

SECTION 26 24 13

SWITCHBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install switchboards.
 2. Provide testing, troubleshooting and startup for the furnished equipment.
- B. Related Sections:
1. Section 26 05 53, Identification for Electrical Systems.
 2. Section 26 05 73, Electrical Power Distribution System Studies.
 3. Section 26 43 00, Surge Protective Devices.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. NEMA PB2, Dead-Front Distribution Switchboards.
 2. UL 891, Dead-Front Switchboards.

1.3 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer: Shall have not less than five years experience manufacturing and servicing materials and equipment substantially similar to those required and upon request shall submit documentation of not less than five installations in satisfactory operation for at least five years each.
 2. Manufacturer shall manufacture circuit protective devices within the assembly.
- B. Component Supply and Compatibility:
1. Obtain all materials and equipment included in this Section regardless of component manufacturer from a single switchboard manufacturer.
 2. Switchboard manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by switchboard manufacturer.
- C. Regulatory Requirements: Comply with the following:
1. NEC Article 408, Switchboards and Panelboards.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Three-line diagrams.
 - b. Dimensional information including front view elevation and plan view.
 - c. Construction details of enclosures with conduit entry locations and connection details between assemblies.
 - d. Components list and nameplate schedule.
 - e. Summary sheets with schedules of equipment.
 - f. Key interlock scheme and sequence of operation.
 2. Product Data:
 - a. Manufacturer's technical information, including catalog information.
 - b. Manufacturer's technical specifications with assembly and component ratings.
 - c. Time current curves for protective devices.
 3. Testing Plans, Procedures, and Testing Limitations:
 - a. At least thirty days prior to factory testing, submit description of proposed factory testing methods, procedures, and apparatus.
 - b. At least thirty days prior to field testing, submit description of proposed testing methods, procedures, and apparatus.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. Certifications required in this Section.
 2. Source Quality Control Submittals:
 - a. Report of results of testing and inspections performed at manufacturer's shop.
 3. Site Quality Control Submittals:
 - a. Report of results of field testing.
 4. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 5. Qualifications Statements:
 - a. Manufacture, when requested by ENGINEER.
- C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

- c. Include record drawings of control schematics, with point-to-point wiring diagrams.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Upon delivery, check for evidence of water that may have entered equipment during transit.
- B. Handle equipment in accordance with manufacturer's instructions. One copy of these instructions shall be furnished with equipment at time of delivery.
- C. Storage:
 - 1. Store switchboards equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
 - 1. Eaton/Cutler-Hammer.
 - 2. General Electric.
 - 3. Schneider Electric/Square D Company.
 - 4. Approved equivalent.

2.2 SWITCHBOARD EQUIPMENT

- A. Ratings:
 - 1. Switchboard shall be 600-volt class, suitable for operation on three-phase, 60-Hertz system.
 - 2. System operating voltage, number of wires, bus ampacity, and short circuit withstand capability and interrupting rating shall be as shown on the Drawings, or as otherwise indicated in the Contract Documents.
- B. General:
 - 1. Switchboards shall be dead-front type with individual and group-mounted devices, front-accessible.
 - 1. Switchboards shall be dead-front type with individual mounted devices, rear-accessible.
 - 2. Arrange switchboards with number of sections and compartments required for distribution arrangement shown.
 - 3. Switchboard shall consist of bus system, structure, circuit breakers, metering, surge protective device (SPD), and enclosure.

4. Switchboards shall be in accordance with NEMA PB2, UL 891, and NEC Article 408.
- C. Bus Bars:
1. Switchboard bus bars shall be tin-plated copper, supported with high-impact, non-tracking insulating material. Secure bus joints with Belleville type washers, and braced bus joints for mechanical forces exerted during short circuit conditions. Mount main horizontal bus bars with all three phases arranged in the same vertical plane.
 2. Bus bar sizes shall be based upon a maximum temperature rise of 65 degrees C over a 40-degree C ambient in accordance with NEMA PB2 and UL 891.
 3. Provide copper ground bus, minimum size of 1/4-inch by two inches, secured to each vertical section and extending entire length of equipment. Ground bus current capacity shall equal one-half the capacity of main power bus.
 4. Conductor hardware shall be high-tensile strength and zinc-plated. Provide bus joints with conical spring-type washers.
- D. Structure:
1. Equipment structure shall be completely self-supporting and shall include required number of vertical sections bolted together to form a single metal-enclosed enclosure.
 2. Enclosure shall be rated NEMA 1.
 3. Enclosure structure frame shall be die-formed, 12-gauge steel bolted together and reinforced.
 4. Equipment shall have identifying nameplates in accordance with Section 26 05 53, Identification for Electrical Systems. Provide nameplates for each breaker circuit and provide typewritten directory of circuits.
 5. Cover sides and rear of enclosure with removable, bolt-on covers. Edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within enclosure.
 6. Sections of switchboard shall be front- and rear-aligned with depth as shown on the Drawings. Devices shall be front-removable and load connections shall be front-accessible.
 7. Provide assembly with adequate lifting means so that assembly is capable of being moved to its installation position.
 8. Conduit entry and exit shall be bottom entry and coordinated by CONTRACTOR.
 9. Quantity of conduits and cables associated with each feeder shall be as shown or indicated on the Drawings.
- E. Circuit Breakers:
1. Circuit breakers shall be molded case type with quantity of poles, voltage, and current ratings shown.
 2. Breakers shall be manually-operated thermal magnetic type, including inverse-time overload and instantaneous short-circuit protection. Contacts

shall be non-welding silver alloy and arc extinction shall be accomplished by arc chutes.

3. Breakers shall be operated by a toggle-type handle and shall have quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of breakers shall be clearly indicated by handle position.
 4. Where shown or required due to capacity, breakers shall be insulated case type. Insulated case breakers shall be manually-operated with stored energy mechanisms. Breakers shall include open-close pushbuttons, five-cycle close time, and rotary operated stored energy handle mechanism providing quick make/quick-break protection.
 5. Breakers shall have 100-amp frames, minimum. Provide overload protection on all poles, with trip settings as shown. Breakers with frame sizes 250 amps and below shall have thermal-magnetic trip units and inverse time-current characteristics, or equal.
 6. Provide breakers 400-amp frame and larger with an electronic solid state adjustable trip unit. For four-wire power systems and circuits, provide a neutral current transformer, and trip unit shall be suitable to accept neutral input. Provide push-to-trip button on front of circuit breaker to provide local manual means of exercising trip mechanism. Electronic trip system shall include:
 - a. Plug-in protection programmer, flux shift trip device, and current sensor package. Construct programmer, sensor, and flux-shifting trip device as integral elements of breaker, requiring no externally mounted assemblies for proper operation.
 - b. Solid state, microprocessor-based, nine-function programmer shall provide true RMS current sensing and include adjustable continuous and instantaneous current elements with adjustable long time, short time, zero sequence ground fault pickup and delay and zone selective interlocking. Main, tie and feeder circuit breakers shall be connected for zone selective interlocking to allow instantaneous bus protection.
 7. Where shown, provide breakers with shunt trips, bell alarms, and auxiliary devices.
- F. Provide main meter device as shown on the Drawings, and in accordance with the following.
1. Type 1 Microprocessor-based Monitoring Device:
 - a. Device shall provide complete electrical metering in one package. Device shall include self-contained potential transformers and self-protected internal fuses.
 - b. Mount device on compartment door to allow personnel access to meter menu and display.
 - c. Device shall include trend analysis, event logging, and recording. Device shall include the following direct reading metered values:
 - 1) Volts: 0.2 percent accuracy.
 - 2) Amperes: 0.2 percent accuracy
 - 3) Watts, Vars, and VA: 0.5 percent accuracy

- 4) Power Factor: 1.0 percent accuracy
 - 5) Frequency: 0.05 percent accuracy
 - 6) Watts, and VA Hours: 0.5 percent accuracy
 - 7) Var Hours: 1.0 percent accuracy
 - 8) Watts, Var, and VA Demand: 0.4 percent accuracy
 - 9) THD-Voltage: 50th harmonic
 - 10) THD-Current: 50th harmonic
 - 11) Individual Ampere Harmonics: 50th harmonic
 - 12) Individual Voltage Harmonics: 50th harmonic
- d. Metering device shall have the following additional features:
- 1) Trend analysis that shall display minimum and maximum values for each metered parameter with date and time of each occurrence.
 - 2) Input range of device shall accommodate external current transformers with ranges from 100/5 to 5000/5 and potential transformers from a ratio of 120:120 to 500,000:120. Three current transformers suitably rated shall be included.
 - 3) Alarm contacts rated five amps at 120 vac.
 - 4) Three analog outputs programmable to reflect the metered parameters, except kilowatt hours and kilovar hours.
 - 5) Communication capability, using RJ45 connection, Modbus TCP Protocol as indicated on the Drawings
2. Type 2 Microprocessor-based Monitoring Device:
- a. Device shall provide complete electrical metering in one package. Device shall include self-contained potential transformers and self-protected internal fuses.
 - b. Mount device on compartment door to allow operator access to meter menu and display.
 - c. Device shall include trend analysis, event logging, and recording. Device shall include the following direct reading metered values:
 - 1) Volts: 0.2 percent accuracy.
 - 2) Amperes: 0.2 percent accuracy
3. Control power shall be drawn from the monitored incoming AC line. Device shall have non-volatile memory and not require battery backup. During power failure, device shall retain preset parameters.

G. Wiring/Terminations:

- 1. Provide small wiring, necessary fuse blocks, and terminal blocks in switchboard as required. Control components mounted in assembly, such as fuse blocks, relays, pushbuttons, switches, and other components, shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- 2. Provide mechanical-type terminals for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of size indicated on the Drawings.
- 3. Provide lugs in incoming line section for connection of main grounding conductor. Provide additional lugs for connection of other grounding conductors as indicated on Drawings.

4. Control wire shall be Type SIS, bundled and secured with nylon ties. Provide insulated locking spade terminals for all control connections, except where saddle type terminals are provided integral to a device. Current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to another device. Provide groups of control wires leaving switchboard with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.
- H. Accessories:
1. Provide a surge protective device in accordance with Section 26 43 00, Surge Protective Devices, for each switchboard bus shown or indicated on the Drawings. Each surge protective device shall be included and factory-mounted within switchboard-by-switchboard manufacturer. Surge protective device monitoring and display shall be visible from switchboard front.
- I. Miscellaneous Devices:
1. Provide control power transformers with primary and secondary protection, as indicated on the Drawings or as required for proper operation of equipment.
- J. Finishing:
1. Exterior and interior steel surfaces of switchboard shall be properly cleaned and provided with rust-inhibiting phosphatized coating by switchboard manufacturer. Color and finish of switchboard shall be light gray.

2.3 SOURCE QUALITY CONTROL

- A. Tests:
1. Factory-test switchboards in accordance with NEMA PB2 and UL 891
 2. Perform factory tests on equipment prior to shipment. Tests shall consist of the manufacturer's standard tests, and shall include:
 - a. Physical inspection and checking of all components.
 - b. Operation and device function tests under simulated service conditions to verify accuracy of wiring and functioning of all equipment.
 - c. Primary, control, and secondary wiring hi-pot tests.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Do not energize equipment without permission of OWNER.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. After installation, inspect and perform field testing of each switchboard. Testing and inspections shall be by Supplier's factory-trained representative, in accordance with manufacturer's recommendations. Inform OWNER and ENGINEER when Supplier's representative indicates that equipment is correctly installed.
 - 2. Perform the following tests and checks before energizing equipment:
 - a. Verify proper installation.
 - b. Inspect all mechanical and electrical devices for proper operation.
 - c. Check tightness of bolted connections.
 - d. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.
 - e. Measure insulation resistance of each circuit breaker, pole-to-pole and from pole-to-ground.
 - f. Check for proper anchorage, required area clearances, physical damage, and proper alignment.
 - g. Clean and lubricate as required.
 - h. Perform other tests and adjustments recommended by equipment manufacturer.
- B. Manufacturer's Services: Provide services of qualified, factory-trained serviceman to perform the following:
 - 1. Instruct CONTRACTOR in installing equipment.
 - 2. Inspect and adjust equipment after installation and ensure proper operation.
 - 3. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
 - 4. Manufacturer's technician shall make visits to the Site as follows:
 - a. First visit shall be for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-Site: 4 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel.

- 1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.
 - 2) Training requirements, duration of instruction and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - 3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
- d. Technician shall revisit the Site as often as necessary until installation is acceptable.
6. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 ADJUSTING

- A. Calibrate, set and program protective devices. Coordinate the protective devices furnished under this Section and provide proper settings of devices per the results of the study specified in Section 26 05 73, Electrical Power Distribution System Studies.

++ END OF SECTION ++