E. VFD: Variable Frequency Drive.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
 - 6. The Okonite Company.
- B. All conductors shall be stranded. No solid conductors shall be allowed.
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-2/THWN-2.
- E. Multi-conductor Cable: Comply with NEMA WC 70 for Types SOOW.
- F. Instrumentation Cable: Comply with NEMA WC 70 for TSP.

2.2 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper.
- B. Branch Circuits: Copper.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground (not into wet well): Type THHN-2/THWN-2, single conductors in raceway.
- C. Branch Circuits, into Wet Well: Type SOOW, multi-conductor hard service cord.
 - 1. Shall be supported by means of a stainless steel, wire mesh, strain relief device located in an assesible location from the wet well access door.
 - 2. Be routed with wet well to not cause damage to cord during operation or removal of serving mechanical equipment or control device for maintenance purposes.
 - 3. Be connected to serving mechanical equipment or control device in such manner as to be rated for a Class I, Division I rated assembly.
- D. Class 1 & 2 Control Circuits: Type THHN-2/THWN-2, in raceway or Type SOOW as applicable.
- E. Analog Instrumentation Circuits: Type TSP, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- C. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION 16120

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SECTION 16130 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, accessories for direct buried duct, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. LFNC: Liquidtight flexible non-metallic conduit.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. RMC: Rigid metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For raceways, wireways and fittings, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Joint details.
 - e. Bell ends.
 - f. Bends.
 - g. Fittings.
 - h. Solvent cement.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.7 COORDINATION

- A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts entrances into handholes with final locations and profiles of ducts as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to handholes.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- B. Aluminum Rigid Conduit: ANSI C80.5.
- C. IMC: ANSI C80.6.

- D. Fittings for Conduit (Including all Types and Flexible and Liquidtight) and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.100 inch, with overlapping sleeves protecting threaded joints.
- E. Joint Compound for Rigid Aluminum Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3 and UL 514B; match to conduit or tubing type and material.
- D. LFNC: Flexible PVC core with PCV jacket, smooth inner surface with integral reinforcement within the conduit wall.

2.3 CUSTOM-BUILT METAL WIREWAYS

- A. Description: Custom-built stainless steel framing with open ventilated stainless steel mesh sides. Mesh sides shall consist of individual framing, and bolted on with stainless steel (316L) bolts for removable access panels to cable within wireway.
- B. Fittings and Accessories: Include stainless steel (316L) couplings, adapters, hold-down straps, strain relief, and other fittings to match and mate with wireways as required for complete system.

- C. Wireway Covers: Bolt-on type, unless otherwise indicated.
- D. Refer to Drawings for additional requirements.

2.4 HANDHOLES FOR EXTERIOR UNDERGROUND WIRING

- A. Polymer-Concrete Handholes: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubble Power Systems, Quazite
 - b. Armorcast Products Company
 - c. Carson Industries LLC
 - d. CDR Systems Corporation
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide the product size indicated on Drawings.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit:
 - a. Wet well to control panel: Rigid aluminum conduit
 - b. Circuit not entering into wet well: RNC, Type EPC-80-PVC, unless noted otherwise on the drawings.
 - 2. Underground Conduit:
 - a. Wet well to control panel: Rigid aluminum conduit
 - b. Circuit not entering into wet well: RNC, Type EPC-80-PVC direct buried, unless noted otherwise on the drawings.
 - 3. Connection to Vibrating Equipment (Including Transformers, HVAC units): LFNC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X stainless steel (316L).
 - 5. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
- B. Minimum Raceway Size: 1-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Aluminum Conduit: Use threaded rigid aluminum conduit fittings, unless otherwise indicated.

- D. Aluminum conduits in contact with concrete or earth shall be wrapped with 2 wraps of anti-corrosion tape, suited for use of protecting metal from corrosion. Tape shall be half-wrapped in one direction, and then back in the opposite direction for a total of 2 half wraps.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 16 Section "Hangers and Supports."
- D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run.
- F. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
- G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- I. Flexible Conduit Connections: Use maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers.
 1. Use LFNC in damp or wet locations.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Division 2 Section "Earthwork."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with

expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."

4. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
 5. Install manufactured duct elbows for stub-ups at poles and equipment, unless otherwise indicated.
 6. Install manufactured rigid aluminum conduit elbows for stub-ups at poles and equipment.
 - a. Couple aluminum conduits to ducts with adapters designed for this purpose.
 7. Warning Tape: Bury warning tape approximately 12 inches above direct-buried conduits.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes or wet well and away from equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- D. Duct Entrances to Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 2. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Clean prior to pulling conductors or cables:
 1. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES

- A. Install handholes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size

holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Division 16 and NFPA 70.

3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to stainless steel finishes in accordance with manufacturer recommendations.
 - 2. Repair damage to PVC finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

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SECTION 16211 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes equipment for utility company's electricity metering.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences. Include the following:
 - 1. Electricity-metering equipment.
- B. Shop Drawings for Electricity-Metering Equipment:
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
 - 3. Mounting and anchoring devices recommended by manufacturer.
- C. Operation and Maintenance Data: For electricity-metering equipment to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

2.3 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

- A. Available Manufacturers:
 1. Milbank Manufacturing Co.
 2. Cooper, B-Line.
 3. Square D; Schneider Electric.
- B. Kilowatt-Hour Meter Feed-Through Socket Enclosure: Electronic three-phase, 5-jaw, measuring electricity used.
 1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated on the Drawings for its application.
 2. Ampacity: Meter ampacity shall be size based upon, and not rated lower, the serving main overcurrent device ampacity rating.
 3. NEMA 4X stainless steel (316L) enclosure.
 - a. UL Listed.
 4. Coordinate additional requirements with utility company standards.
- C. Kilowatt-Hour Meter Socket Enclosure and CT Cabinet: Electronic three-phase, measuring electricity used.
 1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated on the Drawings for its application.

2. NEMA 4X stainless steel (316L) enclosure and CT cabinet.
 - a. UL Listed.
 3. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
 - a. Provide
 - b. Current-Transformers provide by utility company.
 4. Coordinate additional requirements with utility company standards.
- D. Kilowatt-Hour Meter: Provided by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Extend grounding connections as required by utility company.

END OF SECTION 16211

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SECTION 16410 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed circuit breakers:
 1. Enclosed molded-case circuit breakers.
 2. Enclosures.

1.3 DEFINITIONS

- A. HD: Heavy duty.
- B. RMS: Root mean square.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 1. Enclosure types and details.
 2. Current and voltage ratings.
 3. Short-circuit current rating.
 4. UL listing for series rating of installed devices.
- B. Shop Drawings: Diagram power wiring.
- C. Operation and Maintenance Data: For enclosed circuit breakers to include in operation and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed circuit breakers.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

- A. Coordinate layout and installation of enclosed circuit breakers and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Available Manufacturers:
 - 1. Allen-Bradley; Industrial Products.
 - 2. Eaton Corporation; Cutler-Hammer Products:
 - 3. Square D/Group Schneider Electric:
 - 4. General Electric Co.; Electrical Distribution & Control Division:

- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- C. Molded-Case Circuit-Breaker Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
 - 3. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

2.3 RATINGS

- A. UL listed as suitable for service entrance application.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. NEMA 250, Type 4X, stainless steel (316L).
- B. Operating handle shall be capable of being pad-locked in the Off/Open position, and interlocked to prevent the door from opening when the breaker is in the On/Closed position.
- C. Complies with NEC gutter space requirements.
- D. Provide the following factory installed items:
 - 1. Engraved nameplate with white letters on black background.
 - 2. Ground lugs.
 - 3. Rain-tight hubs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed circuit breakers.
- B. Mount enclosed circuit breaker with top at no more than 6'-6", unless otherwise indicated.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify circuit breaker type and labeling.
 - 3. Verify rating of installed overcurrent protection.
 - 4. Inspect proper installation of type, size, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Infrared Scanning:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
 - b. Instruments, Equipment and Reports:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2) Prepare a certified report that identifies enclosed circuit breaker and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Set field-adjustable enclosed circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410

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SECTION 16521 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and drivers.
 - 2. Poles and accessories.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. Luminaire: Complete lighting fixture, including driver housing if provided.
- C. LED: Light Emitting Diode.
- D. Pole: Luminaire support structure, including tower used for large area illumination.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load is 160 mph.

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photoelectric relays.
6. Drivers, including energy-efficiency data.
7. LEDs/LED bars, including life, output, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.
11. Manufactured pole foundations.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Design calculations, certified by a registered Florida professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
3. Wiring Diagrams: Power wiring.

C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

D. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package poles for shipping according to ASTM B 660.

- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: Ten years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 - 4. Warranty Period for LEDs: Replace LEDs and fuses that fail within 5 years from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Drivers: Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. Luminaire: Refer to Drawings for fixture manufacture and model number.
- C. Pole: Provide pole by one of the available manufacturers, unless noted otherwise on the Drawings:
 - 1. Lyte Poles, Inc.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel (316L).
- G. Light Shields: Factory installed in LEDs, arranged to block light distribution to indicated portion of normally illuminated area or field.
- H. Factory-Applied Finish for Luminaire: Durable polyester power-coated finish, utilizing a 5-stage pre-treatment and painting process, able to withstand corrosive environment exposure. Color shall match luminaire color.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with NEMA C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 DRIVERS

- A. Low-Temperature Driver Capability: Rated by its manufacturer for reliable starting and operation of indicated LED(s) at temperatures 0 deg F and higher.
- B. Driver Characteristics:
 - 1. Power Factor: 90 percent, minimum.

2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Driver: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

C. Low-Temperature LED Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F and higher.

D. Average rated life of 100,000 hours (at a base point of 25 deg C), minimum

2.5 LEDES

A. LED: ANSI C78.42, CRI 21 (minimum), color temperature 4000 K, and average rated life of 100,000 hours, minimum.

2.6 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel (316L) fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."

2.7 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: Round, tapered or Square, tapered.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 16 Section "Grounding and Bonding," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel (316L) bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
- E. Finish: Durable polyester power-coated finish, utilizing a 5-stage pre-treatment and painting process, able to withstand corrosive environment exposure. Color shall match luminaire color.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install LEDs in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.

2. Water, Gas, Electric, Communication, and Sewer Lines: 60 inches.
 3. Trees: 10 feet
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 3. Install base covers, unless otherwise indicated.
 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Raise and set poles using web fabric slings (not chain or cable).

3.3 CORROSION PREVENTION

- A. Aluminum: When in direct contact with a earth or concrete, protect aluminum by wrapping the conduit with 0.010-inch- thick, anti-corrosion plastic tape applied twice, with a 50 percent overlap for each wrap application.

3.4 GROUNDING

- A. Ground metal poles and support structures according to Division 16 Section "Grounding and Bonding."
1. Install grounding electrode for each pole, unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 16 Section "Grounding and Bonding."
1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundations.

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.
- C. Illumination Tests:
- D. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

END OF SECTION 16521

16900 – SYSTEMS INTEGRATION

PART 1 - GENERAL

1.1 SUMMARY

- A. The System Integrators shall be responsible for integrating the furnished equipment, material, and software into a fully operational control system.
- B. The System Integrator shall work directly for the Contractor.
- C. The SYSTEMS INTEGRATOR shall be responsible for supplying the following products and services:
 - 1. Field Instruments.
 - 2. Control Panel.
 - 3. Radio Line-of-Sight Study.
 - 4. All Components within Control Panel, as indicated on drawings.
 - 5. All SCADA / HMI programming updates to interface new Lift Station into the overall SCADA / HMI system.
 - 6. All CAT 5e patch cables.
 - 7. All miscellaneous items required for a fully operational control system integrated with the owner's existing SCADA / HMI system.
- D. The CONTRACTOR shall be responsible for supplying the following products and services:
 - 1. Coordinating with the Electrical Utility Company for providing service to the site location.
 - 2. Coordinating the location of the Electrical Equipment and Control Panel, and installing it.
 - 3. Coordinate installation requirements with the Systems Integrator.
 - 4. Installing all field instruments.
 - 5. Providing all conduit and conductors associated with a complete and operational control system.
- E. The System Integrators shall provide all software for this project, to be installed by the Integrator. This software shall include but not be limited to the following:
 - 1. PLC code
 - 2. HMI screens
- F. The Systems Integrator shall provide the following drawings for the control and electrical system (Each of these drawings shall be submitted and approved as a shop drawing.):
 - 1. Block interconnection drawings for the control system and associated electrical equipment (including connections to process control panels).
 - 2. Point to Point wiring diagrams for all equipment connected to the control system.

3. Control Panel Drawing for any panel being built by the Integrator.
 4. Equipment specification sheets.
 5. Flow charts and control narratives for all control system logic to be approved by the Owner prior to implementation.
- G. The Systems Integrator shall provide the following Operation and Maintenance Manuals for the control system (Each of these shall be custom written by the Integrator. In addition, each manual shall be submitted and approved as a shop drawing.):
1. Control System Operations Manual
 2. Control System Maintenance Manual
 3. Laminated Trouble Shooting Guides for both the Operators and the Maintenance Staff
- H. The Contractor shall furnish and install all wiring, piping, conduits and necessary mounting and accessory equipment to provide a complete and fully operational instrumentation and control system.

1.2 SYSTEM INTEGRATOR QUALIFICATIONS

- A. The following is a pre-approved list for Systems Integrators to be used for the project:
1. Automation Control Service, LLC.
 2. Revere Control Systems.
 3. Tesco Controls, Inc.
- B. Systems Integrators wanting pre-approval shall submit documentation indicating they meet the requirements of this specification to the OWNER for review and approval. Pre-approval written acceptance from the Owner shall be in writing and shall be turned in and attached with bid documentation forms.
- C. The Integrator shall be engaged full time in the design and manufacturer of PLC based control systems. The Integrator shall have documented experience in the municipal water and wastewater market.
- D. The Integrator shall be of a sufficient size that the proposed project will utilize less than 20% of the total programming and project management man-hours that the Integrator has available in any given month. The Integrator shall provide a staffing plan that documents how this requirement will be met.
- E. The Control Systems Integrator shall maintain a local office within 100 driving miles of the project site for the past two years. This office shall be equipped with programming equipment, and staffed with a minimum of 3 programmers and 5 service technicians capable of performing routine maintenance, trouble shooting, and field programming changes on the proposed PLC control systems.
- F. The control system Integrator shall have a panel shop located at their main facility and shall be able to obtain a UL listing for control panels.

- G. All software development for this project shall be done in the local office.
- H. The System Integrators shall perform a factory acceptance test for the control system at their local office, and notify the Owner of such time so the Owner has the opportunity to attend. During this test, the Systems Integrator shall demonstrate the complete operation of the control system including any field I/O and network connections. The test shall also have actual dynamic loads provided for each Across-the-Line Starter circuit connected to the control system.
- I. Project Staffing:
 - 1. Project Manager:
 - a. The Project Manager shall be a registered professional engineer licensed in the State of Florida and shall oversee all aspects of the control system project.
 - b. The Project Manager shall have documented experience in the design and construction management of instrumentation / control and electrical systems. This experience shall include emergency power systems, variable frequency drive systems, harmonic correction, voltage drop and load flow analysis, breaker coordination, motor starters, conduit & conductor installation, and PLC / HMI programming.
 - c. The Project Manager shall be located in the Systems Integrators local office.
 - d. The Project Manager shall be the primary contact for the Owner and Engineer.
 - e. The Project Manager shall be on site during the start-up and testing period for the proposed control system.
 - 2. Programmers:
 - a. All Programmers shall be Graduate Engineers or Computer Science Majors with a 4 year college degree. As a minimum, all programmers shall have 5 years of experience in PLC / SCADA / HMI programming.
 - 3. Service Technicians:
 - a. All Service Technicians shall have a minimum of a 2 year Associates Degree in some field related to computers or electrical maintenance.
 - b. All Service Technicians shall have a minimum of five years of experience in PLC /SCADA / HMI systems.
 - c. All Service Technicians shall have experience troubleshooting: motor starters, PLC, SCADA, and HMI systems.
 - d. Service Technicians shall have proficiency in using the following equipment: volt meters, oscilloscopes, PLC programming software, HMI configuration tools

1.3 PLC / HMI PROGRAMMING

- A. All PLC code shall be written in either “Function Block” style. The System Integrator may use “Ladder Logic” for simple logic functions with the Owner’s approval prior to programming.

- B. All PLC / HMI code shall be supplied to the Owner with fully descriptive comments. All HMI code shall be supplied to the Owner with fully descriptive screen and tag data.
- C. The Integrator shall provide the Owner with a flow chart of all PLC code as well as a written algorithm of the codes functions.
- D. The graphic standards to be used for all HMI equipment shall be coordinated with the Owner and the existing HMI system. All control panel screens will be custom.
- E. The Systems Integrator shall provide the Owner with an I/O map of all process variables in the PLC.
- F. All PLC code shall be the property of the Owner.
- G. The Contractor shall provide three copies of all commented PLC, SCADA, and HMI, code/script/screen layouts to the Owner in electronic format prior to acceptance by the Owner. Any documentation not containing symbol information or comments will not be considered acceptable.

1.4 SUBMITTALS

- A. Verification indicating compliance with the all aspects listed under the Systems Integrator Qualifications.

PART 2 - HUMAN-MACHINE INTERFACE (HMI)

- A. The Human-Machine Interface software for the SCADA HMI shall be based upon the existing installation, which shall be field verified. The Systems Integrator shall be responsible for providing all necessary licenses, drivers, and required network and software packages as required, for the configuration as detailed in the project plans. The Systems Integrator shall be required to provide the necessary HMI screens to monitor and control the equipment installed in this project. The Integrator shall be required to submit the proposed HMI screens to the Engineer and Owner for approval a minimum of 4 weeks prior to the factory testing.
- B. All alarms generated by equipment installed on the project shall be displayed in the alarm summary page. The Integrator shall coordinate with the Owner when configuring the system alarms and subsequent actions. The use of HMI alarm tags will not be allowed unless sufficient reason is submitted and approved.

PART 3 - EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall coordinate the System Integrators during construction, testing, start-up, calibration and acceptance of the instrumentation and control system. The Contractor is responsible for a complete and fully operational instrumentation and control system.

3.2 GENERAL INSTALLATION

- A. The instrumentation and control system, peripherals, and accessory equipment shall be installed in accordance with the equipment manufacturer's instructions and located as shown on the Contract Drawings or as approved by the Owner and Engineer.
- B. The Contractor shall coordinate the installation, placing and location of system components, their connections to the process components, panels, cabinets and devices, as required to complete the work subject to the Engineer's approval. The Contractor shall be responsible to insure that all field wiring for power and signal circuits between existing devices, the proposed control system are correctly done in accordance with best industry practice to insure a satisfactory functioning installation

3.3 TEST AND ACCEPTANCE

- A. The Owner shall witness On-site Operability Tests, and have the option to have 1 representative present to during the Factory Acceptance Tests.

3.4 INSTALLATION

- A. All equipment and devices for the instrumentation and control system shall be installed in the locations shown on the drawings, in accordance with the manufacturer's recommendations, and in compliance with the requirements of these specifications. Any alterations to equipment type and locations shall be indicated in the submittal package with a listed reason(s) as to why the change occurred.

3.5 FIELD ACCEPTANCE TESTS

- A. No power shall be activated to any part of the instrumentation and control system until the Owner or Engineer receive a written certified statement by the system supplier that the installation is complete and ready for energizing. The Contractor is responsible for proper coordination and scheduling, and any damage to the instrumentation and control system.

- B. After the installation is completed, the Contractor, through the System Integrator, shall test each component of the instrumentation and control system. After all systems are operating properly, the Contractor shall notify the Owner and demonstrate the full operation of the system. The Contractor shall make all necessary adjustments and correct or replace faulty equipment to the satisfaction of the Engineer.
- C. The control system integrator shall be required to provide all test equipment necessary to test the control system and computer networks (radio) per industry standards.

3.6 FIELD CALIBRATION

- A. All instrumentation and controls shall be calibrated in the presence of the Owner in accordance with the manufacturer's instructions to the accuracy specified.
- B. The Contractor shall provide field calibration as necessary until the project is considered Substantially Complete by the Engineer.

3.7 MAINTENANCE AND CALIBRATION PERIOD

- A. During the first year of operation after substantial completion of the project, the Contractor shall provide maintenance and calibration services for the newly installed instrumentation and control systems. All maintenance and calibration activities shall conform to the manufacturer's requirements and shall be provided by a certified technician. This work shall include all labor, tools, equipment, materials and all other expenses at no additional cost to the Owner. Calibration and maintenance shall be performed a minimum of every 4 months.

3.8 START-UP SERVICES

- A. The System Integrator shall include 8 man-hours for start-up in their bids. These hours will be on the site hours and exclude travel.
 - 1. Any hours not used for Start-up shall be used for Owner Directed Field Programming Changes.
 - 2. Contractor and Integrator shall plan and be prepared for the start-up. Any additional hours required to complete the start-up shall not result additional compensation by the owner.
- B. Coordinate the start-up time and location with the owner at least 1 week prior to scheduled start-up. Owner shall have the opportunity to have representation present during the entire start-up. In the event that the Owner chooses not have representation present for start-up, the Systems Integrator shall obtain written documentation from the Owner indicating they will not require representation during the start-up and it may proceed as scheduled. A copy of this written documentation shall be provided to the Contractor at least 1 day prior to start-up.

PART 4 - AS-BUILT DOCUMENTATION

- A. The Contractor shall coordinate with the Systems Integrators and provide the Owner with a complete set of AutoCAD 2007 control drawings for the project. These drawing shall include site electrical, control panel schematic/layout drawings, programming code, etc.. The drawings shall indicate all wiring numbers.
- B. The Systems Integrator shall provide detailed documentation of all computer code developed for this project. This documentation shall include but not be limited to: written descriptions, comments in PLC code, and HMI scripting. All software and code developed for this project shall be considered property of the Owner.
- C. All As-Built documentation shall be provided in both paper and electronic formats

END OF SECTION 16900

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16910 – CONTROL PANEL CONSTRUCTION

PART 1 - GENERAL

1.1 SCOPE

- A. The Systems Integrator shall furnish, test, and startup all furnished electrical control panels and control system components related to their furnished equipment.
- B. Specifically included are the following control panels:
 - 1. Lift Station Control Panel as indicated in electrical drawings, including equipment listed on equipment list in the indicated corresponding locations within the overall control panel.

1.2 SUBMITTALS

- A. Product Data: For each type of product supplied. Include cut-sheet indicating rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Connection Diagrams: For each type of product supplied, provide a terminal connection diagram showing terminal numbers and corresponding function for each terminal connection. These same terminal references shall be utilized in the point-to-point wiring diagrams.
- D. Alterations to Design: Any and all alterations to design, equipment, devices, instrumentation, layouts, etc. shall be indicated clearly in the submittal package. As part of the alterations, state the reason(s) for the alteration. No alteration shall occur without prior written approval, submitted and accepted by the Owner. Written approval shall be included with the indicated alterations.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CONTROL PANELS

- A. All control panels shall be constructed in accordance with the following standards: National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), Underwriter Laboratories (UL), Nation Fire Protection Association (NFPA), and Instrumentation Systems and Automation Society (ISA)

- B. All control panels shall be constructed in a UL approved production facility and bare all applicable UL labels for panel construction.
- C. The completed panel shall be factory tested prior to shipment. Field installation by the Contractor shall consist only of setting the panel in place and making necessary pneumatic and/or electrical connections.
- D. All control panels shall be designed to operate at the service voltage as indicated in the project plans.
- E. Refer to Equipment List on drawings for product data to be provided with control panel.
- F. The main utility breaker within the panel shall be rated for service entrance, as required per NFPA 70.

2.2 CONTROL PANEL ENCLOSURES

- A. The entire Control Panel Enclosure and assembly shall be rated NEMA 4X.
- B. All enclosures, control panels, and associated hardware interior and exterior hardware shall be constructed of stainless steel (316L).
- C. All interior components shall be clearly identified with plastic identification nametags. The tags shall be white with black lettering.

2.3 CONTROL PANEL WIRING

- A. Wiring, where required, shall be general-purpose open type, neatly bundled and laced or installed in plastic wiring troughs. Wire shall be stranded No. 14 AWG minimum, with thermoplastic insulation rated for 600V and 90 degrees C.
- B. Wiring colors shall be as follows:
 - 1. All ungrounded AC conductors operating at the supply voltage shall be "Black"
 - 2. All ungrounded AC control conductors operating at voltage less than supply shall be "RED"
 - 3. All ungrounded DC control conductors shall be "Blue"
 - 4. All ungrounded AC control conductors or wires that remain energized when the main disconnect is in the "OFF" position shall be "Yellow"
 - 5. All grounded AC current carrying conductors shall be "White"
 - 6. All grounded DC current carrying conductors shall be "White with a Blue stripe"
 - 7. All grounded AC current carrying conductors that remain energized when the main disconnect is in the "OFF" position shall be "White with a Yellow stripe"
 - 8. All ground conductors shall be "Green"
 - 9. A wiring color code legend shall be mounted inside the control panel door.

- C. No terminal strip may be located closer than 8” from any side or bottom of the control panel. This is designed to allow for adequate wire bending radius for field terminations.
- D. All wiring shall be clearly marked with an identification number consistent with the wiring schematic.
- E. Devices mounted on the enclosure door or interior dead front panel shall be run in spiral wrap to avoid pinch points when opening and closing the enclosure door(s) or interior panels

2.4 MISCELLANEOUS

- A. Engraved laminated plastic nameplates shall be furnished for each front panel section of the Control Panel assembly. The Contractor shall coordinate with the Owner for nameplate color and naming conventions. All instruments and components shall be tagged on rear with embossed plastic tape labels.

PART 3 - EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall coordinate the work of the service personnel during construction, testing, and acceptance of the work.
- B. The Contractor shall receive final approval on all panel, enclosure, and equipment layouts by the Engineer and Owner prior to fabrication or installation.

3.2 QUALITY ASSURANCE

- A. All control panels shall be factory tested and certified prior to releasing for shipment. The testing shall consist of but not limited to the following:
 1. Point to point testing of all wiring prior to application of power
 2. The intended supply voltage shall be applied to the control panel and all components shall be tested for proper operation and calibration.
 3. The programmable logic controller and operator interface code shall be loaded, and each shall be tested for functionality.
 4. All components shall be checked to confirm that each device has been installed per the plans and specifications as well as the Manufacturer’s recommendations.
 5. The enclosure shall be inspected for defects and shall be repaired or replaced if necessary.
 6. All labeling and identification tags shall be verified and be clean and visible.
- B. Prior to shipment one copy of the control panel drawings shall be placed in the drawing pocket of the enclosure.

3.3 INSTALLATION

- A. All equipment and devices for the work shall be installed in the locations shown on the drawings, in accordance with the manufacturer's recommendations, and in compliance with the requirements of these specifications.
- B. The Contractor shall be responsible for coordinating the installation of all equipment in the proposed locations with all other trades performing work on the project that may be affected.

3.4 FINAL INSPECTION

- A. Include all changes and/or alterations in the control panels prior to final inspection and acceptance by the owner.
- B. Any changes and/or alterations in the Control Panels shall be reflected/updated in all Control Panel Schematics prior to acceptance by the Owner. This includes all electronic copies delivered to the Owner.

END OF SECTION 16910

16950 – FIELD INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the storage, installation, calibration, and warranty of the instrumentation.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver units as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Lift and support units with the manufacturer's designated lifting and covering.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances for installation.

1.5 COORDINATION AND SCHEDULING

- A. Coordinate with the Owner for the equipment shop drawings (including wiring schematics) and location of mounting areas.

1.6 INSTRUMENT QUANTITIES FOR BIDDING PURPOSES

- A. Refer to drawings and equipment list.

PART 2 - PRODUCTS

2.1 MANUFACTURE AND MODEL

- A. As indicated on Equipment List, located on the drawings.

2.2 WARRANTY

- A. The equipment shall be warranted for a period of two years after startup.
- B. Components failing to perform as specified by the engineers, or as represented by the manufacture, or proven defective in service during the warranty period, shall be replaced, repaired or satisfactorily modified by the manufacture without cost to the Owner when returned to the manufacture.

2.3 WORKMANSHIP

- A. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer to conform within the contract documents. The installation shall be accomplished by workmen skilled in this type of work.

PART 3 - EXECUTION

3.1 DEMONSTRATION

- A. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout".
- B. Demonstrate operation of products specified in this Section. Briefly identify location and describe function, operation, and maintenance of each product.

3.2 INSTALLATION

- A. Install according to manufacturer's written instructions.
- B. Install units with clearances for service and maintenance.
- C. Contractor shall install required electric conduit and cables for all field instruments. Each field instrument shall be supplied with 2#18 AWG twisted-shielded pair of signal wire in a 1" C to the terminal block location indicated within the control panel.

3.3 CONNECTIONS

- A. Electrical: Conform to applicable requirements in Division 16 Sections.
- B. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation and electrical connections, and to report results in writing.
- B. Contractor shall install all equipment and related accessories before having the manufacturer's field service. If additional trips are required due to incorrect installation, Contractor shall pay for the costs for the field services.

3.5 DOCUMENTATION

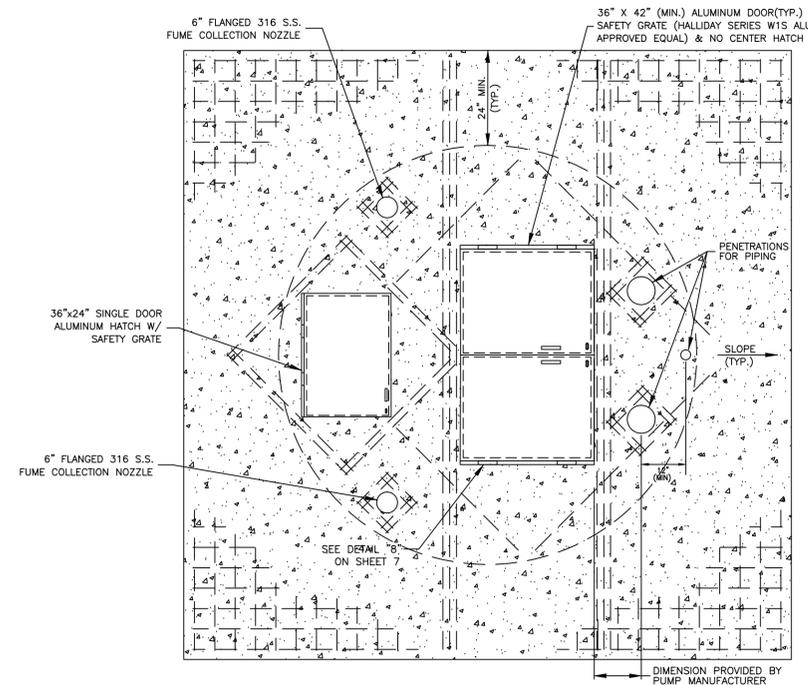
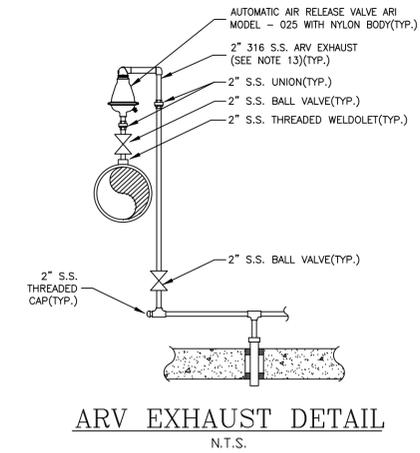
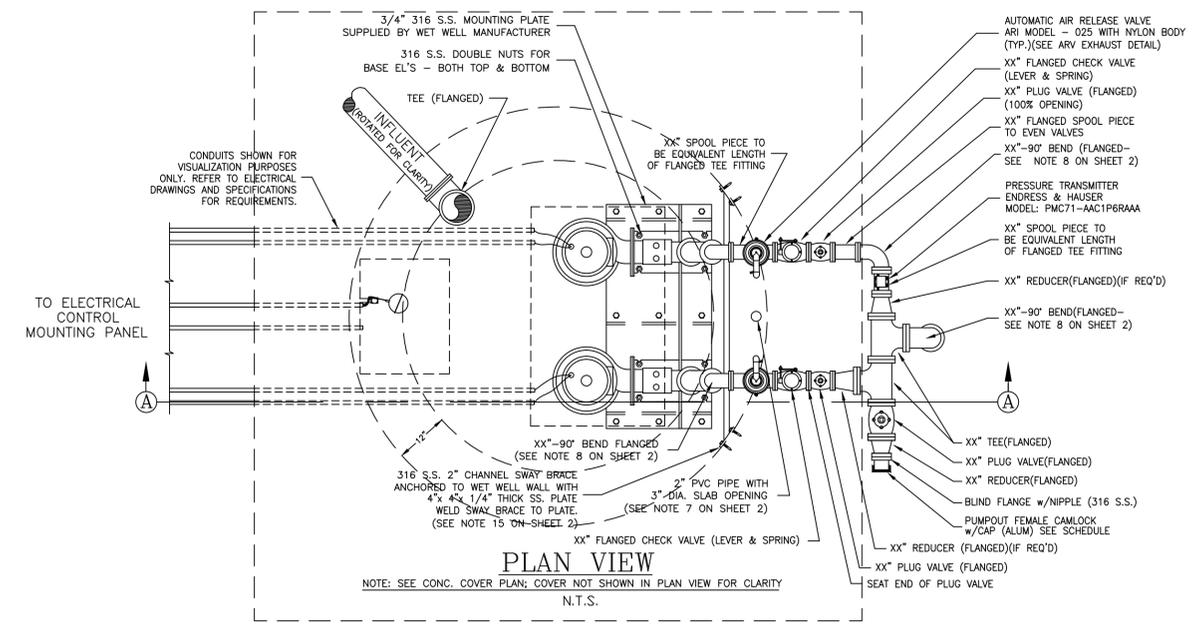
- A. Manuals: Provide the Owner with original copies of the installation, operation, maintenance, and calibration manuals as provided with the equipment. In addition provide the original warranty cards and product literature. Copies of this information shall not be accepted.

END OF SECTION 16950

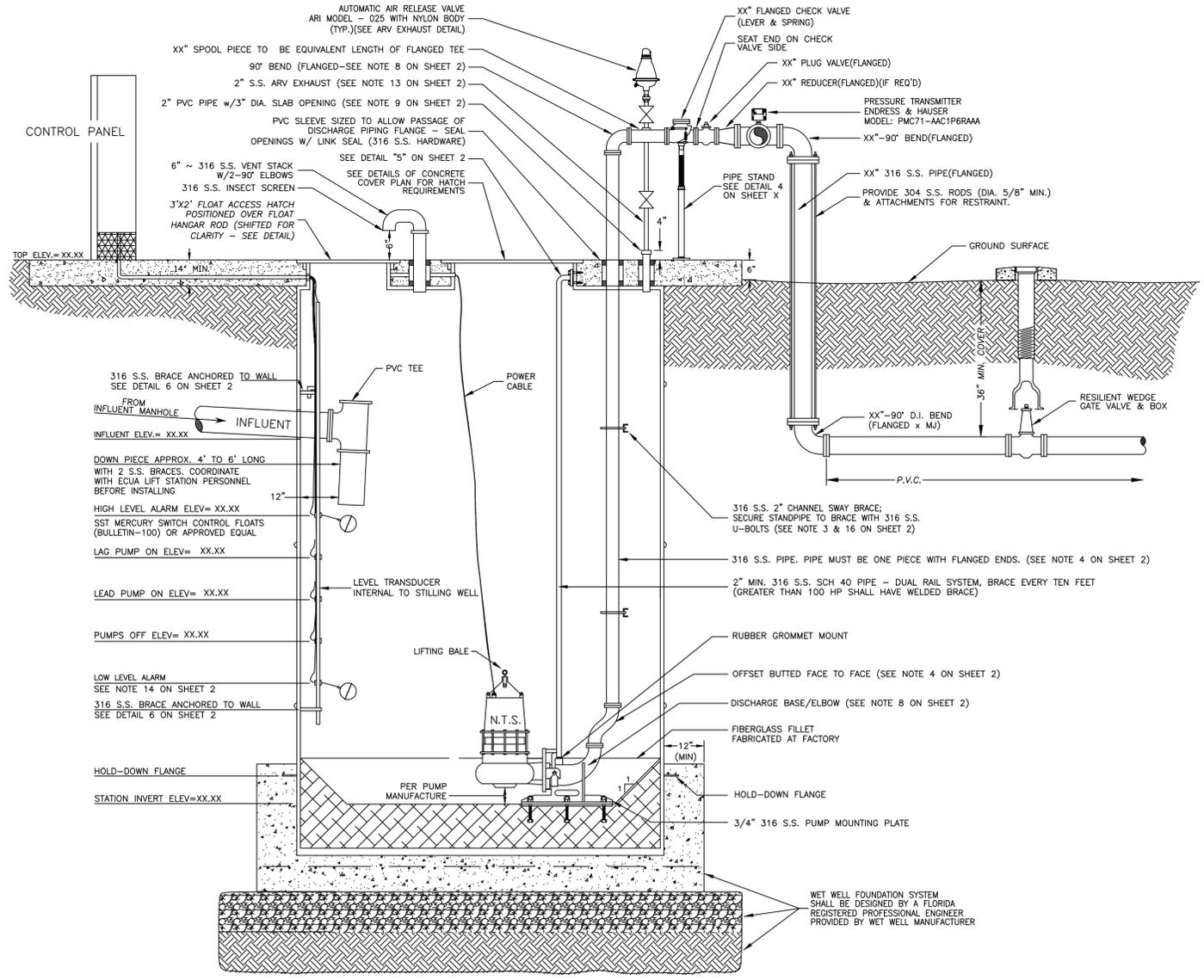
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NOTES:
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO SELECT THE HATCH SIZE THAT WILL ENABLE THE PUMPS TO BE EASILY REMOVED FROM THE WET WELL THROUGH THE HATCH. SEE SPECIFICATIONS FOR CLEARANCE REQUIREMENTS.
- REBAR SIZE SPACING FOR BASE AND CAP SHALL BE DESIGN BY A FLORIDA LICENSED ENGINEER. CAP SHALL BE RATED FOR A MINIMUM 300 P.S.F. PEDESTRAIN LOADING.
- HATCH SHALL BE HALLIDAY TYPE ALUM. W/IS OR APPROVED EQUAL, FLUSH INSTALLATION, SINGLE COVERS, 300 LB/3" LOADING, AND GASKETED TO BE RAIN TIGHT AND PROMOTE ODOR CONTROL.
- SAFETY GRATE(S) SHALL BE HINGED ON SAME SIDE AS HATCH.
- HEAVIER DESIGN LOADS MAY BE REQUIRED.



PUMP OUT SCHEDULE

| DISCHARGE | |
|-------------|---|
| 4 | 4 |
| 6 | 6 |
| 8 | 8 |
| 10 | 8 |
| 12 + LARGER | = |

*COORDINATE WITH ECUA

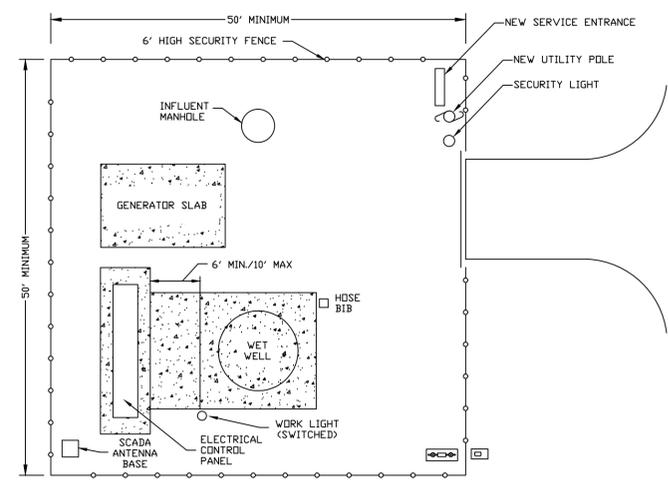
PUMP INFORMATION:

| MANUFACTURER | PER SPECS. |
|-------------------------------|--------------|
| TYPE PUMP | SUBMERSIBLE |
| MODEL NO. | PER SPECS. |
| PUMP DESIGN POINT (GPM @ TDH) | 250 GPM MIN. |
| IMPELLER SIZE & NO. | PER MANUF. |
| DISCHARGE PIPE SIZE | XXXXXX |
| MAX MOTOR H.P. | XXXXXX |
| MAX SPEED | PER SPECS. |
| MIN. EFF. @ DESIGN POINT | XXXXXX |
| VOLT/PHASE | XXX/3PH |

PUMP DISCHARGE SHALL BE CENTERLINE ONLY. NO TANGENTIAL DISCHARGE ALLOWED.

WET WELL INFORMATION:

| | |
|-------------------------|-------------------|
| WET WELL DIAMETER | 8" MIN. |
| WET WELL DEPTH | XX.XX' |
| INFLUENT DIA. - ELEV. | XX'-XX.XX' |
| FORCE MAIN DIA. - ELEV. | XX'-XX.XX' (D.P.) |
| INVERT ELEV OF STATION | XX.XX' |
| PUMPS OFF ELEV. | XX.XX' |
| HIGH LEVEL ALARM ELEV. | XX.XX' |
| TOP ELEV. OF STATION | XX.XX' |



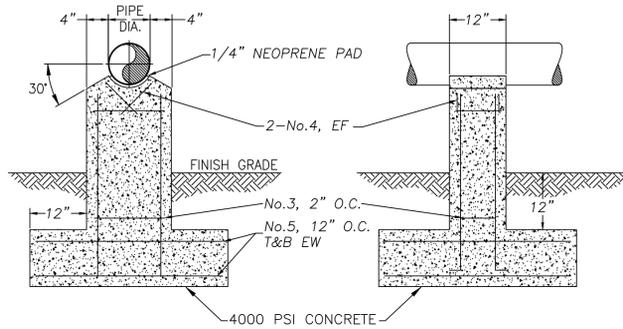
NOTE:
- 6' HIGH FENCE (TO CONFORM WITH SURROUNDINGS) DIMENSIONS, CONFIGURATION & GATE, MAY VARY WITH EACH LOCATION. ECUA L/S PERSONNEL TO VERIFY LOCATION OF GATE PRIOR TO INSTALLATION.
- STORMWATER FLOW SHALL BE DIRECTED AWAY FROM LIFT STATION SITE.
- ALL INFLUENT LINES TO LIFT STATION MUST BE ROUTED TO THE INFLUENT MANHOLE TO THE WET WELL. A SINGLE GRAVITY LINE SHALL CONNECT THE INFLUENT MANHOLE TO THE WET WELL, AT A DISTANCE OF NO GREATER THAN 30 FEET.
- IN-GRADE PULL BOXES SHALL BE LOCATED 10'-0" FROM WET WELL.

IMPROVEMENTS TO WASTE WATER COLLECTION SYSTEM
LIFT STATION XXXXXXXXXXXXX
LIFT STATION DETAIL SHEET ONE

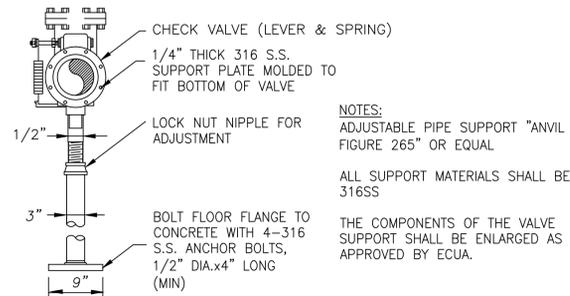


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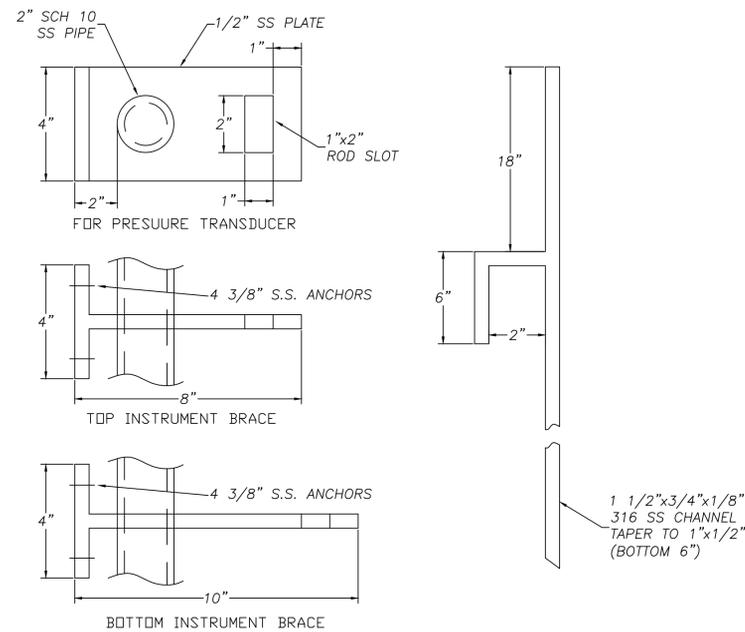
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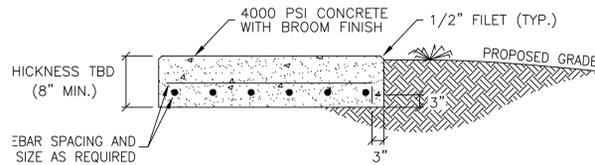
① PIPE SUPPORT DETAIL
N.T.S.



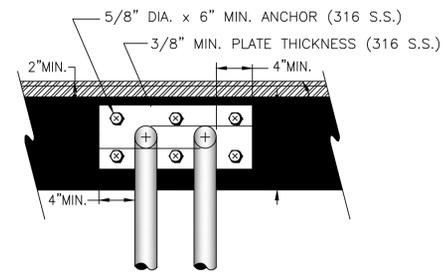
④ ADJUSTABLE PIPE STAND DETAIL
N.T.S.



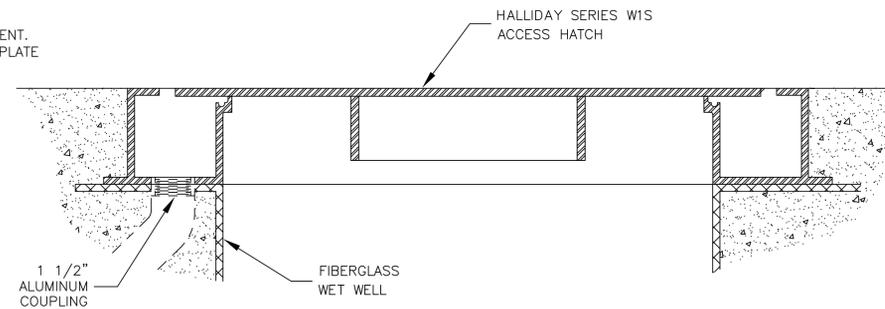
⑥ LEVEL INSTRUMENTATION SUPPORT
N.T.S.



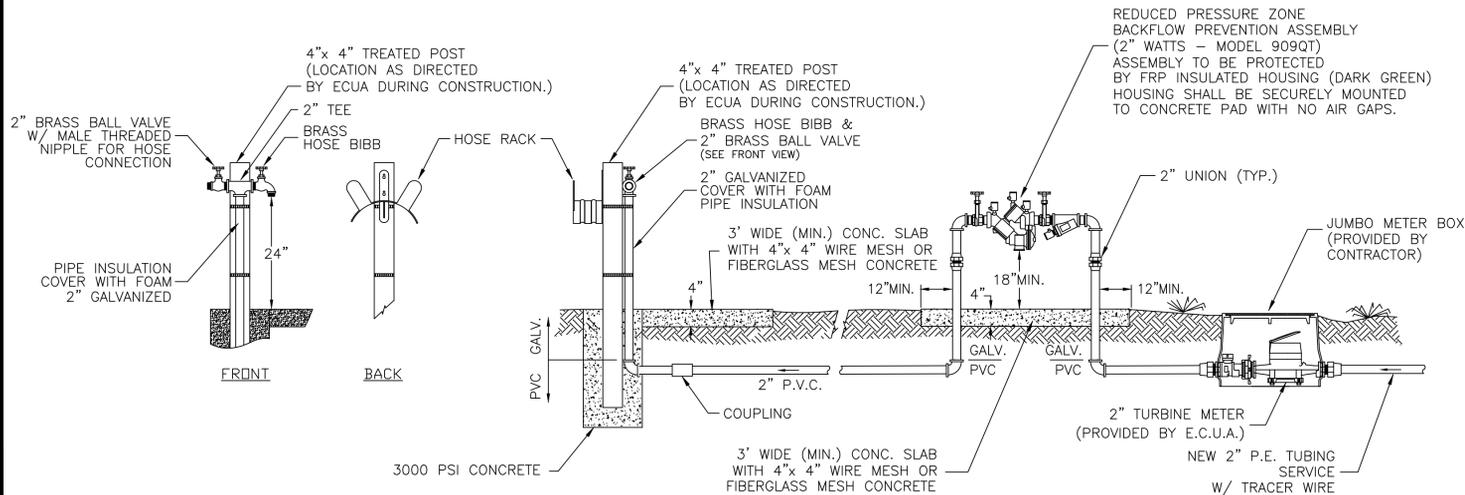
② GENERATOR SLAB DETAIL
N.T.S.



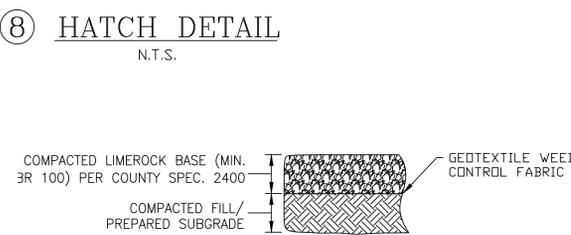
⑤ GUIDE RAIL
N.T.S.



⑧ HATCH DETAIL
N.T.S.



③ LIFT STATION METER DETAIL
N.T.S.



⑦ LIFT STATION SITE DETAIL
N.T.S.

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GENERAL LIFT STATION NOTES

1. THE LOCATION OF INFLUENT LINES, WATER SUPPLY, ETC. ARE DRAWN OUT OF ORIENTATION ON SECTIONAL VIEW. SEE PLAN VIEW FOR ORIENTATION.
2. ALL PENETRATIONS IN WET WELL WALL FOR PIPING, ELECTRICAL, ETC. SHALL BE SEALED & SLEEVED.
3. TO PROTECT STANDPIPE FROM SWAY BRACE, EITHER WRAP PIPE WITH RUBBER SHEETING OR INSERT ALL U-BOLTS THROUGH RUBBER HOSE.
4. PIPING WITHIN THE WET WELL SHALL BE FLANGED SCHEDULE 10 316 STAINLESS STEEL. INTERMEDIATE JOINTS SHALL BE WELDED. FITTINGS WITHIN THE WET WELL SHALL BE FLANGED 316 STAINLESS STEEL. ALL NUTS, BOLTS & ACCESSORIES WITHIN THE WET WELL SHALL BE 316 STAINLESS STEEL.
5. PIPE AND FITTINGS OUTSIDE OF THE WET WELL AND ABOVE GROUND SHALL BE 316 STAINLESS STEEL (FLANGED, SCHEDULE 10).. ALL WELD-ON FLANGES SHALL BE 125# RF SOCKET- WELD FLANGE OR RF WELD NECK FLANGE (TYPE). ALL BOLTS, WASHERS AND NUTS SHALL BE 316 STAINLESS STEEL AND SHALL BE COATED WITH "NEVER SEIZE" TYPE COATING.
6. THE ANNULAR SPACE BETWEEN TOP SLAB AND FORCE MAIN PIPE SHALL BE SEALED VIA LINK SEAL.
7. PROVIDE 4" PIPE (PVC, SCH. 80) THROUGH CONCRETE TOP WITH CAPPED TOP AND OPEN END BOTTOM. SEAL AROUND CONCRETE TOP WITH NON-SHRINK GROUT.
8. INTERIOR SURFACES OF FITTINGS INDICATED, INCLUDING THE FLANGE MATING SURFACES, AS WELL AS THE PUMP IMPELLER, VOLUTE, AND BACKPLATE SHALL BE COATED WITH BELZONA 1321 CERAMIC S-METAL. (UNLESS OTHERWISE SPECIFIED BY OWNER)
9. PLUG VALVES SHALL HAVE AN ALLOWABLE FLOW CAPACITY EQUAL TO 100% OF THE ADJACENT PIPE AREA, AND SHALL ALLOW "PIGGING".
10. THE INTERIOR OF ALL VALVES SHALL BE COATED.
11. CONTRACTOR SHALL PROVIDE 2-3/4" CONDUITS (ONE FOR POWER AND ONE FOR SIGNAL) FOR FLOW METER (IF REQUIRED). CONTRACTOR SHALL TERMINATE WIRES IN OWNER PROVIDED ELECTRICAL CONTROL CABINET.
12. EXHAUST OF ARV'S TO BE FIELD LOCATED, PROVIDE FITTINGS AS NECESSARY, AND PIPED TO WET WELL USING 2" 316 S.S. PIPE.
13. LOW LEVEL ALARM ELEV. TO BE SET IN COORDINATION WITH ECUA AND PUMP MANUFACTURER.
14. CONNECTION OF SWAY BRACE MOUNTING PLATE SHALL BE COORDINATED WITH PUMP MANUFACTURER.
15. A SECOND BRACE IS TO BE INSTALLED WHEN THE DEPTH OF WET WELL IS GREATER THAN 10' DEEP OR WHEN THE PUMPS ARE GREATER THAN 10 HP.

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IMPROVEMENTS TO WASTE WATER COLLECTION SYSTEM
 LIFT STATION XXXXXXXXXXXXXXX
 LIFT STATION DETAILS



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480V 3Ø 1HP – 15HP FULL VOLTAGE STARTER ELECTRICAL STANDARD

FOR EMERALD COAST UTILITY AUTHORITY ESCAMBIA COUNTY, FL

IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
 LIFT STATION CONSTRUCTION DETAILS
 ELECTRICAL STANDARDS
 FINAL SUBMITTAL



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| SHEET NO. | SHEET DESCRIPTION |
|-----------|---|
| 1 | MAIN POWER DISTRIBUTION SCHEMATIC |
| 2 | CONTROL SCHEMATIC |
| 3 | DIGITAL INPUTS SCHEMATIC |
| 4 | DIGITAL OUTPUTS & ANALOG INPUTS SCHEMATIC |
| 5 | ANALOG OUTPUTS & STARTER CONTROL SCHEMATIC |
| 6 | TERMINAL BLOCK LAYOUT AND FIELD CONNECTIONS |
| 7 | LINEAR EXTERIOR PANEL LAYOUT & FIELD CONDUIT REQUIREMENTS |
| 8 | POWER & PUMP 1 INTERNAL PANEL LAYOUTS |
| 9 | PUMP 2 & CONTROL PANEL INTERNAL LAYOUTS |
| 10 | EQUIPMENT LIST |
| 11 | HORSEPOWER RELATED EQUIPMENT & POWER CONDUCTORS |
| 12 | PANEL TO PANEL CONDUCTORS & EQUIPMENT |
| 13 | PANEL TO PANEL WIRING |
| 14 | LINEAR STAINLESS STEEL FRAME LAYOUT |
| 15 | TABLES, LEGENDS & TAGS |
| 16 | ISR INSTRUCTIONS |
| 17 | GENERAL NOTES AND DETAILS |
| 18 | GENERAL NOTES AND DETAILS |

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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
 ELECTRICAL STANDARDS
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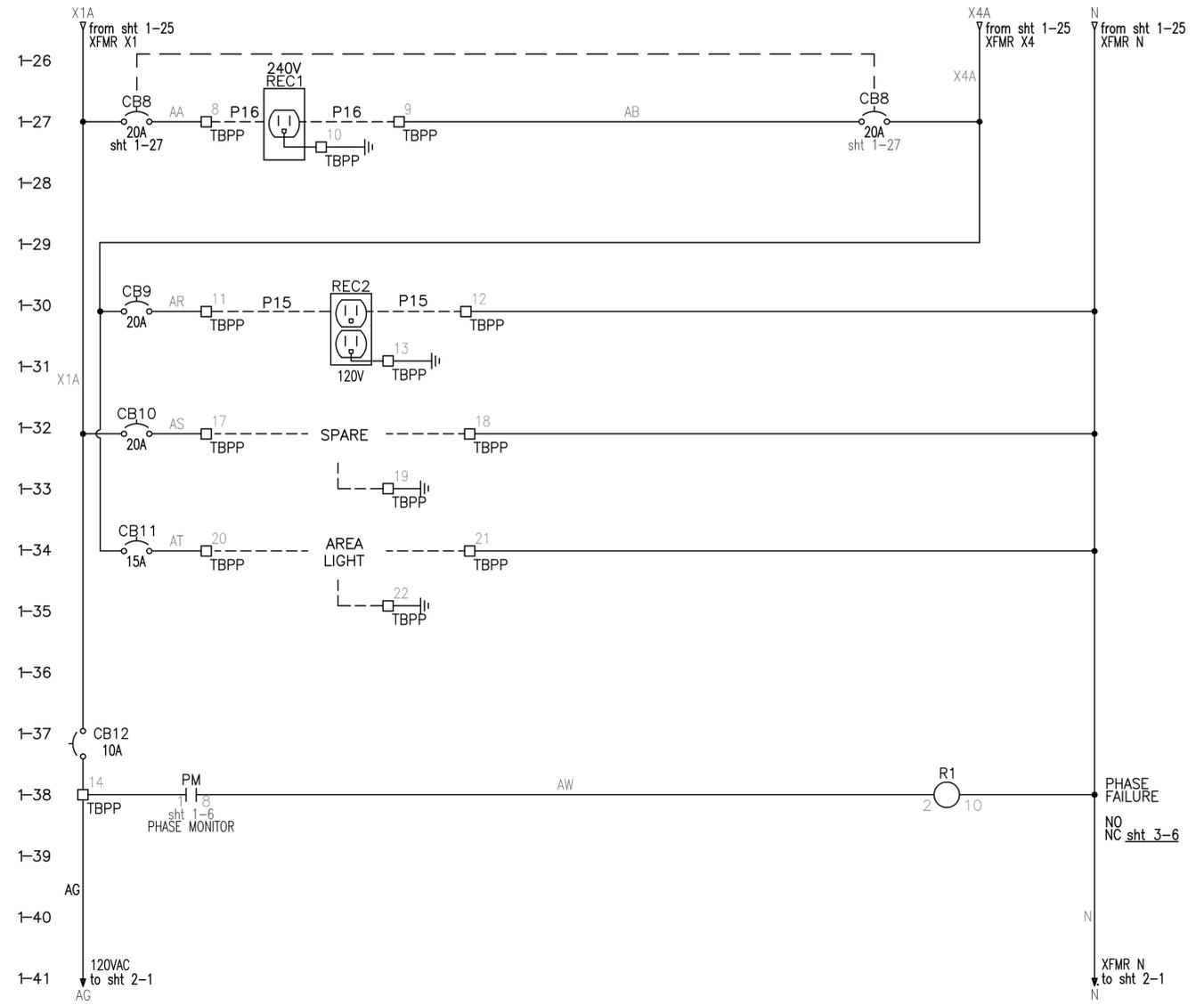
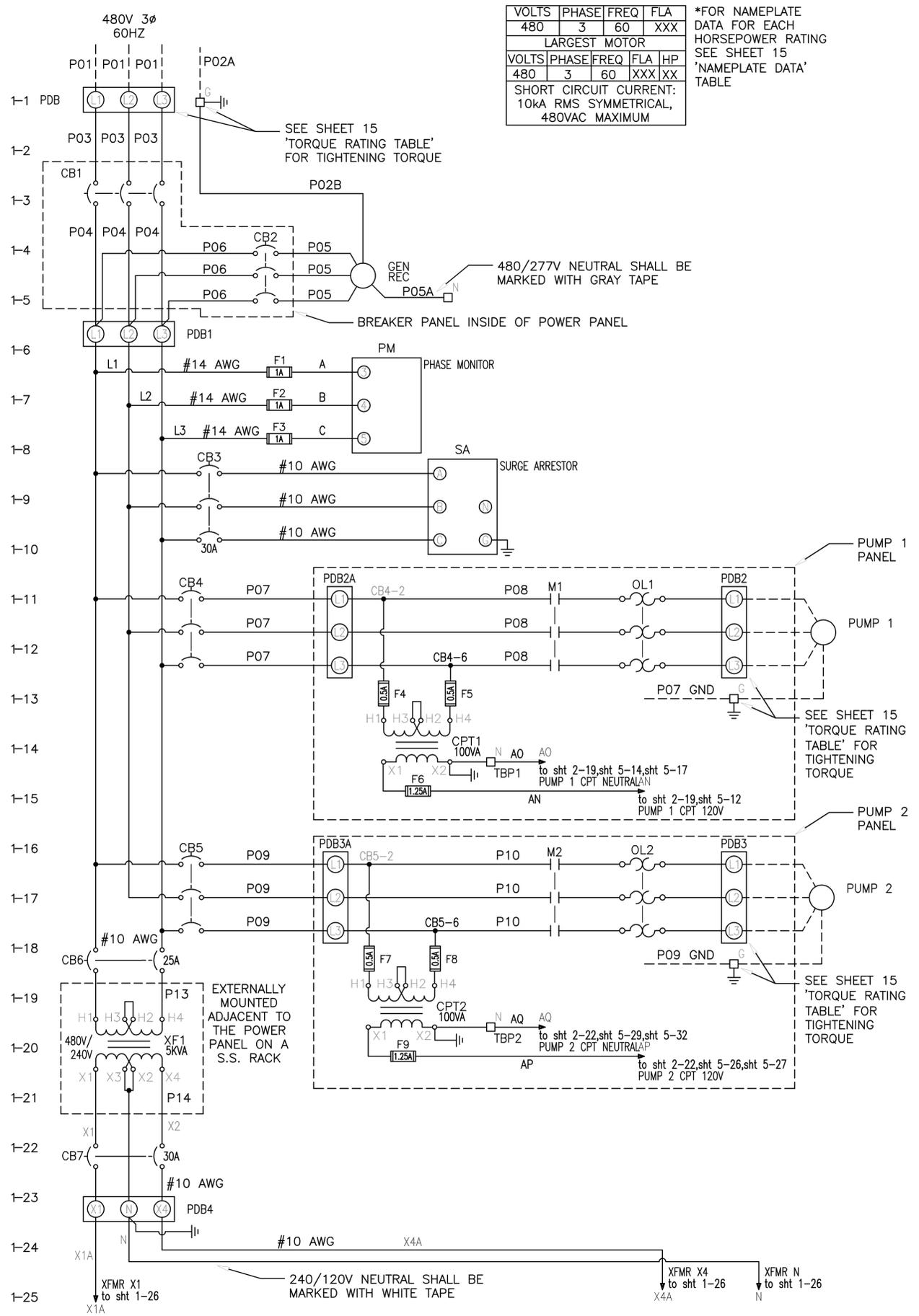
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| VOLTS | PHASE | FREQ | FLA | |
|---|-------|------|-----|----|
| 480 | 3 | 60 | XXX | |
| LARGEST MOTOR | | | | |
| VOLTS | PHASE | FREQ | FLA | HP |
| 480 | 3 | 60 | XXX | XX |
| SHORT CIRCUIT CURRENT: 10KA RMS SYMMETRICAL, 480VAC MAXIMUM | | | | |

*FOR NAMEPLATE DATA FOR EACH HORSEPOWER RATING SEE SHEET 15 'NAMEPLATE DATA' TABLE

NOTES:

- THE COMPLETED CONTROL PANEL SHALL BE LABELED AND MANUFACTURED TO MEET U.L. 508A AND 698A CERTIFICATION.
- CONTROL PANEL WIRING SHALL BE STRANDED COPPER, MINIMUM SIZE #16 AWG WITH 600V 90DEGREE C TYPE THHN INSULATION.
- CONTROL PANEL WIRING SHALL BE NUMBERED AT BOTH ENDS WITH TYPE WRITTEN, HEAT SHRINKABLE WIRE MARKERS.
- ALL WIRING WITHIN THE CONTROL PANEL SHALL BE COLOR CODED OR CODED USING ELECTRICAL TAPE IN SIZES WHERE COLORED INSULATION IS NOT AVAILABLE. THE FOLLOWING CODING SHALL BE USED:
 - UNGROUND AC CONDUCTORS AT SUPPLY VOLTAGE - BLACK
 - GROUND AC CURRENT CARRYING CONDUCTORS - WHITE
 - UNGROUND AC CONDUCTORS BELOW SUPPLY VOLTAGE - RED
 - UNGROUND AC CONTROL CONDUCTORS & CONDUCTORS THAT REMAIN ENERGIZED WHEN THE MAIN DISCONNECT IS OFF - YELLOW
 - UNGROUND DC CONTROL CONDUCTORS - ORANGE
 - GROUND DC CURRENT CARRYING CONDUCTORS - BROWN
 - INTRINSICALLY SAFE WIRING - BLUE
 - GROUND CONDUCTORS - GREEN
- SEE SHEETS 11 & 12 FOR DETAILS REGARDING ALL POWER CONDUCTORS LABELED PXX.
- SEE SHEET 11 'HORSEPOWER RELATED COMPONENTS EQUIPMENT LIST' FOR RATINGS OF OVERCURRENT PROTECTION DEVICES.
- SEE SHEET 6 FOR TERMINAL BLOCK DESIGNATION AND DESCRIPTIONS.



240/120V NEUTRAL SHALL BE MARKED WITH WHITE TAPE

X4A

PHASE FAILURE
NO NC sht 3-6

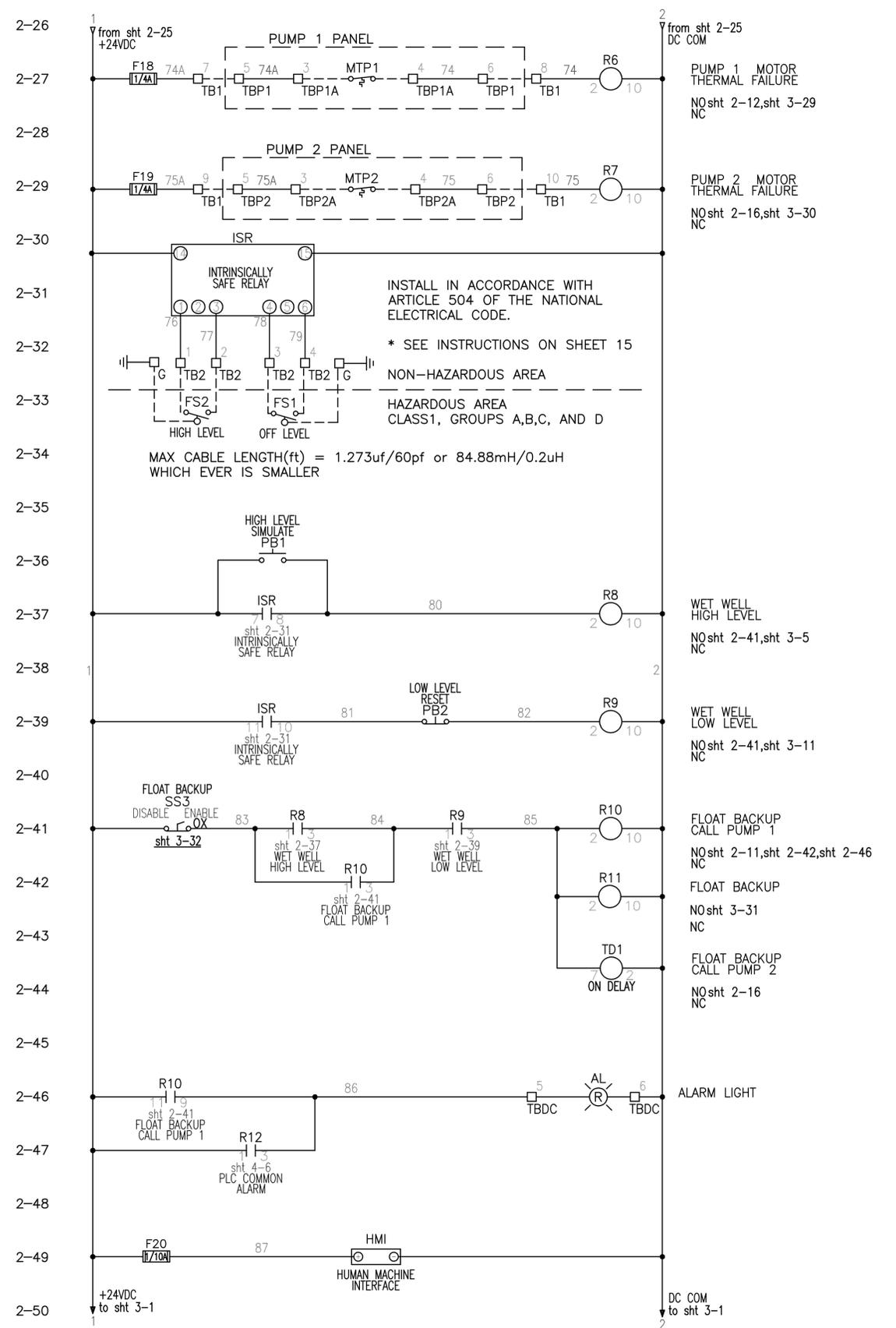
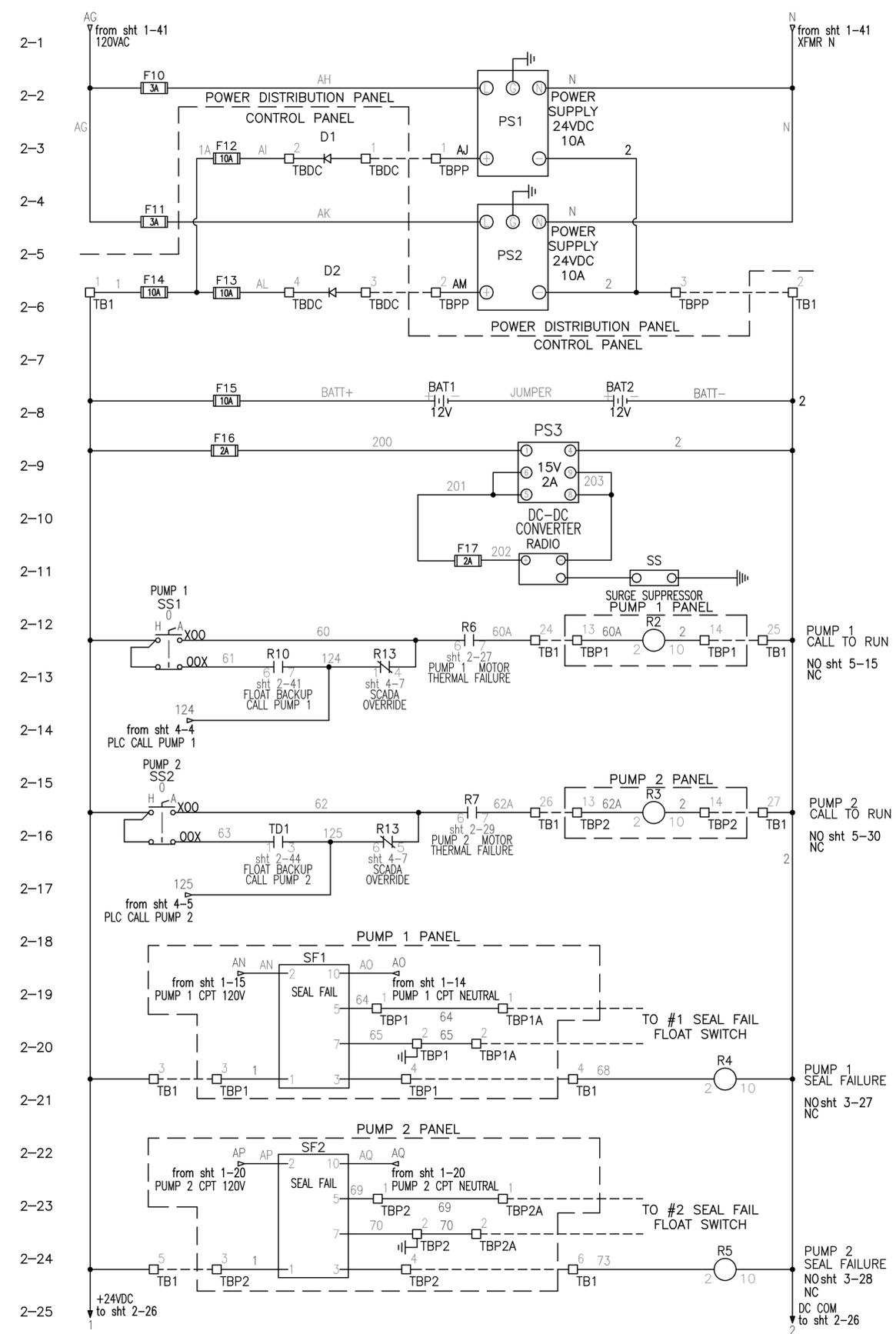
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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
 ELECTRICAL STANDARDS
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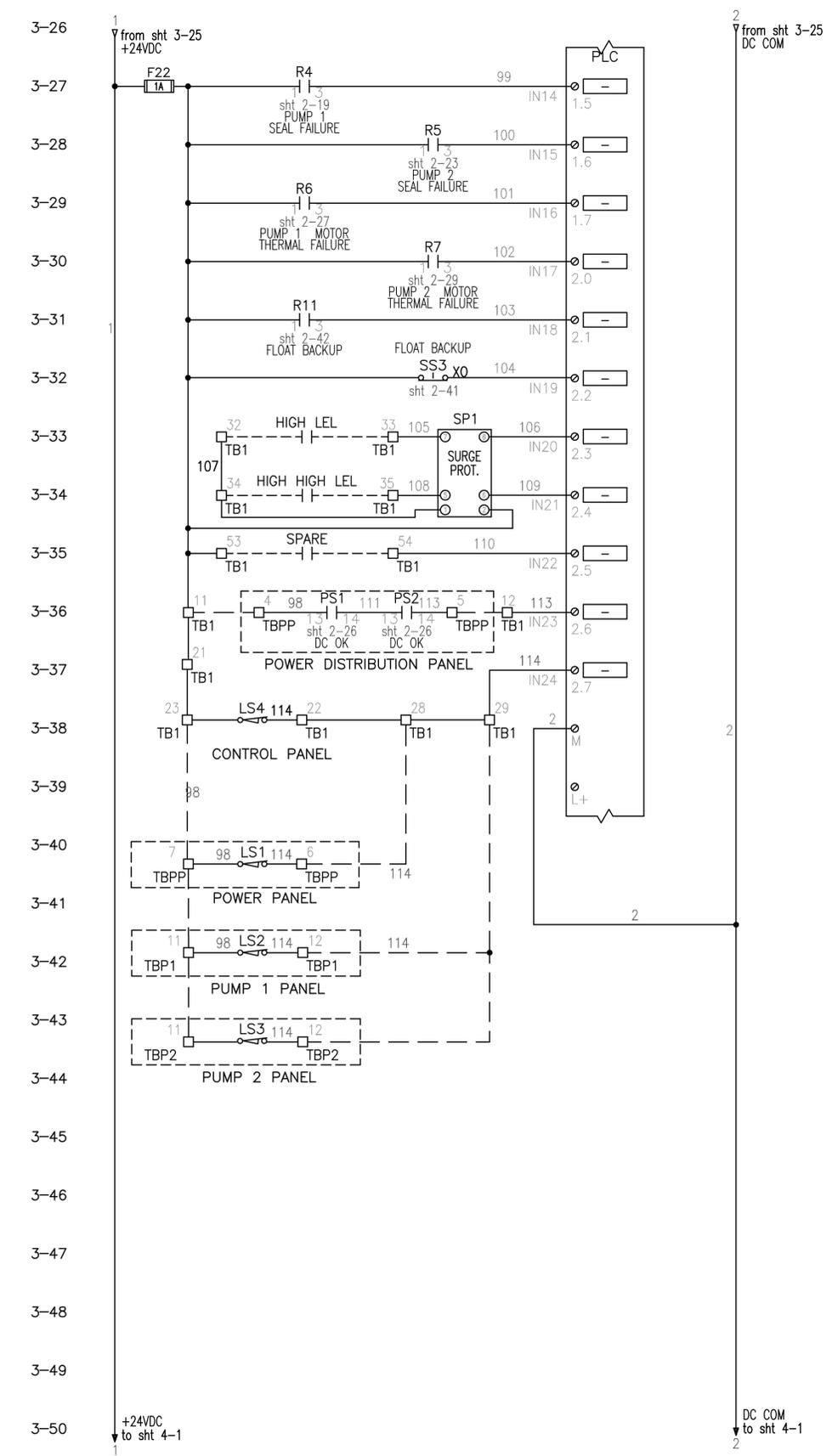
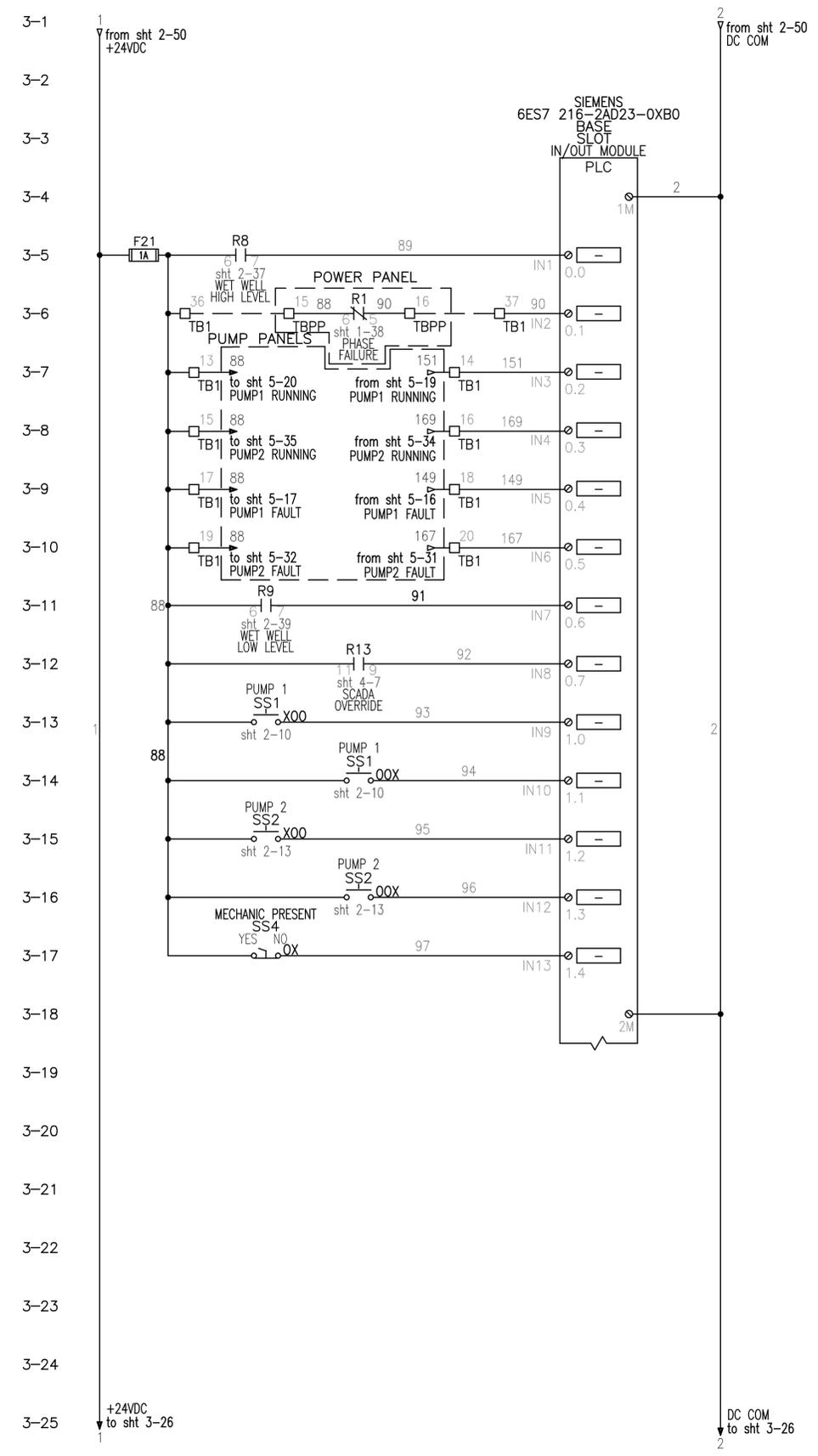
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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
ELECTRICAL STANDARDS
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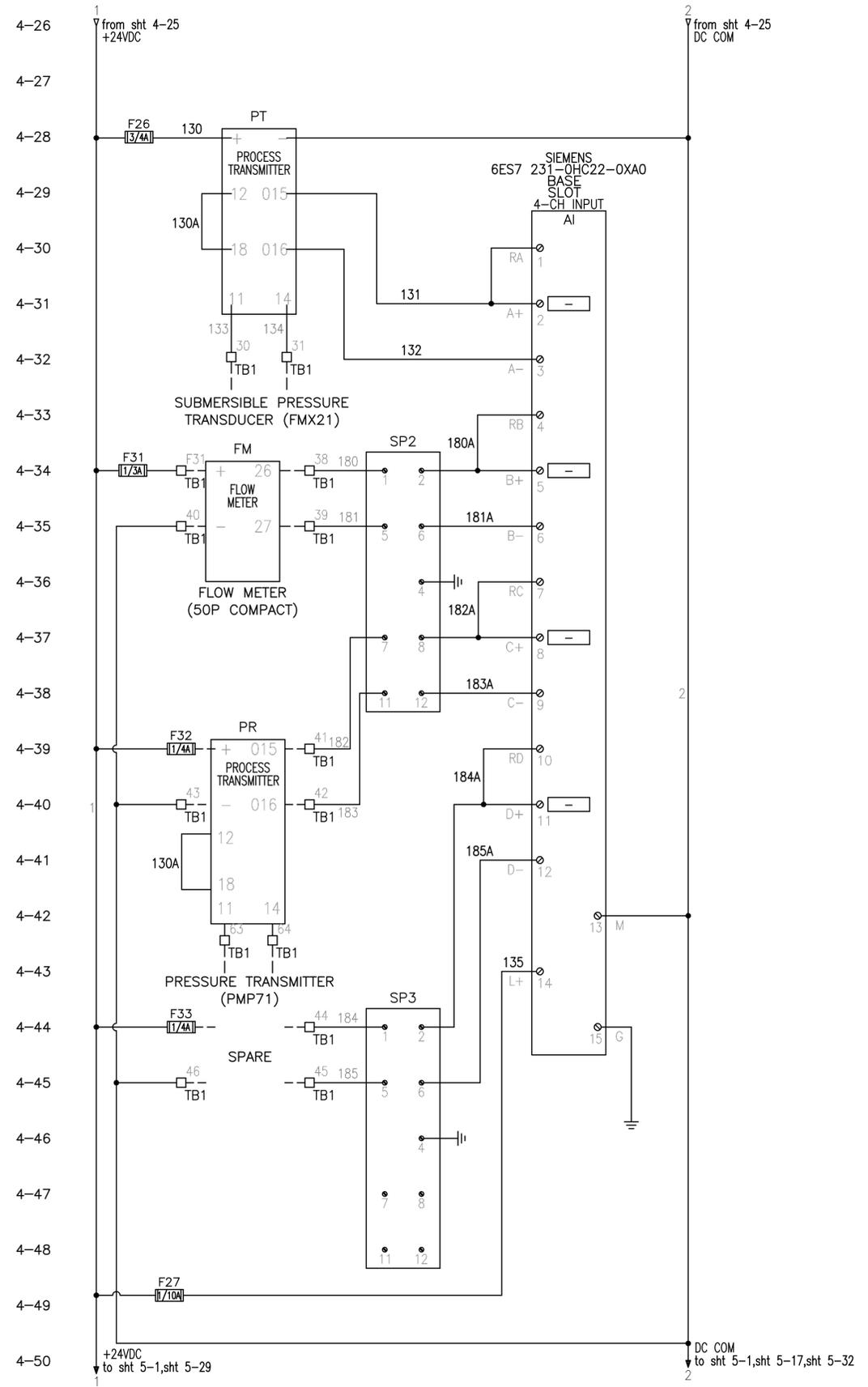
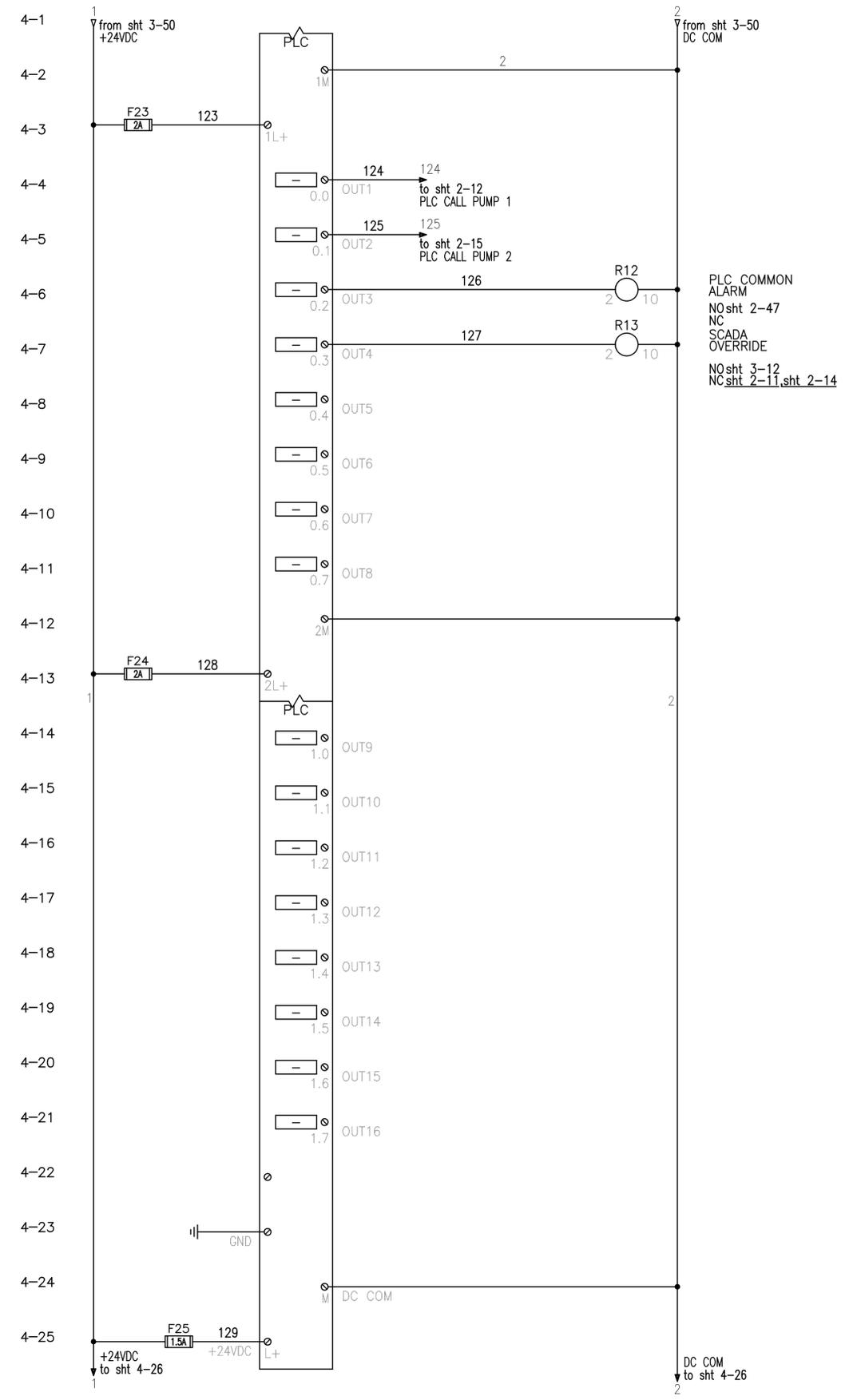
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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
ELECTRICAL STANDARDS
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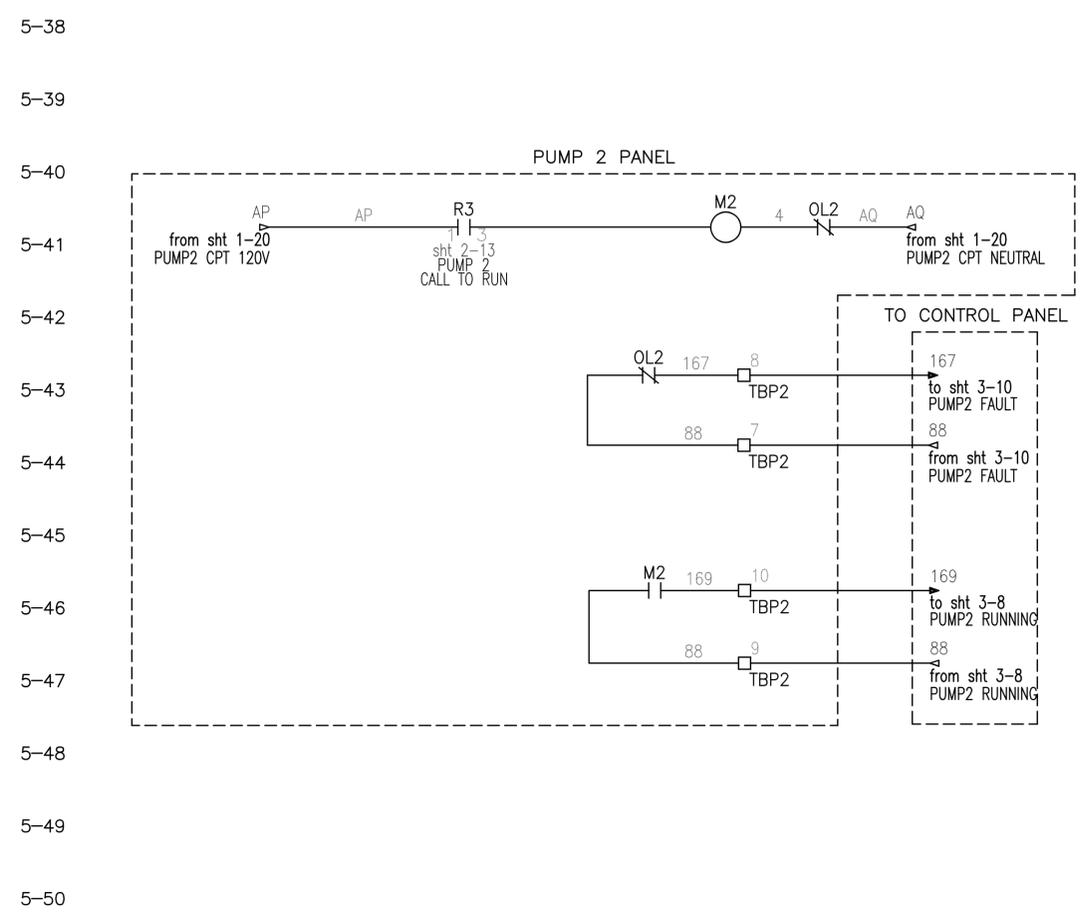
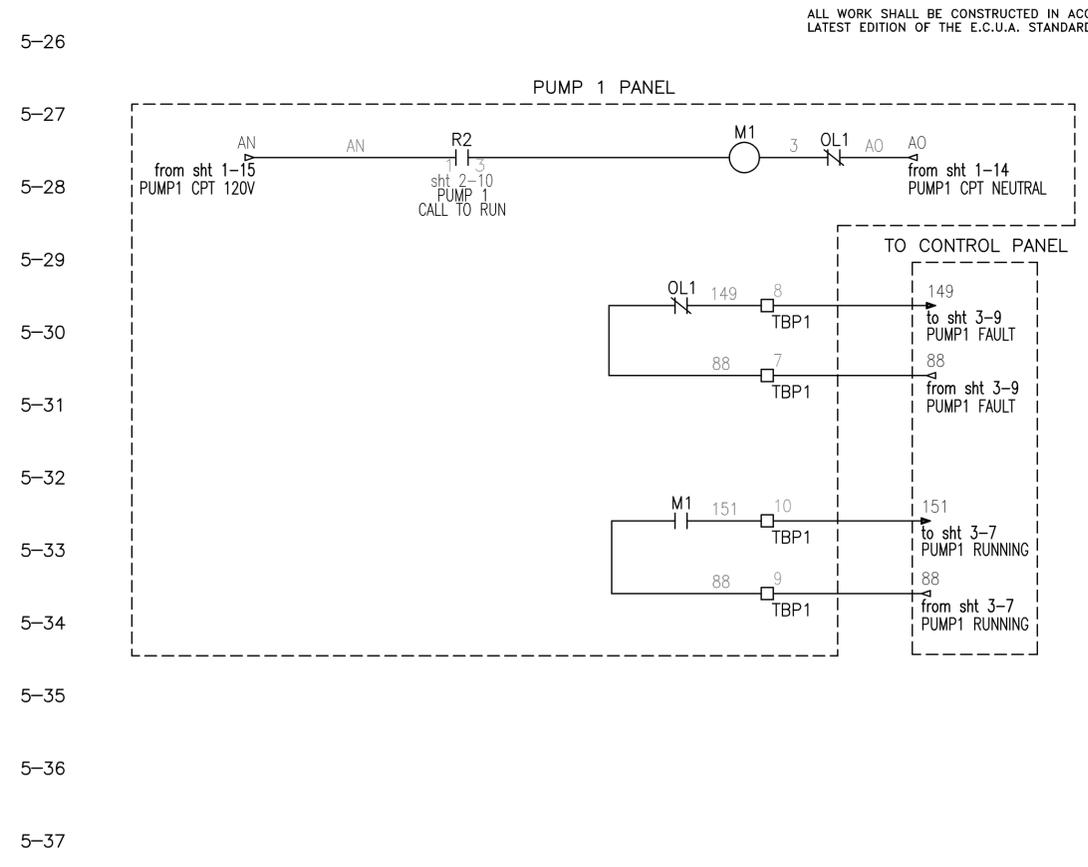
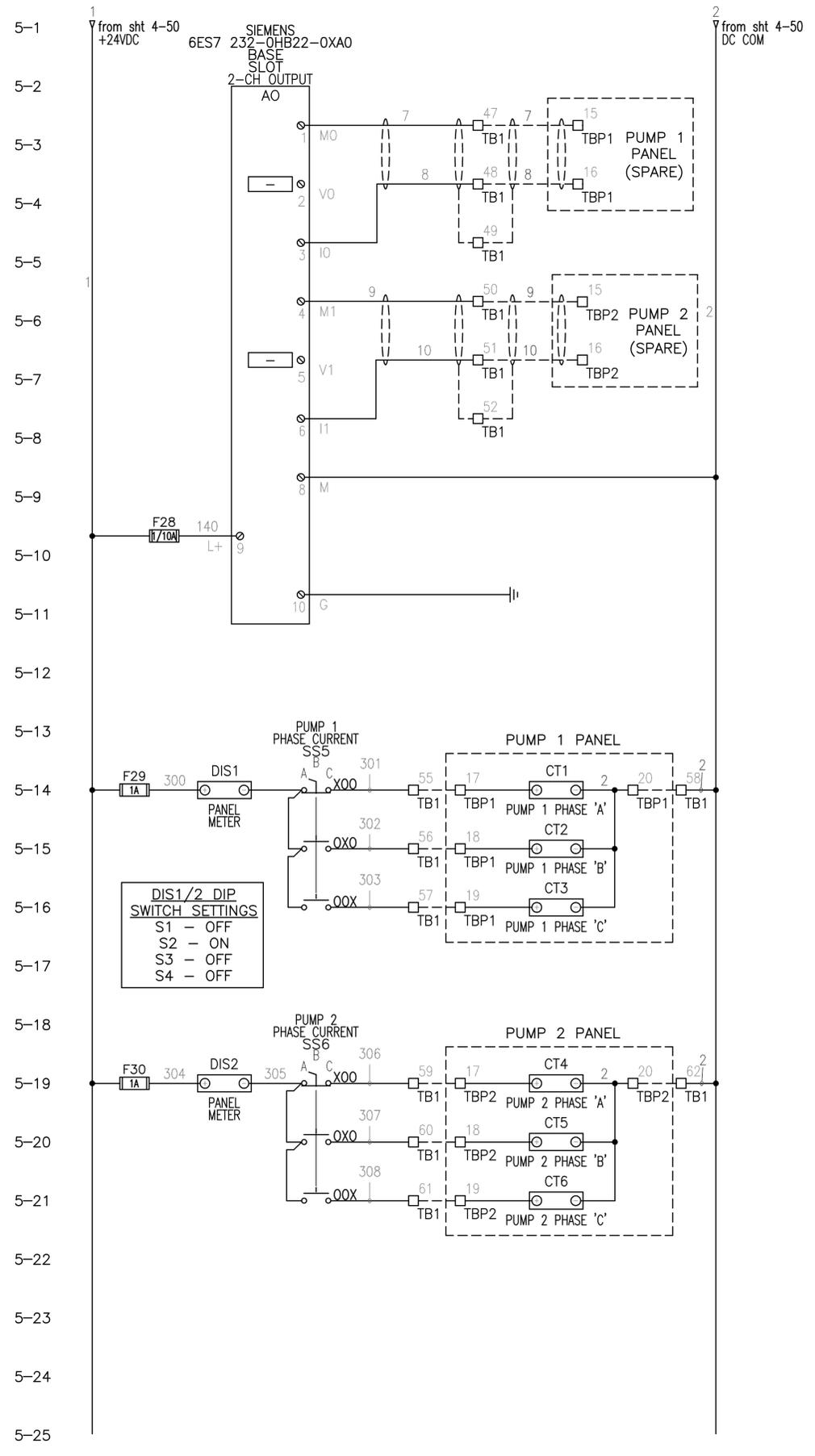
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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
ELECTRICAL STANDARDS
FINAL SUBMITTAL

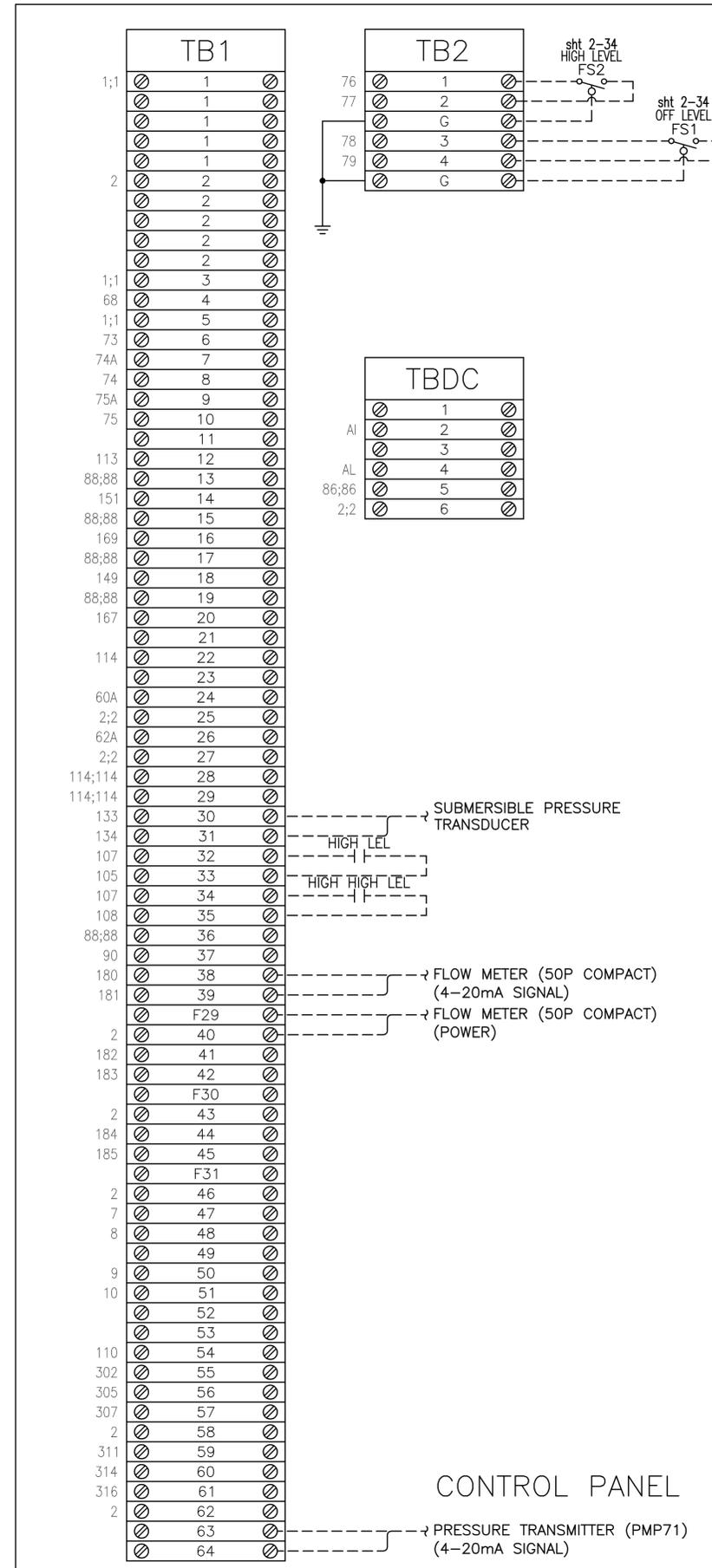
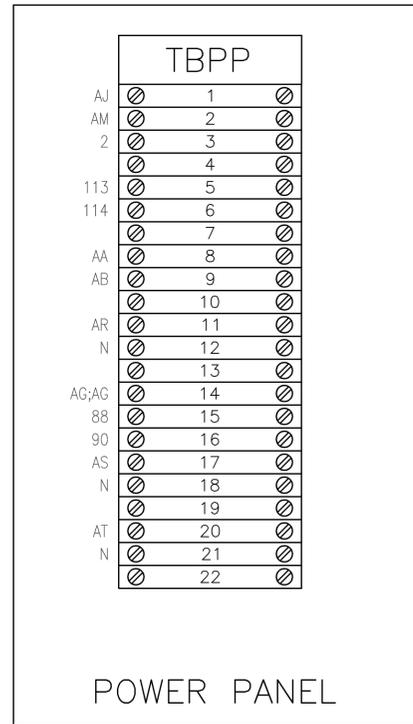


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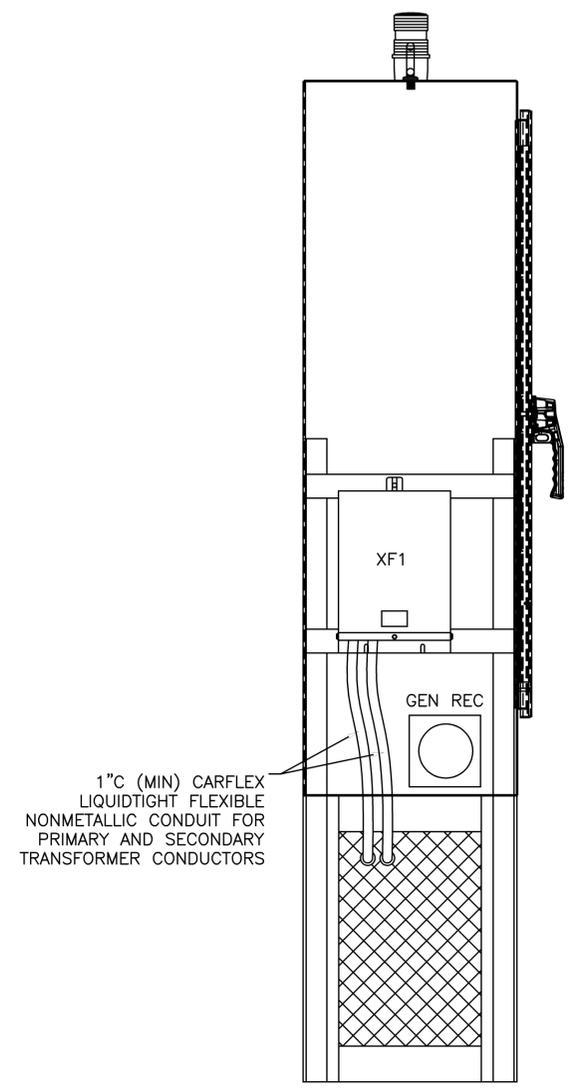
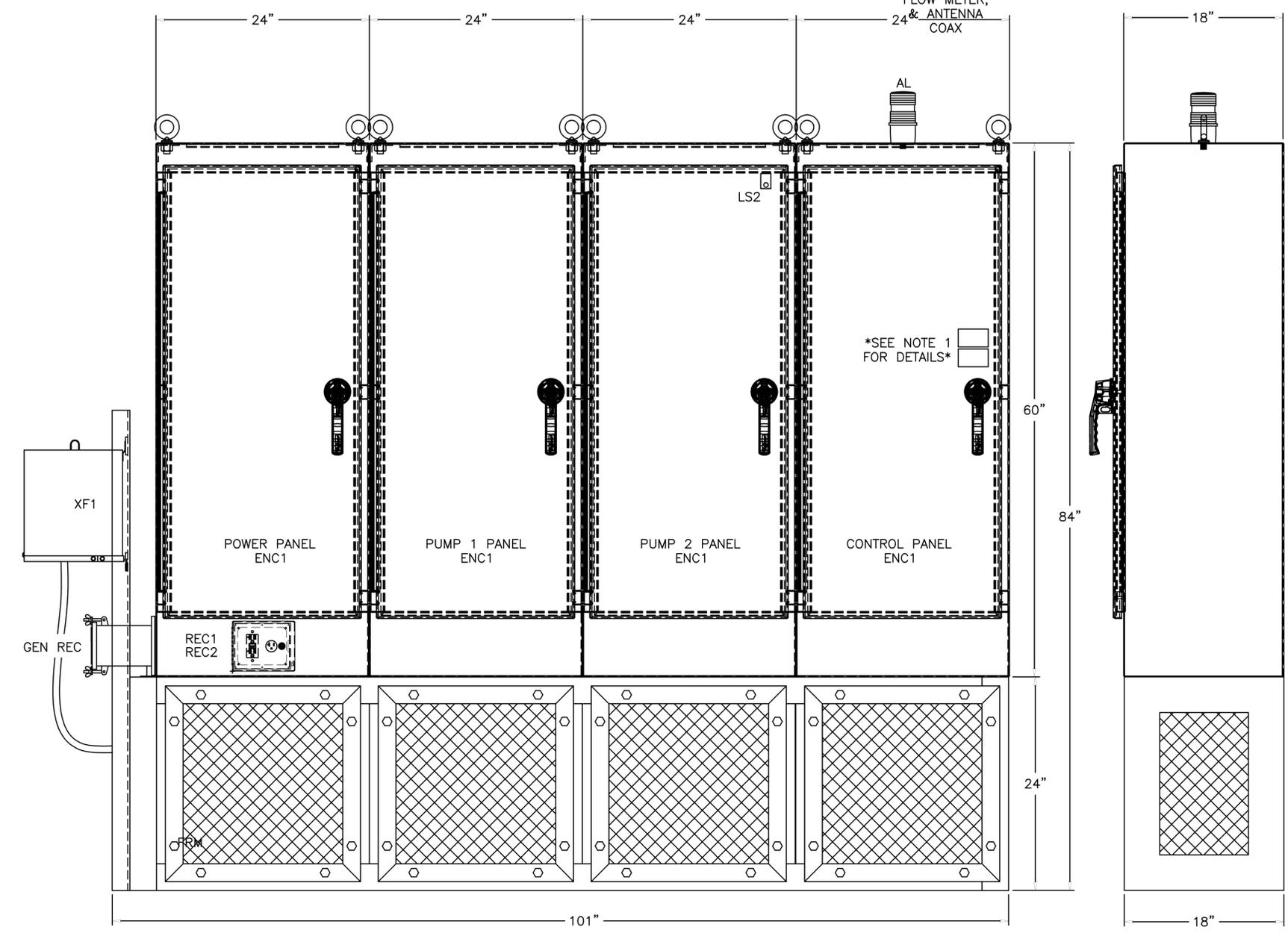
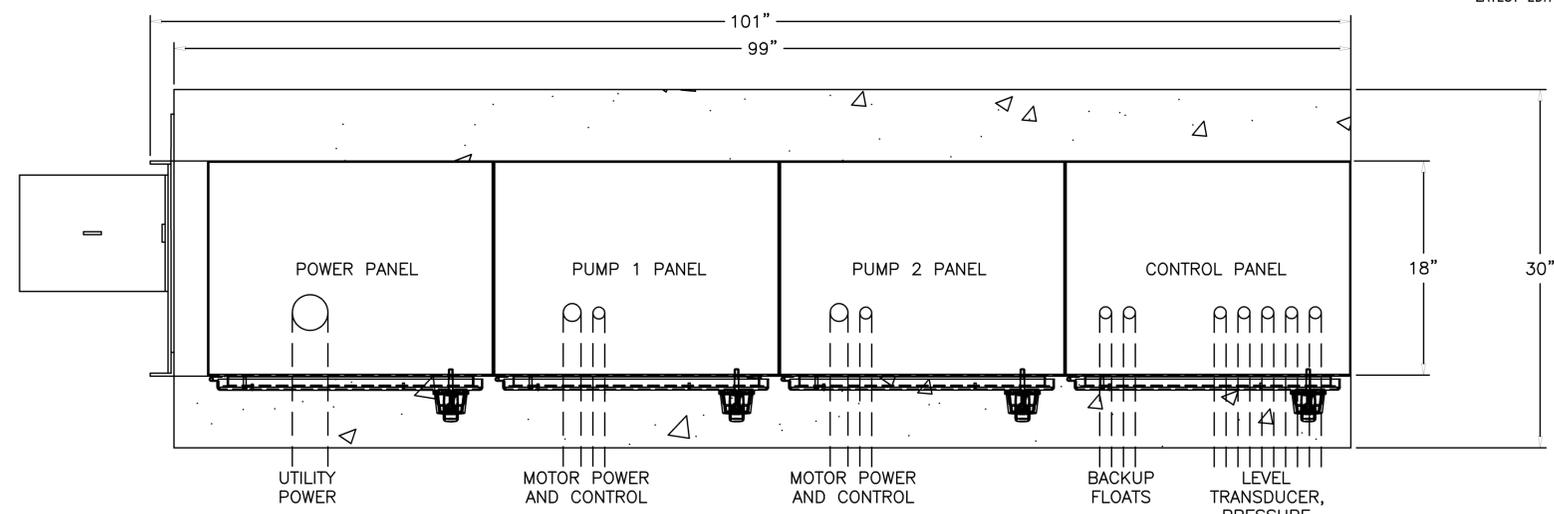
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NOTES

1. SEE SHEET 15 FOR SCHEDULES, LEGENDS AND PANEL TAGS.

ATTENTION

THIS LAYOUT IS ONE OF TWO (2) POSSIBLE CHOICES - SEE SHEET 7A FOR THE OTHER OPTION. IF THIS LAYOUT OPTION IS SELECTED, SEE SHEET 14 FOR ASSOCIATED RACK DETAILS.



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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
 ELECTRICAL STANDARDS
 FINAL SUBMITTAL



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| Of 18 Sheets |

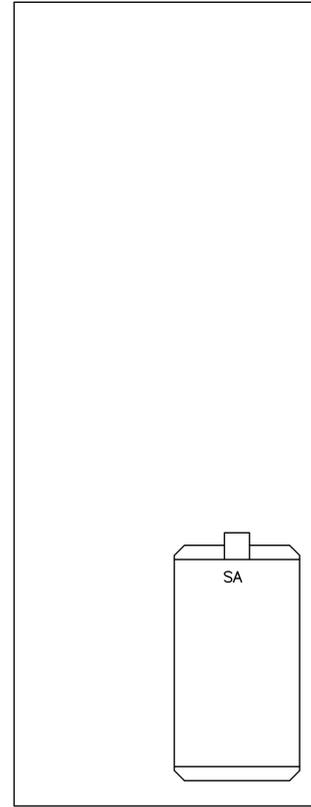
ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE LATEST EDITION OF THE E.C.U.A. STANDARD SPECIFICATIONS

NOTES

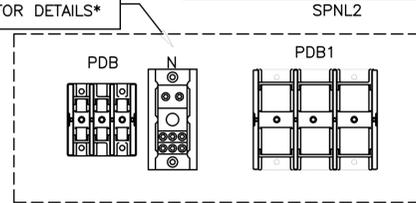
- SEE SHEET 15 FOR SCHEDULES, LEGENDS AND PANEL TAGS.
- LAYOUT OF THE POWER & STARTER SECTIONS DEPICTS THE LARGEST POSSIBLE HORSEPOWER CONFIGURATION.

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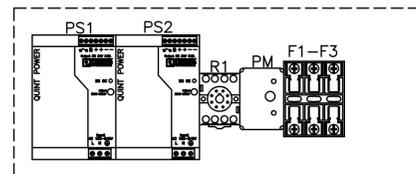
POWER ENCLOSURE
LEFT SIDE PANEL
LAYOUT



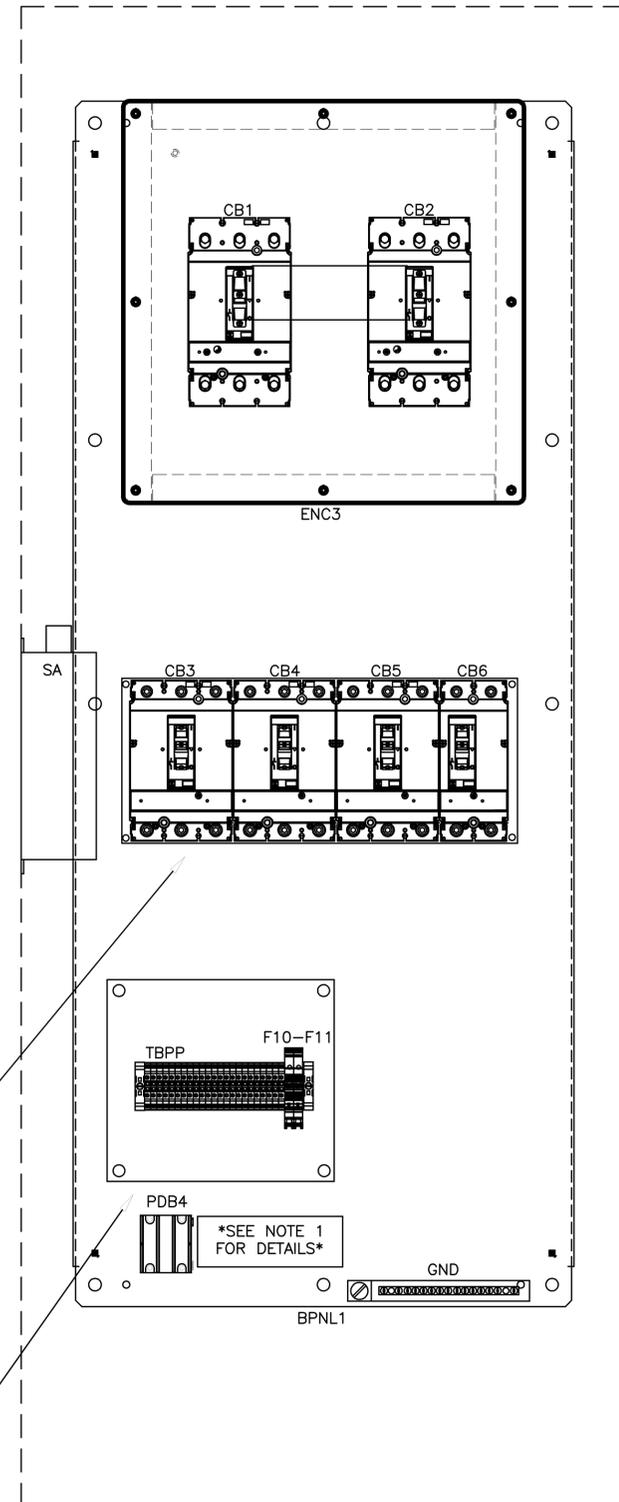
SEE NOTE 1 FOR DETAILS



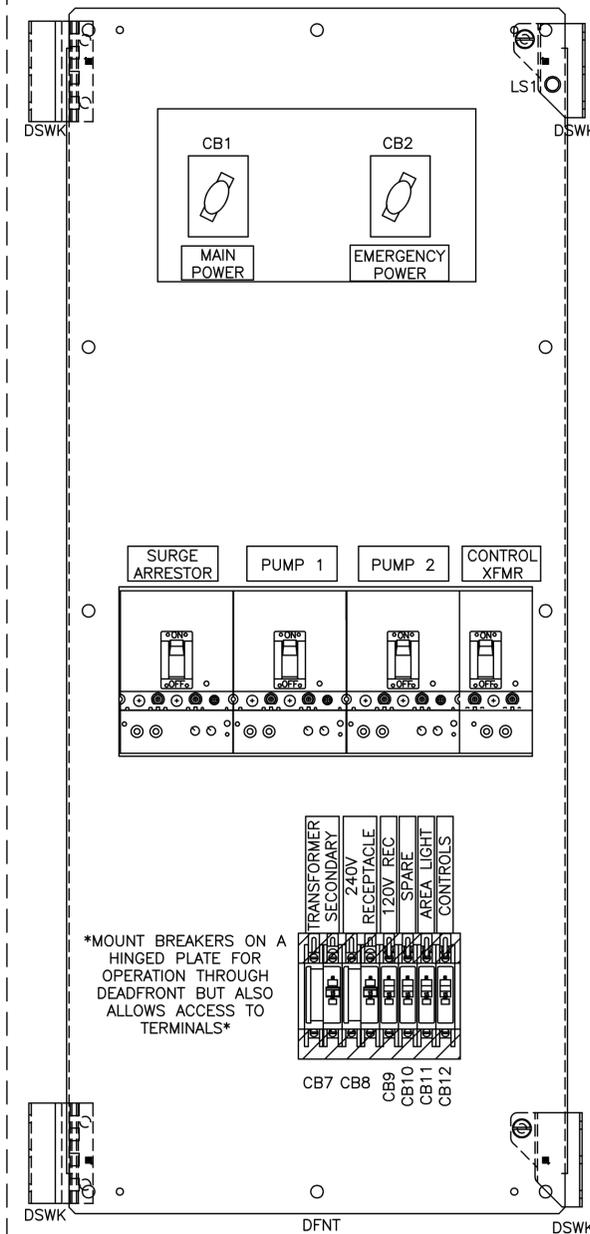
MOUNT POWER DISTRIBUTION BLOCKS BELOW BREAKER STAND TO THE LEFT



MOUNT THESE COMPONENTS BELOW HINGED LEXAN COVER TO THE LEFT

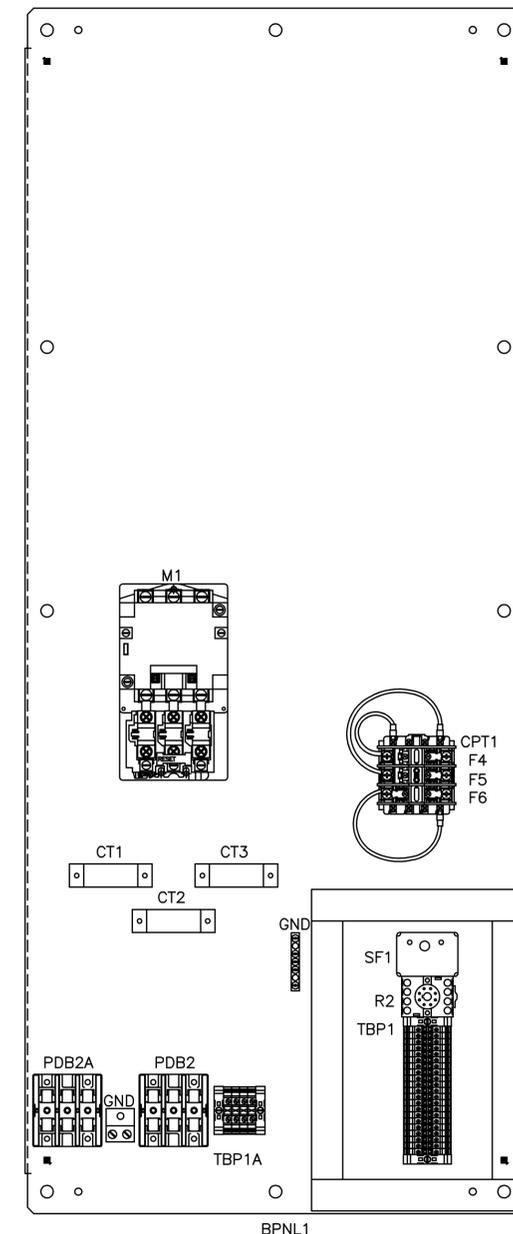


POWER ENCLOSURE
BACKPANEL LAYOUT



MOUNT BREAKERS ON A HINGED PLATE FOR OPERATION THROUGH DEADFRONT BUT ALSO ALLOWS ACCESS TO TERMINALS

POWER ENCLOSURE
DEADFRONT LAYOUT



PUMP 1 ENCLOSURE
BACKPANEL LAYOUT

IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
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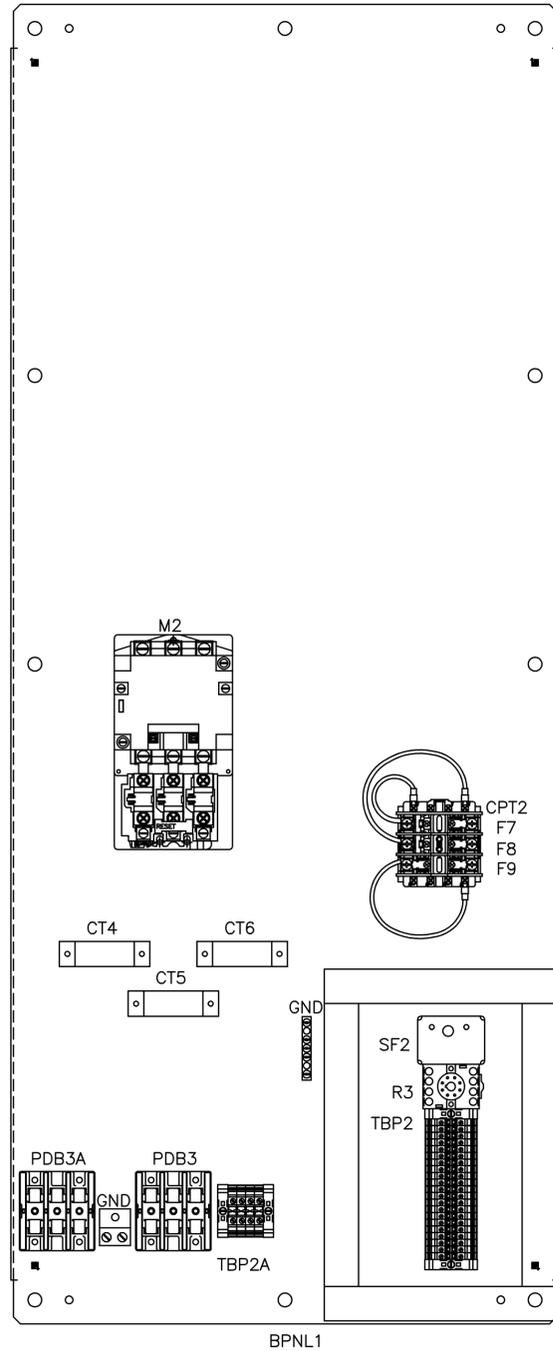
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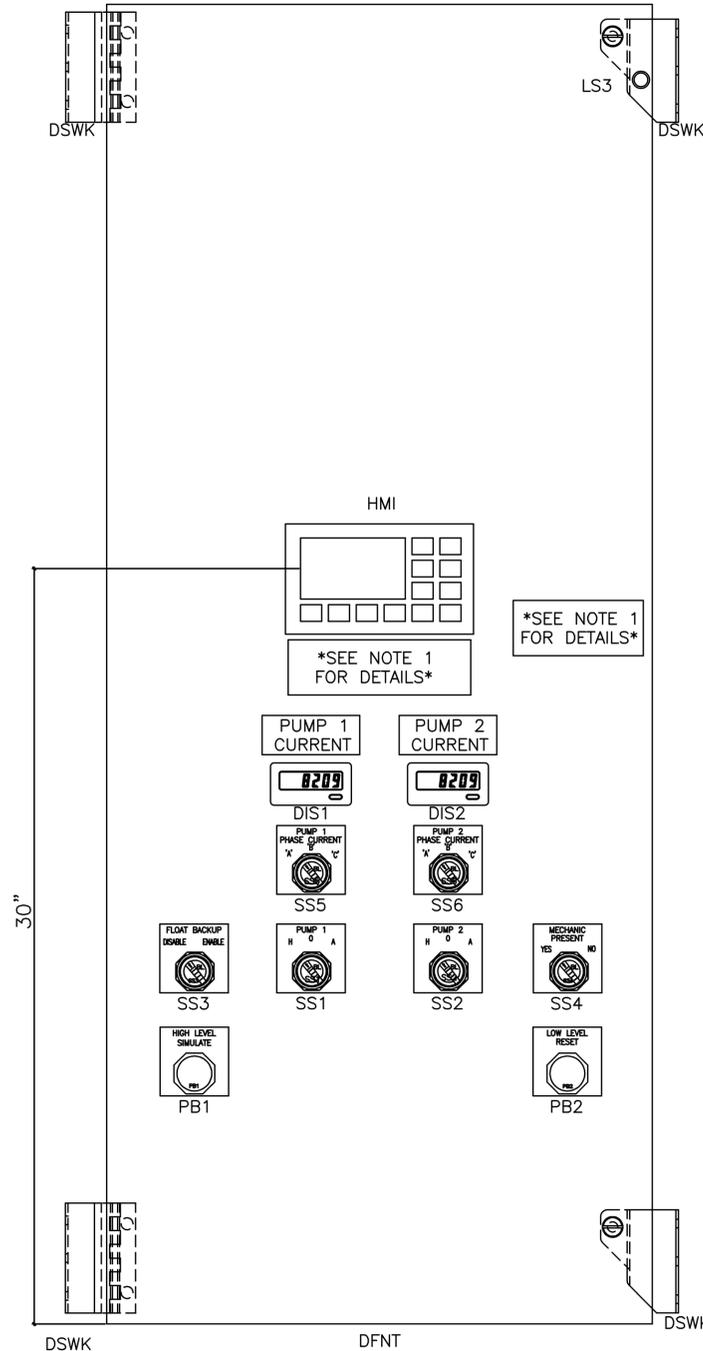
NOTES

1. SEE SHEET 15 FOR SCHEDULES, LEGENDS AND PANEL TAGS.
2. LAYOUT OF THE VFD SECTION DEPICTS THE LARGEST POSSIBLE HORSEPOWER CONFIGURATION.

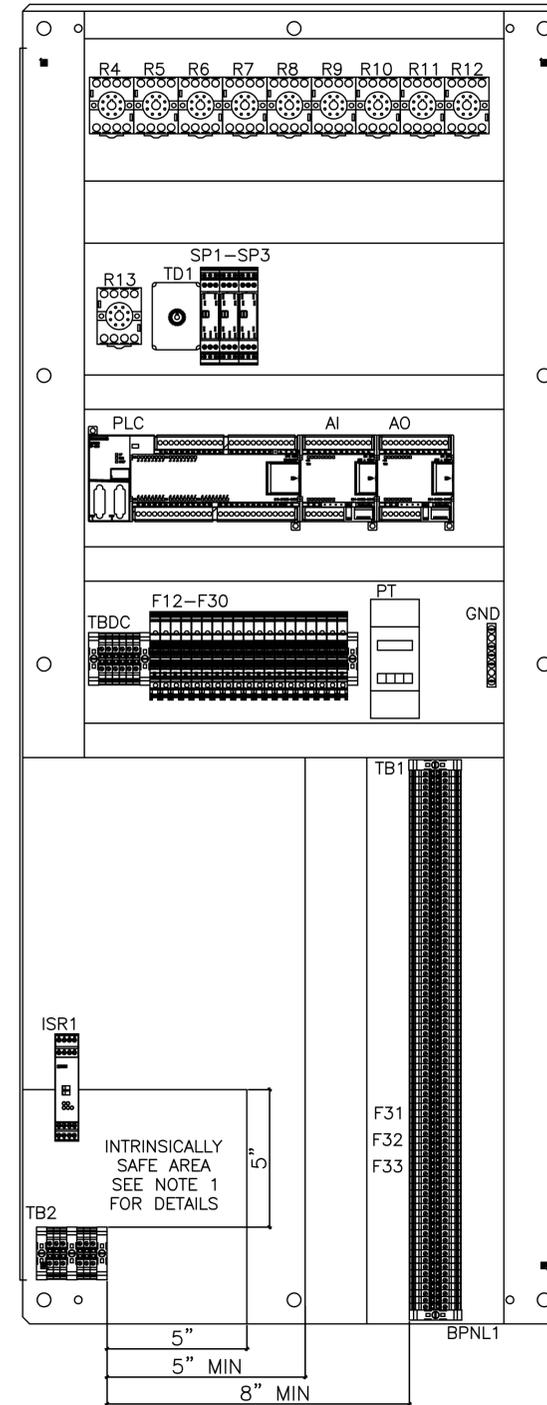
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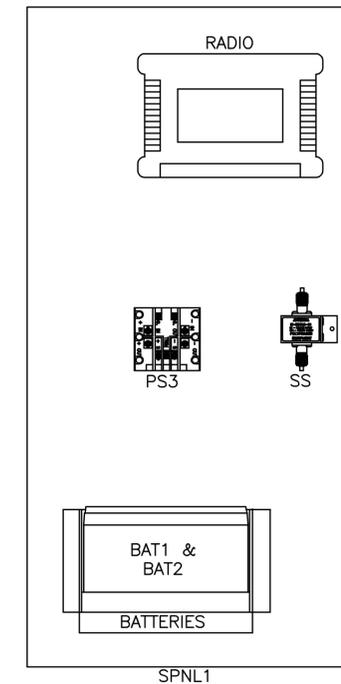
PUMP 2 ENCLOSURE BACKPANEL LAYOUT



CONTROL PANEL DEADFRONT LAYOUT



CONTROL ENCLOSURE BACKPANEL LAYOUT



CONTROL ENCLOSURE RIGHT SIDEPANEL LAYOUT

IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
LIFT STATION CONSTRUCTION DETAILS
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| 480V FVNR Equipment List | | | | | | |
|--------------------------|------------------|---------------------|--|------------------|-----------------------|-----|
| Item | Tag | Panel | Description | Manufacturer | Model | Qty |
| 1 | ENC1 | All | 60X24X18 NEMA 4X SS Enclosure | Hoffman | A602418SSFSN4 | 4 |
| 2 | BNPL1 | All | 60X24 Painted Steel Backpanel | Hoffman | A60P24F1 | 4 |
| 3 | SPNL1 | Control | 28"H x 12"W Aluminum Sidepanel | EWS | Custom | 1 |
| 4 | DFNT | Power & Control | 60x24 Aluminum Deadfront Panel | EWS | Custom | 2 |
| 5 | DSWK | Power & Control | Door Swing Kit | Hoffman | ANADFK | 2 |
| 6 | FRM | All | Expanded Metal Stainless Steel Frame | EWS | SEE DRAWINGS | 1 |
| 7 | PDB | Power | Incoming Power Distribution Block PDB | Square D | 9080LBA362101 | 1 |
| 8 | PDB | Power | Incoming Power Distribution Block PDB Cover | Square D | 9080LBZ3 | 1 |
| 9 | GND | Power | Power Panel Ground Bar | Square D | PK15GTA-L | 1 |
| 10 | ENC3 | Power | 16"H x 16"W x 8"D Screw Cover Type 3R Enclosure | Hoffman | A16168GSC | 1 |
| 11 | CB1 | Power | 600V Main Circuit Breaker | Square D | SEE HP TABLE SHEET 11 | 1 |
| 12 | CB2 | Power | 600V Emergency Circuit Breaker | Square D | SEE HP TABLE SHEET 11 | 1 |
| 13 | CB1, CB2 | Power | Mechanical Interlock for H/J Frame Circuit Breakers | Square D | S29369 | 1 |
| 14 | CB1, CB2 | Power | Door Mounted Rotary Handle for H/J Frame Circuit Breakers | Square D | S29358 | 2 |
| 15 | GEN REC | Power | NEMA 4X Generator Receptacle | Appleton | ADR1044-RS | 1 |
| 16 | GEN REC | Power | NEMA 4X Generator Plug (Ship Loose) | Appleton | ACP1044CD-RS | 1 |
| 17 | PDB1 | Power | Main Power Distribution Block PDB1 | Square D | 9080LBA362106 | 1 |
| 18 | PDB1 | Power | Main Power Distribution Block PDB1 Cover | Square D | 9080LB33 | 1 |
| 19 | F1-F3 | Power | 3 Pole Rejection type Fuse Block | Bussmann | BC6033PQ | 1 |
| 20 | F1-F3 | Power | 1A Rejection Type Fuse, Class CC | Bussmann | KTk-R-1 | 3 |
| 21 | F1-F3 | Power | Fuse Cover | Bussmann | SAMI-7N | 3 |
| 22 | PM | Power | 480V Phase Monitor | Timemark | A257B | 1 |
| 23 | PM | Power | 480V, 8-Pin Relay Base | ABB | OT08PC | 1 |
| 24 | CB3-CB6 | Power | Breaker Stand | EWS | Custom | 1 |
| 25 | CB3 | Power | 30A 480V 3 Pole Circuit Breaker, Main Surge Arrestor | Square D | HDL36030 | 1 |
| 26 | SA | Power | Main Surge Arrestor | SSI | SDLA3H4 | 1 |
| 27 | CB4, CB5 | Power | 600V 3 Pole Circuit Breaker, Starter | Square D | SEE HP TABLE SHEET 11 | 2 |
| 28 | CB4, CB5 | Power | H & J Frame Circuit Breaker Locking System | Square D | S29371 | 2 |
| 29 | PDB2A, PDB3A | Pump 1 & 2 | Starter Power Distribution Block | Square D | 9080LBA362104 | 2 |
| 30 | PDB2A, PDB3A | Pump 1 & 2 | Starter Power Distribution Block Cover | Square D | 9080LB33 | 2 |
| 31 | M1, M2 | Pump 1 & 2 | NEMA Starter | Square D | SEE HP TABLE SHEET 11 | 2 |
| 32 | OL1, OL2 | Pump 1 & 2 | Overload Heaters | Square D | SEE HP TABLE SHEET 11 | 2 |
| 33 | OL1, OL2 | Pump 1 & 2 | Overload Contact, (2) N.C. | Square D | 9999-305 | 2 |
| 34 | GND | Pump 1 & 2 | Motor Ground Lug | NSI | 2-0T | 2 |
| 35 | PDB2, PDB3 | Pump 1, 2 & Control | Motor Power Distribution Block PDB2&3, (1)#14-2/0.....(1)#14-2/0 | Square D | 9080LBA362101 | 2 |
| 36 | PDB2, PDB3 | Pump 1 & 2 | Motor Power Distribution Block PDB2&3 Cover | Square D | 9080LB33 | 2 |
| 37 | F4, F5, F7, F8 | Pump 1 & 2 | 1/2A Rejection Type Fuse, VFD CPT Primary | Bussmann | FNQ-R-1/2 | 4 |
| 38 | CPT1, CPT2 | Pump 1 & 2 | 480/120V 100VA Transformer | Square D | 9070TF100D1 | 2 |
| 39 | CPT1, CPT2 | Pump 1 & 2 | Transformer Finger Safe Cover, VFD CPT Primary | Square D | 9070FSC-1 | 2 |
| 40 | CPT1, CPT2 | Pump 1 & 2 | Fuse Puller, VFD CPT | Square D | 9070FP-1 | 2 |
| 41 | F6, F9 | Pump 1 & 2 | 1-1/4A Fuse, VFD CPT Secondary | Bussmann | FNQ-1-1/4 | 2 |
| 42 | CB6 | Power | 25A 480V 2 Pole Circuit Breaker, XF1 Transformer Primary | Square D | HDL26025 | 1 |
| 43 | XF1 | Power | 5KVA 480V/240-120V Transformer, NEMA 3R Stainless Steel | Square D | SS1FSS | 1 |
| 44 | CB7-CB11 | Power | Hinged Aluminum Bracket for Mounting 240/120V Circuit Breakers through Deadfront | EWS | Custom | 1 |
| 45 | CB7 | Power | 30A 240/120V 2 Pole Circuit Breaker, XF1 Transformer Secondary | Square D | QOU230 | 1 |
| 46 | PDB4 | Power | 240V/120V Power Distribution Block PDB4, (1) #14-2 ... (4) #16-10 | Square D | 9080LBA361104 | 1 |
| 47 | CBB | Power | 20A, 240V, 2 Pole Circuit Breaker | Square D | QOU220 | 1 |
| 48 | REC1 | Power | 20A, 250V, 6-20R Receptacle | P&S | 5872I | 1 |
| 49 | CB9, CB10 | Power | 20A, 120V 1 Pole Circuit Breaker | Square D | QOU120 | 2 |
| 50 | REC2 | Power | 120V 20A GFCI Duplex Receptacle NIEMAS-20R | P&S | 2094-I | 1 |
| 51 | REC1, REC2 | Power | Custom Receptacle Cover NEMA 4X S.S. | HOFFMAN | HIDRPS-Mod | 1 |
| 52 | REC1, REC2 | Power | 3/4 1G AL FD BOX | Appleton | 4CS-1/2 | 2 |
| 53 | CB11 | Power | 15A, 120V, 1 Pole Circuit Breaker | Square D | QOU115 | 1 |
| 54 | CB12 | Power | 10A, 120V, 1 Pole Circuit Breaker | Square D | QOU110 | 1 |
| 55 | R1 | Power | 120V 3PDT General Purpose Relay w/ Indicator Lamp | Potter Brumfield | KRPA-14AN-120 | 1 |
| 56 | R1-R13, SF1, SF2 | All | 11 Pin Relay Base | ABB | NDS-11 | 15 |
| 57 | F10, F11 | Power | Fused Terminal Block w/ 120V Blown Fuse Indication | Allen Bradley | 1492-H4 | 2 |
| 58 | - | Power & Control | 1492-H4 & HS Fused Terminal Block End Cover | Allen Bradley | 1492-H37 | 2 |
| 59 | F10, F11 | Power | 3A Fuse | Bussmann | AGC-3 | 2 |
| 60 | PS1, PS2 | Power | 10A 24VDC Power Supply | Phoenix Contact | 2938604 | 2 |
| 61 | D1, D2 | Power | 10A Diode, P1000A | Newark | S1R7096 | 2 |
| 62 | - | Power | Custom Stand/Lexan Hinged Cover w/ Alum Stand for TBPP & Power Supply Fuses | EWS | Custom | 1 |
| 63 | F12-F30 | Control | Fused Terminal Block w/ 24VDC Blown Fuse Indication | Allen Bradley | 1492-H5 | 19 |
| 64 | F12-F15 | Control | 10A Fuse | Bussmann | AGC-10 | 4 |
| 65 | BAT1, BAT2 | Control | 12VDC Battery | Power Sonic | PS1290 | 2 |

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|--------------------------|---------------------------|------------|---|-------------------|---------------------|---|--|
| Item | Tag | Panel | Description | Manufacturer | Model | Qty | |
| 66 | PS3 | Control | 24VDC-15VDC Converter, 2A | Vicor | V1-J12-EY-B1 | 1 | |
| 67 | RADIO | Control | 400MHz Radio | GE MDS | SD04MD | 1 | |
| 68 | RADIO | Control | DB9 Male/Male Gender Changer | Office Depot | 946660 | 1 | |
| 69 | RADIO/SS | Control | 3 Foot LMR400UF Coaxial Jumper NMale to TNCMale | Tessco | 324503 | 1 | |
| 70 | SS | Control | Coaxial Surge Suppressor, 50-700MHz | Polyphaser | IS-50NX-C1 | 1 | |
| 71 | - | - | 50FT Coaxial Cable, NMale-Nmale, Wireless Solutions 400-07-07-P50 (Ship Loose) | Tessco | 370875 | 1 | |
| 72 | - | - | 400MHz Yagi Antenna w/ N Female Connector, MAXRAD MYA4506N (Ship Loose) | Tessco | 37634 | 1 | |
| 73 | - | - | Antenna Tower 5' Base Section, ROHN R-SB25G5 (Ship Loose) | Tessco | 64559 | 1 | |
| 74 | - | - | Antenna Tower 10' Mid Section, ROHN R-25G (Ship Loose) | Tessco | 56856 | 1 | |
| 75 | - | - | Antenna Tower 9' Top Section, ROHN R-25AG2 (Ship Loose) | Tessco | 70080 | 1 | |
| 76 | - | - | 21' 1-1/4" S.S. Antenna Mast (Ship Loose) | Bell Steel | 023006 | 1 | |
| 77 | F18, F19 | Control | 1/4A Fuse | Bussmann | AGC-1/4 | 2 | |
| 78 | F16, F17, F23, F24 | Control | 2A Fuse | Bussmann | AGC-2 | 4 | |
| 79 | SS1, SS2 | Control | 3 Position Selector Switch, 30MM | Square D | 9001SKS49BH2 | 2 | |
| 80 | R2-R13 | Control | 24VDC 3PDT General Purpose Relay w/ Indicator Lamp | Potter Brumfield | KRPA-14DN-24 | 12 | |
| 81 | SF1, SF2 | Control | 120V Seal Failure Relay | ATC | SPM-120-AAA-10K | 2 | |
| 82 | ISR1 | Control | Intrinsically Safe Barrier Relay, 24VDC | Pepperl & Fuchs | KFD2-SR2-Ex2.W | 1 | |
| 83 | TB2 | Control | Terminal Block, Blue TB2 | Phoenix Contact | 3044115 | 4 | |
| 84 | TB2 | Control | Terminal Block, Blue End Barrier, TB2 | Phoenix Contact | 3047235 | 1 | |
| 85 | TB2 | Control | Ground Terminal Blocks, TB2 | Phoenix Contact | 3044328 | 2 | |
| 86 | PB1, PB2 | Control | Push Button, Black INO 1NC | Square D | 9001SKR18H13 | 2 | |
| 87 | SS3, SS4 | Control | 2 Position Selector Switch, 30MM | Square D | 9001SKS11BH2 | 2 | |
| 88 | TD1 | Control | 24VDC 0-180 Second Time Delay Relay | Square D | RE48ATM12MW | 1 | |
| 89 | TD1 | Control | 8 Pin Relay Base | ABB | NDS-8 | 1 | |
| 90 | AL | Control | 24VDC Red Alarm Light | Federal Signal | LP3M-012-048R | 1 | |
| 91 | F20, F27, F28 | Control | 1/10A Fuse | Bussmann | AGC-1/10 | 3 | |
| 92 | HMI | Control | TD400C Text Display | Siemens | 6AV6 640-0AA00-0AX1 | 1 | |
| 93 | F21, F22, F29, F30 | Control | 1A Fuse | Bussmann | AGC-1 | 4 | |
| 94 | PLC | Control | S7-200 Dual Com Port Processor w/ 24 DI & 16 DO Points | Siemens | 6ES7 216-2AD23-0XB0 | 1 | |
| 95 | AI | Control | S7-200 4 Point AI Module | Siemens | 6ES7 231-0HC22-0XA0 | 1 | |
| 96 | AO | Control | S7-200 2 Point AO Module | Siemens | 6ES7 232-0HB22-0XA0 | 1 | |
| 97 | PLC | Control | S7-200 Communication cable PC/PP1 RS-232/485 | Siemens | 6ES7 901-3CB30-0XA0 | 1 | |
| 98 | SP1-SP3 | Control | Plug In DI Surge Suppression, PT 4x1...DC | Phoenix Contact | 2838322 | 3 | |
| 99 | SP1-SP3 | Control | Terminal Block Base for Plugable Surge Suppression, PT 4x1-8E | Phoenix Contact | 2839363 | 3 | |
| 100 | L51-L54 | Control | Panel Intrusion Switches, N.C. Contacts | NSI | 76030P5 | 4 | |
| 101 | F25 | Control | 1-1/2A Fuse, PLC Supply | Bussmann | AGC-1-1/2 | 1 | |
| 102 | F26 | Control | 3/4A Fuse, Process Analyzer | Bussmann | AGC-3/4 | 1 | |
| 103 | PT | Control | Level Transmitter | Endress & Hauser | RMA42AAAH2 | 2 | |
| 104 | PT | - | Submersible Level Transducer, 20ft Range w/ 60ft Cable & Mounting Clamp (Ship Loose) | Endress & Hauser | FMX21-FE221GGE21APO | 1 | |
| 105 | F31-F33 | Control | 24VDC Fused Terminal Block With Indication | Phoenix Contact | 3046090 | 3 | |
| 106 | F31-F33 | Control | 1/4A Fuse, Analog Inputs | Bussmann | GMA-250 | 3 | |
| 107 | TBPP,1,DC,P1, 1A, P2 & 2A | All | Terminal Block, Gray 26-10 AWG Wire | Phoenix Contact | 3044102 | 181 | |
| 108 | TBPP,1,DC,P1, 1A, P2 & 2A | All | Terminal Block End Barrier | Phoenix Contact | 3047028 | 8 | |
| 109 | TBPP,1,DC,P1, 1A, P2 & 2A | All | Terminal Block End Anchor | Phoenix Contact | 0806886 | 17 | |
| 110 | TBPA, TBPA | Pump 1 & 2 | Terminal Block, Gray 26-8 AWG Wire, TBVFD1A & TBVFD2A | Phoenix Contact | 3044131 | 8 | |
| 111 | GND | Control | Control Panel Ground Bar | Square D | PK5GTA | 1 | |
| 112 | - | - | Meter Socket (SHIP LOOSE) | Millbank | UAP9701-RRL | 1 | |
| 113 | - | - | Stainless Steel 60" Float (SHIP LOOSE) | Anchor Scientific | PE0NO-SST | 2 | |
| 114 | - | - | Insulated Ground Neutral (SHIP LOOSE) | Square D | SN400LA | 1 | |
| 115 | - | - | Ground Bar Kit (SHIP LOOSE) | Square D | PKDGT1250 | 1 | |
| 116 | - | - | NEMA 4A S.S. Disconnect (SHIP LOOSE) | Square D | J250DS | 1 | |
| 117 | - | - | Antenna Mast Stabilization Plate (Ship Loose) | EWS | Custom | 1 | |
| 118 | - | - | Stainless Steel "U" Bolt, 2" Pole, 5/16" Diameter Bolt w/ 2-1/2" Threads (SHIP LOOSE) | | | 1 | |
| 119 | - | - | 5/16" Stainless Steel Flat Washer for "U" Bolt (SHIP LOOSE) | | | 2 | |
| 120 | - | - | 5/16" Stainless Steel Lock Washer for "U" Bolt (SHIP LOOSE) | | | 2 | |
| 121 | - | - | 5/16" Stainless Steel Nut for "U" Bolt (SHIP LOOSE) | | | 2 | |
| 122 | - | - | Stainless Steel "U" Bolt, 1/4" Diameter (SHIP LOOSE) | | | 2 | |
| 123 | - | - | 1/4" Stainless Steel 1/4" Nut for "U" Bolt (SHIP LOOSE) | | | 4 | |
| 124 | - | - | 1-1/4" Reduction Bushing for Antenna Tower, ROHN R-TB50 (SHIP LOOSE) | Tessco | 36882 | 1 | |
| 125 | PLC | Control | S7-200 Memory Module | Siemens | 6ES7 2918GF230AX0 | 1 | |
| 126 | N | Power | Generator Neutral Block, (1)#6-400kcmil ... (6)#14-2 | Square D | 9080LBA163106 | 1 | |
| 127 | N | Power | Generator Neutral Block Cover | Square D | 9080LB33 | 1 | |
| 128 | SPNL2 | Power | 32"x12" Aluminum Sidepanel | EWS | Custom | 1 | |
| 129 | CT1-CT6 | Pump 1 & 2 | Current Transducer; 4-20mA; 10, 20 or 50A Range; Loop Powered | NK Technologies | AT1-420-24L-FF | 6 | |
| 130 | DIS1, DIS2 | Control | 4 Digit Loop Powered Process Indicator; 4-20mA | Red Lion | CUB4LP40 | 2 | |
| 131 | SS5, SS6 | Control | 3 Position Selector Switch, 30MM | Square D | 9001SKS46BH2 | 2 | |
| 132 | FM | Control | Flow Meter | Endress & Hauser | SOP Compact | 1 | |
| 133 | PR | Control | Pressure Transmitter | Endress & Hauser | PMP71-AAC1PG1RAA | 1 | |

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| Horsepower Related Components Equipment List | | | | | | | | |
|--|----------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Item | Tag | Horsepower | | | | | | |
| | | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 |
| Main Circuit Breaker | CB1 | HDL36030 | HDL36030 | HDL36030 | HDL36040 | HDL36045 | HDL36050 | HDL36080 |
| Emergency Circuit Breaker | CB2 | HDL36030 | HDL36030 | HDL36030 | HDL36040 | HDL36045 | HDL36050 | HDL36080 |
| Starter Circuit Breaker | CB4, CB5 | HDL36015 | HDL36015 | HDL36015 | HDL36015 | HDL36020 | HDL36025 | HDL36040 |
| 480V 3 Phase FVNR Starter | M1, M2 | 8536SAO12V02 | 8536SAO12V02 | 8536SBO12V02 | 8536SBO12V02 | 8536SCO12V02 | 8536SCO12V02 | 8536SDO12V02 |
| Overloads | OL1, OL2 | B3.00 | B4.85 | B6.90 | B11.5 | B17.5 | B25 | B32 |

| Horsepower Related Power Conductors, CGB's and Hubs | | | | | | | | |
|---|--------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Conductor Tag | | Horsepower | | | | | | |
| | | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 |
| P-01, P-03 & P-04 | Description | (3)#10 | (3)#10 | (3)#10 | (3)#8 | (3)#8 | (3)#8 | (3)#4 |
| | Manufacturer | N/A |
| | Catalog # | N/A |
| | Length (Max Ft) | N/A |
| | Cable Dia (in) | 0.164" | 0.164" | 0.164" | 0.216" | 0.216" | 0.216" | 0.324" |
| | Appleton Connector | (3) -CG-1275 | (3) -CG-1275 | (3) -CG-1275 | (3) -CG-1850 | (3) -CG-1850 | (3) -CG-1850 | (3) -CG-3150 |
| | Connector Range | 0.125"-0.250" | 0.125"-0.250" | 0.125"-0.250" | 0.187"-0.312" | 0.187"-0.312" | 0.187"-0.312" | 0.312"-0.437" |
| | Meyers Hub | (3) 3/4" - STA-2 | (3) 3/4" - STA-2 | (3) 3/4" - STA-2 | (3) 1/2" - STA-1 |
| P-02A | Description | (1)#10 | (1)#10 | (1)#10 | (1)#10 | (1)#10 | (1)#10 | (1)#8 |
| | Manufacturer | N/A |
| | Catalog # | N/A |
| | Length (Max Ft) | N/A |
| | Cable Dia (in) | 0.164" | 0.164" | 0.164" | 0.164" | 0.164" | 0.164" | 0.216" |
| | Appleton Connector | (1)-GC-1250 | (1)-GC-1250 | (1)-GC-1250 | (1)-GC-1250 | (1)-GC-1250 | (1)-GC-1250 | (1)-GC-1850 |
| | Connector Range | 0.125"-0.187" | 0.125"-0.187" | 0.125"-0.187" | 0.125"-0.187" | 0.125"-0.187" | 0.125"-0.187" | 0.187"-0.312" |
| | Hub | (1) 1/2" - STA-1 |
| P-02B | Description | (1)#10 | (1)#10 | (1)#10 | (1)#10 | (1)#10 | (1)#10 | (1)#8 |
| | Manufacturer | Southwire |
| P-05 & P-06 | Description | (3)#10 | (3)#10 | (3)#10 | (3)#8 | (3)#8 | (3)#8 | (3)#4 |
| | Manufacturer | Southwire |
| | Catalog # | N/A |
| | Length (Max Ft) | N/A |
| | Cable Dia (in) | 0.164" | 0.164" | 0.164" | 0.216" | 0.216" | 0.216" | 0.324" |
| | Appleton Connector | (3) -CG-1275 | (3) -CG-1275 | (3) -CG-1275 | (3) -CG-1850 | (3) -CG-1850 | (3) -CG-1850 | (3) -CG-3150 |
| | Connector Range | 0.125"-0.250" | 0.125"-0.250" | 0.125"-0.250" | 0.187"-0.312" | 0.187"-0.312" | 0.187"-0.312" | 0.312"-0.437" |
| | Hub | (3) 3/4" - STA-2 | (3) 3/4" - STA-2 | (3) 3/4" - STA-2 | (3) 1/2" - STA-1 |
| P-07 & P-09 | Description | (3)#14 W/G, TC | (3)#10 W/G, TC |
| | Manufacturer | Houston Wire |
| | Catalog # | HW151 1403G | HW151 1003G |
| | Length (Max Ft) | 19 FT |
| | Cable Dia (in) | 0.364" | 0.364" | 0.364" | 0.364" | 0.364" | 0.364" | 0.447" |
| | Appleton Connector | (2) -CG-3150 | (2) -CG-3750 |
| | Connector Range | 0.312"-0.437" | 0.312"-0.437" | 0.312"-0.437" | 0.312"-0.437" | 0.312"-0.437" | 0.312"-0.437" | 0.375"-0.500" |
| | Hub | (2) 1/2" - STA-1 |
| P-08 & P-10 | Description | (3)#14 | (3)#14 | (3)#14 | (3)#14 | (3)#14 | (3)#14 | (3)#10 |
| | Manufacturer | Southwire |

IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
 LIFT STATION CONSTRUCTION DETAILS
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| Power & Control Conductors, CGB's and Hubs | | | | | | | | | | |
|--|-----------------------------|----------------------|---------------|-----------------|----------------|--------------------------------------|-----------------------|-------------------------------|--------------------------|--------------------------|
| Cable Number | Description | Manufacturer | Catalog Numer | Length (Max Ft) | Cable Diameter | Appleton Liquidtight Cable Connector | Connector Cable Range | Crouse-Hinds Myers Hub | From Panel/Enclosure | To Panel/Enclosure |
| P-13 | (3)#8 AWG W/GND, Tray Cable | Houston Wire & Cable | HW 154 00803 | 6 FT | 0.58" | (1) - CG-5075 | 0.500"-0.625" | (1) 3/4" - STA-2 | Power Panel | 480/240-120V Transformer |
| P-14 | (3)#6 AWG W/GND, Tray Cable | Houston Wire & Cable | HW 154 00603 | 6 FT | 0.69" | (1) - CG-6275 | 0.625"-0.750" | (1) 3/4" - STA-2 | 480/240-120V Transformer | Power Panel |
| P-15 | 3-1/C #12 AWG | N/A | N/A | AS REQ'D | N/A | N/A | N/A | N/A | Power Panel | Power Panel |
| P-16 | 3-1/C #12 AWG | N/A | N/A | AS REQ'D | N/A | N/A | N/A | N/A | Power Panel | Power Panel |
| C-01 | (16) #14 AWG, Tray Cable | Houston Wire & Cable | HW 151 01416 | 24 FT | 0.68" | (2) - CG-6275 | 0.625"-0.750" | (2) 3/4" - STA-2 | Power Panel | Control Panel |
| C-02 | (5) #14 AWG, Tray Cable | Houston Wire & Cable | HW 151 01405 | 19 FT | 0.41" | (2) - CG-3750 | 0.375"-0.500" | (2) 1/2" - STA-1 | Control Panel | Pump 1 Panel |
| C-03 | (16) #14 AWG, Tray Cable | Houston Wire & Cable | HW 151 01416 | 22 FT | 0.68" | (2) - CG-6275 | 0.625"-0.750" | (2) 3/4" - STA-2 | Control Panel | Pump 2 Panel |
| C-04 | 1 Pair #16 SH, Tray Cable | Houston Wire & Cable | HW 120 01601 | 22 FT | 0.33" | (2) - CG-2575 | 0.250"-0.375" | (2) 3/4" - STA-2 | Pump 1 Panel | Control Panel |
| C-05 | 1 Pair #16 SH, Tray Cable | Houston Wire & Cable | HW 120 01601 | 19 FT | 0.33" | (2) - CG-2575 | 0.250"-0.375" | (2) 3/4" - STA-2 | Pump 2 Panel | Control Panel |
| PUMP 1-PWR | Per Mfg Specs | N/A | N/A | N/A | N/A | CG Series based on Mfg Specs | N/A | STA Series based on Mfg Specs | Field (Pump 1) | Pump 1 Panel |
| PUMP 1-MTP | Per Mfg Specs | N/A | N/A | N/A | N/A | CG Series based on Mfg Specs | N/A | STA Series based on Mfg Specs | Field (Pump 1) | Pump 1 Panel |
| PUMP 1-SF | Per Mfg Specs | N/A | N/A | N/A | N/A | CG Series based on Mfg Specs | N/A | STA Series based on Mfg Specs | Field (Pump 1) | Pump 1 Panel |
| PUMP 2-PWR | Per Mfg Specs | N/A | N/A | N/A | N/A | CG Series based on Mfg Specs | N/A | STA Series based on Mfg Specs | Field (Pump 2) | Pump 2 Panel |
| PUMP 2-MTP | Per Mfg Specs | N/A | N/A | N/A | N/A | CG Series based on Mfg Specs | N/A | STA Series based on Mfg Specs | Field (Pump 2) | Pump 2 Panel |
| PUMP 2-SF | Per Mfg Specs | N/A | N/A | N/A | N/A | CG Series based on Mfg Specs | N/A | STA Series based on Mfg Specs | Field (Pump 2) | Pump 2 Panel |
| Float Switch 1 | Float Switch Cable | BY OTHERS | N/A | N/A | 0.56" | (1) - CG-5050 | 0.500"-0.625" | (1) 1/2" - STA-1 | Field (Float Switch) | Control Panel |
| Float Switch 2 | Float Switch Cable | BY OTHERS | N/A | N/A | 0.56" | (1) - CG-5050 | 0.500"-0.625" | (1) 1/2" - STA-1 | Field (Float Switch) | Control Panel |
| Pressure Xducer | Pressure Transducer Cable | BY OTHERS | N/A | N/A | 0.35" | (1) - G-3150 | 0.312"-0.437" | (1) 1/2" - STA-1 | Field (Float Switch) | Control Panel |
| Antenna COAX | Coaxial Cable | BY OTHERS | N/A | N/A | 0.408" | (1) - CG-3750 | 0.375"-0.500" | (1) 1/2" - STA-1 | Field (Antenna) | Control Panel |

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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
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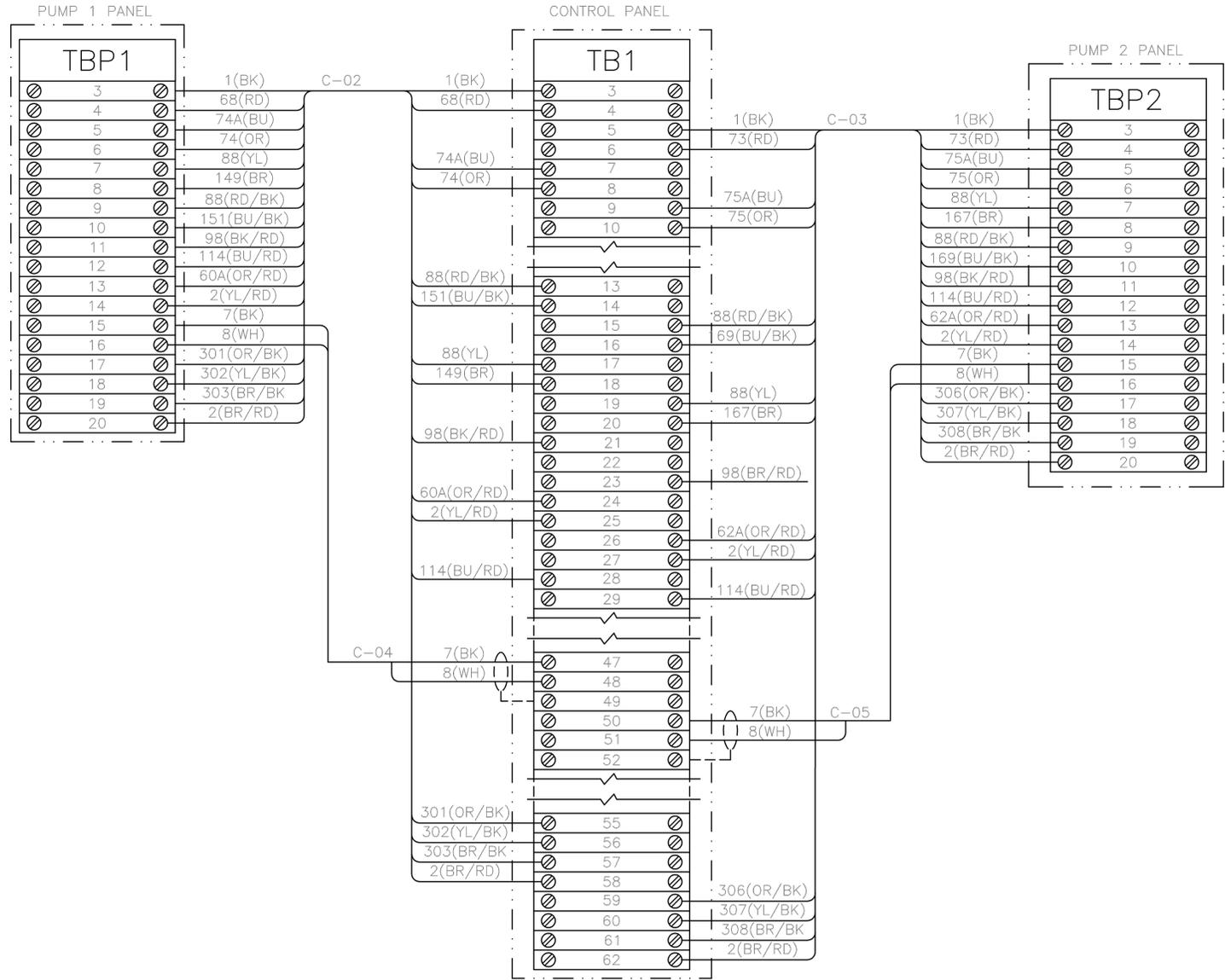
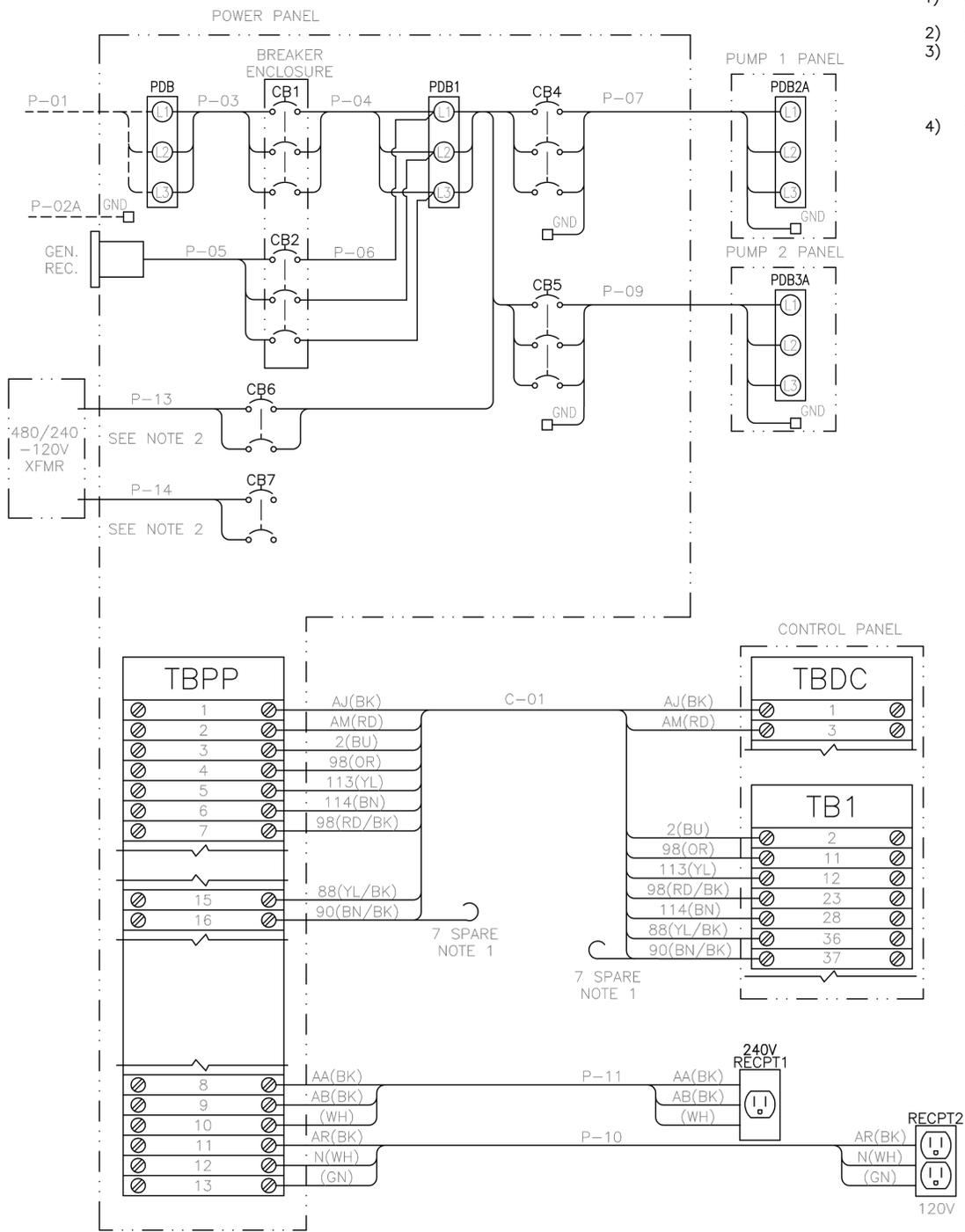
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ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE LATEST EDITION OF THE E.C.U.A. STANDARD SPECIFICATIONS

NOTES:

- 1) ALL SPARE WIRE WILL BE CLEARLY LABELED WITH THE CABLE NUMBER & A SPARE DESIGNATION ON INDIVIDUAL WIRES. THESE SPARES WILL BE LONG ENOUGH TO REACH ANY POINT IN THE PANEL.
- 2) SPARE CONDUCTORS SHOULD BE TRIMMED AND HEAT SHRINK SHOULD BE USED TO SECURE THE SPARE CONDUCTORS IN THE CABLE.
- 3) THE INNER CONNECTING CONDUCTORS BETWEEN THE PANELS ARE CODED AS FOLLOWS: THE FIRST GROUP OF CHARACTER IS THE WIRE NUMBER AND THE SECOND GROUP IS THE COLOR (I.E. 1(BK) SIGNIFIES THAT THE WIRE NUMBER IS 1 AND THE COLOR IS BLACK). WIRE COLOR CODE AS FOLLOWS: BK-BLACK, RD-RED, BU-BLUE, OR-ORANGE, YL-YELLOW, BN-BROWN. FOR COLORS THAT ARE DENOTED AS XX/YY, XX IS THE BASE COLOR AND YY IS THE SPIRAL STRIPE (I.E. RD/BK IS A RED WIRE WITH A BLACK SPIRAL STRIPE).
- 4) SEE SHEETS 11 & 12 FOR PANEL TO PANEL INNER CONNECTING CONDUCTOR AND CABLE DETAILS.



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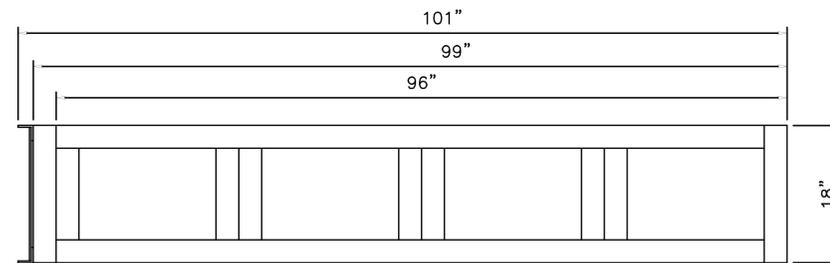


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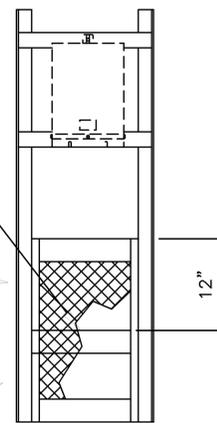
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- NOTES:
1. TOP AND BOTTOM OF BASE TO BE LEFT OPEN.
 2. DRILL TOP OF BASE TO ATTACH ENCLOSURES AS REQUIRED.
 3. DRILL BOTTOM OF BASE TO ATTACH TO SLAB AS REQUIRED.



TOP VIEW

*SEE RACK DETAILS BELOW FOR ADDITIONAL INFORMATION AND DIMENSIONS



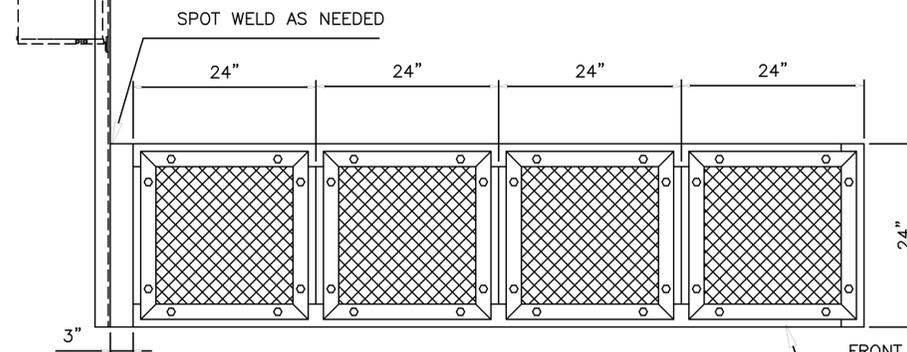
END VIEW

SINGLE HORIZONTAL 2" ANGLE, 3 PLC'S TO SUPPORT INTERNAL CABLES AND CONDUIT. WELD BETWEEN OTHER (3) SUPPORTS

1/4" STAINLESS STEEL MESH BEHIND EXPANDED METAL (TYP.)

3/4" EXPANDED METAL, ON FRONT, BACK, AND SIDES OF BASE. TACH WELDED TO THE INSIDE OF BASE

*SEE RACK DETAILS BELOW FOR ADDITIONAL INFORMATION AND DIMENSIONS

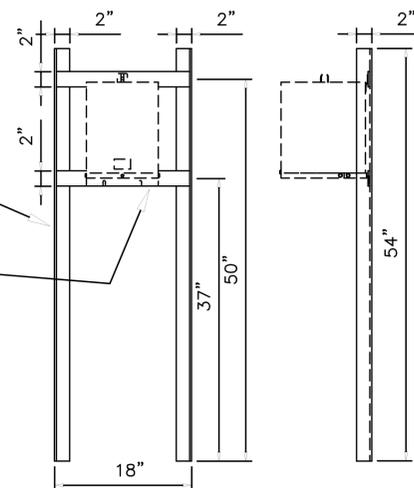


FRONT VIEW

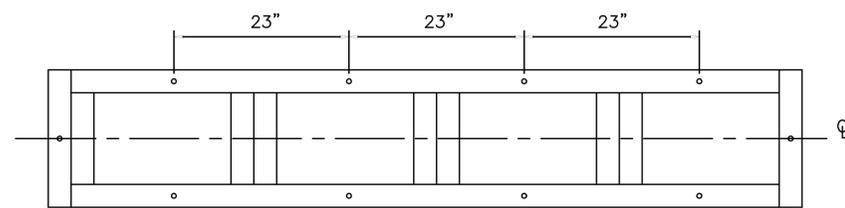
FRONT OF BASE WILL HAVE REMOVABLE PANELS AT EACH OPENING AS SHOWN. ATTACH SCREENS TO BACK SIDE OF REMOVABLE PANELS

2" X 2" S.S. ANGLE FOR VERTICAL MEMBERS

2" WIDE FLAT S.S FOR HORIZONTAL MEMBERS

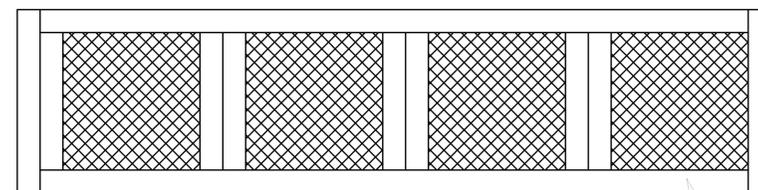


RACK DETAILS



BOTTOM VIEW

DRILL (10) 5/8"Ø HOLES AS SHOWN, CENTERED ON ANGLE



BACK VIEW

ENTIRE BASE MADE FROM 2" STAINLESS STEEL ANGLE, WELDED

IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
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| Power Panel Fuse Schedule | | | | |
|---------------------------|---------|---------|------|------------------------|
| Fuse | Type | Voltage | Amps | Description |
| F1 | KTK-R-1 | 600 | 1A | Phase Monitor A Phase |
| F2 | KTK-R-1 | 600 | 1A | Phase Monitor B Phase |
| F3 | KTK-R-1 | 600 | 1A | Phase Monitor C Phase |
| F10 | AGC-3 | 250 | 3A | Power Supply 1 Primary |
| F11 | AGC-3 | 250 | 3A | Power Supply 2 Primary |

| Pump 1 Panel Fuse Schedule | | | | |
|----------------------------|-----------|---------|------|----------------------|
| Fuse | Type | Voltage | Amps | Description |
| F4 | FNQ-R-1/4 | 600 | 1/4A | Pump 1 CPT Phase A |
| F5 | FNQ-R-1/4 | 600 | 1/4A | Pump 1 CPT Phase C |
| F6 | FNQ-1/2 | 500 | 1/2A | Pump 1 CPT Secondary |

| Pump 2 Panel Fuse Schedule | | | | |
|----------------------------|-----------|---------|------|----------------------|
| Fuse | Type | Voltage | Amps | Description |
| F7 | FNQ-R-1/4 | 600 | 1/4A | Pump 2 CPT Phase A |
| F8 | FNQ-R-1/4 | 600 | 1/4A | Pump 2 CPT Phase C |
| F9 | FNQ-1/2 | 500 | 1/2A | Pump 2 CPT Secondary |

| Control Panel Fuse Schedule | | | | |
|-----------------------------|-----------|---------|--------|------------------------------|
| Fuse | Type | Voltage | Amps | Description |
| F12 | AGC-10 | 250 | 10A | Power Supply 1 Secondary |
| F13 | AGC-10 | 250 | 10A | Power Supply 2 Secondary |
| F14 | AGC-10 | 250 | 10A | Control Power |
| F15 | AGC-10 | 250 | 10A | Batteries |
| F16 | AGC-2 | 250 | 2A | Radio Power Supply Primary |
| F17 | AGC-2 | 250 | 2A | Radio Power Supply Secondary |
| F18 | AGC-1/4 | 250 | 1/4A | Pump 1 Motor Thermal |
| F19 | AGC-1/4 | 250 | 1/4A | Pump 2 Motor Thermal |
| F20 | AGC-1/10 | 250 | 1/10A | Operator Interface |
| F21 | AGC-1 | 250 | 1A | Digital Inputs 0.0-1.4 |
| F22 | AGC-1 | 250 | 1A | Digital Inputs 1.5-2.7 |
| F23 | AGC-2 | 250 | 2A | Digital Outputs 0.0-0.7 |
| F24 | AGC-2 | 250 | 2A | Digital Outputs 1.0-1.7 |
| F25 | AGC-1-1/2 | 250 | 1-1/2A | PLC Power |
| F26 | AGC-3/4 | 250 | 3/4A | Process Transmitter Supply |
| F27 | AGC-1/10 | 250 | 1/10A | Analog Inputs |
| F28 | AGC-1/10 | 250 | 1/10A | Analog Outputs |
| F29 | GMA-1/4 | 250 | 1/4A | Analog Input 2 |
| F30 | GMA-1/4 | 250 | 1/4A | Analog Input 3 |
| F31 | GMA-1/4 | 250 | 1/4A | Analog Input 4 |

| HMI BUTTON LEGEND | |
|-------------------|------------------------------|
| F1 | FAULT RESET/ENABLE INTRUSION |
| SHIFT+F1 | DISABLE INTRUSION |
| F2 | ALTERNATE PUMP ASSIGNMENTS |
| F3 | RESET PUMP 1 RUNTIME |
| SHIFT+F3 | RESET PUMP 2 RUNTIME |
| F4 | ALARMS SCREEN |
| F5 | OVERVIEW SCREEN |
| F6 | PUMP 1 SCREEN |
| F7 | PUMP 2 SCREEN |
| F8 | SETPOINTS SCREEN |

CONTROL PANEL ISR INFORMATION TAGS

THIS AREA IN BLUE IS FOR INTRINSICALLY SAFE CIRCUITS AND DEVICES ONLY. THIS AREA INCLUDES THE AIR SPACE DIRECTLY IN FRONT OF THE BLUE AREA BETWEEN THE BACKPANEL AND THE ENCLOSURE WALLS AND DOOR INCLUDING THE BOTTOM OF THE ENCLOSURE. ONLY INTRINSICALLY SAFE DEVICES AND WIRING ARE ALLOWED IN THIS AREA. DO NOT ROUTE NON-INTRINSICALLY SAFE WIRING THROUGH THIS AREA OF ENCLOSURE.

WARNING
SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY

CONTROL PANEL EXTERIOR TAG INFORMATION

WARNING
TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES DISCONNECT POWER BEFORE SERVICING

PROVIDES INTRINSICALLY SAFE CIRCUIT EXTENSIONS FOR USE IN CLASS 1, GROUPS A, B, C, AND D WHEN CONNECTED PER REFERENCE DRAWINGS ON MAIN NAMEPLATE LABEL

CONTROL PANEL DEADFRONT TAG INFORMATION

SECURELY FASTEN ALL INNER DOOR LATCHES BEFORE CLOSING OUTER DOOR. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD CAUSE THE OUTER DOOR TO JAM WHEN RE-OPENED

| Nameplate Data | | | | | | | |
|------------------|-----|-----|-----|-----|-----|----|----|
| Total Load (FLA) | 16 | 18 | 21 | 27 | 33 | 39 | 53 |
| Motor Hp | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 |
| Motor FLA | 2.1 | 3.4 | 4.8 | 7.6 | 11 | 14 | 21 |

| Component | Torque Rating Table | | | | | | |
|-------------------------------------|---------------------|----------------|----------------|----------------|----------------|----------------|------------------|
| | Horsepower | | | | | | |
| | 1 | 2 | 3 | 5 | 7.5 | 10 | 15 |
| Incoming Distribution Block (PDB1) | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 40lb-in/4.5N-m | 40lb-in/4.5N-m | 120lb-in/13.5N-m |
| Main Ground Block | 20lb-in/2.2N-m | 20lb-in/2.2N-m | 20lb-in/2.2N-m | 20lb-in/2.2N-m | 20lb-in/2.2N-m | 20lb-in/2.2N-m | 25lb-in/2.8N-m |
| Motor Distribution Block (PDB2 & 3) | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m |
| Motor Ground Block | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m | 35lb-in/4.0N-m |

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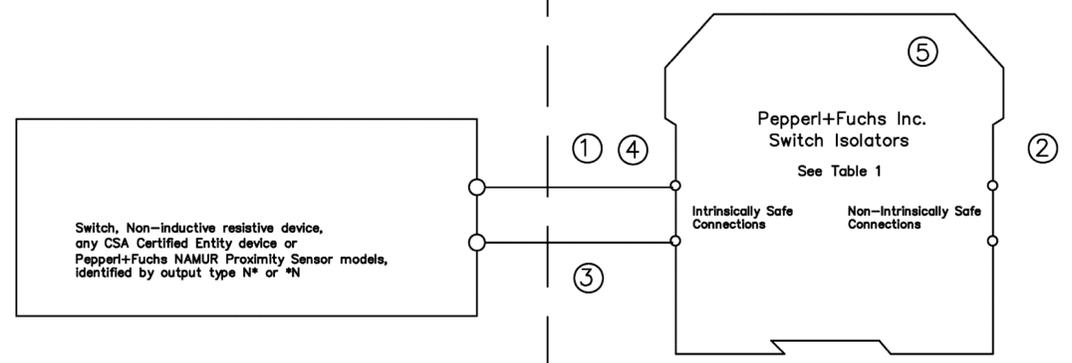
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HAZARDOUS (CLASSIFIED) LOCATION
 CLASS I, ZONE 0 OR 1, GROUPS IIC, IIB, IIA or
 CLASS I, DIVISION 1, GROUPS A,B,C,D
 CLASS II, DIVISION 1, GROUPS E,F,G
 CLASS III, DIVISION 1

NON-HAZARDOUS LOCATION
 CLASS I, ZONE 2, GROUPS IIC, IIB, IIA or
 CLASS I, DIVISION 2, GROUPS A,B,C,D



Notes:

- ① The intrinsically safe wiring must be installed in accordance with the Canadian Electrical Code CSA C22.1, Part 1, Appendix F.
- ② Barriers listed in Table 1 shall not be connected to any device that uses or generates in excess of 250Vrms or DC unless it has been determined that the voltage is adequately isolated from the barrier. Barriers listed in Table 2 shall not be connected to any device that uses or generates in excess of 60Vrms or DC unless the voltage is limited by an adequate means.
- ③ Any combination of up to 10 channels of the barriers listed in Table 1 or Table 2 may be connected in parallel and connected to a switch in a hazardous location.
- ④ The Entity concept allows interconnection of intrinsically safe apparatus with associated apparatus not specifically examined in combination as a system when the approved values of Voc and Isc for the associated apparatus are less than or equal to Vmax and Imax for the intrinsically safe apparatus and the approved values of Ca and La for the associated apparatus are greater than Ci + Ccable and Li + Lcable, respectively, for the intrinsically safe apparatus.
- ⑤ The following models with part number greater than 100000 are approved for mounting in a Class I, Zone 2, Groups IIC,IIB,IIA or Class I, Division 2, Groups A,B,C,D hazardous (classified) location: KF**–SR2–EX1.W, KF**–SR2–EX1.W.LB, KF**–SR2–EX2.W, KFD2–SR2–EX2.2S, KFD2–ST2–EX1.*, KFD2–ST2–EX2.*, KFD2–SOT2–EX1.*, KFD2–SOT2–EX2.*.

WARNING: Substitution of components may impair intrinsic safety and/or suitability for use in Class I, Division 2, Groups A,B,C,D or Class I, Zone 2, Groups IIC,IIB,IIA.
ADVERTISSEMENT: La substitution de composants peut compromettre la sécurité intrinsèque.

| | | | | | | | | |
|-----------|-----------|-------|-------|---------|---|---|-----------|--------|
| Revisions | | | | ECO No. | No changes without prior permission CSA | Title Installation Drawing for CSA Certified Switch Isolators | | |
| In. | Date | Cons. | Resp. | Appr. | Pepperl+Fuchs® Inc. Twinsburg, OH 44087-2202 | Repl.No. | Draw. No. | Sh. |
| | 2-20-2008 | | | | | - | 116-0047j | 1 of 2 |

TABLE 1: Barriers Certified to CSA Standard C22.2 No. 157 (Um = 250 V)

| Model Numbers | Terminals | SYSTEM | | ENTITY | | | | | | | |
|--|-----------------------------|----------------------|----------|---------------------|----------------------|--------------------------|-------|-------|--------------------------|-------|-------|
| | | V _{max} (V) | Res. (Ω) | V _{oc} (V) | I _{sc} (mA) | C _a (uF) GRPS | | | L _a (mH) GRPS | | |
| | | | | | | A,B | C,E | D,F,G | A,B | C,E | D,F,G |
| KFD2–SOT–Ex1*,KFD2–SOT–Ex2* KFD2–SR–Ex1*,KFD2–SR–Ex2* KFD2–SRT–Ex1* KFD2–ST–Ex1*,KFD2–ST–Ex2* | 1–3, 2–3; 4–6, 5–6 | 12.6 | 650 | 12.9 | 19.8 | 1.273 | 3.820 | 10.18 | 84.88 | 298.7 | 744.4 |
| KFA5–SOT2–Ex1*,KFA5–SOT2–Ex2* KFA6–SOT2–Ex1*,KFA6–SOT2–Ex2* KFD2–SR2–Ex1*,KFD2–SR2–Ex2* | 1–3, 2–3; 4–6, 5–6 | 10.5 | 811 | 10.5 | 13.0 | 2.66 | 7.9 | 21.3 | 192 | 671 | 1000 |

TABLE 2: Barriers Certified to CSA Standard E79-11 (Um = 60 V)

| Model Numbers | Terminals | Load Parameters | | | | | | | |
|--|-----------------------------|--------------------------------------|--------------------------------------|--------------------------|--------------|----------------|--------------------------|--------------|----------------|
| | | U _o (V _{oc}) | I _o (I _{sc}) | C _o (uF) GRPS | | | L _o (mH) GRPS | | |
| | | | | IIC (A,B) | IIB (C,E) | IIA (D,F,G) | IIC (A,B) | IIB (C,E) | IIA (D,F,G) |
| KFD2–SOT2–Ex1*,KFD2–SOT2–Ex2* KFD2–ST2–Ex1*,KFD2–ST2–Ex2* | 1–3, 2–3; 4–6, 5–6 | 10.5 | 13.0 | 2.66 | 7.9 | 21.3 | 192 | 671 | 1000 |

| | | | | | | | | |
|-----------|-----------|-------|-------|---------|---|---|-----------|--------|
| Revisions | | | | ECO No. | No changes without prior permission CSA | Title Installation Drawing for CSA Certified Switch Isolators | | |
| In. | Date | Cons. | Resp. | Appr. | Pepperl+Fuchs® Inc. Twinsburg, OH 44087-2202 | Repl.No. | Draw. No. | Sh. |
| | 2-20-2008 | | | | | - | 116-0047j | 2 of 2 |

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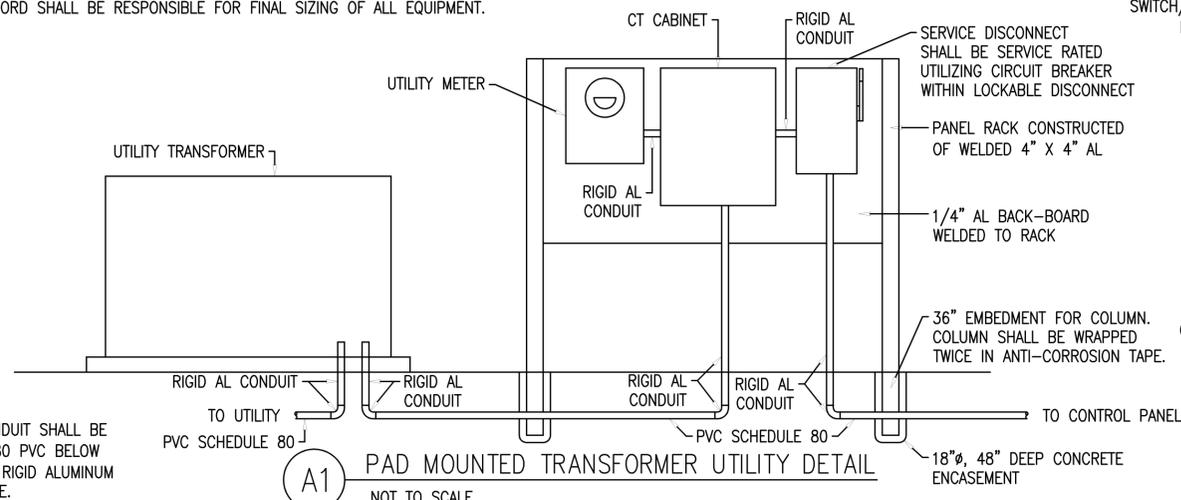
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GENERAL ELECTRICAL NOTES

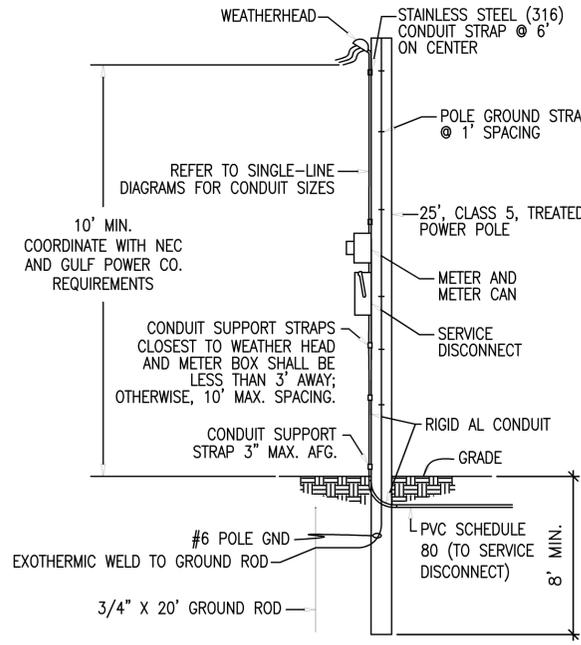
NEW WORK:

- ENTIRE ELECTRICAL INSTALLATION SHALL BE IN ACCORDANCE WITH THE LATEST EDITION (UNLESS NOTED OTHERWISE) OF THE FOLLOWING CODES AND STANDARDS:
 - NATIONAL ELECTRICAL CODE (NFPA 70).
 - STANDARD FOR FIRE PROTECTION IN WASTEWATER TREATMENT AND COLLECTION FACILITIES (NFPA 820).
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR READING ALL PROJECT SPECIFICATIONS AND WILL BE RESPONSIBLE FOR MEETING ALL REQUIREMENTS OUTLINED IN THE SPECIFICATIONS.
- CONTRACTOR SHALL COORDINATE ALL WORK WITH OTHER TRADES PRIOR TO ROUGH-IN AND INSTALLATION.
- WORKING SPACE FOR ALL ELECTRICAL AND CONTROL EQUIPMENT OPERATING AT 600V VOLTS OR LESS TO GROUND AND LIKELY TO REQUIRE EXAMINATION, ADJUSTMENT, SERVICING, OR MAINTENANCE WHILE ENERGIZED SHALL COMPLY WITH NEC, ARTICLE 110.26.
- THE ELECTRICAL DESIGN PROVIDES A NUMBER OF BRANCH CIRCUITS, AMPACITY AND OVERCURRENT PROTECTION FOR OTHER DIVISIONS DESIGN BASIS EQUIPMENT CONFORMING TO MANUFACTURER'S SPECIFICATIONS AVAILABLE AT TIME OF DESIGN. THE CONTRACTOR SHALL VERIFY ALL EQUIPMENT LOADS PRIOR TO ROUGH-IN. IF REQUIREMENTS OF EQUIPMENT ACTUALLY PROVIDED UNDER CONTRACT FOR CONSTRUCTION ARE DIFFERENT, CONTRACTOR SHALL MAKE ALL CHANGES NECESSARY WITHOUT INCREASE IN THE CONTRACT AMOUNT. SUCH CHANGES SHALL BE BASED UPON REQUIREMENTS, NAMEPLATE VALUES AND CODE REQUIREMENTS, WHICHEVER IS MORE STRINGENT, AND MAY INCLUDE, BUT ARE NOT LIMITED TO: SIZE OF CONDUCTORS, SIZE OF CONDUIT, QUANTITY OF CONDUCTORS AND CONDUITS, TYPE AND SIZE OF CIRCUIT BREAKER OR DISCONNECT, OVERLOADS, FULL-VOLTAGE STARTERS, REDUCED VOLTAGE SOFT STARTERS, VARIABLE FREQUENCY DRIVES, AND FUSE PROTECTION.
- THE ELECTRICAL CONTRACTOR IS REQUIRED TO COORDINATE, PROVIDE, AND INSTALL A FULLY OPERATIONAL AND CODE COMPLIANT ELECTRICAL SYSTEM. THIS MAY INCLUDE THE ADDITION OF ELECTRICAL ITEMS NOT SHOWN ON THE ELECTRICAL PLANS, BUT REQUIRED FOR SYSTEM OPERATION.
- CONTRACTOR SHALL COORDINATE INSTALLATION OF ELECTRICAL SERVICE WITH ELECTRICAL UTILITY COMPANY PROVIDING ELECTRICAL SERVICE TO FACILITY. CONTRACTOR SHALL PAY ALL FEES ASSESSED BY ELECTRICAL UTILITY COMPANY TO PROVIDE ELECTRICAL SERVICE TO FACILITY.
- CONTRACTOR SHALL EXCAVATE AND CONDUCT DEMOLITION SO AS TO AVOID DAMAGE TO EXISTING UTILITIES AND OTHER UNDERGROUND OR CONCEALED ITEMS. IF EXISTING OR NEW ITEMS ARE DAMAGED, THE CONTRACTOR SHALL NOTIFY THE OWNER AT ONCE OF ALL DAMAGE AND SHALL REPAIR (OR REPLACE IF NECESSARY) TO THE ORIGINAL CONDITION TO THE SATISFACTION OF OWNER AND ENGINEER AT NO CHARGE IN THE CONTRACT AMOUNT.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING DETAILED ELECTRICAL AND CONTROL EQUIPMENT LAYOUT DRAWINGS TO THE ENGINEER AND OWNER FOR APPROVAL PRIOR TO INSTALLATION.
- ALL CONDUITS NOT LOCATED UNDER SLAB SHALL HAVE A MINIMUM BURIAL DEPTH OF 42", UNLESS NOTED OTHERWISE.
- CONDUITS SHALL BE BURIED 42" (MINIMUM) BELOW GRADE WITH MARKER TAPE 6" ABOVE TOP OF CONDUIT, UNLESS NOTED OTHERWISE.
- MINIMUM SIZE CONDUIT SHALL BE 1" (UNLESS NOTED OTHERWISE).
- CONDUIT ROUTINGS AND DEVICE/EQUIPMENT LOCATIONS SHOWN ARE DIAGRAMMATIC ONLY. CONTRACTOR SHALL FIELD ROUTE AND LOCATE AS REQUIRED.
- CONTRACTOR SHALL PROVIDE PULL BOXES IN POWER CIRCUIT CONDUIT AS REQUIRED TO LIMIT THE NUMBER OF BENDS TO A MAXIMUM OF 270° OR THREE 90° BENDS.
- ALL WIRE SHALL BE COPPER.
- ALL ELECTRICAL CIRCUITS SHALL INCLUDE A GREEN GROUNDING CONDUCTOR SIZED PER NEC.
- CONDUCTORS SHALL BE TERMINATED ON TERMINAL BLOCKS.
- THE CONTRACTOR SHALL TAG ALL POWER AND CONTROL SYSTEM CABLING AT ALL TERMINATION POINTS.
- FINAL CONNECTION TO ALL EQUIPMENT IS SHOWN DIAGRAMMATIC. PROVIDE FINAL CONNECTION AS REQUIRED PER MANUFACTURER OF EQUIPMENT.
- CONTRACTOR SHALL MAINTAIN A SET OF PRINTS AND MARK-UP DURING CONSTRUCTION TO REFLECT "AS-BUILT" CONDITIONS. PRINTS SHALL BE DELIVERED TO THE ENGINEER UPON COMPLETION OF THE PROJECT.
- ALL HARDWARE SHALL BE STAINLESS STEEL.
- ALUMINUM CONDUIT SHALL BE COATED WITH (2) WRAPS OF ANTI-CORROSION TAPE OR RUN THROUGH A SCHEDULE 80 PVC SLEEVE TO WHEN IN CONTACT WITH CONCRETE.
- BARE COPPER SHALL BE COATED WITH (2) WRAPS OF ANTI-CORROSION TAPE OR RUN THROUGH A SCHEDULE 80 PVC SLEEVE TO WHEN IN CONTACT WITH CONCRETE.
- ENGINEER OF RECORD SHALL BE RESPONSIBLE FOR FINAL SIZING OF ALL EQUIPMENT.

* SERVICE LATERAL CONDUIT SHALL BE 3" (MIN) SCHEDULE 80 PVC BELOW GRADE AND 3" (MIN) RIGID ALUMINUM CONDUIT ABOVE GRADE.

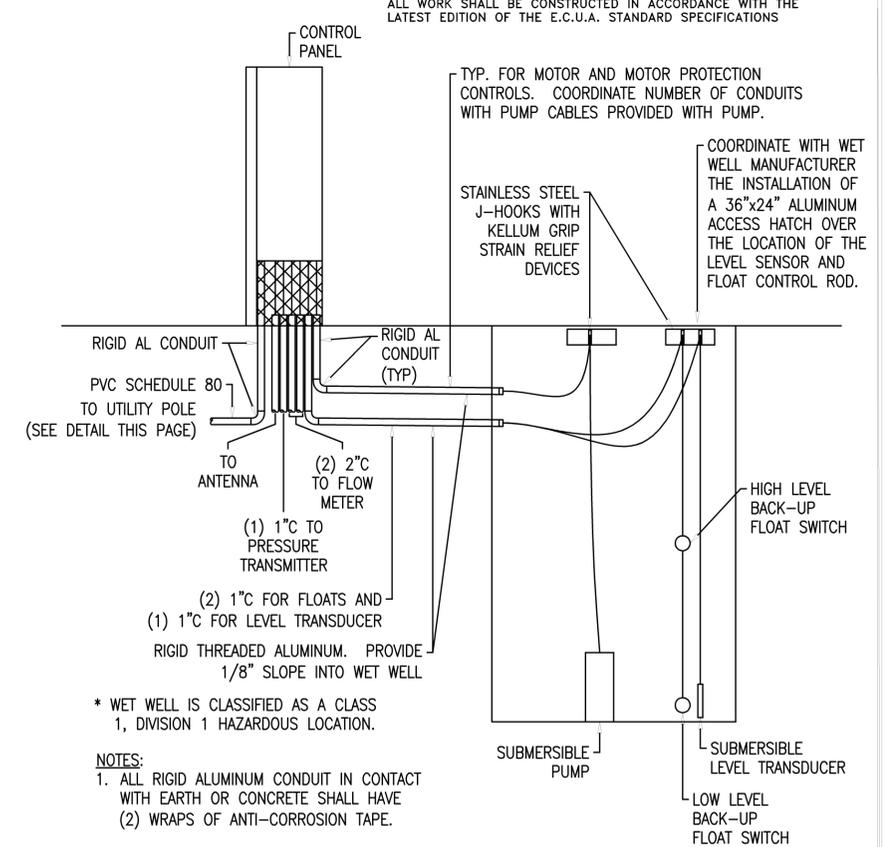


A1 NOT TO SCALE



SERVICE LATERAL CONDUIT SHALL BE 3" (MIN) SCHEDULE 80 PVC BELOW GRADE AND 3" (MIN) RIGID AL CONDUIT ABOVE GRADE. ANY REQUIREMENTS BY THE UTILITY COMPANY SHALL PREVAIL OVER THE REQUIREMENTS OUTLINED HERE AND SHALL BE COORDINATED BY THE ELECTRICAL CONTRACTOR PRIOR TO INSTALLATION.

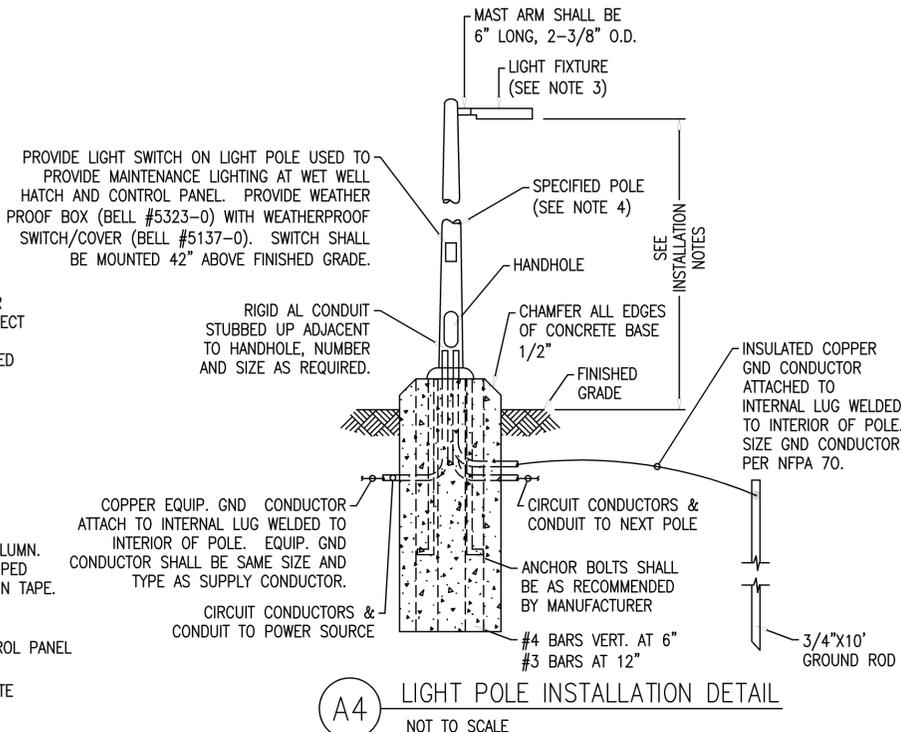
A3 UTILITY POLE DETAIL NOT TO SCALE



* WET WELL IS CLASSIFIED AS A CLASS 1, DIVISION 1 HAZARDOUS LOCATION.

NOTES:
1. ALL RIGID ALUMINUM CONDUIT IN CONTACT WITH EARTH OR CONCRETE SHALL HAVE (2) WRAPS OF ANTI-CORROSION TAPE.

B4 TYPICAL WET WELL SECTION DETAIL NOT TO SCALE



A4 LIGHT POLE INSTALLATION DETAIL NOT TO SCALE

- LIGHTING PERFORMANCE CRITERIA:**
- LIGHTING FIXTURE LAYOUT SHALL BE BASED UPON ACHIEVING 20 FOOT CANDLES (+/- 20%) AT THE FRONT OF THE CONTROL PANEL (WORK-PLANE OF 24" AFG) AND AT THE WET WELL ACCESS HATCH (WORKPLANE OF 0" AFG).
 - GENERAL SECURITY LIGHTING SHALL ENCOMPASS ACCESS GATE AND ALL PIPING/EQUIPMENT AT A MIN. AVERAGE 1 FOOT-CANDLE (+/- 20%, AT WORKPLANE OF 0" AFG).
 - REFER TO LIGHTING CONTROL DIAGRAM ON SHEET No. 18 FOR ADDITIONAL REQUIREMENTS.

- LIGHT POLE INSTALLATION NOTES:**
- BURIAL AND DIAMETER DIMENSIONS INDICATED ARE FOR NOMINAL MINIMAL SIZES ONLY. FINAL DIMENSIONS SHALL BE DETERMINED BY A REGISTERED STRUCTURAL ENGINEER IN THE STATE OF FLORIDA. BASED UPON FIXTURES PROVIDED. PROVIDE SIGNED, DATED, AND SEALED PLANS FOR EACH INSTALLATION TYPE AND FIXTURE TYPE AS PART OF LIGHTING SUBMITTAL PACKAGE.
 - THE POLE AND FOUNDATION DESIGN SHALL BE BY A DELEGATED PROFESSIONAL ENGINEER TO MEET THE FOLLOWING CRITERIA:
 - DESIGN WIND SPEED 160 MPH WITH A 1.3 GUST FACTOR. EXPOSURE CATEGORY C.
 - SIZE EMBEDMENT FOR A MAXIMUM PERMANENT POLE DEFLECTION AFTER DESIGN WIND SPEED EVENT OF 1.00". ALUMINUM, ROUND OR SQUARE, TAPERED.
 - FIXTURE SHALL BE AMERICAN ELECTRIC LIGHTING ATB2 FIXTURE, 40 LED, 1000mA DRIVER, 120V, TYPE 4, WITH PHOTOCONTROL.
 - REFER TO SPECIFICATIONS SECTION 16521 "EXTERIOR LIGHTING" FOR ADDITIONAL REQUIREMENTS.
 - LIGHT FIXTURES SHALL BE MOUNTED AT 15'-0" (MAXIMUM) ABOVE FINISHED GRADE.

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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
 LIFT STATION CONSTRUCTION DETAILS
 ELECTRICAL STANDARDS
 FINAL SUBMITTAL



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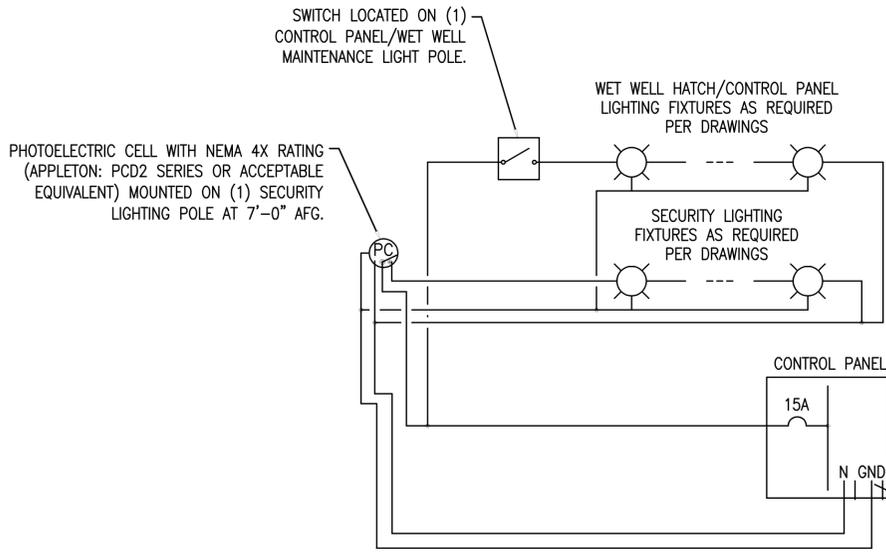
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IMPROVEMENTS TO WASTEWATER COLLECTION SYSTEM
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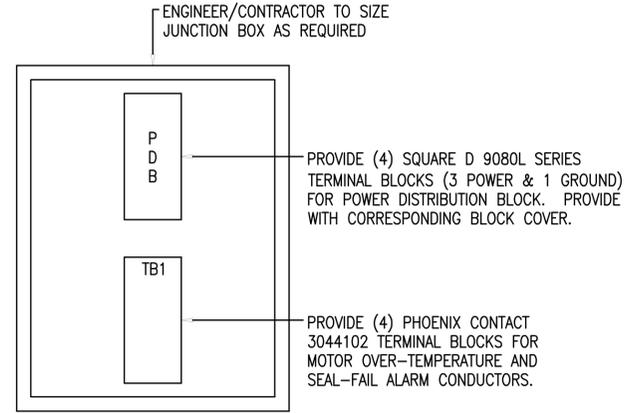


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C2 TYPICAL LIGHTING CONTROL DIAGRAM
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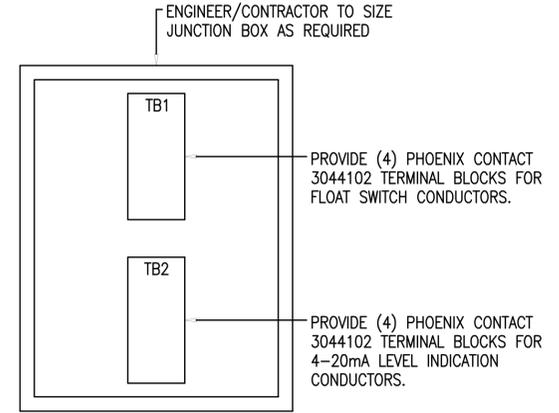


A1 INTERIOR ELEVATION

DETAIL NOTES:

1. ALL TERMINAL BLOCKS SHALL BE PROVIDED WITH CORRESPONDING END BRACKETS AND END COVERS.
2. PROVIDE SEPARATE GROUND LUG IN EACH JUNCTION BOX, BONDED TO JUNCTION BOX.

A1 TYPICAL PUMP JUNCTION BOX ELEVATION
NOT TO SCALE

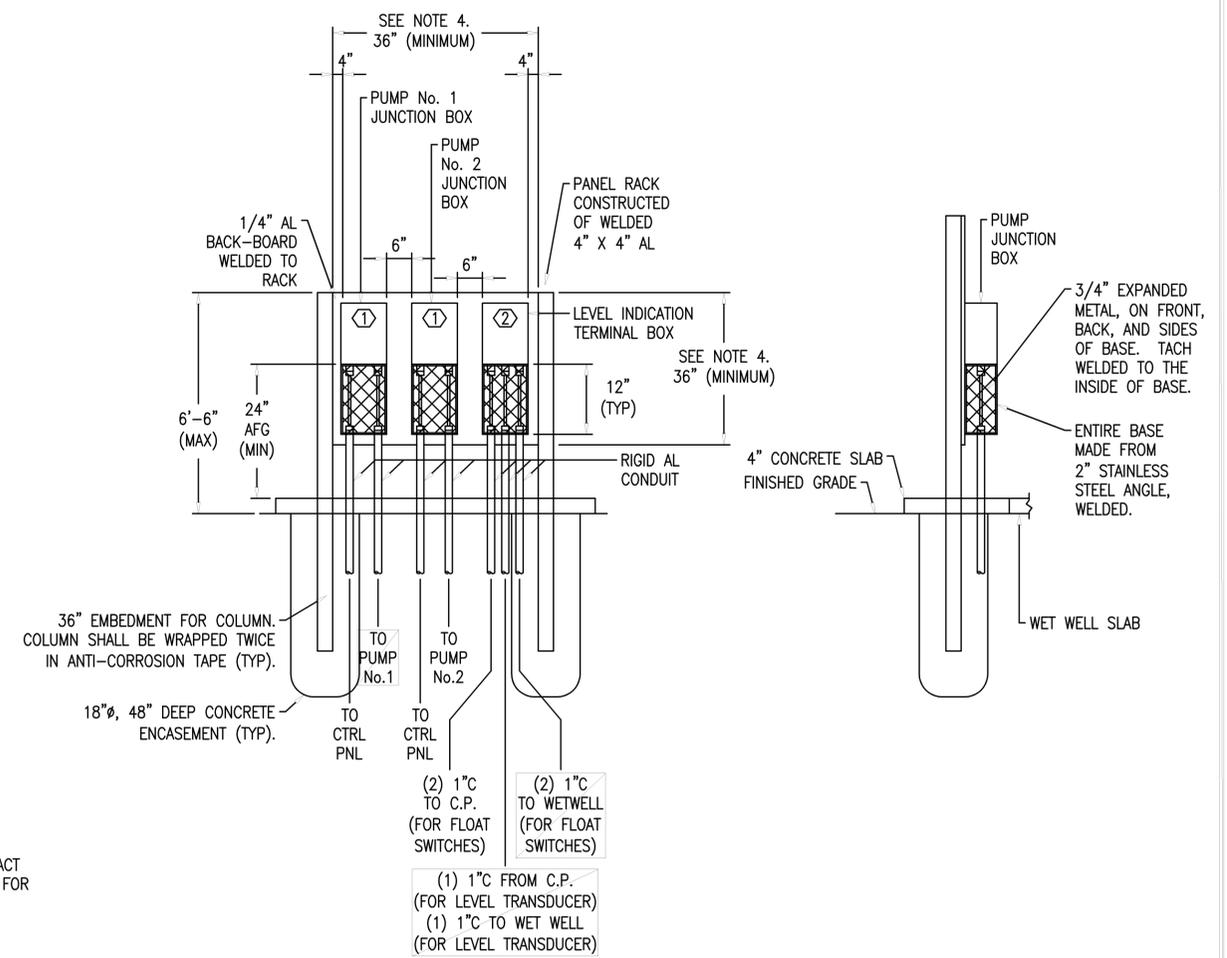


A3 INTERIOR ELEVATION

DETAIL NOTES:

1. ALL TERMINAL BLOCKS SHALL BE PROVIDED WITH CORRESPONDING END BRACKETS AND END COVERS.
2. PROVIDE SEPARATE GROUND LUG IN EACH JUNCTION BOX, BONDED TO JUNCTION BOX.

A3 TYPICAL LEVEL INDICATION JUNCTION BOX ELEVATION
NOT TO SCALE



FRONT ELEVATION

SIDE ELEVATION

DETAIL NOTES:

1. THIS DETAIL SHALL ONLY APPLY WHEN THE CONTROL PANEL CANNOT BE PLACED WITHIN 6'-0" OF THE WET WELL TO ALLOW FOR CONNECTION OF STANDARD 50 FOOT PUMP CABLE CONNECTIONS.
2. BACKBOARD SHALL BE PLACED AT THE EDGE OF THE WET WELL SLAB BETWEEN THE WET WELL AND CONTROL PANEL.
3. JUNCTION BOXES SHALL BE MOUNTED SUCH THAT THEY ARE FACING THE WET WELL.
4. ENGINEER/CONTRACTOR SHALL SIZE JUNCTION BOXES AND BACKBOARDS BASED UPON INSTALLATION REQUIREMENTS PROVIDED AT TIME OF DESIGN.

KEY NOTES

- ① REFER TO "TYPICAL PUMP JUNCTION BOX ELEVATION" (THIS SHEET) FOR ADDITIONAL REQUIREMENTS.
- ② REFER TO "TYPICAL LEVEL INDICATION JUNCTION BOX ELEVATION" (THIS SHEET) FOR ADDITIONAL REQUIREMENTS.

A4 TYPICAL PUMP JUNCTION BOXES
NOT TO SCALE