

SECTION 26 24 13**SWITCHGEAR, SWITCHBOARDS, PANELBOARDS and CIRCUIT BREAKERS****PART 1 - DESIGN DIRECTIVES****1.1 RELATED SECTIONS**

- A. Section 26 21 00 - Low-Voltage Electrical Feeder Entrance.
- B. Section 26 10 00 - Medium-Voltage Electrical Distribution and Feeder Entrance.
- C. Power Study: Short circuit, overcurrent coordination and arc flash hazard analysis study.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 20 00 - Transformers.
- F. Section 26 16 00 - Electric Metering.
- G. Section 26 05 53 – Identification for Electrical Systems.

1.2 DESIGN CRITERIA

- A. Construction Documents:
 - 1. Drawings must contain a schedule for each panelboard/switchboard.
 - a. Clearly indicate the following:
 - 1) Type, voltage rating, number of pole spaces, main bus ampacity, main circuit breaker or main lug ampacity, flush or surface mounting, and short-circuit rating.
 - 2) Circuit Breakers:
 - a) Describe trip size and number of poles (1P, 2P or 3P) for all spaces.
 - b) Show space connections (i.e. 1, 3, and 5).
 - c) Show bus connections (A, B, and C).
 - d) Show other attributes such as gfci, afci, shunt trip, etc.
 - e) Connected load for each breaker.
 - 3) Total connected load for each phase and for all phases.
 - a) Indicate total connected load and diversity factor used in calculating demand load.
 - b. Make schedules available for review by Dartmouth FOM prior to release of final drawings and specifications for construction.
- B. Location:
 - 1. Panelboards:
 - a. Locate In secure rooms/areas or rooms/areas capable of being locked.

- b. When installed in recessed walls or where conduits rise through inaccessible ceilings: Have spare conduits stubbed out to an accessible location.
 - 2. Switchgear, Switchboards: Located in dedicated, secure electrical rooms.
- C. Ground Fault Protection:
 - 1. If specified where not required by NEC, consultant must present technical reasons for ground fault protection.
 - 2. If ground fault protection (trip function) is provided on the building and/or distribution main device, then ground fault protection shall be provided on the next level of distribution feeder devices.
- D. Overcurrent Protection Devices:
 - 1. LSI(G) electronic trip devices shall be provided where full selective coordination is required, and where arc-flash hazard reduction can be achieved through trip unit adjustments. In general, LSI(G) electronic trip devices shall be provided for:
 - a. Building Main disconnects
 - b. Circuit breakers 400A and above.
 - 2. Draw-out protective devices shall be specified/provided in switchgear and switchboards for devices 1000A and above.
- E. Double-Ended Substations are preferred for critical use facilities only such as data centers, critical infrastructure (chiller plants, heating plants), and scientific research buildings/facilities.
 - 1. Transfer (throw-over) Controls
 - a. Transfer (throw-over) Controls shall be presented by manufacturer and discussed during design phase.
 - b. Automated, PC controls are now standard for most double-ended switchgear. These controls offer increased safety in switchgear operations.
 - c. Switchgear transfer controls should allow for electricians to operate switchgear remotely.
 - d. As baseline, double-ended switchgear controls shall offer enhanced manual controls with automatic control safeguards from closing into faults, etc.
 - 2. Uninterrupted Power Supplies shall be located in separated accessible cabinets.
 - 3. Where feasible, buss-tie transfer shall be closed transition.
- F. Spare Breakers and Spare Spaces for new installations (renovation work may be excepted).
 - 1. Panelboards shall have minimum 20% spare branch circuit breakers and 10% spare spaces for future branch circuit breakers.
 - 2. Switchboards and distribution panelboards shall have minimum one spare feeder breaker provided for each frame size of breaker.
 - 3. Switchboards and distribution panelboards shall have spare breaker space provided. A minimum of 20% or two spaces of the largest frame breaker, whichever is greater.
 - 4. Switchboards shall be equipped with all necessary bus work to connect the future breaker(s).

G. Arc Flash Mitigation

1. Energy Reduction Maintenance Switch is required on all switchboards, switchgear with Main OC Devices above 800A or with an arc flash hazard category of Dangerous (above 40 cal/cm²).
2. Separation of Building Main OCD from Distribution Panelboards/Switchboards Sections is required. Methods may include:
 - a. Separate Enclosure for Main OCD.
 - b. ARC Flash Barrier between adjacent switchboard sections.
 - c. Exception – if building feeder originates from a secondary overcurrent device, the Main OC Disconnect may be incorporated within the Main Distribution switchboard/panelboard.
3. Remote operators shall be provided for circuit breakers on equipment with an arc flash hazard category of Dangerous (above 40 cal/cm²) or where the arc flash hazard boundary exceeds the space.
4. Insulation for main bus of main section and main and vertical buses of feeder sections.
5. Arc Protection System– shall be specified for switchboards and switchgear over 1000 Amps. The Arc Protection system shall trip the main secondary breaker, or main primary OCD if an electronic relay is present.
6. Alternative Arc Flash Mitigation Systems shall be evaluated, such as:
 - a. UFES (as manufactured by ABB) – active high-speed device to extinguish arc in <4 milliseconds.
 - b. Arc resistant switchgear.

H. Power Studies – Short Circuit Overcurrent Coordination and Arc Flash Hazard Analysis.

1. The electrical specification shall include a requirement to prepare a coordination study.
2. Power study shall be performed in SKM software.
3. The FOM-Engineering will provide the available fault current for the point at which the building is connected to the medium or low voltage system.
4. The Commissioning agent is responsible to review the coordination study and ensure that all adjustable overcurrent devices are properly set in the field.
5. The Commissioning agent shall tabulate the breaker settings and provide them to the architect for inclusion in the O&M manual.
6. A separate copy of the complete coordination study and settings shall be transmitted to the FOM-Engineering Office at Dartmouth for review and approval prior to implementation.

I. Surge Protection Devices

1. Switchgear and Switchboards– SPDs where specified shall be remote mounted.
2. Panelboards - SPDs where specified shall be integral mounted.

J. Identification:

1. Switchboards and Panelboards on the Emergency systems shall have “EM” in their prefix.

2. Switchboards and Panelboards on the Standby systems shall have “OSB” and/or “RSB” in their prefix.

K. Metering:

1. See Section - 26 16 00 (16430) - Electric Metering.
2. Switchgear – meters and all meter components other than CTs shall be installed in a separate, isolated cabinet section of the switchgear.

PART 2 - PRODUCTS

2.1 LOW VOLTAGE SWITCHGEAR, SWITCHBOARDS, PANELBOARDS

A. APPROVED MANUFACTURERS

1. Basis of Design: Schneider Electric - Square D
 - a. Exception 1 – Other manufacturers’ switchboard and panelboard products are acceptable to match existing systems in buildings. This equipment will typically be Eaton Cutler-Hammer or ABB (previously GE).
 - b. Exception 2 – Alternates from the following may be offered in lieu of Basis of Design products.
 - c. Eaton Cutler-Hammer
 - 1) ABB

B. CONSTRUCTION, TYPE

1. All busses, including the grounding bus shall be hard drawn copper with 98% conductivity.
2. Panelboard covers shall have full piano hinges with door-in-door construction.
3. Panelboards and panelboard breakers shall have a minimum rating of 22 kaic.
4. Laydown bracing shall be provided for switchboards and switchgear.
5. Lift trolley shall be provided for draw-out breakers of 800A frame and higher.

C. CIRCUIT BREAKERS

1. All breakers shall be fully rated with respect to the short circuit current and X/R ratio existing at the location of the equipment as calculated by the Power Study.
2. Series rated equipment shall not be used.
3. 1200A and above breakers shall be individually mounted draw-out type.
4. 400A and above shall be individually mounted.
5. Below 400A breakers shall be allowed to be group mounted.
6. Thermal magnetic branch circuit breakers shall be bolt-on type. No stab-in type shall be allowed.
7. 400A and above breakers shall have LSI(G) trip plug overcurrent protection.
8. Panelboard breakers shall have a minimum rating of 22 kaic.
9. Switchboard breaker ratings shall have a minimum rating above the calculated short circuit current.
10. All switchgear and switchboard circuit breakers shall have means for locking out.
11. Panelboard main breakers shall have means for locking out.
12. Lighting and receptacle power branch circuit breakers shall be a minimum 20A trip.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Switchboards and switchgear shall be installed on and securely fastened to housekeeping pads.
- B. The housekeeping pad shall be a minimum of four inches high and eight inches larger in length and width than the assembly footprint. All edges of the housekeeping pad shall be chamfered.
- C. Locate conduit in the bottom or top of the switchboard in a location that will allow for the safe access and replacement of cable in the future while the equipment is energized. To ensure this goal is attained the contractor must request a conduit entry drawing at the RFQ phase of the project so that base slab conduits can be installed in the proper location.
- D. Pits beneath switchboards will be allowed provided the conduits enter the pit through the bottom and not the sides.
- E. Conduit in pits beneath equipment shall be stubbed to a level at least four inches above the elevation of the housekeeping pad. Conduits that protrude through a concrete floor or pad shall be rigid metal.
- F. All conduits entering the switchboard shall be equipped with grounding bushings regardless of size.
- G. Panelboards installed in recessed walls and/or where conduits rise through inaccessible ceilings, shall have spare conduits stubbed out to an accessible location.
- H. All conductors shall be neatly trained and securely supported in the rear of the switchboard. The individual conductors that make up each feeder shall be grouped together into an assembly from the point at which the conductors leave the conduit to within 12 inches of the termination at the supplying breaker. Neutrals and equipment grounds shall be routed together and supported also.

3.2 IDENTIFICATION, LABELLING

- A. All feeder and branch circuit breakers shall be labeled to indicate the load served.
 - 1. Branch Circuit Panelboards - A directory of circuits shall be type written and permanently mounted to the inside of the door. A spare blank directory shall be included and installed behind the typed directory. The directory shall include as a minimum the designation for the panel as indicated on the design drawings and the voltage, ampere and phase ratings.
- B. Switchgear, Switchboards, Panelboards shall be identified with engraved Nameplate, and shall include labelling requirements of Section 26 05 53 - Identification/Labeling.
 - 1. 'Fed From' information.
 - 2. Identification of other sources including where those sources' feeders enter the building.

- C. Labelling, Markings – Main Disconnects including Main Switchgear, Main Switchboards, and/or Main Panelboards shall have labelling describing:
 - 1. Available fault current at line side of main breaker, with date.
 - 2. CT ratio of main meter.
 - 3. Rotation of system.
 - 4. Fuse size.
- D. Arc Flash Hazard labels shall be affixed within 30 days of energizing.

3.3 ACCEPTANCE TESTING

- A. Circuit Breakers
 - 1. Main (and tie) circuit breakers 800A and above shall be tested with a primary injection test.
 - 2. Main circuit breakers below 800A shall be tested with a secondary injection test.
 - 3. Feeder circuit breakers 1000A and above shall be tested with a primary injection test.
 - 4. Feeder circuit breakers under 1000A shall be tested with a secondary injection test.

3.4 START-UP AND ENERGIZING

- A. Start-up and Energizing requirements: (See Low Voltage Electrical Feeder Entrance for complete building energizing requirements)
- B. Short circuit and coordination study, and arc flash hazard study shall be submitted and approved by FOM-Engineering and engineer of record.
- C. Switchgear, Switchboards shall be tested by third party testing company per specifications, and test reports delivery to FOM Engineering and project commissioning agent.
- D. Switchgear, Switchboards shall be started up and tested by manufacturer per specifications, and reports delivered to FOM Engineering and project commissioning agent.
- E. All protective device settings shall be adjusted per the coordination study.
- F. Switchgear, switchboards, panelboards shall be cleaned, wiped with lint free rags to be free of all dust and dirt.

END OF SECTION