

SECTION 26 24 13

SWITCHBOARDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Switchboards.
- B. Buses.
- C. Circuit breakers.
- D. Instruments, controls, and accessories.
- E. Source quality control.

1.02 MEASUREMENT AND PAYMENT

1. General: Switchboards, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump sum price for Electrical Work as indicated in the Bid Schedule of the Bid Form.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 1. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B. California Code of Regulations (CCR):
 1. Title 24, Part 2 California Building Code
 2. Title 24, Part 3 California Electrical Code
- C. Institute of Electrical and Electronics Engineers (IEEE):
 1. IEEE C37 Circuit Breakers, Switchgear, Substations, and Fuses.
 2. IEEE C57.13 IEEE Standard Requirements for Instrument Transformers
 3. IEEE C37.20.1 Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear
 4. IEEE C37.13 Low-Voltage AC Power Circuit Breakers Used in Enclosures
 5. IEEE C37.17 Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers

SWITCHBOARDS

- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA PB 2 Deadfront Distribution Switchboards
- E. Underwriters Laboratories Inc. (UL):
 - 1. UL 489 UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
 - 2. UL 891 UL Standard for Safety Switchboards
 - 3. UL 1066 UL Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
- F. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code

1.04 REGULATORY REQUIREMENTS

- A. Refer to Section 20 70 26, Common Materials and Methods for Electrical Systems, for requirements

1.05 SUBMITTALS

- A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
 - 1. Refer to local utility electrical service requirement for service switchgear
- B. Product Data: Submit manufacturer's product data for all manufactured materials and equipment. Submit certified reports of factory tests performed on each switchboard unit.
- C. Shop Drawings: Submit detailed Shop Drawings as follows:
 - 1. Master Drawing Index
 - 2. Single line diagrams;
 - 3. Physical arrangement drawings, and weight of equipment and major components;
 - 4. Unit wiring diagrams;
 - 5. Drawings showing space available for conduit entrance and for routing and training of cables. Available space shall take into consideration bending radius requirements of cables;
 - 6. Schematic diagrams for electrically operated equipment;

7. Nameplates Schedule
 8. Component List
 9. Schematic diagrams and templates if anchoring in concrete is required.
 10. Setting diagrams and templates if anchoring in concrete is required;
 11. Assembly and erection diagrams if shipped in sections or if any parts are shipped separately and not installed at the factory; and
 12. Interconnection diagrams for circuits having externally located instruments, controls, alarms, or similar devices.
 13. Assembly rating including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current rating
 14. Major component rating included:
 - a. Voltage
 - b. Continuous current rating
 - c. Interrupting rating
 15. Protective Device Time-Current Curves
- D. Operation and Maintenance Data: Submit data in accordance with Section 01 78 23, Operation and Maintenance Data, including the following requirements:
1. Description of the switchboard and its components;
 2. Manufacturer's operating and maintenance instructions, parts list, illustrations, and diagram for components;
 3. Recommended list of spare parts;
 4. Wiring diagram;
 5. Electrical characteristics of each component including relays or solid state circuitry; and
 6. Relay coordination curves.
- E. Field Test Reports: Submit certified field test reports verifying compliance with Specification requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Securely wrap, package, and label each unit for safe handling during shipment.
- B. Brace and package the equipment for easy and safe handling. Clearly label temporary internal bracing of equipment as "Temporary Bracing: To Be Removed Before Operation."
- C. Use a mechanical impact recorder during shipment, capable of registering maximum acceleration. Submit impact record chart to the Engineer.
- D. Store switchboard in secure and dry storage facility.

PART 2 – PRODUCTS**2.01 SWITCHBOARDS**

- A. Switchboard Requirements
 1. Furnish distribution switchboards that are completely metal enclosed, self supporting, dead front, freestanding, circuit-breaker type for indoor service, that comply with NEMA PB 2, the California Electrical Code, and that are UL listed in accordance with UL 891.
 2. Furnish the required number of vertical sections bolted together to form a rigid switchboard. Furnish the number, type, and ratings of circuit breakers and protective devices as indicated.
 3. Furnish switchboards completely assembled, wired, and tested at the manufacturer's plant. If approved by the Engineer, switchboards may be broken down into convenient shipping sections subsequent to the completion of the tests. Separate shipping split terminals shall be provided and connections disconnected for shipping shall be properly identified and protected.
 4. Switchboards in the same line up fed electrically from different feeders shall have barriers such that a fire caused by an internal fault at one switchboard shall not spread to another switchboard.
- B. Ratings: Furnish completed switchboards rated for service on 480 V, three- phase, four-wire power systems. Symmetrical short circuit current ratings, breaker frame sizes, number of poles, trip unit characteristics, instrument ratings, instrument transformer ratings, and control equipment ratings shall be as indicated. Switchboard current ratings shall be based on operations in a 25 degrees C room ambient.
- C. Physical Size: Furnish switchboards 90 inches high, and of width and depth adequate to accommodate and connect the equipment. Vertical sections shall be aligned front and rear, and shall be equipped with rear doors.

2.02 BUSES

- A. Requirements: Provide silver-plated copper buses of sufficient size to limit the current density to 750 A per square inch cross-section. Brace distribution switchboard buses for the symmetrical fault current indicated.
- B. Main Buses: Extend main buses horizontally from the incoming line sections to all distribution sections if indicated on the same line up. Make provision for extending the main buses for future vertical sections. Neutral bus shall be fully rated, and shall be carried by a neutral pole in the automatic transfer switch.
- C. Section Buses: Extend section buses vertically from the main bus through each vertical section.
- D. Ground Buses: Extend a ground bus through the length of the switchboard and firmly bolt to each vertical section in at least two places. Make provision for connection to the building or station grounding system near each end of the ground bus. Make provision for future extension of the ground bus.
- E. Phasing: Phase buses A B C from left to right, top to bottom, and front to rear as viewed from the front of the switchboard.
- F. Bus Connections: Bus connections shall be made only by means of machine screws into threaded holes or with through-bolts with washers and nuts. Connections shall be provided with lock washers for mechanical locking.

2.03 CIRCUIT BREAKERS

- A. Provide circuit breakers of the draw out mounted, stored energy, electrically operated type, 480 V, three-phase, 60 Hz, in accordance with NEMA PB 2 and UL 891, with the following additional requirements:
 - 1. Rated continuous current: As indicated.
 - a. Symmetrical interrupting rating: As indicated.
 - b. Maximum of five cycle closing time.
 - 2. Breakers shall be equipped with solid state trip unit with voltage and current sensors as indicated, and as required. and a minimum of seven time/current systems coordination adjustment, including ground fault and under-voltage settings.
 - 3. Insulation rating of plug shall be the same as the breaker rating.
 - 4. Circuit breakers shall be capable of performing 4000 close open cycles at rated load, 80 percent power factor and rated voltage, and 4000 close open cycles at no load without maintenance and replacement of parts.
 - 5. Breakers shall have control power and motor charging device of 120 V ac.
 - 6. Breakers shall be equipped with field replaceable contacts.

B. Molded-Case Circuit Breakers

1. Molded-Case type circuit breakers shall be mechanically operated with over-center toggle.
 - a. Rated continuous current: As indicated and as required.
 - b. Symmetrical interrupting rating; As indicated, and as required.
 - c. Maximum of five cycle closing time.
2. Breakers shall be equipped with a solid-state trip with voltage and current sensors as indicated and as required and time/current system coordination adjustment, including ground fault and under-voltage setting.
3. Insulation rating of plug shall be the same as the breaker rating.
4. Breakers have control power and motor charging device of 120V ac.

2.04 INSTRUMENTS, CONTROLS, AND ACCESSORIES

A. Potential Transformers: IEEE C57.13, wound type with polarity markers, suitable for operating meters and relays, with the following additional requirements:

1. Voltage ratio: 480 V primary to 120 V secondary.
2. Insulation class: 600 V with basic impulse insulation level of 10 kV full wave.
3. Temperature Rise: Maximum allowable temperature rise shall not exceed 55 degrees Celsius under continuous full load above an average ambient temperature of 25 degrees Celsius.
 - a. By winding resistance: 30 degrees Celsius.
 - b. By hottest spot in winding: 40 degrees Celsius.

B. Current Transformers:

1. Provide current transformers in a separate compartment isolated from the meter section. Provide metallic shielding to protect current transformers and secondary wiring from induced voltages and to minimize the possibility of insulation failure.
2. Current Transformers shall be bushing or epoxy encapsulated wound type. Secondary terminal blocks shall have covers with integral shorting bars. Secondary wiring shall be connected to readily identifiable terminal block points in the control compartment. Terminal block points shall have integral shorting bars for the current transformer leads.
3. Provide current transformers capable of withstanding thermal and magnetic stresses from the flow of the interrupting and momentary currents of the circuit breakers. Current transformers shall have a mounting frame bolted securely to the switchgear frame. Current transformers shall comply with IEEE C57.13

requirements for relaying accuracy classification under the burdens imposed by the devices specified or implied herein.

C. Meters:

1. Type: IEC 60051, square, taut band, transformer rated, ironvane.
2. Dial: Approximately 4-1/2 inches square, graduated from zero to full range with black figures on white background.
3. Voltmeter rating: 600 V. Ammeter rating: 125 percent of circuit rating, or as indicated.
4. Accuracy Class: One percent of full scale.

D. Relays:

1. Provide one lock out relay for preventing the breaker to re-close after abnormal conditions, except under-voltage.
2. Provide one time delay relay, adjustable from 0 to 6 seconds, for use with under-voltage relay.

E. Control Switches:

1. Provide control switch as required and indicated.
2. Provide relay test switch.
3. Provide manual pushbutton at the front of breaker housing for testing breaker.

F. Control and Instrument Wiring: Provide factory-installed wiring in accordance with the following requirements:

1. Wire: Provide type SIS tinned copper wire not smaller than 14 AWG. Class D stranded wire, not smaller than 12 AWG, shall be used for wiring across hinged joints.
2. Wire Terminals: Tinned copper ring compression terminals with insulated sleeve installed in accordance with the manufacturer's requirements.
3. Terminal Blocks: Provide washerhead screws suitable for ring compression terminals with insulated sleeve. Provide a minimum of 10 percent spare terminals.
4. Position Switch and Auxiliary Contacts: Provide position switch and breaker auxiliary contacts as indicated.
5. Wire Connections: Controls, relays, and metering circuit terminals requiring external connections shall be wired to accessible terminal blocks. Interconnecting wires terminated on terminal blocks shall be provided in each cubicle.

6. Wire Identification: Each wire shall be provided with plastic strip, attached adjacent to terminal connection, marked with the number indicated on the wiring diagrams, and positioned with the label facing out for ease of identification.
- G. Fuses: Provide current limiting fuse in each control circuit.
 - H. Enclosure: Freestanding type, designed for group assembly to be part of complete indoor ac distribution, with the following additional requirements:
 1. Enclosure shall be reinforced with adequate steel framework to form a rigid structure with a smooth outer surface free from burrs, ridges, and other blemishes.
 2. Enclosure shall be fabricated from zinc coated steel sheet conforming to ASTM A653/A653M, zinc coating designation G90.
 3. Enclosure metallic surfaces shall be thoroughly cleaned, degreased, treated with hot phosphate chemical bath, primed with corrosion inhibiting undercoat primer, and painted with finish coat of heavy-duty, industrial-grade, polyurethane enamel, in standard color as selected by the Engineer.
 - I. Automatic Transfer Switch: Provide automatic transfer switch as required by Section 26 32 13, Engine Generators.
 - J. Nameplates: Provide nameplates on each switchboard assembly, individual cabinets, and internal components including relays, switches, lights, and other devices. Nameplates shall conform to the requirements of Section 20 70 26, Common Materials and Methods for Electrical Systems
 - K. Space Heater: Provide a thermostatically controlled space heater having capacity sufficient to maintain interior temperature above dew point in each cubicle. Space heater rated voltages shall be as follows:
 1. Heaters 1.8 kW and over: 480 V, three phase.
 2. Up to 1.8 kW: 208 V, three phase.
 3. Up to 200 W: 120 V, single phase.

2.05 SOURCE QUALITY CONTROL

- A. In addition to the manufacturer's standard tests, as a minimum perform the following tests at the manufacturer's plant:
 1. 60 Hz dielectric tests;
 2. Mechanical operations tests;
 3. Grounding of instruments;
 4. Transformer case tests;

5. Electrical operation tests; and
6. Control wiring checks.

2.06 COMMUNICATION CAPABILITIES

- A. The transfer switch shall be capable of being connected in any of the following network configurations. Interactive Windows(tm) software developed for ATS applications shall be available. The software shall monitor, allow alteration of values, and provide system diagnostics. All values and ATS indications shall be available through the networks.
- B. Point-to-Point Connectivity: It shall be possible to connect the ATS directly to a personal computer in the following ways:
 1. Local Connection - Maximum cable length 50 feet (15 meters) using RS232.
- C. A local area network shall be capable of addressing and interfacing with up to 30 control modules.
- D. The communication cable shall run in separate conduit.

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Install, wire, and connect switchboards ready for operation in accordance with these Specifications, the manufacturer's installation instructions, and as indicated.

3.02 WIRING AND CONDUIT WORK

- A. Refer to Section 20 70 26, Common Materials and Methods for Electrical Systems, Section 20 50 13, Raceways for Facility Services, and Section 26 05 24, Low Voltage Wires and Cables.

3.03 GROUNDING

- A. Refer to Section 26 05 26, Grounding and Bonding for Electrical Systems.

3.04 SWITCHBOARD INSTALLATION

- A. Install switchboards in the locations indicated, secure, plumb and level, and align with related adjoining work. The switchboard anchorage and installation shall conform with California Building Code seismic-restraint requirements. Install switchboard on a 4-inch-high concrete pad with leveling channels.
- B. Provide anchor bolts and anchorage items as required, and field check to ensure proper alignment and location. Provide templates, layout drawings, and supervision

at the jobsite to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.

- C. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, and angles as required to set and rigidly connect the switchboard.
- D. Provide temporary bracing, guys, or other devices as required to accomplish erection and to provide safety and stability until work is in final position and approved.
- E. Control erection tolerance requirements so as not to impair the strength, safety, serviceability, and appearance.
- F. Exercise special care during construction to avoid overloading any part of the structure. Repair or replace items damaged due to overloading.

3.05 FIELD TOUCH-UP PAINTING

- A. After installations are complete, thoroughly clean surfaces where shop paint coating is missing or abraded bare steel, including bolts, nuts, washers and welds, and paint each item with the same paint system as used for shop painting. Provide touch-up painting by approved spray methods or brush where spray-painting is not practical.

3.06 FIELD TESTS

- A. Provide equipment for testing power, lighting, and control circuits after installation, including service test kit. Test under the observation of the Engineer, and demonstrate the following attributes:
 1. Verify that circuits are connected in accordance with the applicable wiring diagrams.
 2. Verify that circuits are continuous and free from short circuits.
 3. Verify that the insulation resistance to ground of non-grounded conductors is megger tested to not less than 10 M Ω .
 4. Verify that the completed equipment grounding system is megger tested at each service disconnect enclosure ground bar to ensure connection to ground.
 5. Verify that circuits are operable. Conduct tests to include operating each control not less than ten times, and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

END OF SECTION 26 24 13