PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.

B. Related Sections include the following:
   1. Division 26 Section "Seismic Controls for Electrical Work."
   2. Division 26 Section "Electrical Power Metering."

1.02 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

F. TVSS: Transient voltage surge suppressor.

1.03 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, TVSS device, ground-fault protector, 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, including required clearances and service space around equipment. 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. Short-circuit current rating of switchboards and overcurrent protective devices.
d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.

e. Utility company’s metering provisions with indication of approval by utility company.

f. UL listing for series rating of installed devices.

g. 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.

C. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section 16071. Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."

3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. Field Test Reports: Submit written test reports and include the following:

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.

F. Manufacturer’s field service report.

G. Maintenance Data: For switchboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," 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.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: In accordance with Section 16030.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NEMA PB 2.
D. Comply with NFPA 70.
E. 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.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path.
B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250-W per section) to prevent condensation in NEMA 3 or NEMA 3R enclosures.
D. Handle switchboards according to NEMA PB 2.1.

1.06 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. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner Representative not less than fourteen days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.

2. Indicate method of providing temporary utilities.

3. Proceed with utility interruptions only after receiving Owner Representative written authorizations.

C. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.

2. Altitude: Not exceeding 6600 feet.

D. Service Conditions: NEMA PB2, usual service conditions, as follows:

1. Altitude not exceeding 6600 feet.

2. Ambient temperatures within limits specified.

1.07 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.08 EXTRA MATERIALS

A. Spares: For the following:

1. Potential transformer fuses.

2. Control-transformer fuses.

3. Fuses and fusible devices for fused circuit breakers.

4. Fuses for fused switches.

5. Fuses for fused power-circuit devices.

B. Spare Indicating Lights: Six of each type installed.
PART 2 - PRODUCT

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   4. Square D Co.

2.02 MANUFACTURED UNITS

A. Front-Connected, Front-Accessible Switchboard: Panel-mounted and Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
B. Front- and Side-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
C. Front- and Rear-Accessible Switchboard: Front and rear aligned, with features as follows:
   1. Main Devices: Fixed, individually mounted.
   2. Branch Devices: Individually compartmented and fixed mounted.

D. Nominal System Voltage: 480Y/277 V and/or 208 Y/120 V
E. Main-Bus Continuous: 2000 A maximum, 600 A minimum

2.03 FABRICATION AND FEATURES

A. Enclosure: Steel: NEMA 250, Type 3R (outdoors) and NEMA 250 type 1 (indoors)
B. Enclosure Finish for Outdoor Units: Factory-applied finish in manufacturer's standard color, including undersurfaces treated with corrosion-resistant undercoating, or plated with cadmium or zinc.
C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard light gray enamel finish over a rust-inhibiting primer on treated metal surface. Coat internal surfaces with corrosion resistant paint, or plate with cadmium or zinc.
D. Barriers: Between adjacent switchboard sections.
E. Insulation and isolation for main and vertical buses of feeder sections.
F. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

G. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
   1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.

H. Owner’s Metering and SCADA Equipment Compartment: Fabricated compartment and section complying with Owner’s requirements. If separate vertical section is required, match and align with basic switchboard.

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

J. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.

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

L. Pull Box on Top of Switchboard: Include the following features:
   1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.

M. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the following features:
   3. Ground Bus: 1/4-by-2-inch minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
   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.


7. Neutral Buses: 100 percent of the ampacity of the phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.

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

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.


3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with 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 I²t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Compression style, suitable for number, size, trip ratings, and material of conductors.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.


4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

6. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

8. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.

2. Two-step, stored-energy closing.

3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments with I^2t response.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. Remote trip indication and control.
5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

6. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

7. Control Voltage: 125- V ac.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.05 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
   1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
   2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
   3. Control-Power Transformers: Dry type.
   4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays 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.
   2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.06 CONTROL POWER

A. Control Circuits: 120 V, 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.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: To test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.


D. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

PART 3 - EXECUTION

3.01 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.02 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

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

3.03 INSTALLATION

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

B. Support switchboards on concrete bases, 4-inch nominal thickness.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Work."
D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures.

F. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section 26 05 53.

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.05 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. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.06 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies switchboards checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.07 ADJUSTING
   A. Set field-adjustable switches and circuit-breaker trip ranges.

3.08 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 and leave touch-up paint with Owner.

END OF SECTION 26 24 13