SECTION 26 24 13 – SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Refer to Section 260571 “Power System Study” for overcurrent protective device coordination and submittal requirements.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Surge protective device.
4. Instrumentation.
5. Accessory components and features.
6. Identification.
7. Mimic bus.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Refer to Section 260571 for Fault Current Coordination and ARC Flash Report requirements.

C. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include diagram and details of proposed mimic bus.
7. Include schematic and wiring diagrams for power, signal, and control wiring.

D. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 2.

E. Comply with NFPA 70.

F. Comply with UL 891.

G. Comply with UL1449 3rd Edition for Surge Protective Devices (SPD)

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards, store indoors, and provide temporary heating according to manufacturer’s written direction to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations: Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

2.2 MANUFACTURED UNITS

A. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections front and rear aligned.

B. Ratings: Provide nominal system voltage, continuous main-bus amperage, and short-circuit current ratings as indicated.

1. Where two distribution sections are provided, vertical/branch bussing in each distribution section shall be rated a minimum of 75% of the main-bus amperage.
2. Where three or more distribution sections are provided, vertical/branch bussing in each distribution section shall be rated a minimum of 67% of the main-bus amperage.

C. Nominal System Voltage: 480Y/277 V, 60 Hz.

2.3 FABRICATION AND FEATURES

A. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

B. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

C. Hinged Front Panels: Allow access to circuit-breaker, metering, accessory, and blank compartments.

D. Buses and Connections: Three (3) phase, four (4) wire, unless otherwise indicated. Include the following features:

1. Phase- and Neutral-Bus Material: Hard-drawn tin-plated copper of 98 percent conductivity with feeder circuit-breaker line connections.

a. Use copper for feeder circuit-breaker line connections.
b. Provide 100% neutral bus.

2. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
3. Ground Bus: 1/4-by-2-inch (6-by-50-mm) minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors.
4. Contact Surfaces of Buses: Silver plated.
5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

E. Barriers:

1. Main Circuit Breaker Section: Provide barrier between main circuit breaker section and any distribution section. Provide horizontal barrier if distribution breakers are mounted in same section as main circuit breaker.
2. Metering Compartment: Provide barriers separating metering compartment from main circuit breaker. Meter, display, and fuses shall be capable of being accessed and replaced without exposure to main circuit breaker terminals.

F. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with full interrupting capacity to meet available fault currents.

1. Electronic Trip Circuit Breakers: Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip and individually field-adjustable long time, short time, and instantaneous trip pickup level settings. Trip unit shall also have adjustable long time and short time delay settings. Provide trip unit power supply for 0-100% current indication. Provide for all switchboard circuit-breaker frame sizes.
   a. Ground Fault Protection: Any 1000A-rated circuit breaker or larger, above 150V L-G, shall have ground fault pickup and time delay settings in addition to overcurrent trip settings indicated above, or where indicated.
   b. For service equipment with ground fault protection on the main circuit breaker, include ground fault protection within the service switchboard on the next level feeder breakers (regardless of rating) immediately downstream of the service disconnect to limit service disconnect nuisance ground fault trip.
   c. Energy Reducing Maintenance Switching with local status indication: All circuit breakers rated 1200A and larger shall have reduced energy let-through switch protection in addition to overcurrent trip settings indicated above.
2. Breakers Serving Transfer Switches: Type and Frame size as required to meet “Specific Coordinated Molded Case Breaker” as required by automatic transfer switch for a minimum 42,000 A withstand rating.
3. Molded-Case Circuit-Breaker (MCCB) Features:

   a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

4. Molded-Case Circuit-Breaker (MCCB) Accessories (where indicated):

a. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
b. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   1) Ground-Fault Personnel Protection (GFI or GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   2) Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
e. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.5 SURGE PROTECTIVE DEVICES

A. General: Externally mounted, modular, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules. All Surge Protective Devices (SPD) systems shall be modular permanently connected, parallel designs. Series suppression elements shall not be acceptable. SPD system shall be a hybrid design utilizing thermally Protected Metal Oxide Varistors and Filter capacitors to suppress EMI/RFI electrical noise

B. The SPD shall be rated for 480/277VAC, three-phase, four-wire plug ground. The SPD system shall provide surge protection in all possible modes (L-N, L-G, L-L, and N-G). Each replaceable module shall provide the ability to deliver full surge current rating per mode.

1. Per Mode: 250 kA.
2. Per Phase: 500 kA.

C. The SPD shall provide EMI/RFI electrical noise attenuation of 36 to 44dB in the range of 50 kHz to 100 MHz.

D. Voltage Protection Ratings: The UL 1449 3rd Edition Voltage Protection Ratings “VPR” (6kV, 3000 Amps, 8/20µs waveform) shall not exceed the UL assigned values listed below:

1. L-L: 2000 V.
2. L-N, L-G, N-G: 1200 V.

E. The SPD shall have a minimum UL 1449 3rd Edition Nominal Discharge Current Rating (I_n) of 10,000 Amps.

F. Each individual module shall feature a green LED indicating the individual module has all surge protection devices active and a red LED indicating protective device is off-line.

G. Accessories shall include the following:

1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
2. Audible alarm activated on failure of any surge diversion module.
3. Six-digit transient-counter set to totalize transient surges that deviate from the sine-wave envelope by more than 125 V

H. Connect SPD leads into an unoccupied branch overcurrent device. Device shall be located immediately adjacent to the branch overcurrent device serving it. Factory leads shall not be extended or spliced, device must be installed in a manner to utilize the factory leads. Device shall not be mounted to removable panels on the switchboard.

2.6 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

    a. Phase Currents, Each Phase: Plus or minus 1 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    d. Megawatts: Plus or minus 2 percent.
    e. Megavars: Plus or minus 2 percent.
    f. Power Factor: Plus or minus 2 percent.
    g. Frequency: Plus or minus 0.5 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
    j. Contact devices to operate remote impulse-totalizing demand meter.

2. Communications: Meter shall have a communications/network interface module, which enables the meter to communicate to the building automation system (BAS) via RS-485 Modbus protocol and a network management system via Owner's network infrastructure. The interface module shall include internal hardware and software to communicate (via SNMP and HTTP) to any I.P.-based Ethernet network through a RJ-45 connector. The module shall have redundant paths for

communications that make it possible to connect to the BAS using Modbus while simultaneously communicating to through SNMP and HTTP. A terminal block shall be provided to connect to Modbus.

3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.7 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic nameplate.

B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Install filler plates in unused spaces of panel-mounted sections.

E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

3.3 CONNECTIONS

A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.4 IDENTIFICATION

A. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Physical inspection and Testing

a. Verify equipment rating correspond to drawings and specifications.
b. Inspect the physical and mechanical condition and verify that it complies with manufacturer’s standards.
c. Verify equipment is properly secured and aligned with the required clearances as specified in the drawings and specifications. Assure that the equipment is properly grounded.
d. Verify that all packing materials have been removed and the equipment has been cleaned.
e. Confirm all breaker sizes, quantities, and configurations correspond to the drawings and specifications.
f. Confirm bolted electrical connections are provided with high impedance using one of the following means:
    1) Measure the resistance with a low-resistance ohmmeter. Bolted electrical connection resistances shall be compared to resistances measured on similar connections. Any similar resistance values that deviate more than 50 percent should be investigated.
    2) Inspect the bolted connection and verify that it is at the manufacturer’s rated torque using a calibrated torque wrench. If manufacturer’s data is not available verify the torque meets the requirements of Table 100.12 in the ANSI/NETA ATS-2009.

g. A thermographic test shall be conducted. Equipment will be open at the time of the scan in order to get an accurate reading from the testing device. All equipment should be energized and loaded during test. Thermographic images of any connections that fail the test must be submitted with a description of the failure including the probable cause of the failure.
h. Inspect any moving electrical components and ensure that proper lubricant is applied to allow for easy operation.
i. Verify insulators have not sustained physical damage or been exposed to contamination.
j. Verify all active components operate correctly.

2. Electrical Inspection and Testing
   a. Test ground resistance at the main electrical distribution ground bus.
   b. Verify all meters functionality and accuracy after testing and calibrating all inputs.
   c. Verify transformers meet all the requirements of the drawings and specifications.
      1) Test transformer wiring integrity and proper transformer operation.
      2) Verify transformer output voltage is at the specified level.
   d. Verify phases are connected to the same bus for switchboards with multiple sources so that loads do not cross phases when sources are transitioned.

3. Test Reports: Prepare a written report to record the following:

   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.6 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges. Unless otherwise noted, trip settings shall mimic trip characteristics for thermal magnetic circuit-breakers of similar trip rating.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 26 24 13