CCSUD ELECTRICAL DESIGN CRITERIA

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PART 1 - GENERAL REQUIREMENTS

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 CCSUD at least two (2) weeks in advance.

PART 2 - ELECTRICAL

A. General

1. If enclosures, panels, instrumentation, and controls are not located within a building, electrical equipment shall be mounted on a rack with a shade roof (detail provided upon request). Electrical rack with roof shelter for electrical and control equipment orientation of shelter shall be such that panels face east or north.
2. Electrical work shall be installed in accordance with CCSUD standard details (see attachments).
3. Electrical equipment buildings shall be located between distances of 50’ minimum to 150’ maximum, from pump motor locations.
4. 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 in-line diagrams for all control panels and MCCs.
5. All equipment shall be designed to automatically reset after power outages.
6. Main electrical service shall be provided with a Transient Voltage Surge Suppressor (TVSS)/Surge Protection Device (SPD) including overcurrent protection on each leg. Schneider/Square-D(SQ-D) surge protection devices (SPD) shall be provided and located at service entrances.
7. Electrical service shall be 480V 3-phase. Phase converters are not allowed. Requests for smaller electrical service shall be reviewed and considered for approval on a case-by-case basis.
8. Electrical service disconnects shall be enclosed circuit breakers.
9. 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 10’ from each pump.
10. Electrical panels shall have tinned copper bus and bolt-on type circuit breakers.
11. All surface mounted device boxes shall be FD type sand cast aluminum with 316SS cover screws.
12. All receptacles shall be duplex 120V 20A GFCI-WR. Outdoor locations shall have aluminum while in-use covers.

13. Schneider/SQ-D Mini-Power Centers (MPZ) shall be used at locations where requires for 240/208/120V.
14. Schneider/SQ-D electrical panels and appurtenances shall be used throughout locations unless other manufacturers have been approved by CCSUD.
15. Provide type written panel circuit directories in all electrical panels. An as-built laminated one-line diagram shall be located in each electrical room.
16. Use aluminum hardware, struts, and straps. If anchors are necessary, 316SS anchors shall be used. All exterior mounted electrical enclosures and devices shall be mounted on struts.
17. All electrical enclosures shall have black heavy duty 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 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:
    a) 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.
    b) Transformers: identify kVA rating, voltage, and phase for both primary and secondary, power source and circuit number, and loads served.
    c) Enclosed switches, circuit breakers, and motor controllers: identify voltage, phase, power source and circuit number, and loads served.
    d) 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.
18. 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.
19. Non-fused disconnect switches, NEMA 4X 316SS type, shall be used at pump locations in lieu of emergency stop switches.
20. Power studies sealed by a professional engineer shall be performed by Schneider/SQ-D or by designated contractors as approved by CCSUD.
    a) Perform analysis of electrical power distribution system using 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.
    c) Arc flash and shock risk assessment: perform incident energy and arc flash boundary calculations using alternate scenarios to determine the worst-case

scenarios to determine the worst-case scenario. Apply arc flash warning labels compliant with ANSI Z535.4 to all equipment components.

d) Provide reports to the Engineer of record and the Owner for all analysis/studies performed.

21. Contractor shall perform operational demonstration testing. Contractor shall startup, test, and verify all equipment is operational prior to scheduling CCSUD to witness demonstration testing. Operator training shall be conducted on a separate day after demonstration testing has been completed. Contractor shall coordinate scheduling with CCSUD at least two (2) weeks in advance.

B. Motor Starters

1. Provide Soft Start for all 10 hp and larger motors unless Owner determines that a variable frequency drive (VFD) is required. Provide VFD for applications where motor speed control is required and as determined by Owner. In water applications, motors 10 hp and larger shall be furnished with variable frequency drives. All motors driven by a variable frequency drive shall be inverter-duty rated.
2. 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.
3. Yaskawa (Square D) are the allowable manufacturers for Variable Frequency Drives (VFD). The Toshiba VF model VFD, Toshiba H7 VFD, or the Schneider Altivar Process VFD shall be provided for all motors unless determined otherwise by CCSUD. All VFDs shall be supplied with harmonic filters. Manufacturer substitutions are allowed only with written approval from CCSUD.
4. All VFDs shall be supplied with harmonic filters per IEEE 519.
5. If motors have across the line starters, Siemens or Eaton contractors shall be used.

C. Lighting

1. Provide manually controlled, dark sky compliant, LED site lighting in each process area: 15,000 lumens and 4,000K. Provide intermediate hinged aluminum poles in bronze color; anchors and hardware shall be stainless steel. Provide photocells and receptacles at all light poles. Receptacles shall be located on the light pole base and shall be circuited separately from the light circuitry. Switches shall be located on electrical rack or in electrical room. Where applicable, Cooper # GALN-SA2D-740-U-XX-BZ pole light fixtures shall be used on Valmont Structures light pole base.
2. Interior light fixtures throughout sites shall be vapor tight LED fixtures: 4000 lumens and 4000K.
3. Exterior light fixtures installed on equipment buildings shall be weatherproof LED full cutoff wall pack with photocells and motion sensors. Provided lights shall be wall/surface mount above doors, 4000K and 24W minimum. Cooper # IST-SA1X-740-U-XX-BZ wall pack light fixtures shall be used where applicable.

D. Conduit

1. All exposed/above ground conduit shall be rigid aluminum (¾" minimum) only. Stub-ups from underground to 6" above grade including the 90-degree bends shall be PVC coated aluminum conduit or shall be 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. For flexible conduit, use Type LFNC flexible seal tight conduit for ¾" minimum to 2" sizes (½"LFNC flex will be allowed for instruments with ½" threaded hub entries, all other flex shall be ¾" or larger). Use aluminum core liquid tight flexible metal conduit for sizes 2 ½" and larger. Maximum length of flex conduit shall be 24". All connectors shall be aluminum. No smurf tube shall be used.
4. Conduit fittings, not including couplings and connectors, shall be Form 7 sand cast aluminum with aluminum covers and 316SS screws. Snap-on covers are not permitted. Couplings and connectors shall be aluminum.
5. Use aluminum Myers hubs, grounding type, with insulated throats for all exterior enclosure entries or wet locations.
6. Use UNY and UNF aluminum unions. Galvanized unions are not permitted.
7. Use aluminum seal-off fittings where required by NEC, seal with 3M-2123 re-enterable sealing compound.
8. Use Noalox or other comparable anti-oxidizing agent on all conduit threads.
9. Field bending of conduit shall be accomplished using the appropriate tools. Flame bending is not allowed.

E. Grounding

1. Engineer to design site grounding system to include fencing, electrical rack, generator, RTU, antenna, etc. Resistance to ground for site grounding shall be 5 Ohms or less. Testing report shall be provided at project close out.
2. A separate grounding conductor is required for every raceway, including electrical and I&C. Minimum size is 10 AWG.
3. A grounding grid shall be used throughout sites in accordance with NEC 250.4.
4. All motor tails shall be grounded by grounding rings. All motor tails shall be grounded to grid for lightning protection.
5. Megger test load and line conductors of all power circuits and submit test reports.

F. Conductors

1. All MCC control wiring shall be UL-508 compliant, flexible 41 strand tinned copper, size 14 AWG minimum, 600V insulation, Type MTW for MCCs.
2. All other conductors shall be stranded copper XHHW-2.
3. Phase colored insulation is required for all conductors.
4. A separate neutral conductor is required for every 120VAC or 277VAC circuit.
5. Coordinate sizes of components to accommodate voltage drop. Coordinate direct buried cable with other trades to mitigate conflicts. Coordinate with equipment installed by other trades to provide suitable terminations for equipment installed by others.

6. Color code conductors using integrally colored insulation. Use the following conventions (listed in phase A, B, C, Neutral order). Maintain consistent color coding throughout the project:
    a) 480Y/277 V, 3-Phase: brown, purple, yellow, gray.
    b) 208Y/120 V, 3-Phase: black, red, blue, white.
    c) 240/120 V, 3-Phase High Leg Delta: black, orange, blue, white.
    d) 120/240 V, 1-Phase: black, red, white.
    e) Grounding in all systems shall be green.
7. Label wiring with yellow heat shrink type markers with black machine printing. Cloth wire wrap shall be permitted in the field.

PART 3 - INSTRUMENTATION AND CONTROLS

A. General

1. Provide 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.
2. All equipment shall be designed to automatically reset after power outages.
3. All panels shall be tested in accordance with NFPA 70.
4. Provide LED strip lighting with door switch inside control panels of the enclosure size is greater than or equal to 30” wide and greater than or equal to 12” deep.
5. 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 CCSUD approved equal. Furnish a spare pump controller, backup programming CD, and one spare I/O module of each type.
6. All PLCs shall be of the same communication type; each with 10% minimum spare I/O, all mapped to the top end. This applies to the entire site and all equipment.
7. 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 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) Daily pump run time hour meters (display on control room screens, reset daily at noon).

n) Intrusion alarms (pump control panel and RTU).

o) Submersible transmitter level.

p) Communications fail.

8. 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.

9. All control panels shall not be penetrated through the top of panels.

10. All enclosures shall be NEMA 4X 316SS with external mounting lugs and lockable 3-point latch system. Mount all enclosures on aluminum struts.

11. All control panel wiring shall be flexible 41 strand tinned copper, size 14 AWG minimum, 600V insulation, Type SIS for control panels, and color coded as follows:
    a) AC controls Red
    b) DC controls Blue
    c) DC (+) power Red
    d) DC (-) power Black
    e) AC hot Black
    f) AC neutral White

12. All 4-20mA signal wire shall be 18 AWG twisted shielded.

13. The contractor shall maintain service to existing wastewater systems at all times during construction. Any work involving power outages, bypass pumping, pump and haul, 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, pump and haul, temporary plugs, etc., shall be furnished ad performed by the contractor. Coordinate and schedule any such activities with CCSUD at least two (2) weeks in advance.

PART 4 - SCADA

A. General

1. All sites shall have a SCADA system, appropriate for the applicable service area with the ability to connect to CCSUD's existing SCADA platform.

2. Panels shall be provided by Neltronics (Stan Nelke).

3. Coordinate with CCSUD and Neltronics Staff to determine service area, site specific requirements, and appropriate radio. SCADA system shall be designed and installed in accordance with CCSUD standards. All SCADA points inside the pump control panel shall be landed on terminal strips mounted on the backplane.

PART 5 - LIFT STATIONS

A. General

1. All lift stations shall have a SCADA system, appropriate for the applicable service area.
2. Wet well junction box shall be NEMA 4X 316SS with external mounting lugs and lockable 3-point latch system. Mount all enclosures on vertical strut.
3. Equipment control panel shall have an aluminum dead-front inner door. Panels shall be tested in accordance with NFPA 70.
4. Lift station pump controllers and pump control panels shall be provided by the pump manufacturer. Provide an OIT on the touch screen for local systems monitoring and adjustment of setpoints. Mount the OIT on the exterior door of the pump control panel with a hinged UV protective cover by Shade Aide, or CCSUD approved equal. Furnish a spare pump controller, backup programming CD, and one spare I/O module of each type.
5. For lift stations located at a plant site, pump controllers shall be connected to the plant main RTU via serial MODBUS connection.
6. All PLCs shall be of the same communication type; each with 10% minimum spare I/O, all mapped to the top end. This applies to the entire site and all equipment.
7. The primary level control shall be a Dwyer Model PBLTX (0-15psi) submersible level transmitter. Provide stilling well for transmitter. Provide staggered lead/lag/standby pump operation and first on/first off alternation. Backup level control shall be two floats. Provide one high level float and one low level float. Both floats, when either is activated, shall disengage primary transmitter control and provide alarms to SCADA and provide local horn and beacon alarms. High floats shall provide alarms and turn all pumps on. Low float shall provide alarms and turn all pumps off, regardless of HOA position. Pumps shall remain in backup control until manually reset locally. System in backup alarm shall latch in until manually reset locally; including horn, beacon, and SCADA.
8. All floats shall have one NO and one NC set of contacts.
9. Provide start delay relay timers for each pump to stagger starts in hand and auto, primary and backup control modes, regardless of power source whether normal or emergency.

PART 6 - EMERGENCY GENERATOR

A. General

1. Provide a permanent emergency generator and an automatic transfer switch at each necessary location. All site requirements shall be confirmed with CCSUD.
2. Provide Zenith transfer switch, automatic (ATS) or manual (MTS) 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. All automatic transfer switches (ATS) shall be delayed transition type. ATS Hand/Off/Auto Switch: Provide HOA switch that allows the ATS to switch to source 2 (emergency power) via "hand" position and operate facility under generator power. The switch shall remain in “hand” until the user manually selects a different position. The intent of the HOA is to allow the user to test the generator under facility load or manually engage the

generator if desired, without having to operate the normal power circuit breaker feeding the ATS.

3. Generator shall be manufactured by Cummins. Manufacturer substitutions are allowed only with written approval from CCSUD. 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.
4. Provide diesel 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.
5. Level of sound shall be 60 to 80 d(B)A maximum measured at full load at 7 meters with provided steel sound attenuation enclosure.
6. Generator shall have a battery charger and dry contacts for all alarms. Generator and ATS alarms shall be monitored via Modbus to SCADA.
7. Generators shall be equipped with a low fuel alarm.
8. 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.
9. Perform onsite load bank testing in accordance with NFPA 110:
   a) Perform cold start block test at 100% load.
   b) Perform 4-hour load bank testing, 2-hours of which shall be at 100% load.
   c) Perform 1.5-hours facility/plant load testing.
   d) Refill fuel tank to 90% capacity upon completion of testing.
10. All testing shall be performed by the contractor and witnessed by CCSUD. Test equipment must be calibrated annually.
11. Contractor shall perform operational demonstration testing. Contractor shall startup, test, and verify all equipment is operational prior to scheduling CCSUD to witness demonstration testing. Operator training shall be conducted on a separate day after demonstration testing. Contractor shall coordinate schedule with CCSUD at least two (2) weeks in advance. 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.

PART 7 - SUBMITTALS

A. Construction submittals shall be provided for CCSUD/Engineer review prior to purchase of materials.

B. Provide electronic backup copies of programming for PLCs, pump controllers, HMI and other controls.

C. Provide two (2) hard copies and one (1) electronic copy of the O&M Manual.

END OF SECTION