ADDENDUM NO. 4

FOR

WASTEWATER TREATMENT SYSTEM UPGRADE

AND DISCHARGE RELOCATION FOR

THE TOWN OF CROSSVILLE

CW ARPA PROJECT NO. CS0110326

AUGUST 12, 2025

TO: ALL PLAN HOLDERS AND INTERESTED PARTIES

SUBJECT: Plans, Specifications and Contract Documents are hereby amended, modified, and changed as follows:

I. Reference Part VI – Technical Specifications, Division No. 8 – Aluminum Windows

A. Add attached Specification 08520 marked Addendum No. 4.

II. Reference Part VI – Technical Specifications, Division No. 11– Sequencing Batch Reactor (SBR) Wastewater Treatment Plant

A. Replace specification 11388 with the attached specification 11388 marked Addendum No. 4.

III. Reference Part VI – Technical Specifications, Division No. 16 – Electrical, Sections

A. Add attached specifications 16010, 16011, 16100, 16110, 16111, 16120, 16130, 16140, 16170, 16181, 16182, 16201, 16261, 16450, 16459, 16461 and 16432 marked Addendum No. 4.

IV. Reference Addendum No. 2 – Technical Specifications, Division No. 11 – Closed Channel Ultraviolet Wastewater Disinfection

A. Change to read as follows:

1.09.A.2 The manufacturer shall have a minimum of 50 fully operation systems in municipal wastewater plants.

B. Remove Section 1.09.A.3.

V. Reference Plans

A. Plan Sheet 8 shows a 6" floor drain; replace this with a 4" floor drain.

B. On Plan Sheet 8, the 1" AVR/AVV shall be installed downstream of the 8" flow control valves exiting the UV units.

C. Plan sheet 10 shows a 2" line discharging from the Sludge pump. This line shall be a 2 ½" line.

D. On Sheet 10 Detail B/10 Manual valve and Check valve from the sludge pump to the pond shall be installed vertically 4' above the existing grade.

E. On Plan Sheet 10, Post-Eq Basin note shall be *30.0' x 15.0'* in lieu of the *30.0' x 12.0'* shown.

F. Replace Plan Sheets E-1 – E-6 with attached sheets E-1 – E-6 marked as "Addendum No. 4".

G. On plan sheets M-01 -M-03, replace Job No. 2276.1 with 2280.

H. On Plan sheet M-01, replace note "INLINE BOOSTER PUMP AND 62 GAL BLADDER TANK BY OTHERS" to read "INLINE BOOSTER PUMP AND 62 GAL BLADDER TANK"

I. On Plan sheet M-01, replace note "2" DCW ENTRY BOOSTER PUMP AND BUFFER TANK BY OTHERS" to read "2" DCW ENTRY BOOSTER PUMP AND BUFFER TANK"

VI. Clarifications

A. The floor drain in the building doesn't have a water line to it, but a trap primer unit is shown on sheet M-3, is the trap primer required since there is only one (1) floor drain? *The floor drain model number indicates a 1/2" trap primer connection. The trap primer supply line shall be installed as detail indicates and field routed from the primer to the floor drain.*

VII. Reference Part V— Special Conditions

A. In reference to Paragraph 24 Erosion and Siltation Control, Contractors are advised that a CBMPP has been prepared for this project and is available in electronic form upon request. Contractor is responsible for all costs associated with the permit including ADEM fees and all required inspections.

THIS ADDENDUM ISSUED THIS 12th DAY OF AUGUST, 2025.

LADD ENVIRONMENTAL CONSULTANTS, INC.

Adam Lea

Adam Lea, P.E.

ALABAMA LICENSED NO. 30411 PROFESSIONAL ENGINEER ADAM JARED LEA 08/12/25

SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.01 Section Includes

A. Extruded aluminum windows with fixed and operating sash; glass shop and site glazed, including infill panels.

B. Operating hardware and insect screens.

C. Perimeter sealant.

1.02 Related Sections

A. Applicable to Work of this Section are the Drawings and General Provisions of the Contract, including: Part IV, General and Supplementary Conditions; Part V, Special Conditions; Part VI, Technical Specifications; Division No. 1, General Requirements.

1.03 System Description

A. Windows: Tubular aluminum sections, shop fabricated, factory pre-finished, vision glass, infill panels, related flashings, anchorage and attachment devices.

B. Configuration: Single hung sash; insulated glass (double pane).

C. Glazing: Exterior.

1.04 Performance Requirements

A. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with Standard Building Code.

B. Limit member deflection to flexure limit of glass, with full recovery of glazing materials.

C. System to accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.

D. Limit air leakage through assembly to 0.35 cfm/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf in accordance with ASTM E283.

E. Water Leakage: None, when measured in accordance with ASTM E331 with a test pressure difference of 2.86 lbf/sq ft.

F. Maintain continuous air and vapor barrier throughout assembly primarily in line with inside pane of glass and heel bead of glazing compound.

G. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.05 Submittals

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related Work and installation requirements.

C. Product Data: Provide component dimensions, anchorage and fasteners, glass and internal drainage details.

D. Submit two samples, 12 inches in size illustrating frame section and anodized aluminum color.

E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.06 Qualifications

A. Manufacturer: Company specializing in manufacturing aluminum windows with minimum three years documented experience.

B. Installer: Company specializing in the installation of aluminum windows with minimum three years documented experience.

1.07 Delivery, Storage and Handling

A. Deliver, store, protect and handle Products to site under provisions of Section 01600.

B. Protect pre-finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.08 Field Measurements

A. Verify that field measurements are as shown on shop drawings.

PART 2 PRODUCTS

2.01 Manufacturers

A. Alenco Division of Redmond Industries, Byran, TX; Series 495 single hung DH-C30 (Insulated Glass).

B. Other Acceptable Manufacturers Offering Equivalent Products

1. EFCO Corporation, Monett, MO.

2. Graham Architectural Products Corporation, York, PA.

C. Substitutions: Under provisions of Section 01600.

2.02 Materials

A. Extruded Aluminum: 6063 alloy.

B. Sheet Aluminum: ASTM B209 alloy temper.

C. Steel Sections: Profiled to suit mullion sections.

D. Fasteners: Galvanized steel.

E. Shop and Touch-Up Primer for Steel Components: SSPC 15, Type 1, red oxide.

F. Touch-Up Primer for Galvanized Steel Surfaces: SSPC 20, zinc rich type.

ADDENDUM NO. 4

2.03 Components

A. Frames: Thermally broken with interior portion of frame insulated from exterior portion flush glass stops of snap-on type.

B. Reinforced Mullion: Extruded aluminum with integral reinforcement of shaped steel structural section.

C. Sills: Extruded aluminum; sloped for positive wash; fit under sash leg to 1/2 inch beyond wall face; one piece full width of opening.

D. Infill Panel: Internally reinforced, glazing edge sealed permitting internal air movement to glazing space, outside air barrier line.

E. Insect Screens: FSRR-W-365, Woven aluminum mesh; 14/18 mesh size.

F. Operable Sash Weather Stripping: Resilient PVC; permanently resilient, profiled to effect weather seal.

G. Fasteners: Galvanized steel.

2.04 Glass and Glazing Materials

A. As specified in Section 08800: Double Pane, Insulated.

2.05 Sealant Materials

A. Sealant and Backing Materials: As specified in Section 07920.

2.06 Hardware

A. Sash Lock: Lever handle with cam lock.

2.07 Fabrication

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to ensure concealment from view.

E. Prepare components with internal reinforcement for operating hardware.

F. Provide internal reinforcement in mullions with galvanized steel members to maintain rigidity.

G. Permit internal drainage weep holes and channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through weep holes.

H. Assemble insect screens of rolled aluminum rectangular tubular sections. Miter and reinforce frame corners. Fit mesh taut in frame into frame and secured. Fit frame with four spring loaded steel pin retainers.

I. Double weatherstrip operable units.

J. Shop glaze window units.

2.08 Finish

A. Finish coating to conform to AAMA 608.1.

B. All Exposed Aluminum Surfaces: AAMA A41 anodized to 0.7 mil coating (215R1).

C. Color: Bronze.

D. Sample: As required in Paragraph 1.06, Submittals.

PART 3 EXECUTION

3.01 Examination

A. Verify site opening conditions under provisions of Section 01039.

B. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.02 Installation

A. Install window frames, glass and glazing and hardware in accordance with manufacturer's instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent Work.

D. Install sill and sill end angles.

E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Coordinate attachment and seal of perimeter air and vapor barrier materials.

G. Install operating hardware.

H. Install glass and infill panels in accordance with Section 08800.

3.03 Tolerances

A. Maximum Variation from Level or Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

3.04 Adjusting

A. Adjust Work under provisions of Section 01700.

B. Adjust operating hardware for smooth operation.

3.05 Cleaning

A. Clean Work under provisions of 01700.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.06 Schedule

A. As shown on Drawings.

[2280]
[9/93]

END OF SECTION

SECTION 11388

SEQUENCING BATCH REACTOR (SBR) WASTEWATER TREATMENT PLANT

PART 1 GENERAL

1.01 Section Includes

A. Design Parameters

B. Basin Structure.

C. Aeration System.

D. Influent Plug Valve.

E. Decanter Assembly.

F. WAS Pump.

G. Portable Pump Hoist Assembly.

H. Diffuser System.

I. Blowers.

J. Air Control Valves.

K. Dissolved Oxygen Sensors.

L. Pressure Transducer.

M. Level Sensors.

N. Post-Equalization Transfer Pump.

O. Aerobic Digester Sludge Pump.

P. SBR Control Panel with Motor Starters.

Q. Programmable Logic Controller.

R. Software.

S. Spare Parts.

1.02 Related Sections

A. Applicable to Work of this Section are the Drawings and General Provisions of the Contract, including: Part IV, General and Supplementary Conditions; Part V, Special Conditions; Part VI, Technical Specifications; Division No. 1, General Requirements.

B. The valves, equipment, materials of construction and controls specified under this section supersedes valves, equipment, materials of construction and controls specified elsewhere in the Contract Documents for the SBR system components specified in this Section.

ADDENDUM NO. 4

1.03 Submittals

A. Submit under provisions of Section 01300.

B. Product Data: Descriptive literature, shop drawings, details, dimensions, specified operating parameters, materials of construction, connections, electrical and control facilities, piping, valves, fittings and all related items.

C. Manufacturer's Installation Instructions: Indicate special installation requirements, configurations, elevations, dimensions, equipment and related items.

1.04 Operation and Maintenance Data

A. Submit under provisions of Section 01700.

B. Maintenance Data: Include all required start-up, operational, routine maintenance requirements, troubleshooting, including specific operational and maintenance instructions.

1.05 Spare Parts and Equipment

A. One complete set of spare parts and equipment as recommended by the Manufacturer shall be furnished (See Paragraph 2.25).

1.06 Delivery, Storage and Handling

A. Deliver Products to site under provisions of Section 01600.

B. Store and protect Products under provisions of Section 01600.

1.07 Project Record Documents

A. Accurately record actual location of all equipment and concealed utilities in accordance with Section 01700.

B. Provide electrical and control drawings reflecting any revisions made during installation or start-up.

1.08. Quality Assurance

A. In accordance with Section 01400.

1.09 Qualifications

A. Manufacturer: The SBR system shall be supplied by a company of good reputation that is regularly engaged in the manufacture and fabrication of SBR wastewater systems. The manufacturer must have a minimum of five years documented experience in manufacturing the specified equipment. The manufacturer's experience shall include a minimum of ten installations in the USA where equipment of similar size and design have been in operation successfully in a similar process for a minimum of five years. As a minimum, the supplier shall be the manufacturer of the following components: decanter, mixers, and controls. All SBR equipment listed in this specification shall be from a single source supplier unless indicated otherwise.

B. Installer: The installer shall have at a maximum five years documented experience in the installation of similar equipment and facilities.

1.10 Responsibility

A. The Contractor shall be responsible for the installation of all SBR equipment. The Contractor shall assign full responsibility for the functional operation of all SBR System components to a single source supplier unless indicated otherwise.

B. The Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractors equipment installation and connections, calibrate, and place into operation the SBR system along with all other equipment and accessories as specified herein.

1.11 Regulatory Requirements

A. All components and the completed total assembly installation shall comply with all OSHA Requirements, National Electrical Code (Latest Edition), IBC Mechanical Code (Latest Edition) and all other applicable codes, regulations and guidelines.

1.12 Field Measurements

A. Verify that field measurements are as shown on Drawings and as instructed by manufacturer.

B. Verify that all excavation work, shape, configuration, elevations, dimensions, and related work meeting equipment manufacturer's approval prior to installation of equipment.

1.13 Warranty

A. Except as otherwise specifically indicated herein, the SBR System manufacturer shall provide at least two (2) year parts and labor warranty on all of the SBR System components, including the decanter assemblies, transfer pumps, mixers, diffuser assemblies, valves, pipes, fittings, blowers, dissolved oxygen sensors, pressure transducers, level sensors, control panel, programmable logic controller, software and all related equipment.

B. The warranty period shall begin on the date of the Owner's written acceptance of the completed, installed, and fully operational SBR facility.

PART 2 PRODUCTS

2.01 General Description

A. The SBR System shall be designed to allow a single reactor to function as an equalization basin, aeration basin, and clarifier. The process shall be designed such that one reactor fills, while the other reacts, settles, and decants. Influent flow shall be alternated between two reactor basins. An aerobic digester and post-equalization basin shall be incorporated as part of the SBR System design. Flow-through SBR Systems will not be allowed.

B. The SBR System components shall be from a single source of supply.

C. The System manufacturer shall be completely responsible for the proper design of their system, including but not limited to, diffused aeration equipment, transfer pumps, mixers, decanters, and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the Plans and Specifications.

D. The SBR area electrical classification shall be Non-classified. Motors within the basin shall be rated for a temperature code T2A (280˚C).

E. These specifications and accompanying drawings are based on the use of the AquaSBR System manufactured by Aqua-Aerobic Systems, Inc. and the ABJ SBR System manufactured by ITT Sanitaire Americas.

F. Manufacturer: The SBR System shall be the AquaSBR System, manufactured by Aqua-Aerobic Systems, Inc., Rockford, IL; the ABJ SBR System, manufactured by ITT Sanitaire Americas, Brown Deer, WI; or approved equal.

2.02 Manufacturer Service

A. The System manufacturer shall furnish the services of a factor trained representative for a maximum of 3 trips and 12 eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

B. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the Contractor, the additional service days will be at the Contractor's expense. The System manufacturer may invoice the Contractor for the indicated service time for travel and living cost incurred and the System manufacturer's standard per diem field service rate.

C. See Paragraph 3.06.

2.03 Design Parameters

A. Average Daily Flow: 0.25 MGD.

B. Peak Hourly Flow: 0.50 MGD.

C. Maximum Daily Flow: 0.312 MGD.

D. Influent Design Loadings:

1. BOD5: 250 mg/l.
2. TSS: 250 mg/l.
3. TKN: 40 mg/l.
4. NH3-N: 28 mg/l.
5. pH: 6 to 9.
6. Phosphorous: 8 mg/l.
7. Alkalinity: 250 mg/l.

E. Effluent Design Loadings:

1. BOD5: 20 mg/l.
2. TSS: 20 mg/l.
3. NH3-N: 2 mg/l.
4. Total Nitrogen: 3 mg/l.

5. Total Inorganic Nitrogen: 2.5 mg/l.

6. pH : 6 to 8.6.

7. Phosphorous: 1 mg/l.

8. DO: 7 mg/l (minimum).

F. Jobsite Elevation: 1,132 Ft. MSL.

G. Ambient Air Temperature: 30˚F to 90˚F.

H. Alpha (maximum value allowed): 0.70.

I. Beta (maximum value allowed): 0.95.

J. F/M Ratio: As recommended by manufacturer.

K. MLSS (at low water level): 4,500 mg/l.

L. Cycles: Maximum cycles at maximum daily flow - 5.

M. Oxygen Requirements:

1. 1.25 lbs O2/lb BOD_5 applied.

2. 4.60 lbs O2/lb TKN applied.

N. Aeration: Maximum Hourly AOR – 43.125 lbs O_2/Hr.

O. System Control

1. Minimum Aeration Time: 1.73 hrs/cycle at maximum daily flow.

2. Minimum Mixing Time: 1.25 hrs/cycle at maximum daily flow.

3. Minimum Settling Time: 1.08 hrs/cycle at maximum daily flow.

4. Control strategy to be time based with level override. Flow and/or level based only control systems are not acceptable.

2.04 Basin Structure

A. The basin shall be of common wall concrete construction. The basins shall be constructed in accordance with the Drawings. See Section 03300 for concrete basin construction specifications. NO CHANGE IN BASIN GEOMETRY WILL BE ALLOWED.

B. SBR Basin

1. The SBR System shall be field erected in two (2) basins as shown on the Contract Drawing.

2. The inside dimensions of the basins shall be 30 feet by 30 feet. The basin shall be 20 feet in total depth.

3. Each basin shall have a minimum operating capacity of 124,540 gallons.

4. The minimum operating depth of the basin shall be 13.9 feet.

5. The maximum operation depth of the basin shall be 18.5 feet.

6. The centerline of discharge shall be 1 foot feet from LWL.

C. Aerobic Digester/Sludge Holding Basin

1. The Aerobic Digester/Sludge Holding Basin shall be an existing pond/basin shown on the Contract Drawing.

2. The basin shall have a minimum operating capacity of 57,600 gallons.

3. The basin shall provide a minimum 40 day SRT.

D. Post-Equalization Basin

1. The Post-Equalization Basin shall be field erected in one (1) basin as shown on the Contract Drawings.

2. The inside dimensions of the basin shall be 30 feet by 15 feet. The total depth of the basin shall be 6 feet.

3. The basin shall have a minimum operating capacity of 21,720 gallons. The basin shall provide a sufficient volume to hold the difference between the peak decant rate and the maximum flow rate of the plant.

4. The minimum operating level of the basin shall be 0 feet.

5. The maximum operation level of the basin shall be 4.0 feet.

2.05 Aeration System

A. The Aeration System is defined as the aeration supplied to the SBR. The Aeration System shall be designed to provide oxygen distribution to the entire basin. It shall also ensure mixing to promote suspension of all biological solids in the basin. The velocity and mixing in the basin shall be sufficient to ensure complete biological solids suspension and dispersion.

B. The Aeration System for the aeration basins shall be capable of providing mixing such that when operated under any combination of the specified design conditions it shall suspend all biological floc and mixed liquor suspended solids throughout the liquid mass in each basin. The Aeration System shall further be capable of maintaining complete aerobic conditions and suspension of biological floc and suspended solids throughout the liquid mass in each basin.

C. The Aeration System shall be designed to operate within a minimum of 13.9 feet and a maximum of 18.5 feet side water depth and shall be capable of transferring a sufficient amount of process oxygen (A.O.R.) into the wastewater.

2.06 Influent Plug Valve

A. Plug valve shall be an 8 inch diameter electrically operated flanged plug valve to control the influent flow to the SBR. Provide one valve for each basin influent line.

B. Valve shall be constructed of an ASTM A-126 Class B cast iron body with welded in nickel seat, neoprene coated cast iron plug, assembled and tested. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size.

C. Each valve shall include a manual override with limit switch feedback to the micro-processor in both the open and closed positions.

D. Field wiring and junction box/disconnect shall be provided by the Contractor.

E. Electric Actuator

1. The plug valve shall include a 115 volt, single phase, 60 cycle open/close service electric actuator. The valve actuator shall include a compartment heater. Provide one electric actuator for each influent plug valve.

2. The electric valve actuator shall be AUMA Model SG or SA as manufactured by AUMA Actuators, Inc., Canonsburg, PA.

F. Manufacturer: The influent plug valve shall be a Milliken 601-NO 125# flanged end connection as manufactured by Milliken Valve Company, Bethlehem, PA; DeZurik Model PEC as manufactured by DeZurik, Sartell, MC; or approved equal.

2.07 Decanter Assembly

A. One decanter assembly shall be provided for each SBR basin for a total of two decanter assemblies as specified for B. Floating Mechanical Decanter. The decanters shall be designed to remove clarified effluent.

B. Floating Mechanical Decanter

1. The decanter assembly shall be a 6 x 4 mechanical floating decanter and related equipment accessories as described herein for each basin. Provide one decanter assembly for each SBR basin. Each decanter shall consist of an integral flotation unit, a stainless steel movable weir assembly, and an electric motor-driven actuator to open and close the weir.

2. Each decanter shall be capable of withdrawing decant fluid from 4-6 inches beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 2-6 inches. The weir shall be circular in shape and permit liquid to enter the decanter from the entire 360 degrees without obstruction.

3. The decanter shall meet the following conditions:

a. The maximum allowable water depth in the basin is 18.5 feet.

b. The minimum allowable water depth in the basin is 13.9 feet.

c. The centerline of each decant pipe must be located 1 foot below the low water level (LWL) by the Contractor.

d. The decanter shall be rated for an average flow of 710 gallons per minute.

4. Weir

a. The weir shall be constructed of 304 stainless steel, be circular in shape, and shall include vortex control baffles permanently affixed to the weir. The weir shall be attached to the actuator through a removable single shaft which shall also function as the torque restraint.

b. The weir actuator shall include a reversible electric motor operated linear actuator. The actuator shall be capable of operating with a closing force of 1500 pounds and shall operate

from a 115 volt, single phase, 60 hertz source. Adjustable limit switches shall be included to permit adjustment of the weir opening. A coil spring shall be included to provide for travel after the weir has closed and provide desired closure pressure.

c. A corrosion resistant removable cover shall be included to provide protection to the actuator and motor during normal operation. The power section is painted steel. A #14 AWG ten-conductor power cable shall be provided from the NEMA 4X junction box of the unit to the basin wall.

d. Supply of junction box/disconnect at the basin wall shall be the responsibility of the Contractor.

5. Flotation

a. Each decanter assembly shall be equipped with a modular float constructed of fiberglass filled with closed cell polyurethane foam having a minimum 2.0 lbs/ft^3 density. Float shall be completely sealed to prevent the foam from being in contact with the external environment.

b. A urethane type seal shall be molded into the bottom of the float assembly to receive the decanter weir.

c. The float shall have 657 pounds of reserve buoyancy to ensure stability and to provide support flotation required during decanter servicing.

6. Restrained Mooring System

a. A restrained mooring system shall be furnished as part of the decanter assembly.

b. The restrained mooring assembly shall be a galvanized steel mooring frame which shall permit the assembly to move up and down following the change in liquid level while retrained within the vertical pylons.

c. The mooring frame shall consist of two – 4 inch diameter Schedule 40 vertical pylons with base plate constructed of galvanized steel. Each pylon and base-plate shall be attached to the basin floor and be filled with concrete by the installing Contractor.

d. Mooring post supports, if specified by the manufacturer, shall be provided for attachment to the basin wall by the installing Contractor.

7. Discharge Hose

a. Each decanter shall include a discharge hose of sufficient size to permit vertical movement of the decanter and provide sufficient capacity to handle the design decant flow rate.

b. Discharge hose shall be an 8 inch diameter EPDM tube, tire chord braided with helix wire reinforcement. A painted cast iron flanged end 90 degree elbow shall be provided. Proper flanged connections to the decanter and the discharge point shall be provided for trouble-free operation while permitting a means for disconnecting for service.

c. Through-the-wall pipe, gaskets, and hardware beyond the 90 degree elbow shall be provided by the Contractor. The Contractor shall provide a 3/4 inch valve with hose bib connection on the decant line between the decanter and the decant valve.

d. All piping, supports, gaskets, and hardware beyond the terminating flange of the decant pipe flexible joint shall be supplied by the installing Contractor.

8. Decant Flow Control Valve

   a. The decant flow control valve shall be a AWWA C-504 Class 150B electrically operated butterfly valve to control the decant rate. Provide one decant flow control valve for each basin.

   b. The electrically operated butterfly valve shall be 8 inches in diameter with ANSI Class 125# flanged end. The valve shall have an ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an electric actuator.

   c. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions.

   d. Each valve shall include a 13 foot valve stem extension constructed of painted steel. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the Contractor.

   e. Field wiring, junction box/disconnect and provisions for valve access shall be provided by the Contractor.

   f. Electric Actuator

      1. Each valve shall include a 115 volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater, winding protection, manual override and limit switch feedback in open and closed position. Provide one electric actuator for each decant flow control valve.

      2. Actuator(s) include local controls consisting of push buttons, selector switches, and lights.

      3. The electric actuator shall be a AUMA SG10 as manufactured by AUMA Actuators, Inc., Canonsburg, PA.

   g. Manufacturer: The electrically operated decant flow control butterfly valve shall be a Milliken 511A as manufactured by Milliken Valve Company, Bethlehem, PA; or approved equal.

C. Endura® Series DDM Mixer

1. Furnish AquaDDM® mechanical floating mixer(s) and related equipment accessories as described herein for each basin.

2. Each mixer shall consist of a motor, direct-drive impeller driven at a constant speed, an integral floatation unit, and impeller volute.

3. The Endura Series shall incorporate design enhancements that provide for three (3) years without routine maintenance (greasing).

   Quantity: 1 per basin.

   Mixer Properties

   Zone of Complete Mix: 55 ft.

   Direct Pumping Rate: 4,520 gpm.

Recirculation Rate: 149,000 gpm.

Basin Turnover Time: 0.813 Minutes at HWL.

MLSS: 4,500 mg/l or less.

Motor Size: 3 HP.

Motor RPM: 1200 RPM.

Efficiency: Premium.

Mounting Base Material: 304 Stainless Steel.

Float Diameter: 71 inches.

Float Shell Material: Fiber Reinforced Polyester Skin (FRP).

Impeller Volute Material: 304 Stainless Steel.

D. Performance

1. Each mixer shall meet the requirements summarized above. Complete mix shall be defined as maintaining biological suspension of all mixed liquor suspended solids with the specified MLSS concentration without the introduction of air.

E. Mixer Drive Motor

1. The motor shall be vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum factor of 1.15 shall be furnished.

2. The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F". A lip seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from 17-4 PH stainless steel.

3. Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings shall be of combined radial and axial thrust type. The lower motor bearing inner brace shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

4. Submerged motors, jet pumps, submerged gear motors or gearboxes shall not be acceptable.

F. Motor Mounting Base

1. The motor shall be securely mounted onto a solid base which is integral with the motor base extension. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.

2. The upper portion of the motor mounting base, immediately below the lower motor bearing, shall include two independent acting air seals. The two seals shall be capable of sealing off the flow of air from suction action of the pumped flow, and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir, but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

G. Floatation

1. Each unit shall be equipped with a modular float with a central float passage of a size to allow installation and removal of the pump impeller. The float shall be foamed full of polyurethane foam of the closed cell type, and shall be totally sealed to prevent the foam from being in contact with the external environment.

H. Impeller

1. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 or 15/5 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

I. Intake Volute Assembly

1. The impeller shall operate in a volute made of stainless steel plate, minimum 3/16 inch thick.

J. Vibration

1. The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

K. Cable Mooring System

1. Each unit shall be provided with a mooring system, as described below:

   a. Cable Material: 304 Stainless Steel.

   b. Anchor Material: 304 Stainless Steel.

   c. Anchor Type: Adhesive anchors by System Manufacturer.

   d. Electrical Cable: #twelve-four conductor.

2. Each unit shall be provided with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors (if necessary), and extension springs as shown on the drawings. Field attachment of mooring points to the tank shall be the responsibility of the installing contractor.

L. Electrical Power Cable

1. Each unit shall include power cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with kellems grips at the motor and basin wall terminations.

2. Electrical cable(s) shall be attached with cable ties provided by the equipment supplier.

3. Attachment of cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing Contractor.

2.08 Sludge Wasting Pump (WAS)

A. The WAS pump shall be a submersible non-clog sludge pump located in the SBR basins. One pump shall be provided for each SBR basin. Pump shall be Flygt Model 3069 (2.4 HP).

B. Each pump shall be equipped with a submersible electrical motor connected for 460 volt, three phase, 60 hertz operation. Pump housing shall be painted cast iron. Pump shall include an adequate length of multi-conductor chloroprene jacketed type SPC cable suitable for submersible pump applications. The power cable shall also be sized according to NEC and ICEA standards.

C. The pump shall be supplied with a mating cast iron discharge elbow and be capable of delivering 40 GPM at 27 feet TDH. Each unit shall be fitted with an adequate length of stainless steel lifting chain of adequate strength to permit raising and lowering the pump.

D. The 3-inch diameter discharge connection elbow shall be permanently installed with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter the basin or pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump.

E. A stainless steel upper guide bar bracket shall be provided with each pump. The entire weight of the pumping unit shall be guided by galvanized steel guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. No sealing of the discharge interface by means of a diaphragm, O-ring, or other devices shall be acceptable. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of water tight integrity to a depth of 65 feet.

F. Supply of all discharge piping, supports, gaskets, and hardware beyond the flanged connection of the pump discharge connection elbow shall be the responsibility of the Contractor. The discharge piping shall be 3 inch diameter ductile iron. The pump shall be adequately sized to ensure a minimum velocity of 3 feet per second.

G. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

H. The motor and pump shall be designed and assembled by the same manufacturer.

I. The combined service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C.

J. Discharge Plug Valve

1. Each pump shall include a manually operated discharge valve to control the design transfer flow rate.

2. The valve shall be a 3 inch diameter plug valve with 125# flanged end connection. The valve shall have a ASTM A-126 Class B cast iron body with welded in nickel seat, neoprene resilient plug facing. The valve shall be non-lubricated type with a port area of at least 80% of full pipe size.

3. Valve shall be provided by the Manufacturer loose for installation within the discharge piping by the Contractor. Valve gaskets and hardware shall be supplied by the Contractor.

4. Valves shall be installed as indicated on the Contract Drawings.

5. Manufacturer: The manually operated discharge valve shall be a Milliken 601-N0 as manufactured by Milliken Valve Company, Bethlehem, PA; DeZurik Model PEC as manufactured by DeZurik, Sartell, MN; or approved equal.

K. Adhesive anchors of 304 stainless steel shall be provided for anchoring the pump.

2.09 Diffuser System

A. One complete diffuser system shall be provided for each SBR basin, the Aerobic Digester, and the Post-Equalization basin for a total of four diffuser systems. Each diffuser system shall be as specified in C. Coarse Bubble Diffuser System.

B. Submittals: Submit information to establish compliance with the specifications in accordance with the provisions of Section 01300.

1. Submittal Drawings showing plan, elevation and cross sections of the equipment.

2. Component details of the aeration equipment showing diffusers, diffuser holders, gaskets retainer rings, supports, threaded union and/or flanged joints and a purge system.

3. Materials and Manufacturing Specifications.

4. Equipment booklet including:

   a. Equipment Data Sheets.

   b. Performance data including oxygen transfer calculations.

   c. Headloss calculations and pressure requirements.

   d. Descriptive literature and pressure requirements.

5. Operation and Maintenance Manual with installation instructions. Submit after approval of equipment and prior to shipment.

6. Detailed list of any exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.

7. Shop Oxygen Transfer Test

   a. Conduct a performance test to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.

   b. Base all tests on the following criteria:

      1. A minimum of 3 tests for each specified condition in complete accordance with ASCE Clean Water Test Procedure (1192 or latest edition).

2. Conduct tests by an independent aeration testing firm in a full scale aeration test tank (minimum of 200 sq. ft.) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.

3. Conduct shop test with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.

4. Plot pounds of oxygen per day per 1000 cubic feet of tank volume versus air per 1000 cubic feet of tank volume in tap water at 14.7 psia, 20°C and zero dissolved oxygen at the specified submergence.

c. Certify and stamp all tests by a Progression Engineer.

d. Include all costs for the testing (exclusive of witness expenses) in the equipment price. All tests may be witnessed at Owner/Engineer option. Cost of travel and living expenses for Owner/Engineer to be paid by the Owner.

e. Submit all test data from oxygen transfer tests for approval by the Engineer prior to manufacturing equipment.

C. Coarse Bubble Diffuser System

1. The aeration system for the SBR basins shall be a coarse bubble diffuser air system and shall be a fixed configuration as shown on the Drawings. One Coarse Bubble Diffuser System shall be supplied for each basin.

2. The aeration system shall be capable of delivering 605 SCFM for each SBR basin. Pressure at top of drop pipe shall be 8.6 PSIG.

3. The Maximum Oxygen Transfer Efficiency (Standard Conditions) allowable for the coarse bubble diffusers shall be 1% per foot of diffuser submergence.

4. The diffuser system shall consist of diffusers, supports, manifold, and riser pipe. Diffuser quantity is 10 duplex tubes per basin.

5. Each diffuser shall be constructed of cast stainless steel alloy equivalent to 316L SS Schedule 80. The diffuser manifold pipe internal to the basin shall be constructed of minimum 12 ga, stainless steel. Diffuser pipes shall be not less than six-inch nominal diameter. Each diffuser section shall be supplied with uniformly-spaced machined orifices located on the top of each section. Size and number of orifices shall be provided to ensure a uniform air distribution.

6. Each diffuser section and manifold pipe shall be supported at span lengths not greater than 6 feet by stainless steel supports. No unsupported end shall be longer than 2 feet. Diffuser sections shall be secured to the supports with a corrosion resistant retainer. Support brackets shall be adjustable to provide header leveling within ± 1/4 inch of a fixed elevation for each aeration basin.

7. The diffuser system shall be field assembled by the Contractor. All submerged PVC joints 8 inches and smaller shall be socket welded joints. Expansion joints shall be included to compensate for thermal expansion for PVC manifold runs longer than 40 feet. Pipe sizing, location and supports shall be shown on the Drawings. Diffuser sections and internal manifold piping shall have flanged connections for disassembly.

8. The 6 inch diameter stainless steel riser pipe shall terminate in a flanged connection at the top of the basin wall. All piping, gaskets, and hardware beyond the riser pipe's flanged connection shall be provided by the Contractor.

9. Adhesive anchors of 304 stainless steel shall be provided for anchoring the diffuser supports.

2.10 Blowers

A. The blowers shall be rotary lobe type, positive displacement blowers. Each blower shall be 40 HP, three phase, 460 volt, 60 cycle with T.E.F.C. Class F insulation premium efficiency U.S. Electric, Teco Siemens or equal motor. Each blower shall be capable of delivering the required amount of air at the design pressure (605 SCFM per blower discharge pressure of 8.62 PSIG). The blowers shall be manifolded for individual and/or combined operation.

B. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

C. Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, rubber expansion joint, discharge pressure gauge, inlet vacuum pressure gauge, discharge temperature gauge, and a high temperature shut-down switch. A personnel protection guard shall be included over the belts and sheaves.

D. All inlet and outlet piping shall be installed so that no weight or strain will be imposed on the blower or silencers.

E. All gages and instruments are to be package mounted with all necessary tubing and hardware unless otherwise shown on Drawings. Location, height and angle shall allow ease in viewing by a standing operator.

F. The discharge liquid filled pressure gauge shall be installed on all blower discharge lines as follows:

1. Range: 0-20 psig.

2. Dial: 4 inch.

3. Case: 300 Series stainless steel.

4. Accuracy: ± 2% of span (Grade B)

5. Manufacturer: Equivalent to U.S. Gage, Ashcroft, Aerzen 32 -0053 -02, or approved equal.

G. The discharge pressure relief valve shall be a spring or weighted valve installed on the discharge silencer. Set the valve to 1.5 psig above the blower operating pressure. The relief valve shall be tested during a shop performance test.

H. The discharge butterfly isolation valve shall be installed on the discharge piping to isolate the blower from the air piping. Valve to have lever handle with notched plate.

I. Blower Enclosure

1. A blower enclosure shall be provided for each blower. The enclosure shall be a powder coated carbon steel acoustical hood with oil drip pan to help reduce the resultant noise level for each blower.

2. The enclosure shall be constructed of a powder coated galvanized steel with a sound absorbing internal surface to maintain attenuation levels of the room. Maintenance access doors shall be

provided to facilitate servicing of the blower. The heavy duty enclosure shall include latch, and vents.

3. A baffled inlet shall be provided to allow supply and cooling air to enter the enclosure during the operation of the blower. An exhaust fan sized for proper enclosure ventilation will be supplied by the manufacturer.

4. Supply of concrete pad and installation of the blower enclosure shall be the responsibility of the Contractor.

J. System Blower Requirements

1. SBR

a. Blower shall be sized as recommended by the SBR Manufacturer.

b. Provide two blowers for the SBR basins.

c. Blowers shall provide sufficient air to maintain complete mixing as described in Paragraph 2.05 and achieve the required treatment levels indicated in Paragraph 2.03.

d. The butterfly discharge isolation valve shall be sized per the Manufacturer's recommendation.

2. Aerobic Digester/Sludge Holding

a. Blower shall be sized as recommended by the SBR Manufacturer.

b. Provide two blowers for the Digester basin or provide one blower and connect to the SBR blowers as a back-up, provided the SBR blowers can provide sufficient air for the proper operation of the Digester in simultaneous operation with the SBR basins.

c. Blowers shall provide sufficient air to maintain complete mixing and provide adequate sludge digestion.

d. The butterfly discharge isolation valve shall be sized per the Manufacturer's recommendation.

3. Post-Equalization

a. Blower shall be sized as recommended by the SBR Manufacturer.

b. Provide one blower for the Post-Equalization basin or connect the Post-Equalization air piping to the Digester or SBR blowers. A back up air supply shall be provided by connecting the Post-Equalization blower to the Digester or SBR blowers.

c. The air supply to the Post-Equalization basin shall be capable of providing sufficient air to maintain a minimum D.O. of 7 mg/l at all times, under all conditions as required by the NPDES permit.

d. The butterfly discharge isolation valve shall be sized per the Manufacturer's recommendation.

K. Sufficient blower capacity shall be provided such that all operations can be performed simultaneously with any one blower off line. An isolation valve shall be included on all cross connection piping to allow blowers to operate in any combination necessary to meet back up supply requirements.

L. The blower package supplier shall supply a certified ASME PTC-9, Method B performance test data based on a factory 1.0 psi shop test. A certified test report, signed by a professional engineer, shall be submitted for record.

M. Manufacturer: The positive displacement blowers shall be Aerzen Model GM 25 S; Roots; Sutorbilt; or approved equal.

2.11 Air Control Valve

A. An electrically operated air control butterfly valve shall be provided by manufacturer – 2 shared for all SBR basins.

B. The valve shall be a 6 inch diameter, AWWA C-504 Class 150B valve, with ANSI class 125# flanged end ASTM A-536 ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested. Valves shall be ABZ 397.

C. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions.

D. Field wiring, junction box/disconnect and provisions for valve access shall be provided by the installing Contractor.

E. Electric Valve Actuator

1. The valve actuator shall be 115 volt, single phase, 60 cycle open/close service electric actuator. Provide one actuator for each butterfly valve.

2. The valve actuator shall include a compartment heater, motor winding protection, manual override, and limit switch feedback in the open and closed position.

3. Manufacturer: The electric valve actuator shall be a AUMA Model SG as manufactured by AUMA Actuators, Inc., Canonsburg, PA.

F. Manufacturer: The electrically operated butterfly valve shall be a Milliken Fig. 511 as manufactured by Milliken Valve Company, Bethlehem, PA; ABZ 397 as manufactured by ASC Engineered Solutions, Romeoville, IL; Bray Series 30 as manufactured by Bray Controls, Houston, TX; or approved equal.

2.12 Dissolved Oxygen Sensors

A. A dissolved oxygen sensor, transmitter, and signal converter shall be provided for each basin.

B. A 304 SS handrail bracket and pipe shall be provided for each sensor for installation to the side of the basin.

C. Field wiring, conduit, and installation of cable shall be the responsibility of the Contractor.

D. Manufacturer: The dissolved oxygen transmitter shall be a Danfoss OXY 4100 with OXY 1100 sensor and the signal converter shall be a Danfoss USC 5000 as manufactured by Danfoss Inc., Milwaukee, WI; Aztec ADS420, Hach Model LDO or approved equal.

2.13 Pressure Transducer

A. Provide a submersible pressure transducer unit constructed of stainless steel for each basin. The transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid.

B. Transducer output shall be a 4-20 mA signal. Electrical connection shall be to an attached two wire, 24 gauge polyethylene shielded cable. 35 feet of cable per unit shall be provided.

C. Attachment of the cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing Contractor.

D. Transducers shall be suspended on a removable 304 stainless steel mounting pipe assembly.

E. Field attachment of the cables and brackets to the basin shall be the responsibility of the installing Contractor.

F. Adhesive anchors of 304 stainless steel shall be provided for anchoring the pressure transducer suspension cables and mounting pipe assembly.

G. Manufacturer: The submersible pressure transducer unit shall be the Keller Level rat as manufactured by Keller America, Inc., Newport News, VA; Wika Model LS-10 as manufactured by F.N. Cuthbert Inc., Toledo, Ohio; or approved equal.

2.14 Level Sensor

A. Provide a level sensor assembly for each basin.

B. Level sensor assembly to consist of a polypropylene cased liquid level sensor with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall.

C. Field wiring and junction box/disconnect shall be provided by the Contractor.

D. Adhesive anchors of 304 stainless steel provided for anchoring the level sensor mounting bracket and attachment of the level sensor assembly to the tank shall be provided by the Contractor.

2.15 Post-EQ Modulating Valve

A. Furnish electrically operated flanged butterfly valve for post-eq basin to control the effluent flow.

1. Valve Quantity: 1 per basin.

2. Valve Size: 8 inch.

3. Valve Model: Milliken 601.

4. Actuator: Auma.

5. Actuator Power: Three phase.

6. Actuator Type: Modulating.

B. Valve shall be a 125# flanged end connection, ASTM A-536 cast iron body with welded in nickel seat, coated non-lubricated ductile or cast iron plug with 80% port opening, assembled and tested with an electric actuator.

C. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s).

D. Field wiring and junction/box disconnect shall be provided by the installing contractor.

2.16 Influent/Effluent Flow Meter

A. One effluent flow meter shall be provided. Flow meter shall be 6" Krohne Enviromag 2000 F series. Output shall be 4-20 mA.

B. The flow meter shall be provided loose to be installed and wired by the installing contractor.

2.17 Level Sensors

A. Equipment manufacturer shall furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin.

B. Each float switch shall be provided with a three conductor electrical cable.

C. Electrical cable shall terminate at a junction box/disconnect located at the basin wall.

D. Field wiring and junction box/disconnect shall be provided by the installing contractor.

E. Field attachment of the level sensor assembly to the tank shall be the responsibility of the installing contractor.

2.18 Process Control Instrumentation

A. Manufacturer: Hach.

B. Controller

1. Quantity: 1 per basin.

2. Model: SC4500.

3. Inputs: 2 per controller.

C. Probes

1. DO Quantity: 1 per basin.

2. DO Model: LDO.

D. Probe Mounting

1. Material: 304 stainless steel.

2.19 SBR Control Panel with Motor Starts

A. The SBR Manufacturer shall furnish a complete SBR control system. This shall include a master control panel with a Graphic Operator Interface, Programmable Logic Controller, Motor Starts, Variable Frequency Drives, Control Switches, and Pilot Lights. The panel shall include an internal light, service outlet, and be UL approved.

B. Local control stations shall be included for the Decanters, if required (per Manufacturer's recommendation). The local control station for the decanter shall consist of a 4-position switch enclosed in a NEMA 4X enclosure. The local station shall allow manual raise and lower control as well as off and automatic control.

C. The control system shall be designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

D. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.

E. The control system shall include a circuit breaker, disconnect, control transformer, branch protection, motor starters, microprocessor control, indicator lights, HAND-OFF-AUTOMATIC selector switches.

F. Controlled Equipment: The incoming service of the control system shall be 460 volt, 60 hertz, three-phase. Motor starters for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through the operator interface of the SBR control panel for equipment indicated by an asterisk(*).

1. SBR Equipment Description

    a. Two – Flow Control Valves – 8” with Actuators

    b. Two – Blowers* (40 HP as recommended by Manufacturer)

2. Post-SBR Equipment Description

    a. Two – 8” Flow Control Valves with Actuators.

    b. 4 -20 mA Pressure Transducer(s)

G. Additional Controlled Equipment: In addition, controls (as shown on the Contract Drawings) for the following equipment shall be included within the SBR control panel:

1. SBR Equipment Description

    a. Two – Influent Plug Valves

    b. Two – Decanter Valves

    c. Two – Air Control Valves (up to two additional air control valves may be required, depending on the recommended manufacturer blower configuration)

    d. Two – 4-20 mA D.O. Signals

    e. Two – 4-20 mA Pressure Transducers

    f. Two – Level Sensors

    g. One – Common Alarm

    h. Low D.O. Dry Contact Signal

    i. High D.O. Dry Contact Signal

    j. High Alarm D.O. Dry Contact Signal

k. Two – UV Contact (by others)

l. One – 4-20 mA Flow Meter Signal (by others)

2. Post-Equalization Equipment Description

a. One – 4-20 mA D.O. Signal

b. One – 4-20 mA Pressure Transducer

c. One – Level Sensor

H. Control Enclosure

1. The automatic controls shall be provided in a UL listed, NEMA Type 12 mild steel (12 gauge) floor mount enclosure that provides a degree of protection for electrical controls and components from dust, dripping water and external condensation of non-corrosive liquids.

2. The enclosure is intended for indoor installation. Enclosure shall include gasketed overlapping doors with a 3-point latch mechanism operated by an oil tight key-lock handle.

3. The enclosure shall have white polyester powder paint inside with ANSI 61 gray polyester powder paint outside over phosphatized surfaces.

4. The enclosure shall include a painted white mild steel (10 gauge) sub-panel mounted with collar studs.

5. Enclosure shall be manufactured by Hoffman or approved equal.

6. The control enclosure shall be mounted remotely.

7. Each control enclosure assembly shall be provided with corrosive inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

I. Main Disconnect Circuit Breaker

1. A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions.

2. The disconnect breaker shall have a door mounted operating mechanism with trip indication.

3. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided.
4. The disconnect circuit breaker shall be a Square D/HDL, JDL, LDL, MDL, PDL or approved equal.

J. Motor Starter

1. A full voltage non-versing integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor.

2. The starter shall be NEMA rated IEC form factor and shall have certifications according to UL and CSA standards and shall be NEMA rated IEC form factor and shall have certifications according to UL and CSA standards and shall bear the CE marking.

3. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit.

4. The starter shall have a mechanical durability of 15 million operations.

5. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

6. A full voltage non-reversing NEMA Style motor starter shall be provided for motor applications over 15 kW. Each starter shall consist of a circuit breaker, contactor and overload relay.

7. The starter shall be NEMA rated and shall have certifications according to UL and CSA standards and shall bear the CE marking.

8. The starter shall have a maximum rated operational voltage of 600V and provide a minimum 18 kA @480VAC and 25 kA @ 240 VAC interrupt rating on short circuit when used in combination with a PowerPact circuit breaker.

9. The starter shall have a mechanical durability of 2 million operations.

10. The solid state overload relay shall have class 10/20 (selectable) tripping characteristics with trip current adjustment, phase loss and unbalance protection.

K. Variable Frequency Drive **– NOT USED.**

1. UL Listed Variable Frequency Drives (VFD) shall be provided to control pumps and/or blowers.

2. The VFD's shall control pump and/or blower speed via an analog signal from the PLC.

3. The VFD output frequency shall be programmable.

4. The VFD shall be provided in a NEMA Type 20 panel mount package and rated for an operating temperature of -4° to 122°F (-20° to 50°C).

5. The VFD shall have a 65 kA maximum short circuit rating when protected with an Allen Bradley 140M motor circuit protector or Class CC/J fuse.

6. The VFD shall be Allen Bradley PowerFlex or approved equal.

L. Solid State Reduced Voltage Motor Starter

1. The solid state reduced voltage starter shall be 480V AC, 3-phase, rated and used for the controlled starting and/or stopping of AC induction motors.

2. The controller shall comply with UL, CSA, EN/IEC standards.

3. Each controller shall have selectable (off, 10, 15 or 20) overload trip class protection, over-temperature monitoring, phase reversal protection, phase loss, and phase imbalance features. The 120/240V AC integral control module provides reset and test pushbuttons with fault LEDs.

4 Each controller provides auxiliary contacts rated for 0.6 Amps at 120V AC. The solid state reduced voltage starter shall be Allen Bradley SMC-3 or approved equal.

M. Transformers

1. A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase.

2. The transformer power wire connections (incoming and outgoing) shall be protected with a finger safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided.

3. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish.

4. Transformer shall be Square D 9070T or approved equal.

N. Transformer Primary and Secondary Fuse

1. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer.

2. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact.

3. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC.

4. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal.

5. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

O. Circuit Breaker

1. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

P. Fuse

1. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure.

2. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse.

3. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal.

4. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps.

5. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

Q. Operator Device

1. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for all automatic controlled equipment.

2. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status.

3. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be as required as follows:

   Amber – Alarm active, caution

   Green – Valve open, motor running

   Red – Valve closed

   White – Information

4. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections.

5. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Square D 9001 or approved equal.

R. High Frequency Noise Filter

1. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120VAC operating at 50/60 Hz.

2. The unit shall provide surge capacity of 25,000 amps and provide transient protection in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be a SolaHD STFV or approved equal.

S. Ground Fault Duplex Receptacle

1. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only.

2. The receptacle shall be protected with a 5 AMP circuit breaker.

3. The receptacle shall carry a 20A / 120VAC rating.

4. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuity from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

T. 24 Volt DC Power Supply

1. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such related components.

2. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power.

3. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

U. Control Relays

1. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state.

2. The relay socket shall be panel or DIN rail mounted inside the enclosure.

3. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

V. Terminal Block

1. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections.

2. All terminals shall be numbered per the wiring schematic printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen Bradley 1492; J4 (35A max) and 1492-J16 (85A max) or approved equal.

W. Programmable Logic Controller

1. Automatic operation of the AquaSBR shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel.

2. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules.

3. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks.

4. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32°F and 140°F. The PLC processor shall be an Allen Bradley Compact Logix 1769-L30ER or approved equal.

5. Modular equipment shall be provided to complete the PLC system. These Allen Bradley components include: 1769-PA4 – Power Supply, 1769-IA16 – Discrete input (16 point) modules, 1769-OW16 – Discrete output (16 point) modules and 1769-IF8 – Analog input (8 point) modules, 1769-OF4CI – Analog output (4 point) modules.

X. PLC Power Supply

1. Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL Listed.

Y. Discrete Input Module

1. Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA, off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL listed.

Z. Discrete Output Module

1. Operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA, at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, IL Listed.

AA. Analog Input Module

1. Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

BB. Analog Output Module

1. Backplane current draw at 5 VDC = 120mA, at 24VDC = 170mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, IL Listed.

CC. Ethernet Switch

1. An unmanaged Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking.

2. The switch shall support both 10 and 100 Mbit/s operation.

3. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m.

4. The unit shall be DIN rail mounted and required 24VDC power. Diagnostic LEDs for power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen Bradley Stratix 2000 1783-US5T, or approved equal.

DD. Remote Ethernet Access Gateway

1. A cULus marked, remote access VPN gateway shall be supplied to securely connect to a PLC via the Internet using an Ethernet port and a secure VPN tunnel.

2. The gateway can be DIN rail or wall screw mounting and provide WAN/LAN 10/100 Mb Ethernet ports. The gateway shall be a Ewon Cosy + ETH.

EE. Human Machine Interface

1. The operator interface shall be a NEMA Type 12, 13, 4X rated, 10.4” diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD).

2. The display type shall be color active matrix thin-fil transistor (TFT) with 800 x 600 pixel resolution.

3. The rated operating temperature shall be 32° to 131°F (0° - 55°C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 10°.

FF. Control Panel Wiring and Assembly

1. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.

2. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum with PVC insulation.

2.20 Software

A. PLC: The PLC function shall be to control, sequence, and monitor the SBR.

B. Phase Control: The software shall provide for the regulation of the process cycles of the SBR up to the maximum daily flow of the plant.

C. Aeration Control: The software shall provide for the regulation of the aeration system to achieve optimum process control.

D. Component Monitoring: The software shall provide for the monitoring of components for fault conditions and the orderly alarming and logging of the fault.

2.21 Process Guarantee

A. Statement of Warranty: The System Manufacturer warrants to the Owner that if the Treatment System defined as Aqua Aerobic SBR (hereinafter known as The System) supplied by The System Manufacturer, is erected, started up, operated and maintained by the Owner in accordance with the System's Manufacturer's design and drawings, O & M manuals, and instructions, and when the influent wastewater to the System for each calendar month of performance testing is within all of the parameters as summarized in Paragraph 2.03.D. - Influent Design Loadings, and the conditions are met relating to the other unit processes included as a part of the overall treatment scheme, the System shall meet the specified effluent wastewater characteristics as summarized in Paragraph 2.03.E – Effluent Design Loadings.

B. The Process Performance Warranty Testing Program shall begin not less than sixty days from the date of Beneficial use of the Wastewater Treatment Facility in which the System is installed, and shall extend until such time that one of the following occurs:

1. A 30 day testing period shows that both influent wastewater characteristics and effluent values comply with this warranty.

2. A 30 day testing period shows that effluent values comply with this warranty, regardless of the influent characteristics.

3. Any monthly period shows the influent characteristics to exceed the limits specified; retesting is required by the Owner.

4. A 30 day retesting period shows that both influent wastewater characteristics and effluent values comply with this warranty.

C. Process Performance Warranty Testing

1. The Process Performance Warranty Testing shall be initiated following completion of the Preliminary Testing Program and will require the collection and laboratory analysis of not less than twelve nor more than twenty pairs (not necessarily consecutive) of influent and effluent samples as specified herein during a thirty day test period.

2. The System Manufacturer shall be notified in writing by the Owner prior to initiation of the Process Performance Warranty Testing and shall be permitted to witness any or all sampling and laboratory analysis performed.

3. Split samples will be provided as requested by the System Manufacturer.

D. Compliance With Warranty

1. If during the 30 day period of the Process Performance Warranty Testing Program, the monthly effluent wastewater characteristics meet the requirements indicated in Paragraph 2.04, then the Owner shall consider the System to have met all the requirements of the warranty.

2. The Owner shall then so notify the System Manufacturer in writing of compliance with the stipulated Process Performance Warranty.

E. Consequences of Influent and/or Effluent Not Conforming to Specified Limits

1. If during any monthly period of the Process Performance Warranty Testing Program, the influent wastewater characteristics are not within the specified limits and the effluent wastewater characteristics are more than the permitted values, then the Owner shall not deem the System to be in breach of the Process Performance Warranty for that period.

    a. Under these conditions, the Owner may take corrective actions as necessary until the influent wastewater characteristics meet the specified requirements for a minimum period of three weeks, until the system appears to have achieved steady-state conditions.

    b. The Owner may then recommence the Process Performance Warranty Testing.

2. If during any monthly period of the Process Performance Warranty Testing Program, the influent wastewater characteristics are within the specified limits and the effluent wastewater characteristics do not meet the specified limits, the Owner shall deem the System to be in breach of the Process Performance Warranty and shall issue in writing to the System Manufacturer a Notice of Non-Compliance.

3. Upon issuance of Notice of Non-Compliance as provided above, the System Manufacturer will provide a written performance evaluation of the System, and may recommend operational changes to obtain compliance, upon which the Owner shall initiate said operational changes within a reasonable period of time.

4. If installation of additional equipment or modifications to equipment are required, then the System Manufacturer shall initiate said equipment changes within a reasonable period of time, at no cost to the Owner.

5. Following modifications to process operations (operational changes), installation of additional equipment or modifications to existing equipment as recommended by System Manufacturer, and after a minimum period of three weeks, until the System appears to have achieved steady-state conditions, the Owner may then recommence the Process Performance Warranty Testing.

6. If the effluent values are not within those warranted after this retest, then the System Manufacturer shall be deemed in breach of this warranty.

7. The manufacturer herein agrees to continue working with the Owner, during the entire two year warranty period, as required to resolve any operational problems to achieve compliance.

2.22 Spare Parts

A. One complete set of spare parts as recommended by the manufacturer shall be furnished. The recommended spare parts to be furnished are:

1. One – Decanter linear actuator with capacitor.

2. One – Decanter limit switch with arm.

3. One – Input card.

4. One – Output card.

5. Two – Blower inlet filters for each blower supplied.

6. One – Set of bearings for each blower size.

7. One – Drive end cover seal for each blower size.

8. One – Set of gaskets for each blower size.

9. One – Set of V-belts, for each blower supplied.

B. Spare parts shall be delivered to the Owner for storage and use as required, prior to project closeout.

C. Any spare parts consumed during the course of equipment startup shall be replaced by the equipment manufacturer.

D. Complete parts lists, indicating parts recommended for normal stock by the Owner, shall be provided as part of the Operation and Maintenance Manuals provided by the equipment manufacturer.

PART 3 EXECUTION

3.01 Examination

A. Verify site conditions under provisions of Section 01039.

B. Verify that concrete, piping, anchor bolts and all related structural supports are ready to receive Work and dimensions are as shown on Drawings and meeting the approval of the manufacturer.

C. Verify that electric power is available and of the correct characteristics.

D. Verify the location and installation of all related mechanical equipment.

E. Verify the location of SBR equipment and controls.

F. Verify that the site has been prepared in accordance with Division No. 2 – Sitework.

G. Verify that the basins and related items have been constructed according to Division No. 3 - Concrete

3.02 Preparation

A. Verify all dimensions, location, elevations, configuration, foundations, mechanical equipment, supports, structural and all related items.

B. Verify anchor bolt placement.

C. Verify proposed installation conforming to Drawings and meeting the approval of manufacturer of the equipment and any related equipment.

D. Verify all SBR equipment items are on hand and of the correct size, function, and type of material.

E. Inspect all equipment for damage prior to installation. Damaged equipment shall not be installed.

F. Clean basins thoroughly. Remove all debris

3.03 Installation

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with standards required by authority having jurisdiction.

C. Anchor equipment securely in place in accordance with the Drawings.

D. Install in accordance with IBC Mechanical Code (Latest Edition), National Electrical Code (Latest Edition), NEMA, OSHA and all other applicable codes, regulations and guidelines.

E. Sequence installation to insure piping and electrical connections are provided in a correct, orderly and expeditious manner.

F. Assemble all components as instructed by manufacturer.

G. Grout in place all installed equipment and facilities as instructed by manufacturer.

H. Shim all equipment as required with machinery wedges as recommended by manufacturer.

I. Level and plumb all equipment. Verify installation elevations.

J. Install all drives and motors as recommended by manufacturer. Check rotation.

K. Install electrical and control equipment as instructed by manufacturer and in accordance with Division No. 16. Provide connection to electrical service. Coordinate with local electrical utility.

3.04 Adjusting

A. Adjust Work under provisions of Section 01650.

B. Check all mechanical components for freedom of movement and rotation.

C. Check all anchors and supports. Tighten as required.

3.05 Field Quality Control

A. Perform field inspection and testing under provisions of Section 01400.

3.06 Start-Up

A. Provide start-up under provisions of Section 01650 and as indicated herein.

B. The equipment manufacturer shall furnish the services of a factory trained representative for a minimum of three (3) trips and a minimum of twelve (12) eight-hour days at the jobsite to inspect the installation, start-up, supervise the initial operation of the equipment and the complete training and instruction of the plant operating personnel in proper operation and maintenance, control system and provide process assistance.

C. The equipment manufacturer shall provide as a minimum the following start-up services and shall include these services in the total cost of the equipment:

1. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence or other conditions which may cause damage.

2. Verify that all items listed in manufacturer's instructions have been checked prior to start-up.

3. Verify that all safety equipment, devices and mechanisms are properly installed, connected and fully operable.

4. Verify that all equipment protective devices including, but not limited to, overload switches/alarms, shutdown switches/alarms, high water level switches and alarms and similar equipment and devices are properly installed, connected and fully operable.

5. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.

6. Verify wiring and support components for equipment are complete and tested.

7. Verify that all equipment and controls are properly installed, supported, connected and ready for operation.

8. Verify that all equipment and controls are properly set and adjusted for proper operation.

9. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, alarms, safety features, shutdown and all other miscellaneous features of each item of equipment to the Owner.

10. A complete set of operation and maintenance data and manuals shall be furnished to the Owner with the equipment delivery. See Section 01700.

11. Manufacturer shall demonstrate fully to the satisfaction of the Owner and Engineer that the equipment meets the required performance and is properly set and adjusted for its intended purpose in the overall plant operation.

12. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the Contractor, the additional service days will be at the Contractor's expense.

13. The selected SBR manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life of the plant. The line shall connect to a live service technician who shall have the capability to the control panel via internet, with the operator's permission.

D. Prior to acceptance of the equipment, the manufacturer shall provide the Engineer with a written report stating that the system has been properly installed, properly started-up and is functioning properly.

E. Warranty

1. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of two (2) years from the date the goods are put into service, or thirty (30) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or part which has been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attach/degradation, negligence or accident.

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END OF SECTION

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PART VI – TECHNICAL SPECIFICATIONS

ALABAMA REGISTERED No. 19310 PROFESSIONAL ENGINEER ALAN WAYNE BOYDSTON

8/11/2025

SECTION 16010

ELECTRICAL-GENERAL PROVISIONS

PART 1 GENERAL

1.01 General Conditions

A. The accompanying General Conditions shall apply to and form a part of this Section.

1.02 General Requirements

A. Carefully examine General Conditions, other specification Sections, and other drawings (in addition to electrical), in order to be fully acquainted with their effect on electrical work.

B. Do all work in compliance with all applicable codes, laws and ordinances, the National Electrical Code (hereinafter referred to as "Code" or "NEC"), and the regulations of the local authorities having jurisdiction and, where applicable, utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like, and deliver such certificates to the Engineer.

C. Cooperate with other trades and contractors at job. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the condition of the structure and installation of equipment will permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by electrical workmen.

D. It is the intent of these plans and specifications to direct attention to the absolute necessity to use safe techniques and to provide quality installations in compliance with good practice and the plans and specifications of Divisions 16.

1.03 Drawings

A. Indicate only diagrammatically the extent, general character and approximate location of work. Where work is indicated but with minor details omitted, furnish and install it complete and so as to perform its intended functions. For building details and mechanical equipment follow architectural, structural, and mechanical drawings and fit electrical work thereto.

B. Take finish dimensions at the job site in preference to scale dimensions.

C. Except as above noted, make no changes or deviations from the work as shown or specified except on written order of the Engineer.

D. Obtain from manufacturer's data on all equipment, the dimensions of which may affect electrical work. Use this data to coordinate proper service characteristics, entry locations, etc., and to ensure minimum clearances are maintained.

1.04 Qualifications Of Contractor

A. The electrical contractor shall have had experience of at least the same size and scope as this project, on at least two other projects, within the last 5 years in order to be qualified to bid this project.

B. Workmen shall be experienced in their respective trade. Workmanship of installed work shall be first class and will be so judged by the Engineer. Substandard work shall be removed and replaced.

C. Qualifications stated for the electrical contractor shall also apply to any subcontractors employed by the electrical contractor during the course of this work.

1.05 Site Visit

A. The Bidders shall visit the site to thoroughly familiarize themselves with existing conditions prior to submitting their bid. No allowances will be made for lack of knowledge of existing conditions.

1.06 Electrical Service Characteristics:

A. Main services shall be as shown on drawings.

1.07 Warranty

A. See GENERAL CONDITIONS (One Year warranty of conformance with drawings and specifications).

B. In addition to the foregoing warranty, Contractor shall and does hereby warrant all materials and equipment furnished under this Division of the Specifications to be free from defects and to function or operate satisfactorily for one year after final acceptance of the work, and that any items not meeting this requirement will be made good by him without cost to owner, provided such defects or failures are not due to abuse, neglect, or lack of reasonable and ordinary maintenance.

PART 2 PRODUCTS

2.01 Approved Materials And Devices

A. Where not otherwise specified, provide only new, standard first grade materials throughout, conforming to standards established by Underwriter's Laboratories, Inc., and so marked and labeled, together with manufacturer's brand or trademark. All equipment is subject to approval of Engineer before installation. All like items shall be of one manufacturer.

2.02 Electrical Equipment

A. Where shown on the drawings or specified herein, furnish and install electrical equipment.

B. Furnish all materials, hardware, equipment, labor and services required for the installation of complete and properly working installations as shown on the drawings and described herein.

C. References in these specifications to a particular manufacturer or model number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Equipment by manufacturers other than those specified shall be submitted for review in accord with Section 16011.

D. All equipment shall be installed by qualified workmen who shall have reviewed all manufacturer's data for purposes of coordinating service characteristics, entry locations, mounting requirements, dimensions, etc.

E. The contractor shall cooperate with the Owner, other trades, etc. for coordination of their requirements or the effects of the installed equipment on the overall project.

2.03 Auxiliary Systems

A. Where shown on the drawings or specified herein, furnish and install electrical auxiliary systems. Auxiliary systems shall consist of instrumentation systems, control systems, SCADA systems or others as specified.

B. Furnish all materials, hardware, equipment, labor and services required for the installation of complete and properly working systems as shown on the drawings and described herein.

C. References in these specifications to a particular manufacturer or model number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Equipment by manufacturers other than those specified shall be submitted for review in accord with Section 16011.

D. All systems equipment shall be installed by qualified systems technicians in the employ of the systems contractor, or by qualified workmen in the employ of the Contractor under the supervision of qualified representatives of the manufacturer. "Qualified representatives" shall be factory authorized or certified by the systems equipment manufacturer.

E. The systems technicians and/or contractor shall cooperate with the Owner, other trades, etc. for coordination of their requirements or the effects of the installed systems on the overall project.

PART 3 EXECUTION

3.01 Workmanship

A. The work shall be in accordance with the NEC and the rules and regulations of local bodies having jurisdiction.

B. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance upon completion.

C. Care shall be exercised that all items are plumb, straight, level.

D. Care shall be exercised so that not less than code clearance is allowed for all panels, switchboards, motor control centers, etc. Do not allow other trades to infringe on this clearance. Minimum code clearance shall be as required by Article 110 of the NEC.

E. Care shall be exercised that no piping, ducts, or equipment foreign to the electrical equipment or architectural appurtenances shall be allowed to be installed in, enter or pass through the exclusively dedicated spaces above, adjacent to and below switchboards and panelboards as set forth in Article 110, paragraph 26, of the NEC.

3.02 Equipment Testing

A. During the course of the work, field tests shall be performed to demonstrate that all cables, switchgear and transformers installed under this contract, are properly manufactured and installed to meet accepted industry standards. Testing shall be performed by technicians skilled in the use of the tools and instruments involved. Material failing to meet test criteria shall be repaired or replaced after which it shall be retested.

B. Tests shall be conducted per IEEE Standards 43-1974 2000 and 62-1995 and as follows:

1. Cables 600 Volts: Test all feeders and branch circuits Number 6 AWG and larger with a 1000 VDC insulation resistance tester, 0 - 500 megohms full scale. Test branch circuits for one minute with readings recorded at one minute intervals.

2. Grounds: Ground connections for new service equipment and for any new motors over 5HP shall be tested with a ground resistance tester. Ground connections having a resistance greater than 5 ohms shall be augmented with additional rods and conductor.

3. Motors:

   a. During the course of the work, all new process motors shall be subjected to an insulation resistance test before being placed in service.

   b. Motors 5 HP and less shall have 500 volts DC applied with an insulation resistance tester for one minute with readings at 30 seconds and one minute. 480 volt motors with an insulation resistance less than 1.5 megohms or at 60/30 second rates of less than 1.3 shall not be energized.

   c. Motors larger than 5 horsepower shall be tested for 10 minutes with readings recorded at the end of each minute. Motors with a 10/1 minute reading rates of less than 2 shall not be energized.

C. Results of the test shall be recorded on a test record card similar to that available from the James G. Biddle Company. Data recorded shall include the name and location of the equipment, date, value of test results, temperature of the motor at the time of the test and insulation resistance corrected for temperature. Record cards shall be turned over to the owner for use in future maintenance testing.

3.03 Acceptance Testing

A. Upon completion of work, the entire wiring system shall be tested, and shall be shown to be in perfect working condition in accordance with the intent of the specifications and drawings. It shall be the responsibility of the Electrical Contractor to have all systems ready for operation and to have an electrician available to operate same in accordance with and under the supervision of the inspection representative of the Engineer. The electrician shall be available to assist in removal of panelboard fronts, etc., to permit inspection as required.

END OF SECTION

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[08/2025]

SECTION 16011

ELECTRICAL-SCOPE OF WORK

PART 1 GENERAL

1.01 Work Required

A. Arrange with local utility companies for such services as shown or herein specified.

B. Removal or relocation of all electrical services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the completed project or any code pertaining thereto.

C. Complete electric lighting systems, power systems and auxiliary systems as shown or herein specified.

D. Complete standby generator system with automatic transfer switch.

E. Furnishing and installation of all electrical items shown on plans or herein specified, unless shown or specified otherwise.

F. Complete standby power system.

G. Connection of all equipment requiring electrical connection, mentioned in this Section or shown on drawings, whether furnished by electrical contractor or others.

H. Complete ground ring system.

PART 2 PRODUCTS

2.01 Proposed Substitutes

A. Submit to Engineer no less than ten (10) days prior to bid date, any items which are proposed as substitutes for those specified.

2.02 Shop Drawings And Catalog Data

A. Submit to Engineer within fifteen (15) days after award of contract, prior to purchasing, six (6) copies of manufacturer's shop drawings and catalog data for the items listed below.

B. All shop drawings of a specific item or system shall be in one submittal and shall be marked to clearly identify the manufacturer, the intended use of the item, and if not readily apparent, the intended location for installation of the item.

C. Shop drawings of all power equipment shall contain exact details of device placement, phasing and numbering, in form of elevations, for each piece of equipment.

D. Shop drawings submittals shall include:

Panelboards	Wireways
Starters	Lighting Fixtures
Safety Switches	Wiring Devices
Circuit Breakers	Standby Generator
Transformers	Automatic Transfer Switch
Cable	

As Required By Individual Sections Of These Specifications

E. Shop Drawings for the following items may consist of typewritten lists, listing manufacturer with description, to be used (one only for each item).

Building Wire	Conduit, PVC
Conduit: Rigid	Wire Connectors
Grounding Materials	

F. None of the above items shall be installed until shop drawings or catalog data has been accepted in writing. Any listed item not submitted even if specified shall be considered not acceptable and shall be removed if directed.

G. Shop drawings shall include large scale plan layouts and elevations of each electrical equipment room or other space having panelboards, switchboards, or major electrical equipment installed therein. Plans shall be one half inch equal one foot scale minimum and shall show all required clearances and all pertinent conditions.

H. Utilities confirmation as specified below under "Clearance with Utilities".

PART 3 EXECUTION

3.01 Clearance With Utilities

A. It shall be the responsibility of this contractor, prior to bid, to reaffirm with the utility companies involved that the location, arrangement and connections to the utility service(s) are in accordance with their regulations and requirements. Coordination with the electric utility shall include verifying system voltage, phase, and metering requirements.

B. The electrical contractor shall furnish and install all conduits, hardware, etc. as directed by each utility. Underground conduit installations shall include trenching, backfilling and, where required, concrete encasement. Conduits shall be run to locations, and terminated, as directed by the utility.

C. Transformer pads shall be of steel reinforced concrete, sized as directed by the electric utility. Clearances around transformer pad and utility equipment shall be maintained in accordance with utility requirements.

D. All materials installed for use by a utility shall be in strict accordance with the requirements of that utility.

E. Where specific utility requirements, locations, etc. are at variance with these drawings and specifications, the contract price shall include any additional cost necessary to meet those requirements without extra cost to the Owner after a contract is entered into, unless such requirements are not available prior to bid and the contractor so documents at the bid opening by submitting a letter so stating with his bid.

F. On many projects a utility company may levy charges due to the location, size or type service involved. The owner shall be responsible for these.

G. Coordinate and arrange with utility companies for installation of such equipment, services, metering, etc., as shown or herein specified. Furnish with shop drawings a signed document from each utility company describing the location and type of service to be furnished and any requirements they may have. This document shall be signed for each utility company by a person responsible for granting such services.

3.02 Motors Starters And Controls

A. Unless otherwise specified or shown, all motors will be furnished and installed under other sections of these specifications.

B. Unless otherwise specified or shown, all individually mounted starters and/or equipment control contactors shall be furnished installed under this section of these specifications.

C. Unless otherwise specified or shown, all control items will be furnished, installed and wired in conduit under this section of these specifications. Where control items are noted as furnished with equipment, the electrical contractor shall coordinate with equipment supplier to produce a coordinated system, functioning as specified.

3.03 Excavation, Cutting, Patching

A. Perform all excavating and cutting as required to receive electrical work, and after inspection and approval of work by Engineer, do all required backfilling, patching and repairing. Obtain specific approval of Engineer before cutting into any structural members.

B. For all such work employ competent workmen, and finish a neat and workmanlike manner, equal to quality and appearance to adjacent work.

3.04 Painting

A. Finish painting of any exposed raceways is not included in this Section. (See Painting and Finishing Section).

3.05 Identification

A. Identification nameplates shall be laminated plastic and shall indicate the equipment name, or purpose, and the equipment's source and source location, in accordance with NEC (2023) paragraph 110.22 and paragraph 408.4.

B. Each switchboard, motor control center and panelboard shall be equipped with a nameplate with 1/4" minimum letters.

C. Each individual mounted circuit breaker, switch, starter, contactor and/or any other control or protective device shall be equipped with a nameplate with 1/4" minimum letters. Nameplates on fusible equipment shall state fuse size.

D. Each branch circuit in a switchboard, motor control center and panelboard shall be identified.

1. Panelboards with covers and directory pockets shall have typewritten directories.

2. Switchboards, motor control centers and panelboards without directories shall have a nameplate with 1/8" minimum letters installed adjacent to each circuit device stating equipment fed and fuse size, if applicable.

E. Nameplates shall be white micarta with black core.

F. All wires shall be clearly numbered at each end using Brady Co. Bradysleeve wire marking sleeves or heat-shrink type wire markers or approved equal. Wire bundles shall be identified by using Bradey non-adhesive cable tags or approved equal.

3.06 Storage Of Materials

A. Store all materials to prevent damage from rust, corrosion, physical injury, etc.

B. Keep site clean of accumulation of cartons, trash, debris, etc.

3.07 "As Built" Drawings

A. During the progress of the work, the Contractor shall maintain an accurate set of "record" electrical drawings. The information contained on these drawings shall be delivered to the Engineer at the completion of the work. "Record" drawings shall be kept on the job site during the progress of the work and shall be available for review by the Engineer at any time.

B. The information contained in the "record" drawings shall include but not be limited to the following:

1. Accurate location and routing of all concealed conduit within the buildings and/or structures.

2. Accurate locations of all underground duct banks, manholes and pull boxes.

3. Terminal numbers of connections of all control and instrumentation conductors.

4. Circuit numbers of all outlets and appliances fed from lighting and power panels if different from that shown on the drawings.

5. Any variations in size or number of conductors from that shown on the drawings.

6. Any field changes in control circuits.

7. Accurate locations of any outlets or appliances when different from that shown on the drawings.

C. The "record" drawings delivered to the Engineer at the completion of the work shall be accompanied by complete record drawings of all electrical equipment and electrical controls and components furnished as part of mechanical equipment.

3.08 Operations And Maintenance Instruction

A. At the completion of the job, the electrical contractor shall turn over to Owner one (1) set of marked "as built" drawings, three (3) sets of all equipment catalog and maintenance data and three (3) sets of shop drawings on all equipment requiring same. The contractor shall explain and demonstrate all systems to the Owner's representative(s).

END OF SECTION

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SECTION 16100

BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 Scope

A. This section outlines the intent of Division 16 with regard to Basic Materials and Methods.

PART 2 PRODUCTS

2.01 Materials Furnished As Specified

A. Material proposed to be furnished as specified shall be in strict accordance with the plans and specifications of Division 16. Shop drawings shall be furnished as required by Section 16011. All materials furnished are subject to the approval of the Engineer and his authority of approval is final.

2.02 Material Substitutions

A. No material substituted for specified, except by written approval of Engineer. Specified catalog numbers are used for description of equipment and standard of quality only. Equivalent material will be given consideration only if adequate comparison data including samples are provided.

2.03 Samples

A. Samples of materials shall be furnished where required by plans and/or specifications of division 16, or as requested by the Engineer on items proposed as substitutes.

PART 3 EXECUTION

3.01 Safety

A. Maximum consideration shall be given to job safety and only such methods as will ensure the safety of all persons shall be employed. The codes and regulations of OSHA shall be given strict compliance as well as such other codes, laws, and regulations as may be applicable.

3.02 Technique

A. It is the intent of these plans and specifications to direct attention to the absolute necessity to use safe techniques and to provide quality installations in compliance with good practice and the plans and specifications of Division 16.

END OF SECTION

[2280]
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SECTION 16110

RACEWAYS - METAL

PART 1 GENERAL

1.01 Scope

A. This section deals with the materials to be used as metal raceways, connections, and supports and the installation of all raceways.

PART 2 PRODUCTS

2.01 Material Type

A. Conduit: Rigid metal conduit shall be galvanized outside and inside by hot dipping. Conduit shall be as manufactured by Republic, Wheatland, Allied Tube and Conduit or approved equal.

B. Rigid, heavy wall aluminum conduit shall conform to ASA standards and be as manufactured by Republic, Wheatland, Allied Tube and Conduit or approved equal. Installation shall be in accordance with manufacturer's recommendation. Conduit expansion fittings shall be installed where required.

C. Watertight flexible metal conduit shall consist of flexible galvanized steel tubing with a liquidtight jacket of PVC. All flexible conduit shall have a copper bonding conductor wound into conduit body.

D. Flexible steel conduit shall be continuous spiral wound and interlocked galvanized material conforming to UL standards for flexible metal conduit. Fittings for flexible metal conduit shall be galvanized steel, insulated throat, UL approved for grounding means.

E. Couplings and connectors on rigid conduit shall be standard threaded type, galvanized outside and inside by hot dipping. Clamp type and threadless are not acceptable. Couplings and connectors, for rigid conduit shall be as manufactured by Raco or Appleton.

F. Connectors raintight: Meyers or approved equal.

G. Bushings on rigid conduit shall be threaded malleable iron with integral noncombustible insulator. Rigid conduit bushings shall be O-Z/Gedney "IBC" series, T & B BIM series, Midwest Electric series 1031 - 1043 or equal by Penn Union. Grounding bushings shall be O-Z/Gedney "IBC-L" series, T & B 3870 - 3999 series, Midwest Electric GLL series or equal by Penn Union.

H. Fittings for aluminum conduit shall be aluminum with less than 0.4% copper content for use in contaminated atmospheres. On exterior locations, fittings shall be provided with gasketed covers. Aluminum fittings shall be as manufactured by Thomas and Betts, Crouse-Hinds, Appleton, Pyle-National or equal.

I. Fittings for flexible liquid-tight conduit shall be malleable iron sealing type with insulated throat and cast integral grounding lugs. Fittings shall be O-Z/Gedney, Burndy, Appleton or equal.

J. Conduit clamps and supports shall be as manufactured by T & B, Midwest Electric, or O-Z/Gedney.

K. Conduit fittings shall be manufactured by Pyle National, Appleton, Crouse Hinds, O-Z/Gedney, Killark or Russellstoll.

2.02 Hardware

A. All hardware such as expansion shield, machine screws, toggle bolts, "U" or "J" bolts and machine bolts shall be of corrosion resistant materials.

B. Corrosion resistance shall be accomplished by plating, galvanizing or use of stainless steel or other approved corrosion resistant materials. All shall be furnished by the Contractor.

C. Hardware in contact with aluminum conduit, handrails, plates and structural members and hardware outdoors and in corrosive areas shall be stainless steel.

PART 3 EXECUTION

3.01 Conduit, Type Of Installation

A. Unless shown or specified otherwise, rigid steel conduit shall be used in all locations. Minimum conduit size shall be 3/4" trade size.

B. Aluminum conduit shall be used in all exposed locations outdoors and in process areas subject to corrosive gases. In no case shall Aluminum conduit be installed in concrete.

C. Provide watertight flexible metal conduit for connections to all motors, transformers or other equipment which has moving or vibrating parts.

D. EMT may be utilized for branch circuits and auxiliary systems where concealed in ceiling or cavity walls in dry locations only.

3.02 Installation Of Conduit

A. Conduits shall be sized in accordance with the latest National Electrical Code except where shown to be larger on the drawings or when required by local Code.

B. Follow methods which are shown on the drawings. Where not otherwise shown, specified, or approved in a particular case, run all conduits exposed.

C. Exposed conduits shall be run parallel with or at right angle to building walls and shall be supported on walls or ceilings. Conduit supports attached to concrete or masonry construction shall be made by means of expansion anchors or power tool driven inserts, Phillips Red Head or equal.

D. Where rigid conduits enter boxes they shall be secured in place by approved locknuts and bushing.

E. Conduit ends shall be plugged during construction.

F. The use of running threads is absolutely prohibited. All conduit shall be jointed with approved conduit couplings. All couplings on rigid conduit shall be threaded.

G. Before installing raceways for motors and fixed appliances, check location of motor and appliances connections to locate and arrange raceways appropriately. Provide flexible conduit connections to all motors and/or any equipment which has moving or vibrating parts. Flexible conduit shall generally not exceed 24" in length and shall in all cases be equipped with a ground wire, bonded at both ends.

H. Fasten conduit securely in place by means of approved conduit clamps, hangers, supports and fastenings. Arrangement and methods of fastening all conduits shall be subject to Engineer's direction and approval.

I. All exposed conduit threads or breaks in the galvanizing, exposed to the elements or exterior of building, shall be treated with cold galvanizing compound.

J. All conduits shall be supported within 3 feet of each coupling, fitting, outlet box, junction box, cabinet or equipment enclosure Conduit supports shall be independent of ducts, plumbing piping, ceiling supports, etc. Conduits shall not be supported by junction boxes, pull boxes, fixtures, etc.

K. All conduit connections to sheet metal cabinets or enclosures subject to the elements shall terminated by use of raintight hubs.

L. A 100 pound test polypropylene pull cord shall be installed in each empty conduit.

M. Apply two coats of asphaltum paint to all underground metallic conduit. Carefully retouch any breaks in paint and allow to dry before covering with earth. Leave exposed until after Engineer's inspection. In exposed wet or outdoor installations coating shall extend 6" above slab.

N. No conduit with an external diameter larger than 1/3 the thickness of the slab, shall be placed in the slab and conduits in the slab shall not be spaced closer than 3 diameters on center.

O. No conduit shall be run in slag or fill under the ground floor slab. Where running in the slab is not permissible, conduits shall be run in trenches, 18" minimum, below grade and backfilled.

P. Any conduit stubbed out for future shall be capped and marked with a 2" minimum red metal tag which identifies conduit origin. Conduits stubbed up above grade or roof shall be tagged on the conduit. Conduits stubbed out below grade shall be tagged on nearest building wall, curb, etc., directly over the conduit run.

Q. Conduit runs through walls below grade shall be installed with watertight fittings, OZ/Gedney FSK, Century-Line or equal.

R. Conduits to meters and other electronic devices below grade level shall be provided with a conduit seal and drain, Crouse-Hinds type EYS and ECD, Appleton, or equal to prevent moisture in conduit from entering enclosure.

S. Except as shown otherwise, communications and shielded signal conductors shall not be run in raceways containing power or control voltage conductors. Communications and shielded signal conductor conduits shall be separated from power conduits one foot or more as recommended by IEEE Standard 518-1982. Such conductors shall not enter the same junction box or pull box used for power or control voltage conductors. All communications and shielded signal conductors shall be run in steel conduit.

T. Conduit runs between buildings or structures shall be grouped in duct banks. All conduit runs outside buildings shall be encased in a minimum of 3 inches of concrete on all sides. Concrete shall be steel reinforced as shown on the plans. All conduit runs outside buildings shall be a minimum of 30 inches below grade except within 10 feet of a structure where conduit must rise to enter the structure. Where conditions dictate less depth, add two (2) additional inches of concrete for each twelve (12) inch reduction.

U. Concrete for underground conduit shall have the top surface tinted red.

V. All conduit runs shall be identified by means of a round brass or copper tag with stamped identification as shown on the conduit schedule and shall be attached with soft brass wire or non-corrodible chain at conduit terminations and all junctions or pull boxes.

END OF SECTION

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SECTION 16111

RACEWAYS – NON-METALLIC

PART 1 GENERAL

1.01 Scope

A. This section deals with the materials to be used as raceway where shown on the plans or specified as non-metallic conduit.

1.02 Where Used

A. Except in hazardous (classified) locations non-metallic conduit shall be used for branch circuits, 120 volt control circuits and feeders where below grade between buildings or structures.

B. Non-metallic conduit shall convert to rigid metal conduit prior to leaving concrete in areas where conduit would be exposed. Conduit adapters shall be used for transitions.

C. Direct bury non-metallic conduit shall convert to rigid metal conduit prior to emerging from grade. Rigid metal bends and risers shall be used for the conversion.

D. Non-metallic conduit shall be used where indicated on the plans.

E. Non-metallic conduit shall be used in lieu of metallic conduit in all instances for individual grounding conductors.

PART 2 PRODUCTS

2.01 Composition

A. Conduits and fittings shall be constructed of polyvinyl chloride compounds in accordance with the applicable requirements of UL, NEMA and the NEC.

2.02 Schedule 40, Rigid PVC

A. Shall be U.L. listed for use with 90 degrees C. rated conductors and in conformity with Article 352 of the NEC.

2.03 Fittings

A. All couplings, adapter, bells, reducers, etc., shall be of the same material and by the same manufacturer as conduit.

2.04 Cement

A. Solvent cement shall be as recommended by the manufacturer.

2.05 Manufacturer

A. The conduit manufacturer shall have had a minimum of 5 years experience in the manufacture of the products. Non-metallic conduit shall be as manufactured by Carlon, Queen City, Can-Tex, National Pipe, Allied Tube and Conduit or approved equal.

PART 3 EXECUTION

3.01 Installation

A. All elbows, bends, etc., shall be either factory bends or made with an approved heat bender.

B. All cuts shall be made with an approved saw and ends deburred.

C. All joints shall be made as follows: Clean the outside of the conduit to depth of the socket, and the inside of socket with an approved cleaner. Apply solvent cement to the interior of the socket and exterior of conduit, making sure to coat all surfaces to be joined. Insert conduit into the socket and rotate 1/4 to 1/2 turn and allow to dry.

D. No P.V.C. conduit shall be run exposed except as otherwise specified.

3.02 Duct Type

A. Non-metallic conduit shall be Schedule 40 unless specifically noted otherwise.

B. Duct lines shall be installed as shown on the drawings and as specified in Section 16110.

END OF SECTION

[2280]
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SECTION 16120

CONDUCTORS

PART 1 GENERAL

1.01 Scope

A. This section outlines the quality and type of conductors to be used in the various systems, locations and conditions.

PART 2 PRODUCTS

2.01 Wire And Cable 600 Volt

A. Conductors shall have current carrying capacities as per NEC, #12 minimum except for control cable specified below.

B. Conductors shall be stranded copper.

C. All conductor insulation shall be 600 volt.

D. Insulation for all power conductors shall be cross-linked polyethylene insulation type XHHW.

E. Conductors shall have permanently colored insulation. Conductor color codes shall be as set forth below.

2.02 Control Wire

A. Control wire shall be not less than 14 AWG annealed uncoated copper (THHN/THWN), 600 volt. Type TC Control cable for use in accordance with Article 336 and 392 of the National Electrical Code may be used.

2.03 Instrumentation Wire And Cables

A. Instrumentation loop (DC) cables - shielded shall not be less than #18 AWG, stranded bare copper conductors, insulated with 15 mils of 105 degree polyvinyl chloride, twisted into pairs, shielded with an aluminum mylar tape shield and tinned copper drain wire.

B. Single pair cables shall have polyvinyl chloride jacket overall. Multi-pair cables shall have individually shielded pairs cabled, with an aluminum mylar tape shield and tinned copper drain wire, and polyvinyl chloride jacket overall. Three hundred volt 105 degrees C UL listed Power Limited (Low Energy) Circuit Cable.

C. Instrumentation loop (DC) tray cables - shielded shall be not less than #18 AWG stranded Class B bare copper conductors, each insulated with 15 mils PVC, twisted into pairs, each numbered and shielded with a 0.85 mil aluminum mylar tape shield and a tinned 18 gauge copper drain wire. Multiple pair bundled with a jacket of 50 mil black flame retardant PVC. Cable shall be listed as 300 volt power limited control cable type TC.

2.04 Manufacturer

A. Wire and cable shall be manufactured by Cablec, Okonite, Kirite, Belden, Triangle, General or approved equal.

2.05 Wire And Cable Connectors And Terminals

A. 600 Volt Class and Less

1. Connections made in 20 amperes or less lighting or receptacle branch circuits may be made with solderless connectors, Ideal Wing nuts, 3 M Hyflex, T&B Marrette, or equal.

2. All power connections and connections of wire #12 and larger, except as previously noted, shall be made with compression or bolted connectors or terminals.

3. Compression connectors shall be of tin plated copper, properly sized for the conductor and installed with listed tools and dies.

4. Bolted connections shall be two or four bolt clamps of bronze or tin plated copper. Lugs shall be of bronze, tin plated copper or tin plated aluminum alloy.

5. Hardware for power connections shall be silicon bronze, stainless steel or cadmium plated steel. Wire nuts, crimp caps and split bolt connectors are prohibited, except as noted otherwise.

6. Terminal strips shall be as follows

a. Compression type, 300 or 600 volt rating, with numeric identifiers beside each connection; 600 volt rated for all power and control, 300 volt rated for DC signal connections.

b. Furnish as spare approximately 20% of the terminals used for each type of wiring, that is, dc signal wiring, dc control wiring and ac power and control wiring .

c. Terminal strips shall be Allen-Bradley, Buchanan or approved equal.

7. All instrumentation and control wire connections shall be made with solderless compression type connectors and terminals, Thomas and Betts Sta-Kon, Burndy Hylug, or equal.

B. Ground

1. All ground wire connections below grade or exposed to corrosive atmospheres shall be of the crucible weld process, Cadweld or Thermoweld.

2. Above grade ground connections shall be made with solderless type connectors and terminals designed specifically for grounding installations; all shall be as manufactured by Burndy, OZ or equal.

3. Ground bus in panels shall be fabricated of seamless copper tubing or bar with individual vee shaped holes and tightening screw. Ground bus shall be similar to ILSCO type CAN.

PART 3 EXECUTION

3.01 Installation Of Wire And Cable

A. No conductor shall be smaller than #12 except where designated on the drawings or hereinafter specified.

B. Multi-wire branch circuits shall be used only as indicated and shall have provisions for simultaneously disconnecting all ungrounded conductors in accordance with NEC 210.4.B.

C. All joints and splices in wire shall be made with approved solderless connectors, and covered so that insulation is equal to the conductor insulation.

D. No splices shall be pulled into conduit.

E. Conductors and conduits shall be continuous between outlets.

F. No conductor shall be pulled until conduit is cleaned of all foreign matter.

G. Where installed in panelboards, cabinets, wireways, switches and equipment wire and cable shall be neatly formed and tied.

H. Where conductors are run in parallel, each conductor making up the feeder shall be exactly the same length, the same size, and the same type of conductor with the same insulation. Further, each group of conductors making up a phase or neutral must be bonded at both ends in the same manner.

I. In installing the main service, additional slack conductors shall be provided as required by the electric utility for connection to their equipment.

3.02 Outlets And Branch Circuits

3.03 Outlets shall be connected to branch circuits as indicated on drawings by circuit number adjacent to Wire And Cable Color Coding

A. A color coding system as listed below shall be followed throughout the entire network of branch circuits.

Voltage	120/240	120/208	277/480
Phase	Color	Color	Color
A	Black	Black	Yellow
B	Orange(high leg)	Red	Orange
C	RED	Blue	Brown
Neutral	White	White	Gray
Ground	Green	Green	Green

B. Conductors shall have permanently colored insulation as indicated above. Where permanently colored insulation is not available, color code with Scotch #35 tape in a half lapped pattern - ground conductors shall be taped for its entire exposed length, ungrounded conductors shall have a minimum of 2” wide band within 12" of each termination and in each enclosure, junction box, etc.

C. Control Conductors: Shall be color coded by use of color coded "tracers".

END OF SECTION

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SECTION 16130

OUTLET, JUNCTION AND PULL BOXES

PART 1 GENERAL

1.01 Scope

A. This section outlines the quality, type and installation of outlet and junction boxes for general and special use.

PART 2 PRODUCTS

2.01 Ceiling And Wall Outlet Boxes

A. Flush outlet boxes shall be standard type, with knockouts, made of hot dipped galvanized steel, Steel City, Raco, Appleton, or Bowers.

B. Single wall outlet boxes shall be two gang with single gang trim rings. Appropriate gang boxes shall be used for mounting ganged switches.

C. Ceiling outlet boxes shall be 4" octagon 1-1/2" deep or larger as required due to number of wires.

D. Boxes shall be provided with approved 3/8" fixture studs when required to support stem mounted light fixtures.

E. Outlet and device boxes on exposed conduit shall be cast metal boxes, type "FS" or "FD".

2.02 Junction Boxes And Wireways

A. Sheet metal junction boxes for dry locations, through 4-11/16", shall be standard type of hot dipped galvanized steel, with knockouts, Steel City, Raco, Appleton, Bowers or approved equal.

B. Cast metal junction boxes, through 4-11/16", shall be type FS, FD, JB, GS, or SEH as required for application.

C. Sheet metal gutters and junction boxes for dry locations larger than 4-11/16" shall be NEMA 1, Code gauge steel, flush or surface mounted as indicated and shall be Hoffman or approved equal.

D. Cast junction boxes larger than 4-11/16" shall be cast aluminum for all below grade and exterior use and where shown. Above grade shall be NEMA 4 and below grade shall be NEMA 6.

E. Non-metallic junction boxes and gutters shall be of fiberglass reinforced epoxy. PVC boxes and gutters shall not be used except where specifically indicated. Non-metallic boxes shall be furnished with stainless steel hardware.

F. Gutters indicated as weatherproof shall be oiltight lay-in wireway. Wireway shall be hinged cover, fully neoprene gasketed, and equipped with pull-down latches. Wireway shall be manufactured of 14 gauge steel with 10 gauge steel end flanges. Wireway shall be treated with a corrosion resistant phosphate treatment and painted with an electrostatically applied epoxy powder coating. Wireways that are shown to be NEMA 4X shall be manufactured with 304 stainless steel with 316 hardware.

G. Sheet metal junction boxes for use outdoors, damp or wet locations or in process areas shall be of aluminum or stainless steel. Boxes and gutters shall be NEMA 4X with full gaskets, screw cover or hinged as indicated.

2.03 Outdoor And Process Area Boxes

A. Boxes installed outdoors, in damp or wet locations or in process areas shall be cast metal, stainless steel, aluminum or, where indicated, non metallic. Painted or galvanized steel boxes shall not be allowed in such locations.

2.04 Below Grade Pull Boxes

A. Concrete pull boxes shall be precast, reinforced for H-20 bridge loading, with a minimum inside dimension of four feet. Pull boxes shall be of size and depth as required for the duct lines. Pull boxes shall be furnished with the following features:

1. Minimum size of 4'x 4'x 6' high inside except a minimum of 4' x 6' x 6' high in ductlines with more than 8 conduits.

2. Pulling irons opposite each window.

3. 15” x 15" x 4" deep sump with cover.

4. Cable racks and supports as required for racking cable around walls. Racks shall be McGraw-Edison Series DU17B or approved equal.

5. Manhole ring and cover: Neenah R-1640-C or approved equal, lettered "Electric". Manhole tops shall be 1-1/2 inches above finished grade, except flush in paved areas.

B. Precast concrete manholes shall be manufactured byFoley Products Company, Oldcastle Infrastructure, Smith-Midland or approved equal.

C. Metal pull boxes shall be heavy duty, flanged, watertight, with recessed checkered steel cover. Metal pull boxes shall be Appleton Type WYT or equivalent by Crouse-Hinds, O-Z/Gedney, Spring City, Hope or equal.

PART 3 EXECUTION

3.01 Installation Of Ceiling And Wall Outlet Boxes

A. Outlet boxes shall be securely fastened to structural members and shall not be supported by dry wall, gypsum board, plaster, etc. The device or plate installed in conjunction with the outlet box shall not be used for support.

B. Surface fixture outlet boxes shall be set so edge of cover comes flush with finished surface.

C. There shall be no more knockouts opened in any outlet box than are actually required.

D. Boxes shall be sealed during construction.

3.02 Installation Of Junction Boxes

A. Provide junction or pull boxes where shown on the drawings and as required to facilitate installing conductors. Such boxes shall be "Code" sized unless required to be larger by the plans or other sections of these specifications. All junction boxes shall be accessible.

B. Junction boxes shall be securely fastened to the building structure. Junction boxes shall not be supported by conduit fittings.

C. There shall not be more knockouts opened in any box than are actually required. All unused openings shall be plugged.

D. Boxes shall be properly protected during construction and shall be cleaned of all foreign matter before conductors are installed.

E. Boxes to be imbedded in concrete shall be properly leveled and anchored in place before the concrete is poured.

3.03 Outdoor Boxes

A. Boxes installed outdoors or in damp locations shall be cast metal, stainless steel or, where indicated, non metallic.

3.04 Below Grade Pull Boxes

A. Pull boxes for underground duct lines shall be located as shown on the drawings with additional boxes if required to avoid exceeding the cable manufacturer's recommended pulling tension. Pull boxes for power ducts shall be concrete. Pull boxes for instrumentation ducts shall be cast iron or aluminum. Cast metal pull boxes shall be set flush in concrete; minimum four inches thick on sides and bottom.

B. Boxes shall be sized as required for the ducts entering the box. Pull boxes for underground instruments duct lines shall be a minimum of 16" x 24" x 12" deep. Boxes shall be set in concrete, minimum of 4" all around.

END OF SECTION

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SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 Scope

A. This section outlines the quality and requirements of the Wiring Devices and Plates, switches, receptacles, etc., to be used and the installation instructions for the devices.

PART 2 PRODUCTS

2.01 Wiring Devices

A. Switches and receptacles shall be nylon industrial specification grade AC type, side and back wired as manufactured by Arrow Hart, Hubbell, Leviton or Pass & Seymour.

B. Switches shall be quiet operation toggle rated 20 amperes, 120/277 volts AC, Hubbell 1221 series or equal.

C. Receptacles shall be industrial specification grade, in NEMA configuration as shown on drawings. 20 ampere, 120 volt duplex receptacles shall be Hubbell Catalog #5262 or equal.

D. Where noted on the drawings, and/or required by code, receptacles shall be equipped with integral Class A ground fault protection. Unless noted otherwise all "GFCI" receptacles shall be duplex, rated 20 amperes, 120 volts with "TEST" and "RESET" buttons, LED indicator lights, and feed through feature for ground fault protection of all devices on the load side of the unit. "GFCI" receptacles installed outdoors shall be identified as “Weather Resistant”. “GFCI” receptacles shall be Hubbell Catalog #GF-5362 or equal.

2.02 Plates And Accessories

A. All devices shall have proper plates, trims, etc. Plates shall be standard size and of the same manufacturer as devices. Oversize plates are not acceptable.

B. Where telephone and other outlets do not have plates furnished by others, appropriate plates shall be provided by this Contractor.

C. Plates shall be 302 stainless steel except where otherwise specified or noted on the drawings.

D. Receptacles installed in wet locations shall be equipped with a device plate and hinged outlet cover assembly which is UL listed for wet locations while in use and identified as “Extra Duty” rated. The hinged cover shall be equipped with reliefs on the bottom to permit cords to exit while the cover is closed and shall also be gasketed to seal to the outlet box. Wet location covers shall be cast aluminum as manufactured by RED-DOT or approved equal.

E. Switches installed in wet locations shall be equipped with a cast aluminum, gasketed weatherproof cover plate with an external operating lever equal to Crouse Hinds #TP7260.

F. Surface mounted devices with exposed conduit in unfinished areas shall have galvanized metal plates with rounded or beveled edges.

2.03 Finishes

A. Devices and plates shall be grey with stainless steel or, grey with galvanized metal.

PART 3 EXECUTION

3.01 Mounting Heights And Locations

A. Symbols on drawings and mounting heights are approximate. Exact locations and mounting heights shall be determined on the job and it shall be the Contractor's responsibility to coordinate with all trades to ensure correct installation, i.e., over counters in or above back-splashes, in block walls, tile, and other specific construction features.

B. Outlets, unless otherwise shown shall be located with the center line of outlet boxes the following distance above the finished floor:

Receptacles, General:	1'-6"
Voice/Data Outlets:	1'-6"
Receptacles Over Counters:	3'-8" or 2" above backsplash
Switches, General:	3'-10"

C. All device mounting heights shall be in accordance with the Americans with Disabilities Act (ADA) and all Federal, State, and Local requirements for making buildings accessible to the handicapped.

3.02 General Mounting

A. Verify all door swings with Architectural. Locate boxes for light switches within 4 inches of door trim on the strike side.

B. Where switches are shown grouped together they shall be installed under a single plate. Where required, barriers shall be provided in the outlet box.

C. All receptacles within 6'- 0" of sinks, showers or normally wet or damp locations shall be equipped with ground fault protection.

D. Where receptacles, voice/data outlets, and auxiliary system outlets are shown on the drawings grouped together they shall be installed with 4 inches between outlets.

E. Devices and associated plates shall not be used as support. Outlet boxes shall be rigidly supported from structural members located on each side of the outlet. Far side box support brackets are not acceptable

END OF SECTION

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SECTION 16170

SAFETY SWITCHES

PART 1 GENERAL

1.01 Scope

A. This section deals with safety switches fused and non-fused. All safety switches shall be NEMA Heavy duty type, 600 volt.

1.02 Service Rating

A. Where required, safety switches shall be labeled for use as service entrance equipment.

PART 2 PRODUCTS

2.01 Safety Switches

A. Shall be quick-make, quick-break, fused or non-fused as shown. Switch blades shall be fully visible in the off position with the door open. The switch handle shall be a part of the box, not the cover.

B. Fusible switches shall have provisions for dual element fuses, UL Class RK-5.

C. Switch cover shall have a defeatable dual interlock to prevent inadvertent opening of the cover with the switch in the "ON" position. Provisions shall be made for padlocking in the "OFF" position.

D. Switches shall be horsepower rated.

E. Switches shall be equipped with ground lugs and where switches contain a neutral conductor shall be equipped with isolated neutral lugs.

2.02 Manufacturer

A. Switches shall be as manufactured by ABB, Square "D", Eaton, Siemens or approved equal.

PART 3 EXECUTION

3.01 Safety Switches

A. Safety switches shall be installed as shown on the plans and in accordance with the N.E.C.

B. Disconnect switches for motors shall be rated in horsepower and shall be sized for motor served.

C. Disconnect switches for non-motor loads shall be sized in accordance with equipment full load current.

D. Safety switches shall be NEMA I enclosure except where installed in locations subject to moisture, in which case, safety switches shall have a watertight enclosure, NEMA 4X, except where other types of enclosures are shown on the plans.

E. Adequate support shall be provided for mounting safety switches. Safety switches shall be securely attached to building structure in all possible instances.

END OF SECTION

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SECTION 16181

FUSES

PART 1 GENERAL

1.01 Scope

A. Furnish and install fuses as shown on the drawings and specified herein.

1.02 Manufacturer

A. Fuses shall be as manufactured by Bussman, Ferraz-Shawmut, Littlefuse, or approved equal. Numbers shown in this Specification are those of Bussman.

PART 2 PRODUCTS

2.01 Fuses

A. Shall be time-delay type U.L. listed with a minimum interrupting rating of 100,000 amperes symmetrical.

B. 600 Amp and below shall be dual element rejection type, Class “RK-5.”

C. 601 Amp and above shall be time-delay Class “L.”

PART 3 EXECUTION

3.01 Installation

A. Fuses shall be sized in accordance with nameplate of equipment served or as shown on Drawings otherwise.

B. One spare set of fuses shall be furnished for each size used. One additional spare set of fuses shall be furnished for each five sets of same size fuses used.

END OF SECTION

[2280]
[08/2025]

SECTION 16182

MOLDED CASE CIRCUIT BREAKERS -INDIVIDUALLY MOUNTED

PART 1 GENERAL

1.01 Scope

A. This section outlines the quality, type and installation of Individually Mounted Molded Case Circuit Breakers.

1.02 Service Rating

A. Individually mounted molded case circuit breakers shall be labeled for use as service entrance equipment, where required

PART 2 PRODUCTS

2.01 Circuit Breakers

A. Shall be quick make, quick break, thermal magnetic type, for alternating current. Breakers shall trip free of the handle and tripping shall be indicated by the handle assuming a position between "Off" and "On". Multi-pole breakers shall be internal common trip with single operating handle.

B. Breakers shall have interrupting ratings as indicated on the Drawings or not less than 35KA otherwise.

2.02 Neutrals

A. Insulated neutral bars shall be furnished in all devices that contain a neutral conductor.

2.03 Ground Bars

A. Ground bars shall be furnished in all devices that contain a separate ground conductor.

2.04 Enclosures

A. Enclosures shall be as noted on the plans, or where types are not shown shall be type NEMA I where installed in dry locations and type NEMA 4X stainless steel where installed in locations subject to moisture. Enclosures shall be UL listed.

B. Raintight enclosures shall be equipped with raintight hubs sized for conduit as shown on the plans.

2.05 Manufacturer

A. Circuit Breakers shall be as manufactured by Square "D", Eaton, ABB., or Siemens.

PART 3. EXECUTION

3.01 Installation

A. All circuit breakers shall be coordinated with the proper trades to ensure proper mounting space and support.

END OF SECTION

[2280]
[08/2025]

SECTION 16201

STANDBY POWER GENERATOR

PART 1 GENERAL

1.01 Scope

A. This section outlines the quality, type and installation of the Standby Power Generator.

B. The standby engine-generator set, shall be furnished and installed as a complete system of the latest type and design. The engine generator set shall be completely built, factory tested and shipped as units by a manufacturer regularly engaged in the production of such equipment for the past ten years. The manufacturer shall manufacture the engine, alternator and controls and it must be assembled in the manufacturing plant. Dealer assembled and/or tested units shall not be considered as equal.

C. The generator supplier shall be the manufacturer's authorized distributor, who has served in this capacity for the last ten (10) years. The supplier shall have factory trained service technicians authorized to provide initial start-up services, conduct field acceptance testing, and warranty service an all equipment specified herein. The supplier shall maintain a permanent parts and service facility within fifty (50) miles of the job site. Service and parts shall be available on a twenty-four (24) hour per day basis seven days a week. The generator supplier shall verify to the Engineer that he has in stock at the above specified locations at least one piston-rod liner set, air and oil filter set and starter for each unit. The generator supplier shall have an established means of parts procurement whereby all parts can be delivered to the job site within 24 hours.

D. Furnish, install the complete engine generator set including a reinforced concrete isolated mounting pad, fuel system, cooling system, exhaust silencer, piping, duct work, excavation and accessories to complete the installation for operation as required and specified herein. Field test the entire installation after completion.

1.02 General Operation

A. The engine-generator set shall consist of an internal combustion engine directly connected to an AC generator, the equipment to automatically start the set upon power failure and automatically stop it on power return. The load shall be automatically transferred unless specifically noted otherwise on the drawings.

1.03 Manufacturer

A. The engine-generator set shall be a Model #C125D6D as manufactured by Cummins or approved equal by Caterpillar or Kohler

1.04 Shop Drawings

A. Complete shop drawings shall be submitted for review and shall include detailed specification data and information on the specific engine-generator proposed. Manufacturer's general product bulletins alone shall not be considered sufficient for review. Options and accessories to be furnished shall be clearly noted and drawings and/or literature provided. Provide thermal damage and decrement curves for the Generator-Alternator.

1.05 Factory Testing

A. The performance of the engine-generator set shall be tested as a unit at the factory and a performance chart shall be supplied to the Engineer indicating the results as to the sets full load ratings, voltage and frequency regulation.

PART 2 PRODUCTS

2.01 Engine-Generator Rating

A. The rating of diesel-engine-generator set shall be based on operation of the set when equipped with all necessary operating accessories such as radiator, fan, air cleaners, lubricating oil pump, fuel transfer pump, fuel injection pump, jacket water heater, generator and exciter regulator.

B. The set shall be rated 156 KVA at .8 power factor 125 KW, 277/480 volt, 3 phase, 4 wire, 60 Hertz. The set shall also be capable of supporting 497 KVA of motor starting without exceeding 15% voltage dip.

C. The above rating shall be for 60 Hertz operation at 1000 feet above sea level and an ambient temperature of 0 degrees F. minimum and 100 degrees F. maximum.

2.02 Engine

A. The engine shall be diesel fueled, water-cooled and shall be a full compression ignition, four-stroke cycle, turbocharged_] unit. The engine shall meet all specifications when operating on No. 2 domestic burner oi. Engine and generator operating speed shall be a maximum of 1800 RPM. Brake horsepower of the engine shall be not less than 320_] BHP at 00RPM according to the manufacturers standard published curves when operating under the environment parameters specified in sub-section 2.01 "ENGINE-GENERATOR RATING", paragraph "C". Special or maximum ratings are not acceptable. The engine shall have a minimum of 6 cylinders in an in-line configuration and a minimum displacement of 408 cubic inches. The engine shall be a standard product of the manufacturer. The manufacturer may be required, at the option of the Engineer to provide evidence that the engine type and design proposed has had a minimum of three (3) years field service prior to bid date.

B. The engine shall have suitable emission control equipment to ensure that gaseous exhaust emissions do not exceed the levels set forth by Federal, State and Local Government regulations.

C. Governor: The engine shall be equipped with an electric speed sensing governor capable of isochronous frequency regulation from no load to full load.

D. Furnish engine mounted instrument panel containing the following instruments: Lubricating oil pressure gauge, Water temperature gauge and Engine running time meter.

2.03 Exhaust And Intake System

A. Exhaust System: Exhaust piping shall be sized according to the engine manufacturer's recommendations which shall include increased sizing to compensate for restrictions such as length of run, number and degree of turns, etc. Exhaust piping shall be installed with adequate support to stand severe service and allow for expansion as required by operating temperatures. Sharp bends shall be avoided by use of sweeping long radius elbows. No weight shall be supported by the engine manifold. A section of seamless flexible exhaust pipe shall be installed between the engine manifold

and rigid exhaust piping. The muffler furnished shall be for "Critical Grade" silencing and shall be installed as close as practical to engine. An approved condensation trap shall be installed at the point where the rise in the exhaust system begins

B. Intake System: The system aspiration air shall be filtered as per the manufacturer's recommendations by dry type or oil bath filters.

2.04 Fuel System

A. The fuel system shall be in accordance with the engine manufacturer's recommendations and shall include all piping, pumps, filters, storage tanks, etc. Fuel lines shall be sized as recommended by manufacturer. A flexible section of tubing shall be used between the engine and the fuel supply line. A replaceable element fuel filter shall be conveniently located for servicing. The engine shall be equipped with a built-in fuel transfer pump capable of lifting fuel against a head of twelve (12) feet. Provide fuel cooler if required.

B. The main fuel tank shall be a capacity sufficient for 24 hours operation at 100% load, base mounted beneath the engine-generator rails, suitable for diesel fuel service, designed and constructed in accordance with NFPA 30, 37 and 110 and be UL 142 Listed and Labeled. The tank shall be designed to support the live load of the generator based on 200% of its wet weight. The tank shall be manufactured of 8 gauge commercial quality carbon steel with reinforced steel box channel for generator support. Tank shall be double wall construction with the exterior shell sized at not less than 1.1 times the tank capacity. Primary and Secondary tanks shall equipped with both normal and emergency vents. Exterior shell shall be furnished with a rupture/leak detector float switch. Exterior shall be prepared with Near White blast cleaning, primed and painted to match the engine generator unit. The fill and vent shall be extended outside the generator enclosure as directed by the equipment supplier. Where fill and vent openings are installed outside the generator enclosure vent openings shall be designed to prevent malicious fuel contamination and fill caps shall be tamper resistant and lockable. A continuously reading level indicator shall be installed in the primary tank. The secondary containment basin shall be equipped with leak detection that is monitored by the generator controller or otherwise has dry contacts that can be remotely monitored. The primary tank shall be equipped with a low fuel level switch for remote monitoring. Openings shall be provided in the tank for fuel suction, fuel return, vent, level gauge, water draw-off and others as required. The fuel tank shall be filled to at least 90% of its capacity, with Number 2 diesel fuel, at the time of acceptance by the Owner.

C. The fuel system shall, when fitted with all associated piping, controls, monitors and alarms, etc., result in an a complete installation which is in strict accordance with all Federal, State and local Government regulations.

2.05 Cooling System

A. The engine shall be equipped with an engine mounted radiator, fan, centrifugal pump for circulation of the engine coolant and accessories. The water temperature shall be thermostatically controlled. The radiator shall be sized to maintain safe operation at 100 degrees F. ambient temperature. The cooling system shall be filled with a solution containing 50% ethylene glycol with recommended corrosion inhibitors.

B. An engine mounted thermostatically controlled immersion type engine coolant heater shall be provided to ensure a minimum coolant temperature 100 degrees F. in a minimum room ambient of 0 degrees F. The heater shall be suitable for operation at 120 volts single phase. Heaters shall be Chromalox or equal.

2.06 Starting System

A. The engine shall be equipped with a 12 volt D.C. electric starting system of capacity recommended by the manufacturer. Batteries shall be maintenance free lead-acid having a minimum capacity of cranking the engine for at least 90 seconds at firing speed in the ambient conditions specified under 2.01, "ENGINE-GENERATOR RATING", paragraph "C", and to start the engine a minimum of four times without recharging. A battery rack of corrosion-proof construction (not wood) shall be provided and all necessary cables and clamps installed.

B. An automatic multi-stage (minimum of four) current limiting battery charger shall be furnished to automatically recharge and maintain batteries to optimize life and performance. It shall include voltage surge, reverse polarity and short circuit protection and shall have electronically limited current output. It shall display the output voltage and current. The following status conditions shall be annunciated both locally through LED indicators as well as through dry contact outputs for remote monitoring: AC power fail, charger fault, battery over voltage, battery under-voltage. Amperage output shall be no less than 10 amperes. The charger shall be mounted inside the generator enclosure by the manufacturer. .

C. An engine driven battery charging alternator capable of operating all generator accessories required for proper operation of the engine-generator set and simultaneously charging the battery shall be provided.

2.07 Engine-Generator Control Panel

A. The engine-generator shall have a microprocessor-based control system that is designed to provide automatic starting and stopping and monitoring; protection and control functions for the generator set . The control panel shall be mounted on the engine-generator with vibration isolation as required. All wiring connections shall be prewired to terminal strips. The control panel shall be NEMA 1, dead front construction.

B. A cranking limiter shall be furnished with a threer cycle cranking mode of fifteen seconds "On" and fifteen seconds "Off". This cranking cycle shall be controlled by a solid state timer.

C. The control panel shall contain, but not be limited to, the following equipment

1. AC Voltmeter, AC Ammeter, Frequency meter and running time meter.

2. Control Devices: Mode Selector Switch (Manual-Off-Auto), Fault Reset button, Emergency Stop button, Voltage and Frequency Adjustment switches.

3. Multi-line alphanumeric LCD display to display system status.

4. Engine start control contact (SPDT).

5. Contacts for remote monitoring of system status and alarms, as specified on the drawings, wired to terminal strips.

6. Generator run relay to open air dampers (relay to open when generator is running).

7. Generator run relay (relay to close when generator is running).

8. Emergency stop button mounted externally on the generator housing.

D. Remote Annunciator: A remote annunciator panel shall be furnished to provide visible and audible indication of all NFPA 110 level 1 required safety indications.

2.08 Generator Main Breaker

A. A generator main line molded case circuit breaker shall be furnished, size as shown on the drawings. The main circuit breaker shall be as specified under other sections of this specification. Breakers shall be equipped with lugs suitable for conductors shown on the drawings. Breaker enclosures shall be equipped with lugs for both ground and grounded (neutral) conductors. Breakers shall be equipped with auxiliary contacts wired to the generator controller and configured to indicate a fault condition when the breaker is open.

2.09 Generator

A. The AC generator shall be a revolving field synchronous type with the rotor coupled directly to the engine flywheel through a semi-flexible driving flange to ensure permanent alignment. The generator housing shall bolt directly to the engine flywheel housing. The rotor shall be supported by a single ball bearing and shall be dynamically balanced up to 25% overspeed. The field shall be equipped with full amortisseur windings. The generator shall conform to NEMA and IEEE Standards.

B. Excitation of the generator field shall be accomplished by a permanent magnet exciter system mounted on the generator motor shaft.

C. The voltage regulator shall be of the static magnetic amplifier type with silicon diode control. Voltage regulation shall match the characteristics of the generator and engine. The regulator enclosure shall be NEMA drip proof and the regulator shall be shock mounted to the generator. Voltage level adjustment shall be a minimum of plus or minus 5%.

D. Voltage regulation shall be within plus or minus 1 percent of rated voltage from no load to rated load. The steady state voltage stability shall remain within a 0.5% band of rated voltage.

E. For any addition of load up to and including 90% of rated load, the voltage dip shall not exceed 20% of rated voltage. The voltage shall recover to and remain within the steady band in not more than 1.5 seconds.

F. The frequency regulation from no load to rated load shall be in accordance with that defined by the engine governor performance. For any addition of load up to 90% of rated load, the frequency shall recover to the steady state frequency band within 5 seconds.

G. The alterator shall be equipped with a 120 volt anti-condensation heater.

2.10 Engine-Generator Mounting

A. The set shall be mounted on a welded base which shall provide suitable mounting on any level surface

2.11 Engine-Generator Housing

A. The engine-generator set shall be furnished complete with weatherproof housing. Side, front and rear panels shall be hinged, or removable, for inspection and maintenance access. All louvers used shall be designed to prevent the entry of water into the housing while the engine is idle or while running. The housing shall be approved for use by the engine manufacturer.

PART 3 EXECUTION

3.01 Installation Of Equipment

A. All equipment shall be properly secured in place.

B. Installation shall be according to the manufacturer's recommendations and shall be done in a neat workmanlike manner. The generator set shall be installed under the supervision of a factory trained technician.

3.02 Wiring

A. All wiring shall conform to manufacturers wiring diagrams and shall be installed in a neat manner, and in accordance with all other sections of the specification. Control wiring shall be stranded and terminated with ring terminals.

3.03 Mounting Foundation

A. An isolated steel reinforced concrete mounting foundation shall be provided for unit mounting and vibration dampening. Mass of concrete shall ,at a minimum, equal mass of engine generator.

3.04 Tests At Site

A. The entire standby power system shall be tested, in its installed location, to verify the proper operation of all components, including but not limited to: engine-generator set, distribution system wiring, automatic transfer switches, control wiring, fuel system and annunciators. Testing shall verify the performance of the engine-generator set as to the sets full power rating and regulation of voltage and frequency. In addition to performance logs, the report shall include a listing of all custom configured parameters in the generator and automatic transfer switch controllers as well as actual observed performance of all configurable time delays. A copy of the certified test results and performance log shall be supplied to Owner and Engineer.

B. After unit installation is complete, notification shall be given the Engineer of the unit's readiness for testing and intention of time of test start.

C. The system shall be tested in accordance with Level 1 Installation Acceptance Testing criteria as detailed in NFPA 110 (latest version), except the initial building load test shall continue for not less than two (2) hours and the full load test shall extend for a total of, not less than, four (4) hours with 100% nameplate kW applied for a minimum of three (3) hours.

D. All fuel and equipment necessary for the test, including load banks, recording frequency meter volt meter, and ammeter shall be furnished as part of this contract.

E. Testing shall be performed by a factory authorized technician.

3.05 Training Of Personnel

A. A factory authorized technician shall instruct the Owner's representative in the proper operation and maintenance of the equipment installed and shall furnish at least two copies of operating and maintenance instructions covering the engine generator and such auxiliary equipment as may require published operating instructions or periodic maintenance.

3.06 Operations And Maintenance Instruction

A. At the completion of the job, the generator supplier shall turn over to the Owner:

1. Three (3) sets of all equipment catalogs.

2. Three (3) sets of shop drawings on all equipment requiring same.

3. Three (3) sets of all equipment maintenance data including wiring diagrams, schematic drawings, circuit descriptions and technical data sheets for each component. Wiring diagrams shall include terminal location and identification.

4. Engine-alternator replacement parts list and ordering information.

5. Special tool list and ordering information.

6. Periodic maintenance schedules.

7. Spare parts: filters, lamps and fuses.

END OF SECTION

[2280]
[08/2025]

SECTION 16261

AUTOMATIC LINE TRANSFER SWITCHES

PART 1 GENERAL

1.01 Scope

A. This section outlines the quality, type and installation of the Automatic Line Transfer Switches.

B. The Automatic Line Transfer Switches shall be furnished and installed as shown on the drawings and specified herein. Transfer switches shall provide automatic engine-generator start-stop signals and shall automatically transfer the load on power failure and retransfer the load on restoration of normal power. Assemblies shall be complete, continuous duty, integral assembly, metal enclosed, dead front, indoor type. Switch components shall be coordinated electrically and mechanically so as to ensure operation as specified. The transfer switch assembly shall be factory wired and assembled so that only the external circuit connections will have to be made at the construction site. See Drawings for exact number, sizes and voltage of switches required.

1.02 Operation

A. Operation of Automatic Line Transfer Switches shall be such that all phases are monitored. In the event of normal source voltage failure or excessive drop, contacts for remote engine-generator start-stop controls shall close. A time delay on engine start-stop control contact closure shall be provided to override momentary normal source power outages. Once the (standby) power source reaches the selected voltage and frequency the transfer switch shall transfer to the (standby) position automatically. Re-transfer to the normal source shall have an adjustable time delay with an unloaded engine-generator running timer If the (standby) source fails during the time delay, it shall be by-passed and the transfer switch shall immediately transfer the load to normal power.

B. The transfer switch assembly shall be factory wired and assembled so that only external circuit connections must be made a the construction site.

1.03 Standards

A. Transfer switches, in addition to the requirements specified herein, shall conform with the latest requirements of NFPA and NEMA Standard ICS 10 and be listed to U.L. Standard 1008.

1.04 Service

A. The manufacturer shall have a local factory trained authorized service organization capable of providing quality service and replacement parts, for the transfer switch, located within 125 miles of the job site. Service shall be available 24 hours per day, 365 days per year, with a normal response time not to exceed eight (8) hours between receipt of a request for service and arrival of service personnel at the job site.

1.05 Clearance With Utilities

A. Where the electric utility company has requirements for the installation and/or use of emergency or standby generation and automatic transfer switching equipment for services connected to their system, it shall be the specific responsibility of the automatic line transfer switch manufacturer to comply with such requirements and to obtain any and all necessary equipment approvals from that utility.

1.06 Submittal

A. Submittal data on the transfer switch shall include but not be limited to all required data such as amperage, control options, enclosure type, terminal layouts, wiring diagrams, and physical details. Submittal data shall include detailed schematic and theory of operation of controls.

1.07 Manufacturer

A. Automatic Line Transfer Switches shall be as manufactured by Russelectric, ASCO, Kohler, Cummins or a prior approved substitute.

PART 2 PRODUCTS

2.01 Ratings

A. Provide switches in the number, configuration and ratings that are shown on the drawings. Switches shall be rated to carry 100% of the rated current continuously in the enclosure supplied. Indicated ratings apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of the switch amperage rating. .

B. Where a fourth pole (switched neutral) is specified the fourth pole shall be fully rated and identical to the primary phase poles.

C. Fault-Current Closing and Withstand (WCR) Ratings: Switches shall be tested and identified in accordance with UL 1008. Unless specified otherwise, switches shall utilize the corresponding 3 cycle "Time Based" rating to satisfy the specified WCR rating. Switches may also utilize the "Specific Breaker" rating where this rating is properly coordinated, by the contractor, with the switch's actual upstream overcurrent protective device and the switch is specifically identified as suitable for use with that breaker at the specified fault current level. All switches shall have a minimum WCR of 100kA (at 480V) when protected by Current Limiting Fuses (CLF).

2.02 Enclosure

A. The transfer switch with its auxiliary equipment shall be built into a NEMA standard control cabinet constructed of not less than code gauge steel. The enclosure shall be non-ventilated with hinged door. Door shall have provisions for padlocking. Enclosure shall be wall mounted so as not to be subject to vibration.

B. Enclosures installed outdoors shall be rated NEMA 4X and be constructed of stainless steel.

2.03 Switch Mechanism

A. The switch shall be double throw mechanically held, electrically operated utilizing momentarily energized solenoid operator(s). Operating current for transfer shall be obtained from the source to which the load is to be transferred The switch shall be capable of assuming the neutral position on retransfer to utility. Mechanical and electrical interlocks shall prevent normal and standby sources from energizing the load at the same time. The complete time of transfer shall not exceed 1/6 second. Main contacts shall be silver alloy with wiping action and protected by arcing contacts. Shaft mounted auxiliary contacts shall be rated 10 amperes at 480 volts, 60 Hertz. A manual operator shall be provided to allow for transfer in either direction.

B. The switch shall be capable of assuming the neutral position during transfer. Duration of the neutral position shall be determined by an adjustable programmed transition module. adjustable from 0-60 seconds, factory set at 0 seconds.

2.04 Control Panel

A. The Control Panel shall be isolated from the Switch Mechanism and shall be easily removed from the enclosure by means of plug connectors. The control panel shall have a protective cover.

B. Sensing and control logic shall be solid state, mounted on plug in printed circuit boards. Interfacing relays shall meet NEMA and IEEE test standards for general purpose type control relays. Relays shall be plug-in type with dust covers.

C. The control panel shall provide the following field adjustable functions:

1. Full phase close differential voltage monitoring of the normal source. Pick-up voltage sensing from 85% to 100% of nominal, factory set at 95%. Drop out voltage sensing from 75% to 98% of the pick-up voltage value.

2. Time delay on engine starting contacts from 0.5 to 90 seconds to override power dips, factory set at 30 seconds.

3. Lock out sensing to prevent transfer until source reaches adequate voltage and frequency. Voltage pick-up factory set at 90% and frequency pick-up factory set at 95%, each independently field adjustable.

4. Time delay on retransfer to normal of 0.5 to 30 minutes, factory set at 15 minutes.

5. Unloaded engine run time delay of 0 to 10 minutes after retransfer to normal, factory set at 5 minutes.

6. Programmed transition with switch assuming a neutral position for 0-60 seconds, factory set at 0 seconds.

7. Automatic exerciser, to exercise plant weekly unloaded for 15 minutes.

2.05 Accessories

A. The following accessories shall be provided as a part of each automatic line transfer switch:

1. Pushbutton on enclosure trim to by-pass time delay on retransfer to normal.

2. LED Pilot lights to indicate standby position and normal position, normal source available and standby source available.

3. Test switch mounted in trim of enclosure to simulate a power failure.

4. Two sets of auxiliary contacts, one to close on normal and one to close on standby (mounted on same shaft with main contacts).

5. Disconnect switch in series with engine starting contacts for maintenance.

6. Neutral lugs (as required by switch service, see Drawings).[_

7. Meter group consisting of AC voltmeter, AC ammeter, and frequency meter. Meters shall be connected to read values on the load side of the transfer switch. Metering shall maintain a time/date stamped log of peak values, based on a 15 minute average, of current and power.]

8. UPS to maintain controller functionality during extended start delays.

2.06 Service Entrance Transfer Switches

A. Where switches are shown on the plans to be used as “Service Equipment” equipment they shall be specifically intended, by the manufacture, for use as service entrance equipment, and labeled “Suitable for Use as Service Equipment” and listed for the application.

B. Switches shall contain over current protective devices as shown on the drawings.

C. The entire assembly shall be listed and labeled to UL 1008. Molded case circuit breakers shall be UL 489 listed.

PART 3 EXECUTION

3.01 Installation

A. Installation shall be in a neat and workmanlike manner. Wall mounted transfer switches shall be properly supported with additional wall support provided if required. Floor mounted transfer switches shall be installed on a 4” thick concrete pad extending a minimum of 3” beyond all sides and having beveled edges.

B. Engine-generator start-stop controls shall be coordinated with the requirements of the engine generator set, all necessary contacts and wiring shall be provided.

END OF SECTION

[2280]
[08/2025]

SECTION 16450

GROUNDING

PART 1 GENERAL

1.01 Scope

A. This section deals with the grounding of service equipment, transformers, surge protection equipment, non-current carrying conductive surfaces of equipment, metal buildings, structures and other equipment.

B. All grounded connections shall be installed in accordance with the National Electrical Code and all local codes and requirements. Such codes shall be considered minimum requirements and installation of the grounding system shall insure freedom from dangerous shock voltage exposure and provide a low impedance ground fault path to permit operation of overcurrent and ground fault protection devices.

PART 2 PRODUCTS

2.01 Conductors

A. Grounding conductors shall be insulated copper unless specifically shown or specified otherwise.

B. Grounding conductors shall be identified by green insulation or by green tape.

C. All buried grounding system wire shall be bare, solid, soft-drawn, annealed, copper sized #2 AWG minimum, or as shown on drawings.

2.02 Ground Rods

A. Ground rods shall be 5/8 inch by 10 feet, copperweld unless noted otherwise on the drawings.

2.03 Connections

A. The connection of a grounding conductor to other ground conductors, ground rods, building steel or process piping shall be by means of a cadweld or thermoweld process.

B. Grounding conductor connections to conduit terminations shall be made with approved ground bushings.

C. Where thermoweld connections are not practical, mechanical connections may be submitted for approval; submittals shall identify the specific application where each type of connection is proposed to be used. Connections shall be of the heavy duty, high copper alloy cast, bolted type or irreversible compression type equal to Burndy Hyground. Connectors shall be UL listed for the proposed application.

PART 3 EXECUTION

3.01 Main Service Ground

A. The main service shall have the grounded conductor (neutral) grounded to the grounding electrode system at the supply side of the service disconnecting means by a grounding electrode conductor not smaller than that shown in Table 250-66 of the NEC.

B. The grounded conductor (neutral), the grounding electrode conductor, and the equipment grounding conductor connections shall be made inside the service entrance equipment.

C. The equipment grounding conductor shall be connected to the grounded conductor on the supply side of the service disconnecting means in accordance with Article 250 of the NEC for the ampere rating of the service equipment.

3.02 Grounding Electrode System

A. Shall consist of each of the following electrodes bonded together by the grounding electrode conductors:

1. The grounding grid.

2. All underground metallic pipes.

3. The metal reinforcement of concrete structures and building footings.

4. Driven Ground Rods: as shown on the drawings.

5. Other grounding electrodes if available shall be connected to the grounding electrode system as described in Section 250-50 of N.E.C.

B. A No. 2 ground wire shall be installed on top of the main duct runs and connected to the utility system ground and all ground mats around structures. Others shall be as shown on the drawings.

C. Ground grids as shown shall consist of bare copper conductors and ground rods. Conductors shall be Number 2 AWG unless shown otherwise and be 30" below finished grade. Ground rods shall be 5/8" by ten foot copper clad steel. All connections shall be exothermically welded.

D. An earth impedance tester shall be utilized to determine the actual resistance to ground. The maximum acceptable resistance to ground is 5 OHMS, if this value or less is not obtained, additional ground rods shall be driven and connected in parallel until an instrument reading of less than 5 OHMS is obtained. All test readings shall be recorded and submitted to the Engineer for review.

3.03 Cadwelding

A. Cadwelding shall be performed in strict accordance with the manufacturer's requirements.

B. All personnel performing cadwelding shall have been trained by factory certified representatives and proof of this training shall be presented to the Architect/ Engineer at the time of Cadweld inspection.

C. Cadwelding shall not be performed during conditions of high humidity which inhibit the process from proper bonding. Consult the Manufacturer's instructions for acceptable conditions and do not attempt any Cadwelding during such times as these conditions do not exist.

D. Cadweld molds shall be sized and configured for the specific welding application. Molds which have been field modified for application other than their original purpose will not be utilized under any circumstance. Cadweld "one shot" connections shall not be utilized.

E. In no circumstances will worn out or loose Cadweld molds be utilized. Molds which experience "blow out" during the welding process shall be replaced immediately and any welds made which exhibit evidence of incomplete welding shall be cut off and rewelded.

3.04 Separately Derived Systems

A. Separately derived systems (dry type transformers with primary and secondary electrically isolated and secondary having a grounded circuit neutral conductor) shall be grounded in accordance with NEC Article 250.

B. Separately Derived Systems shall be grounded to the site grounding system.

3.05 Equipment Grounding

A. An equipment grounding conductor shall be installed in the same raceway with all circuit conductors.

B. Equipment grounding conductors shall be bonded at each enclosure. Where an equipment grounding bus, bonded to the equipment enclosure, is provided, all equipment grounding conductors shall be connected thereto. Where an equipment grounding bus is not provided, the contractor shall furnish and install ground bus as specified in Section 16120.

C. Metal conduits shall be made electrically continuous and shall be suitable to serve as the required equipment ground. At terminating ends all conduits shall be strapped together and connected to ground. Flexible conduit connections shall be jumpered with a ground wire strapped to conduit ends or connected between conduit and equipment.

D. All components of the instrument and control system shall have enclosures solidly connected to the plant grounding system. AC power sources to instrumentation and control equipment shall be grounded to the plant grounding system. Signal conductors shall be grounded at the device powering the loop. Signal conductor raceways shall be grounded.

END OF SECTION

[2280]
[08/2025]

SECTION 16459

DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01 1.01 Scope:

A. This section outlines the quality, type and installation for Dry Type Transformers.

B. Transformers shall be for indoor service unless shown exterior, single or three phase, and with KVA rating shown on the drawings.

PART 2 PRODUCTS

2.01 Transformer Insulation:

A. Transformers shall have Class H insulation and shall be constructed so that under full load the average conductor temperature does not exceed 115°C rise.

2.02 Taps

A. Transformers 30 KVA and above shall have 2 - 2 1/2% taps above and 4 - 2 1/2% taps below normal rated primary voltage.

B. Transformers below 30 KVA shall have 2 - 5% taps below normal rated primary voltage except that single phase transformers up to 10 KVA shall not require taps.

2.03 Sound Rating

A. The transformer core and coil shall be mounted on internal vibration isolator pads. Sound level shall not exceed the following:

KVA	**Design Sound Level**
45 - 150	50 dB
225 - 300	55 dB
500	62 dB

B. Sound levels shall be determined in accordance with NEMA and ASA Standards and certified test data shall be submitted at the request of the Engineer.

2.04 Enclosures

A. The transformer shall be protected by a ventilated metal enclosure. Ventilating openings shall have baffles. The enclosure shall be degreased, cleaned, phosphatized, primed and finished with baked enamel.

2.05 Vibration Isolators

A. All interior units shall be mounted utilizing spring type vibration isolators. See "MOUNTING", sub-section 3.01 of this Section.

2.06 Manufacturer

A. Transformers shall be Eaton, Square "D", ABB, or Siemens.

PART 3 EXECUTION

3.01 Mounting

A. Transformers shall be floor or suspended from structure as shown.

B. Maintain all required NEC 110.26 working clearances.

C. Contractor shall use extreme care to eliminate noise and vibration.

1. Interior floor mounting units shall be mounted on free standing spring isolators sized in accordance with actual weight of unit installed. Floor mounted spring isolators shall be Amber/Booth Type LXS, Consolidated Kinetics Type SM or approved equal.

2. Suspended units shall be suspended from structure utilizing steel channel and threaded rods (4). Provide in each rod spring isolators Amber Booth Series BS, sized on actual weight of unit.

3. All final connections to transformers shall be in flexible conduit.

D. A minimum of 4 inch space shall be allowed around all ventilation openings.

END OF SECTION

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SECTION 16461

PANELBOARDS-LIGHTING/RECEPTACLE

PART 1 GENERAL

1.01 Scope

A. Furnish and install circuit breaker lighting and/or receptacle panelboards as shown on the drawings and as specified herein. Panelboards shall be dead front type manufactured in accordance with Underwriter's Laboratories, Inc., standard of panelboards and enclosing cabinets and be so labeled.

B. Panelboards shall be factory assembled.

C. Where required, lighting/receptacle panelboards shall be labeled for use as service entrance equipment.

PART 2 PRODUCTS

2.01 Panelboard Boxes

A. Panelboard boxes shall be fabricated from sheet steel (galvanized or equivalent rust-resistant). The size of the wiring gutters and gauge of steel shall be in accordance with NEMA and U.L. Standards for panelboards unless shown or specified to be larger.

B. Boxes shall not be furnished with prepunched knockouts except where otherwise noted.

C. Boxes for panelboards with 18 or more single pole circuit breaker spaces shall be 20 inches wide.

D. Boxes for outdoor use shall be rated NEMA 4X and be constructed of stainless steel.

2.02 Panelboard Fronts And Trims

A. Fronts shall be designed for surface or flush mounting as shown on the drawings and shall include hinged door, lock and latch.

B. Fronts for flush panels shall overlap the box by a minimum of 3/4 inch all around. Surface fronts shall have the same overall dimensions as the box.

C. Nema 1 fronts shall be of double hinged door construction. The entire cover assembly shall be hinged and secured closed with screws. The cover assembly shall open to provide access to bussing and panelboard live parts without removal of the complete cover. A hinged inner door, with key lock, shall provide access to circuit breaker trip handles only and shall expose no live parts.

D. Fronts shall be Code gauge steel with interior and exterior surfaces cleaned and finished with gray baked enamel over a rust-inhibiting phosphatized coating.

E. All panelboards, except those installed in motor control centers, shall be furnished with locks. Locks shall be flush, cylinder type, held in place by concealed screws to a captive nuts welded to the inside of the door. All panelboard locks shall be keyed alike.

F. A circuit directory with clear plastic cover shall be affixed to the inside of the door.

G. Panelboards shall have no exposed or accessible live parts when the front is installed whether the door is open or closed.

2.03 Panelboard Bus Assembly

A. Bus bars shall be silver plated copper and all connectors shall be plated.

B. Bussing shall be arranged for distributed phase arrangement so that one, two, and/or three pole breakers may be installed in any location. The removal, replacement or installation of circuit breaker units shall be allowable without disturbing adjacent units and without drilling or tapping.

C. Ampacity, service voltage, service entrance (main breakers or lugs) and branch breakers shall be as shown on the drawings.

D. Neutral bars shall be full sized and equipped with lugs to accommodate all conductors to be connected.

E. Ground bars shall be furnished in all panelboards, equipped with lugs to accommodate all conductors to be connected. Where more than one ground bar is furnished, each shall be interconnected with a conductor sized not less than the panelboard feeder grounding conductor.

F. Multi-section panelboards shall be furnished, as indicated on the panelboard schedule or on the plans, in equal bus sections and mounted in equal sized enclosures.

G. Unless noted otherwise, sub-feed lugs and feed through lugs shall utilize a full sized conventional main lug arrangement bolted directly to the main bus; branch mounted lug kits will not be accepted.

2.04 Circuit Breaker Arrangement

A. Circuit breakers shall be bolt-on, factory installed.

B. The entire left row shall be filled, then begin top right.

C. Breakers shall be numbered vertically beginning top left. Multi-section panelboards shall be numbered consecutively through all sections.

D. Circuit breaker numbers shall be plastic or metallic, permanently attached to trim. Stick-on paper numbers will not be accepted.

2.05 Circuit Breakers

A. Circuit breakers shall be quick-make, quick-break, thermal magnetic, trip indicating, molded case type, alternating current. Breakers shall trip free of the handle and tripping shall be indicated by the handle assuming a position between "OFF" and "ON". Multiple pole breakers shall have internal common trip with single operating handle; external handle ties are not acceptable.

B. Single pole breakers shall be UL listed as "Switching Breakers" and shall carry the "SWD" marking.

C. Breakers shall be bolt-on type.

D. Where noted on the panelboard schedule or on the plans ground fault protection breakers shall be provided:

1. Circuit breakers identified as Ground Fault (GF) or GFCI sized 0-60 ampere, in 1, 2 and 3 pole configurations on systems rated 150 volts or less to ground, shall have integral UL labeled Class A ground fault protection (4-6 milliampere sensitivity). This feature shall not require additional panelboard space.

2. Circuit breakers sized 0-100 ampere identified as Ground Fault Protection of Equipment (GFPE) shall have integral 30 milliampere sensitivity ground fault protection. This feature shall require no additional panelboard space, except that circuit breakers rated 277/480 volts may utilize one additional pole space.

E. Main Breakers shall be thermal magnetic industrial frame equal to Square D "H" frame or larger. Main breakers shall not be branch mounted.

F. Where branch breakers are noted to be equipped with breaker handle locking attachments: Attachments shall be capable of padlocking the breaker in either the on or off position and shall be arranged so that it cannot be readily removed, in accordance with the provisions of NEC 110.25.

G. Other breaker accessories shall be furnished as shown on the drawings.

2.06 Panelboard Equipment Short Circuit Rating

A. Each panelboard, as a complete unit, shall have a fully rated short circuit current rating equal to or greater than the rating shown on the panelboard schedule or on the plans. Where the rating is not shown larger on the drawings, the minimum short circuit rating shall be 10,000 amperes symmetrical for panelboards with up to 240 volt rating and 14,000 amperes symmetrical for panelboards with 277/480 volt rating. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage.

2.07 Special Requirements

A. Any special requirements on the drawings, such as for increased interrupting rating, ground fault protection, etc., shall supersede these specifications, but only insofar as that particular requirement is concerned.

B. Panelboards larger than 400A shall conform to the requirements for power panels.

2.08 Manufacturer

A. Panelboards shall be as manufactured by ABB, Siemens, Square D, Eaton or approved equal.

PART 3 EXECUTION

3.01 Installation

A. All panelboard dimensions shall be carefully checked and coordinated with the proper trades to ensure proper mounting space and support.

B. Panelboards to be surface mounted on exterior walls shall be secured to two (2) vertical runs of 7/8" x 1-5/8" steel strut each 8'- 0" minimum in length and securely anchored to the wall by means of lead anchors or toggle bolts.

C. Where multi-wire branch circuits are used, provide a means to simultaneously disconnect all ungrounded conductors in accordance with NEC 210.4(B).

D. Wiring in panelboard gutters shall be done in a neat and workmanlike manner. To avoid derating of conductors otherwise required by NEC 310.15(C) wiring shall not be bundled.

E. Panelboard directories shall be typewritten and shall be field verified by the contractor to ensure accuracy. Directories shall include adequate descriptions to allow accurate identification of the load and location served.

END OF SECTION

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SECTION 16462

PANELBOARD POWER

PART 1 GENERAL

1.01 Scope

A. Furnish and install power panelboards as shown on the drawings and as specified herein. Power panelboards shall be dead front type, manufactured in accordance with Underwriter's Laboratories, Inc., standard of panelboards and enclosing cabinets and be so labeled.

B. Panelboards shall be factory assembled.

C. Panelboards shall contain circuit breakers as shown in the panelboard schedule on the drawings.

D. Panelboards shall be labeled for use as service entrance equipment where required.

PART 2 Products

2.01 Panelboard Boxes

A. The panelboard assembly shall be enclosed in a sheet steel cabinet of rigidity and gauge as specified in UL Standards 50.

B. Single section cabinets shall not exceed 72 inches in height unless noted otherwise on the drawings. Boxes shall have a minimum width of 26 inches. Clear space from bottom of lugs to bottom of gutter shall be in accordance with U.L. Standards.

C. Panelboard boxes shall be galvanized or equivalent rust-resistant.

D. The size of the wiring gutter shall be in accordance with U.L. Standards 67 except where noted to be larger.

2.02 PanelBoard Fronts and Trims

A. Power panelboards shall be equipped with hinged door fonts to conceal overcurrent protection devices unless noted otherwise on drawings or specified herein.

B. Where so designated on the drawings power panelboards shall be furnished with a four piece trim in lieu of a separate door. Each top, bottom and side wireway shall be provided with an individual wireway section cover secured to the panelboard enclosure with screws.

C. Surface mounted power panelboards shall be equipped with fronts which have the same overall dimensions as the box.

D. Flush mounted power panelboards shall be equipped with fronts which overlap the box by a minimum of 3/4 inch all around.

E. Fronts shall have interior and exterior steel surfaces cleaned and finished with gray baked enamel over a rust-inhibiting phosphatized coating.

F. Panelboards shall have no exposed or accessible live parts when the front is installed.

G. Power panelboard fronts with doors shall be of double hinged door construction. The entire cover assembly shall be hinged and secured closed with screws. The cover assembly shall open to provide access to bussing and panelboard live parts without removal of the complete cover. The hinged inner door shall provide access to circuit breaker trip handles only and shall expose no live parts.

2.03 Panelboard Bus Assembly

A. Power panelboard bussing shall be rated as shown in the panelboard schedules on the drawings. Such ratings shall be established by heat rise test with maximum hot spot temperature on any connector or bus bar not to exceed 50 degree C. rise above ambient, at full rated load.

B. Bussing shall be silver plated copper.

C. Ampacity, service voltage, service entrance (main breakers, main switches or lugs) and branch breakers shall be as shown on the drawings.

D. Neutral bars shall be full sized and equipped with lugs to accommodate all conductors to be connected.

E. Ground bars shall be furnished in all panelboards, equipped with lugs to accommodate all conductors to be connected. Where more than one ground bar is furnished, each shall be interconnected with a conductor sized not less than the panelboard feeder grounding conductor. Each ground bus shall be sized 25% minimum of panelboard bussing.

2.04 Circuit Breakers

A. Circuit breakers shall be arranged so that the face of each breaker shall be flush with the other breakers. Large permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". The breaker ampere rating shall be clearly visible when the breaker is installed in the panelboard. Unless otherwise shown on the drawings or specified, circuit breakers shall be standard molded case type.

B. Circuit breakers shall be bolt-in or, where panelboard bus is of I-line construction, shall be equipped with bolted bus connectors.

C. Standard Molded Case Circuit Breakers: shall be quick-make, quick-break, thermal magnetic type for alternating current. Each pole shall provide inverse time delay overload and instantaneous short circuit protection. Multi-pole breakers shall be internal common trip with single operating handle. Circuit breakers shall be trip free so that contacts cannot be held closed against abnormal circuits. Breakers shall be completely enclosed in a molded case and shall be GE "E" frame or larger.

2.05 Panelboard Equipment Shirt Circuit Rating

A. Each panelboard, as a complete unit, shall have a fully rated short circuit current rating equal to or greater than the rating shown on the panelboard schedule or on the plans. Where the rating is not shown larger on the drawings the minimum short circuit rating shall be 18,000 amperes symmetrical for panelboards with up to 240 volt rating and 25,000 amperes symmetrical for panelboards with 277/480 volt rating. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

2.06 Special Requirements

A. Any special requirements on the drawings, such as for increased interrupting rating, ground fault protection, etc., shall supersede these specifications, but only insofar as that particular requirement is concerned.

2.07 Manufacturer

A. Panelboards shall be as manufactured by ABB, Siemens, Square "D", Eaton or approved equal.

PART 3 EXECUTION

3.01 Installation

A. All panelboard dimensions shall be carefully checked and coordinated with the proper trades to ensure proper mounting space and support.

B. Panelboards to be surface mounted on exterior walls shall be secured to two (2) vertical runs of 7/8" x 1-5/8" steel strut each 8'- 0" minimum in length and securely anchored to the wall by means of lead anchors or toggle bolts.

C. Wiring in panelboard gutters shall be done in a neat and workmanlike manner. To avoid derating of conductors otherwise required by NEC 310.15(C) wiring shall not be bundled.

3.02 Branch Circuit Identification

A. Each branch circuit overcurrent device installed in a power panelboard shall be identified by an engraved nameplate mounted adjacent to the device.

END OF SECTION

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