

SECTION 262413 - SWITCHBOARDS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Service and distribution switchboards rated 600 V and less.
 2. SPD devices.
 3. Disconnecting and overcurrent protective devices.
 4. Instrumentation.
 5. Control power.
 6. Accessory components and features.
 7. Identification.

1.2 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, SPD device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Integrated Short-circuit current rating of switchboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring

1.3 QUALITY ASSURANCE

- A. 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.
- B. Comply with NEMA PB 2.
- C. Comply with NFPA 70.
- D. Comply with UL 891.

1.4 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS**2.1 GENERAL REQUIREMENTS FOR SWITCHBOARDS**

- A. Refer to the drawings for Voltage, Amperage, Mains rating type/size, flush or surface mount, and AIC integral rating of each switchboard.

- B. All electrical distribution equipment shall be of one manufacturer, unless specifically noted otherwise or approved by the Engineer.
- C. Switchboard layouts on the drawings are based upon one manufacturer. Verify dimensions of proposed manufacturer's equipment for compliance with layout shown on the drawings prior to bidding. Any required layout changes due to larger equipment sizes shall be submitted to the Engineer prior to bidding. NFPA 70 working clearances shall be maintained at all times.
- D. Panelboard Short-Circuit Current Rating: Each device within a panelboard shall be rated to interrupt a symmetrical short-circuit current level indicated in the panelboard schedule on the drawings. Do not use series ratings for devices within a panelboard.
 - 1. Minimum "integrated" ratings (fully rated) unless noted otherwise in the panelboard schedule on the drawings:
 - a. 208V power distribution panelboards: 100,000 AIC
 - b. 480V power distribution panelboards: 65,000 AIC

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:

	Square D	Eaton
600V (4000A max)	QED	POW-R-LINE C

- B. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- C. Indoor Enclosure: Steel, NEMA 250, Type 1.
 - 1. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Outdoor Enclosure: Steel, NEMA 250, Type 3R.
 - 1. Enclosure Finish for Outdoor Units: Factory-applied finish in manufacturer's standard color, including undersurfaces treated with corrosion-resistant undercoating.
- E. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- F. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 3. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- G. Phase and Neutral Buses and Connections: Three phase, four wire unless otherwise indicated. Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 1. Ground Bus: 1/4-by-2-inch- minimum size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors.
 - 2. Main Phase Buses Neutral Bus and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

3. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables.

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

2.3 SURGE SUPPRESSION DEVICES

- A. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
 1. Fuses, rated at 200-kA interrupting capacity.
 2. LED indicator lights for power and protection status.
 3. Audible alarm, with silencing switch, to indicate when protection has failed.
 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device.
 5. Transient-event counter set to totalize transient surges.
- B. Peak Single-Impulse Surge Current Rating: **120 kA per mode/240 kA per phase.**
- C. Withstand Capabilities: 5000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 and 208Y/120-V, three-phase, four-wire circuits shall be as follows:
 1. Line to Neutral: 800 V for 480Y/277; 400 V for 208Y/120.
 2. Line to Ground: 800 V for 480Y/277; 400 V for 208Y/120.
 3. Neutral to Ground: 800 V for 480Y/277; 400 V for 208Y/120.
- E. All switchboards shall receive Surge Protection Device (SPD).

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with **interrupting capacity** to meet available fault currents as indicated in panel schedules.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: **Mechanical** style, suitable for number, size, trip ratings, and conductor material.

- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: **Integrally mounted** relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: **Circuit-breaker-mounted** communication module with functions and features compatible with existing power monitoring and control system.
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at **[55] [75]** percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - h. Auxiliary Contacts: **[One SPDT switch] [Two SPDT switches]** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
- 1. Fixed circuit-breaker mounting.
 - 2. Two-step, stored-energy closing.
 - 3. **Standard**-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time time adjustments.
 - c. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Remote trip indication and control.
 - 5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."

2.5 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
- 1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 3. 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.
- 2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.6 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- B. Arc Energy Reduction: Energy reducing maintenance switching with local status indicator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install switchboards and accessories according to **NEMA PB 2.1**.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in **Section 033000 "Cast-in-Place Concrete."**
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch 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 a lightning surge arrester on main service entrance per manufacturers installation instructions (Square D Cat. No. SDSA3650 or equal). Refer to plans for voltage and phasing of service.
- F. Install over-current protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.

- G. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. 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 Section 260553 "Identification for Electrical Systems."

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Tests and Inspections:
1. Follow NECA 90, Annex A Electrical Testing Procedures.
 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove panel fronts so joints and connections are accessible to portable scanner.
 - a. Instrument: Use an infrared scanning device designed to measure temperature and detect significant deviations from normal values. Minimum resolution 320x240, 45deg. field of view. Equal to Flir E8-XT or Fluke TiS60. Provide calibration record for device used. Follow instructions of test equipment used.
 - b. Comply with ASTM E1934-99a. Standard guide for Examining Electrical and Mechanical equipment with Infrared Thermography.
 - c. Prepare a certified report identifying items checked and describing results of scanning. The infrared thermographer shall provide documentation for all infrared examinations. The following information shall be included in a report to the end user:
 - 1) The name, affiliation, address, and telephone number of the infrared thermographer, and his/her certification level and number, if applicable.
 - 2) The name and address of the end user,
 - 3) The name(s) of the assistant(s) accompanying the infrared thermographer during the examination,
 - 4) The manufacturer, model and serial number of the infrared imaging system used,
 - 5) The inventory list with notations of the items of equipment that were examined and explanations for the items not examined. Also, the items with low-emissivity surfaces should be identified.
 - 6) The date(s) of the inspection and when the report was prepared.

- 7) When performing a qualitative infrared examination, the infrared thermographer shall provide the following information for each item identified:
 - a) Its exact location.
 - b) A description, such as its significant nameplate data, phase or circuit number, rated voltage, current rating and/or rotation speed.
 - c) The measured voltage and measured current.
 - d) The ambient air temperature and, when relevant, the wind speed and direction and the sky conditions at the time of the examination.
 - e) The time the item was documented.
 - f) Hardcopies of the thermal image (thermogram) and of a corresponding visible-light image.
 - g) The field of view or magnification multiplier of the infrared imager lens, and any imager settings that could affect the accuracy, reliability, or repeatability of the inspection data.
 - h) Notation of any attenuating media, such as windows, filters, atmospheres, or external optics.
 - i) A subjective repair priority rating provided by the qualified assistant or end user representative, or both, based on the importance of the exception to the safe and profitable operation of the facility.
 - j) Any other information or special conditions which may affect the results, repeatability, or interpretation of the exception.
- d. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
4. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 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.

END OF SECTION 262413