



ELECTRICAL STANDARDS
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ELECTRICAL

1. General

1. All electrical plans shall be approved by Texas Water Company (TWC) or their designated representative prior to commencing construction.
2. Where discrepancies exist between manufacturer recommendations, Contractor practices, and TWC Standards, TWC Standards shall govern unless written approval is granted by TWC.
3. All electrical work is subject to inspection by Texas Water Company (TWC) or their designated representative.
4. All electrical work shall be installed in accordance with the current version of NFPA 70 National Electrical Code and with TWC standard details (see attachments).
5. Electrical equipment buildings shall be located at a maximum of 150ft from pump and motor locations unless otherwise permitted by TWC.
6. Engineer to provide complete design drawings and specifications. Drawing package to include site plan, load calculations, one-line diagrams, schematics, panel layouts, grounding design, etc. Include types, sizes, quantities, and routing of all raceways and conductors. Each duct bank section shall be detailed. Provide interior and exterior layout details, schematics, and one-line diagrams for all control panels and motor control centers (MCCs).
7. Any temporary power required during construction or prior to permanent power shall be the responsibility of the Contractor.
8. The design engineer shall be responsible for notifying electrical utility prior to any construction.
9. All equipment shall be designed to automatically reset after power outages.
10. Electrical service shall be 480Y/277V 3-phase. Phase converters are not allowed. Requests for alternate voltage electrical services shall be reviewed and considered for approval by TWC on a case-by-case basis.
11. Provide electrical rack with roof shelter for electrical and control equipment installed outdoors. Orient front of outdoor-mounted panels to face east or north.
12. Use aluminum hardware, struts, and straps. If anchors are necessary, corrosion-resistant 316SS anchors shall be used. All exterior mounted electrical enclosures and devices shall be mounted on struts.
13. Lockout/Tagout (LOTO) boards shall be provided in electrical room buildings to provide a hazard abatement means during maintenance or repair work of equipment.
14. Provide ability to operate facility with one pump removed for maintenance, by utilizing a Hand-Off-Auto (HOA) switch and control that alternates remaining pumps in service with no parallel switching. This allows for proper lockout procedures to be followed when performing maintenance.
15. Power studies sealed by a professional engineer shall be performed by the equipment manufacturer or a designated Contractor as approved by TWC.

- a. Perform analysis of the electrical power distribution system using SKM software and data from actual installed equipment and components. Hand calculations are not permitted.
 - b. Protective device coordination studies: analyze all known alternate power source scenarios and determine suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for personnel, equipment, and conductors. Contractor shall complete coordination study and adjust all trip settings prior to start up.
 - c. Arc flash and shock risk assessment: perform incident energy and arc flash boundary calculations using alternate scenarios to determine the worst-case scenarios. Apply arc flash warning labels to all equipment components in accordance with both ANSI Z535.4 and NFPA 70E 130.5(H).
 - d. Provide reports to the Engineer of record and the Owner for all analysis/studies performed.
 - e. SKM files shall be provided to TWC at project closeout.
16. Contractor shall perform operational demonstration testing. Contractor shall start up, test, and verify all equipment is operational prior to scheduling TWC to witness demonstration testing. Operator training shall be conducted on a separate day after demonstration testing has been completed. Contractor shall coordinate scheduling with TWC at least two (2) weeks in advance.
17. The Contractor shall maintain service to existing systems at all times during construction. Any work involving power outages, bypass pumping, or any other interruption of flow must be performed between 8:00am and 5:00pm, excluding weekends and holidays. All necessary temporary power, bypass pumping, temporary plugs, etc., shall be furnished and performed by the Contractor. Coordinate and schedule any such activities with TWC at least two (2) weeks in advance.
18. As-built drawings, O&Ms, equipment submittals, owner training shall all be completed prior to final payment or retainage.
- a. As-builts shall include Contractor redlines.
 - b. As-builts shall be submitted in both PDF and CAD format.
 - c. GPS points shall be taken for all underground utilities and provided to TWC.
19. The Contractor shall provide own due diligence to locate all existing underground utilities prior to construction.
- a. Provide SUE investigation in accordance with ASCE standards
 - b. Provide QLA locates for all utility crossings and/or conflicts.
 - c. Provide PDF and CAD file of SUE investigation to TWC inspector prior to pre-construction meeting.
20. Hydrovac shall be used as the primary method for excavation and trenching at existing operating facilities, unless otherwise approved.

2. Electrical Equipment

1. Enclosures
 - a. Enclosure types:
 - i. Outdoors (non-corrosive): NEMA 3R

- ii. Wastewater treatment plants, lift stations, or other corrosive environments: NEMA 4X, 316SS
 - iii. Indoors (within pump room): NEMA 4
 - iv. Indoors (within dedicated electrical/controls room without pumps): NEMA 1
- b. All electrical enclosures shall have black industrial-grade, UV-stable, chemical-resistant plastic labels with white 3/8" block lettering or engraved aluminum labels. Labels shall be attached with aluminum rivets on NEMA 1 panels or for indoor installations only. All instruments shall have round shaped black plastic tags with white 1/4" block lettering or engraved aluminum tags, attached with corrosion-resistant 316SS cable. Label circuit numbers on all device covers with white adhesive tape type labels with black machine printed 3/16" block lettering. All tags shall be consistent throughout locations. Identification for electrical systems shall be as follows:
- i. Panelboards: identify panel name, ampere rating, voltage, phase, power source and circuit number, and main overcurrent protective device. Provide a typed circuit directory to identify loads served.
 - ii. Transformers: identify kVA rating, voltage, and phase for both primary and secondary, power source and circuit number, and loads served.
 - iii. Enclosed switches, circuit breakers, and motor controllers: identify voltage, phase, power source and circuit number, and loads served.
 - iv. Label each junction/pull box cover plate with the circuit number of the circuits it contains. Label each exiting conduit at the point where it exits the junction box with the circuit number it contains. If the raceway system is in an exposed area label the inside of the junction/ pull box cover plate only.
- c. Panel penetrations are only permitted from the bottom and sides for outdoor applications.
2. Disconnects
- a. Electrical service disconnects shall be enclosed circuit breakers unless otherwise approved by TWC.
 - b. All service disconnects shall be placed on exterior electrical rack or on exterior wall of building.
 - c. Non-fused disconnect switches, NEMA 3R type, shall be used at pump locations in lieu of emergency stop switches.
 - d. Non-fused disconnects shall be installed within 20 feet of motors located within pump rooms to meet NEC 430.102(B) requirements for motor disconnects being in the line of sight of motor locations.
3. Panels
- a. Electrical panels shall have tinned copper bus and bolt-on type circuit breakers.
 - b. Square-D or Eaton electrical panels and appurtenances shall be used throughout locations unless other manufacturers have been approved by TWC. ABB electrical equipment shall not be permitted.
 - c. Electrical panels shall not be permitted in chlorine rooms.
4. Low Voltage Step-down Transformers
- a. Any step-down transformer larger than 15 kVA shall be 208/120V, 3-phase.

- b. 30KVA shall be the maximum size of a Mini-Power Zone.
 - c. Square-D Mini-Power Zones or Eaton Mini-Power Centers (MPZ) shall be used at locations where required for 240/208/120V power.
 - d. Transformer and low voltage panel configurations are allowed if space permits.
 - e. Breaker sizing shall follow manufacturer recommendations; typical values are 175% primary, 125% secondary.
5. SPDs
- a. Main electrical service shall be provided with a Transient Voltage Surge Suppressor (TVSS)/Surge Protection Device (SPD) including overcurrent protection on each leg. Eaton surge protection devices (SPD) shall be provided and located at service entrances.
 - b. Type 1 SPDs shall be required at the main distribution panel.
 - c. Type 2 SPDs shall be required on low voltage panels feeding sensitive electrical equipment, IT equipment, security, or SCADA equipment.
6. Receptacles
- a. Provide general use receptacles for temporary loads, power tools, etc. The receptacles shall be located in the electrical room, at the electrical rack, and within 25' from each pump.
 - b. Provide a 20-amp receptacle with a dedicated circuit for heat trace and freeze protection. A standard 20A receptacle shall be mounted inside a 16"x16"x8" (minimum) NEMA 4 enclosure, and the circuit shall be protected by a 30-mA GFPE breaker located in the serving panel. At minimum, dedicated circuits shall be provided at each of the following locations (where applicable): well, high-service or booster pumps, transducer, and chlorine dosing line.
 - c. All surface mounted device boxes shall be FD type sand cast aluminum with corrosion-resistant 316SS cover screws.
 - d. All general use exterior receptacles shall be duplex 120V 20A GFCI-WR. Exterior receptacles shall have aluminum weatherproof "while in-use" covers.
 - i. This requirement does not apply to dedicated heat trace receptacles installed inside NEMA 4 enclosures.

3. Motor Starters

- 1. All full voltage starters shall be NEMA sized, minimum size of 1. Half-sized starters and IEC starters are not allowed. These starters shall be provided with solid state overload relays.
- 2. Schneider (Square D) is the allowable manufacturer for Variable Frequency Drives (VFD). The Schneider Altivar Process VFD shall be provided for all motors unless determined otherwise by TWC. VFD manufacturer substitutions are allowed only with written approval from TWC.
- 3. All VFD installations shall be provided with input (line) harmonic filters and output dv/dt filters. The Contractor shall be fully responsible for mitigating harmonic distortion, voltage flicker, and voltage dips caused by VFD operation such that:
 - a. Total harmonic distortion (THD) and individual harmonic distortion remain within the limits of IEEE Std. 519-1992, Section 10 at the point of common coupling (PCC).
 - b. Primary voltage dip resulting from motor starting or VFD operation does not exceed 2%.

- c. All requirements of the serving utility's Service Policy regarding continuity of service are met.
- 4. The filter shall be positioned to maintain all applicable code- and manufacturer-required service and working clearances for the VFD.
- 5. VFD cables shall be required where recommended by the manufacturer (200 feet and greater). Where VFD cables are required, Belden cables shall be used unless otherwise approved by TWC or the Engineer of Record (EoR).
- 6. If reduced voltage solid state (RVSS) soft starters are to be used at locations, Benschaw or Schneider/SQD shall be used.
- 7. If motors have across the line starters, Siemens, Square D, or Eaton contactors shall be used.
- 8. All VFD installations shall comply with manufacturer grounding and bonding requirements, including bonding of motor frame, conduit, VFD enclosure, and cable shield to ensure proper mitigation of electrical noise and to maintain warranty compliance.
- 9. All electrical systems shall be designed with capacity to provide 60HP minimum for all wells.

4. General Lighting

- 1. Site Lighting
 - a. Provide dark-sky-compliant LED site lighting in each process area, rated at 15,000 lumens maximum and 4000K correlated color temperature (CCT) unless otherwise required by jurisdiction.
 - b. Provide intermediate hinged aluminum poles, bronze finish.
 - c. Anchors and hardware shall be stainless steel.
 - d. Lighting switches shall be located on the electrical rack or within the electrical room, as applicable.
 - e. Where applicable, use Cooper GALN-SA2D-740-U-XX-BZ pole-mounted luminaires on Valmont Structures light pole bases.
 - f. Provide Hand-Off-Auto (HOA) control panel with exterior switch selector for site lighting control. HOA control panel shall allow:
 - 1. HAND: Manual override of site lighting "ON"
 - 2. OFF: Lighting disabled
 - 3. AUTO: Lighting controlled via timeclock
 - 4. HOA switches shall be clearly labeled, and located on the exterior of the building or on exterior electrical rack, coordinated with the lighting control scheme.
- 2. Interior Lighting
 - a. Pump Room
 - 1. Interior light fixtures shall be vapor-tight LED luminaires, rated for 4000 lumens and 4000K CCT, unless noted otherwise.
 - b. Electrical Room
 - 1. Interior light fixtures shall be LED luminaires, rated for 4000 lumens and 4000K CCT, unless noted otherwise.

3. Exterior Building-Mounted Lighting
 - a. Exterior luminaires installed on equipment buildings shall be weatherproof, full-cutoff LED wall packs.
 - b. Fixtures shall be surface-mounted above doors.
 - c. Maximum rating: 24 watts, 4000K CCT
 - d. Where applicable, use Cooper IST-SA1A-740-U-T4FT-HSS-BZ wall pack luminaires.
4. Emergency Lighting
 - a. Provide 90-minute minimum emergency battery backup for all interior and exterior egress luminaires throughout the site.
5. Dark Sky Compliance
 - a. All outdoor lighting shall utilize full cutoff luminaires and shall comply with dark sky requirements, including maximum 4000K CCT unless a more restrictive requirement (e.g. 2700K) is mandated by the governing authority.
 - b. Provide house-side shields on perimeter lighting.
6. Authority Having Jurisdiction (AHJ)
 - a. All lighting design, equipment, and installation shall comply with the adopting county and/or city jurisdiction.

5. Obstruction Lighting

1. Structures 150 Feet and Below
 - a. Elevated storage tanks and other structures 150 feet in height or less shall be furnished with an FAA L-810 double obstruction light.
 - b. Both light engines shall operate simultaneously.
 - c. Provide RTO-CR27-002 LED L-810 double obstruction light, rated 120–240 VAC, with infrared, unless otherwise approved by TWC.
2. Obstruction Lighting Controller
 - a. Provide Eaton L-810 obstruction lighting controller, Model No. 70026-RTO, single-phase, for control of obstruction lighting systems.
 - b. All obstruction lighting shall be automatically controlled by means of a photocell or timer, in accordance with FAA AC 70/7490, Section 5.3.
3. Structures Between 150 Feet and 350 Feet
 - a. Elevated storage tanks and other structures greater than 150 feet and up to 350 feet in height shall be furnished with an L-810 double obstruction light configured to flash in conjunction with an L-864 beacon.
 - b. Flash rate shall be 30 flashes per minute (fpm)
 - c. Allowable tolerance: ± 3 fpm
4. Structures Above 350 Feet

- a. Elevated structures exceeding 350 feet in height are subject to additional FAA requirements. Refer to FAA Advisory Circular AC 70/7490, Obstruction Marking and Lighting, for applicable lighting standards.

6. Conduit

1. All exposed/above ground conduit shall be rigid aluminum (1" minimum) only. Stub-ups from underground to 6" above grade including the 90-degree bends shall be PVC coated aluminum conduit or shall be rigid aluminum conduit wrapped in corrosion tape. No steel galvanized rigid, EMT, or IMC conduit shall be used.
2. Underground conduit shall be Sch 40 PVC (1" minimum) and shall be installed with detectable red tape and backfilled with sand.
3. Red dye reinforced 3000 psi concrete shall be required for the following:
 - a. All underground primary unless otherwise prohibited by the Electric Service Provider.
 - b. All Line side conductors from transformer to first means of disconnect.
 - c. All 480Y/277 Volt underground feeders and branch circuits.
 - d. Red dye shall be mixed prior to placement.
4. For flexible conduit, use Type LFNC flexible seal tight conduit for 3/4" minimum to 2" sizes (1/2" LFNC flex will be allowed for instruments with 1/2" threaded hub entries, all other flex shall be 3/4" or larger). Use aluminum core liquid tight flexible metal conduit for sizes 2-1/2" and larger. Maximum length of flex conduit shall be 24". All connectors shall be aluminum. No smurf tube permitted.
5. All submersible leads from the junction box to the well head shall be type LFNC seal tight conduit with the proper seal tight fittings.
6. All conduit fittings shall be Form 7 sand cast aluminum with aluminum covers and corrosion-resistant 316SS screws. Snap-on covers are not permitted.
7. Use aluminum Myers hubs, grounding type, with insulated throats for all exterior enclosure entries or wet locations.
8. Use UNY and UNF aluminum unions. Galvanized unions are not permitted.
9. Use aluminum seal-off fittings where required by NEC, seal with 3M-2123 re-enterable sealing compound.
10. Use Noalox or other comparable anti-oxidizing agent on all metal conduit threads.
11. Field bending of conduit shall be accomplished using the appropriate tools. Flame bending is not allowed.
12. All conduit shall be PVC or non-metallic when installed in chlorine rooms.
13. Electrical conduit shall maintain a minimum separation of 18 inches from all process piping, chemical feed lines, water lines, and wet utilities unless crossing. Conduit shall cross piping at 90 degrees.
14. Horizontal separation shall be five foot minimum from all wet utilities.
15. Minimum burial depth for electrical conduit shall be 24 inches or greater unless otherwise required by NEC or utility provider.

7. Conductors

1. All conductors shall be copper. Aluminum conductors shall not be permitted for any feeders, branch circuits, control wiring, or equipment connections unless specifically approved by TWC.
2. Minimum conductor size shall be #12 AWG for power circuits and #16 AWG for instrumentation and control wiring unless otherwise noted. For site branch circuits #10 AWG minimum.
3. Voltage drop shall not exceed 3% for branch circuits and 5% total for feeders plus branch circuits. Contractor shall provide voltage drop calculations upon request.
4. Color coding shall comply with NEC and TWC standards:
 - a. 480Y/277V 3 ϕ systems: Brown, Orange, Yellow (phases), Gray (neutral), Green (ground).
 - b. 208Y/120V 3 ϕ systems: Black, Red, Blue (phases), White (neutral), Green (ground).
 - c. 240/120V 1 ϕ systems: Black and Red (ungrounded conductors), White (neutral), Green (ground).
 - d. 480 Δ and 240 Δ are not permitted.
5. Insulation shall be colored. Tape is prohibited.

8. Grounding

1. Engineer to design site grounding system to include fencing, electrical rack, generator, RTU, antenna, etc.
2. All grounding electrode conductors and bonding jumpers shall not have any bends greater than 90 degrees.
3. All grounding connections shall be exothermic welded connections unless otherwise stated on EOR plan.
4. A grounding test well shall be installed on the main grounding electrode. The main ground rod shall be installed with a short conductor extension (pigtail) from the ground loop so that the injected test signal will be forced down the ground rod. Refer to Ground Test Well detail.
5. All underground water pipes in contact with earth for 10 feet or more shall be grounded in accordance with NEC 250.52(A)(1). Minimum size is 10 AWG.
6. A grounding ring shall be used throughout all TWC sites in accordance with NEC 250.4.
7. A grounding ring shall be installed around all generators, structures, tanks, and buildings.
8. All motor tails shall be grounded by grounding rings. All motor tails shall be grounded to grid for lightning protection.
9. Megger-test the load and line conductors of all power circuits and submit test reports. Resistance to ground for site grounding shall be 5 Ohms or less. Testing report shall be provided at project close out.
10. Ground ring conductors shall be a minimum of #2 AWG.

9. Tracer Wire

1. Tracer wire shall be installed continuously along 100% of all water mains, services, hydrants, blowoffs, and appurtenances. Splices shall be avoided where possible.
2. Tracer wire shall be #12 AWG solid copper with a minimum 45-mil HDPE insulation rated for direct burial. Color shall be blue for potable water unless otherwise noted.

3. Tracer wire shall be attached to the top of pipe at intervals not exceeding 10 feet.
4. Services under 50 feet shall use a single tracer wire.
5. All splices shall be made using UL-listed, waterproof, direct-burial splice kits (e.g., DryConn DBY/DBR or approved equal). No unapproved connectors, tape, or wire nuts shall be used.
6. Tracer wire shall terminate in accessible locations including valve boxes, meter boxes, or dedicated tracer wire access points. A minimum of 6 to 12 feet of extra wire shall be coiled neatly for future locating.
7. Tracer wire risers shall be installed in Schedule 40 PVC or aluminum conduit where required to bring the wire to grade.
8. Tracer wire shall be installed and inspected prior to backfilling. Damaged wire shall be replaced back to the nearest acceptable splice point.
9. Tracer wire shall not be installed in tension and shall maintain separation from metallic components where practical to reduce interference.
10. All tracer wire in chlorine rooms or chemical environments shall be enclosed in non-metallic conduit.

10. HVAC

1. Electrical buildings shall be provided with air conditioning for temperature control.
 - a. Buildings 20 feet by 12 feet or smaller shall be provided with a ductless mini-split air conditioning system rated up to 2 tons, in accordance with the Small Building Standard.
 - i. Outdoor unit shall utilize housekeeping pad on grade.
 - b. Electrical room buildings larger than 20 feet by 12 feet, shall be provided with Bard wall-mounted air conditioning units rated at 3 tons or greater, in accordance with the Large Building Standard. Bard units shall include low-ambient control, filter pressure switch, and alarm relays.
 - c. Redundant AC units shall be provided for electrical equipment rooms serving three or more motors.
 - d. Where multiple Bard units are provided, units shall be installed with dual lead-lag control. A Bard MC4002-B thermostat shall be provided for control of two (2) units. Each unit shall be sized to handle design conditions.

11. Emergency Generator and Transfer Switch

1. Provide a permanent emergency generator and an automatic transfer switch (ATS) at each necessary location. If a permanent generator is not required by TWC, provide a NEMA 3R ATS with camlocks for a portable generator to be connected. All site requirements shall be confirmed with TWC.
2. Provide ATS with programmable exerciser (with and without load), mounted on vertical strut or housekeeping pad, external mounting lugs, and lockable 3-point latch system. Substitutions are not allowed.
 - a. Provide ASCO Series 300 or 7000 ATS.
 - b. All ATS's shall be delayed transition type.
 - c. ATS shall have switched neutral. Solid neutral ATS require approval by TWC.
 - d. Solar shade shall be provided for controller display.
3. Provide a docking station at all water treatment plants and waste water treatment plants.
 - a. Docking station shall be Try Star dual purpose dual breaker model (DPDS-5).
4. Enclosure types:
 - a. Outdoors: NEMA 3R, unless otherwise approved by TWC
 - b. Indoors (within dedicated electrical/controls room): NEMA 1
5. Generator shall be manufactured by Caterpillar.
 - a. Caterpillar GC generator models preferred.
 - b. Size generator to operate the facility at 100% capacity with 20% maximum voltage drop and 10% frequency dip for any motor starting conditions. Max loading 90% of rated capacity.
 - c. For permanent or portable generators, provide diesel or propane powered generator. Fuel capacity shall be 24 hours minimum at 100% generator load rating. Maximum storage for fuel calculations shall be 90% of tank capacity.

- d. Level of sound shall be 60 to 80 d(B)A measured at full load at 7 meters with provided sound attenuation enclosure.
 - e. Generator shall have a battery charger and dry contacts for all alarms.
 - f. Generator and ATS alarms shall be monitored via Modbus to SCADA.
 - g. UL-142 or UL-2085 tanks shall be provided.
 - h. Generators shall be equipped with a low fuel alarm and leak detection.
 - i. Generator phase rotation shall be modified to match utility phase rotation by generator technician.
 - j. Generator shall be mounted on a cast-in-place reinforced concrete pad with perimeter beam. Concrete pad shall allow for a 3-foot working clearance (minimum) around entire generator.
 - k. All generators shall be equipped with batteries one year old or newer.
 - l. For all Water Treatment Plants or Wastewater Treatment Plants.
 - i. Remote annunciator shall be provided located in main electrical room.
 - ii. Remote mounted EPO shall be located adjacent to the ATS.
6. All testing shall be performed by the Contractor and witnessed by TWC.
- a. Contractor shall perform operational demonstration testing.
 - b. Contractor shall start up, test, and verify all equipment is operational prior to scheduling TWC to witness demonstration testing.
 - c. Operator training shall be conducted on a separate day after demonstration testing. Contractor shall coordinate schedule with TWC at least two (2) weeks in advance.
 - d. Demonstration testing shall include HOA and generator testing from supply 1 to supply 2 for a minimum duration of 30 minutes and then back to supply 1.
 - e. Test equipment must be calibrated annually.
2. Perform onsite load bank testing as follows:
- a. Perform cold start block test at 100% load.
 - b. Perform 2-hour load bank testing, 1-hour minimum at 100% load.
 - c. Perform 0.5-hour minimum facility load testing.
3. Contractor shall be responsible for fueling generator. Refill fuel tank to 100% usable capacity upon completion of all testing.

12. Instrumentation and Controls

- 1. All sites shall have a SCADA system appropriate for the applicable service area. Panels shall be provided by The Dudley Company (Hierholzer Engineering Inc.) based in Marion, TX.
- 2. Coordinate with Hierholzer Engineering Inc. staff to determine service area, site specific requirements, and appropriate radio. SCADA system shall be designed and installed in accordance with TWC standards. All SCADA points inside the pump control panel shall be landed on terminal strips mounted on the backplane.

3. Provide a Power Quality Meter (PQM) in its own separate enclosure on load side of service or on load side of main disconnect. A PQM shall be used at locations with 400A services or larger. The PQM shall be EATON POWER XPERT METER 6000, or similar, with outputs as required to provide amperage readings of all three phases to the applicable control room(s) via SCADA.
4. All panels shall be tested in accordance with NFPA 70.
5. Provide LED strip lighting with door switch inside control panels if the enclosure size is greater than or equal to 30" wide and greater than or equal to 12" deep.
6. For packaged systems, pump controllers shall be provided by the pump manufacturer. Provide an OIT touch screen for local system monitoring and adjustment of setpoints. Mount the OIT on the exterior door of the pump control panel with a hinged UV protective cover, if exterior, by Shade Aide or TWC approved equal. Furnish a spare pump controller, backup programming CD, and one spare I/O module of each type.
7. All PLCs shall be of the same communication type as established by Hierholzer Engineering Inc. (HEITX); each with 10% minimum spare I/O, all mapped to the top end. This applies to the entire site and all equipment.
8. At a minimum, the following points shall be monitored in the control room(s):
 - a. Pump run status for each pump.
 - b. Pump auto status for each pump.
 - c. Common pump fault for each pump (seal fail, over temp, fail to start, motor overload).
 - d. Generator runs.
 - e. Generator fault.
 - f. Generator low fuel alarm.
 - g. Power fail.
 - h. ATS position.
 - i. High float.
 - j. Low float.
 - k. System in backup.
 - l. PQM ampacities.
 - m. Transmitter(s) level.
 - n. Communications fail.
9. RTU backup power supply shall be a 24V battery system with trickle charger. The battery system shall have sufficient capacity to power the RTU for a minimum duration of four (4) hours.
10. All control panels shall not be penetrated through the top of panels.
11. Where voltages greater than 120 V are present within a control panel, the panel shall be compartmentalized to segregate higher-voltage components from low-voltage control circuits.
12. Provide AC for control panel cabinets. Fans and louvers are acceptable for panels located within dedicated electrical rooms.

13. All enclosures shall be at least NEMA 3R rated with external mounting lugs and lockable 3-point latch system. Mount all enclosures on aluminum struts.
14. All control panel wiring shall be flexible 41 strand tinned copper, size 14 AWG minimum, 600V insulation, Type THHN for control panels. Per section 66.9.1 of the UL508A, the following color coding shall be implemented through the panel:
 - a. Black – all ungrounded control circuit conductors operating at the supply voltage.
 - b. Red – ungrounded AC control circuits operating at a voltage less than the supply voltage.
 - c. Blue – ungrounded DC controls circuits.
 - d. Yellow or orange – ungrounded control circuits or other wiring.
 - e. White or gray or three white stripes on other than green, blue, orange, or yellow – grounded AC current-carrying control circuit conductor regardless of voltage.
 - f. White with blue stripe – grounded DC current-carrying control circuit conductor.
 - g. White with yellow stripe or white with orange stripe – grounded ac control circuit current-carrying conductor that remains energized when main disconnect switch is in the “off” position.
15. All 4-20mA signal wire shall be 18 AWG twisted shielded.

13. Physical Security

1. Security System Classification
 - a. Facilities shall be designated by TWC as having either:
 - i. Non-Networked Security Systems, or
 - ii. Networked Security Systems
 - b. The applicable security system classification shall be identified during design and shown on the drawings.
 - c. Electrical design and dry utility infrastructure shall support the security systems associated with the designated classification.
2. Non-Networked Security Systems
 - a. Non-networked security systems shall be provided at facilities requiring physical access control only and shall include, at a minimum:
 - b. CLIQ key cylinders at all manually operated site gates
 - c. CLIQ key cylinders at all exterior doors
 - d. No on-site network server, network equipment, cameras, or electronic access control systems are required unless otherwise approved by TWC.
 - e. Electrical scope shall be limited to coordination of power requirements and locations for any powered CLIQ components, where applicable.
3. Networked Security Systems
 - a. Networked security systems shall be provided at facilities designated by TWC based on site size, equipment complexity, and operational requirements, including whether the facility is manned.

- b. Networked security systems typically include the following, as required by TWC:
 - i. 360-degree pan-tilt-zoom (PTZ) security cameras positioned to provide full site coverage
 - ii. Electronic access control devices, including badge readers, at selected doors, gates, or secure areas
 - iii. An on-site network server provided to support communications and connectivity for site systems, with a limited portion of adjacent rack-mounted space allocated for security-related equipment, as specified by TWC
 - c. The network server and associated rack-mounted equipment shall be located in one of the following:
 - i. A dedicated secure room provided with badge-access control, or
 - ii. A secure equipment cage (e.g., Acorn cage) located within the electrical room and provided with badge-access locks
4. Electrical and Coordination Requirements
- a. Electrical design shall include power provisions to the network server and associated enclosure or rack.
 - b. Electrical drawings shall identify the locations of:
 - i. Security cameras
 - ii. Card readers
 - iii. Network equipment enclosures
 - c. Network server equipment and associated hardware shall be specified by TWC.
 - d. Network server rack layout and space allocation shall be determined by TWC IT department.
 - e. Detailed security system design, internal wiring, network configuration, and device programming shall be by the security system vendor.
 - f. Networked security systems shall be coordinated with TWC-approved security vendors (Convergent).

14. Tank Control Valves

- 1. Tank control valves shall be provided where required by TWC.
- 2. The civil engineer shall propose the tank control valve location and valve type in accordance with TWC requirements, subject to TWC review and approval.
- 3. Electrical design shall provide required power and interfaces for electrically actuated tank control valves.
- 4. Control and integration requirements shall be coordinated with TWC and the SCADA Contractor.