

READ THIS FIRST

Notice to the Design Engineer, this document is part of Facilities and Infrastructure standards for Electrical Systems. Designers are advised to NOT use this template (*.doc) document as part of any project contract documents. Designers shall use the Port of Seattle MasterSpec specifications from the following link:

<https://www.portseattle.org/page/guide-specifications>.

Designers shall edit the corresponding Port's MasterSpec specification to meet the F&I Electrical Standard outlined in this specification. Note that Port's MasterSpec specifications contain specifications and languages for both Aviation and Maritime Divisions. F&I Standards are strictly for Aviation Division, and any Maritime related specs or languages should be removed from the project specifications.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY AND NOTES TO DESIGNER

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Molded-case switches.
 - 6. Enclosures.
 - 7. Service disconnecting means
 - 8. Feeder and branch circuit protection
 - 9. Motor and equipment disconnect means.
- B. Provide communications capability on switches and circuit breakers as required by engineering considerations.
- C. Provide fusing on current limiting circuit breakers as required by engineering considerations.
- D. The following functions may be required based on specific project parameters. Coordinate use with F&I:
 - 1. Undervoltage Trip.
 - 2. Auxiliary Contacts.

3. Keyed Interlocks.
4. Electrical Operator.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. 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.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.8 QUALITY ASSURANCE

- A. Comply with:
 - 1. UL or other certification agency acceptable to Authority Having Jurisdiction.
 - 2. NEMA AB 1 and NEMA KS 1.
 - 3. NFPA 70 as adopted and enforced by the State of Washington.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

- D. 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.
- E. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 1000

1.10 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Design with fusible switch or switches shall be coordinated and approved by F&I.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. Eaton Electrical Inc.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- C. Type HD, Heavy Duty, Single Throw, 240V OR 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated.
 - 1. Provide fuse clips (rejection type where possible) to accommodate indicated fuses
 - 2. Lockable handle with capability to accept 3/8 inch hasp padlock.
 - 3. Mechanical/electrical interlock with cover in closed position.
 - 4. Rated to accommodate available fault currents. No series rated breakers allowed.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 240V OR 600V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate

indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- E. Type HD, Heavy Duty, Double Throw, 240V OR 600V ac, 1200A and Smaller: UL 98 and NEMA KS 1, horsepower rated.
 - 1. Provide fuse clips (rejection type where possible) to accommodate fuses
 - 2. Lockable handle with capability to accept 3/8 inch hasp padlocks.
 - 3. Mechanical/electrical interlock with cover in closed position.
 - 4. Rated to accommodate available fault currents. No series rated breakers allowed.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: One OR Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open, where required by engineer of record.
 - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 5. Accessory Control Power Voltage: Remote mounted and powered; 120V ac.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240V OR 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated.
 - 1. Provide lockable handle with capability to accept 3/8 inch hasp padlocks.
 - 2. Mechanical/electrical interlock with cover in closed position.
 - 3. Rated to accommodate available fault currents. No series rated breakers allowed.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 OR 600V ac, 200A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept 3/8 inch hasp padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240V OR 600V ac, 1200A and Smaller: UL 98 and NEMA KS 1, horsepower rated.
 - 1. Provide lockable handle with capability to accept 3/8 inch hasp padlocks.

2. Mechanical/electrical interlock with cover in closed position.
3. Rated to accommodate available fault currents. No series rated breakers allowed.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary reversible contacts, arranged to activate before switch blades open, where required by engineer of record.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Accessory Control Power Voltage: Remote mounted and powered; 120V ac.

2.3 **SHUNT TRIP SWITCHES**

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

1. Eaton.
2. Cooper Bussmann, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

B. General Requirements: Comply with UL 50, and UL 98, with 200kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120V ac; as indicated on drawings with a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories - Where Required by Design:

1. Oiltight key switch for key-to-test function.
2. Oiltight red ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm reversible contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 120V ac coil voltage.

2.4 ENCLOSED CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. 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 250A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
 - 5. Other adjustable parameters as required by application.
 - 6. Communications capability as required by contract drawings.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
 - 1. Apply according to manufacturer's data.
- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations.
 - 1. 5mA sensitivity for personnel protection.
- H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
 - 1. Required for solidly grounded wye service entrance switches over 150 Volts to ground, not exceeding 600 Volts and rated 1000 Amps and above.
- I. HACR type for heating, air-conditioning and refrigeration applications
- J. Switch Duty (SWD) rated type for switching lighting fixtures. Note that energy code restricts use of circuit breakers as sole means of switching lighting circuits (See State of Washington Non-residential Energy Code).

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Integral OR DIN-rail-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip - where indicated on contract drawings: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Provide as indicated on contract drawings.
9. Alarm Switch: One NO/NC reversible contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position. Provide where indicated on contract drawings.
11. Electrical Operator: Provide remote control for on, off, and reset operations, where indicated on contract drawings.
12. Accessory Control Power Voltage: Integrally mounted, self-powered 120V ac.

2.5 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
1. Standard frame sizes and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; integrally mounted and self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip – where required by engineering considerations: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Provide as required by engineering considerations.
7. Alarm Switch: One NO/NC contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position, where required by engineering considerations.
9. Electrical Operator: Provide remote control for on, off, and reset operations, where required by engineering considerations.
10. Accessory Control Power Voltage: Integrally mounted, self-powered, 120V ac.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 3. Outdoor Locations: NEMA 250, Type 3R.
 4. Outdoor dirty/oily and washdown locations such as Aircraft Operations Areas: NEMA 250 Type 4.
 5. Hazardous Locations: NEMA 250 Type 7, 8 or 9 depending on hazardous area classification and location.
 6. Corrosive Locations: NEMA 250 Type 4X stainless steel.

PART 3 - INSTALLATION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 1. Operator handle typically at 5'-0", but not to exceed 6'-6" above floor.
- B. Working Space: Comply with NFPA 70 Section 110 working space requirements.

- C. Mount on substantial structure and secure to meet seismic zone 3 requirements. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Torque all connections per manufacturer's recommendations. Apply spot of red paint after torqueing such that paint will be visibly disturbed if lugs are disturbed.
- G. Set adjustable parameters and provide testing and calibration as required by project parameters.
- H. Comply with NECA 1.

3.3 SPECIAL SYSTEM APPLICATIONS

- A. Security Gates
 - 1. Safety disconnect switch for security gate control system shall be external to the gate controller enclosure.
 - 2. Safety disconnect switch shall be sized for the control system, and shall be rated for the surrounding environment.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Provide caution sign identifying special considerations of shutting down load served.
 - 3. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to initially inspect, test, and adjust components, assemblies, and equipment installations, including connections. Verification will be by third party testing agency.
- C. Perform tests and inspections.
- D. Acceptance Testing Preparation:

FACILITIES AND INFRASTRUCTURE
ELECTRICAL SYSTEMS STANDARDS
**SECTION 26 28 16: ENCLOSED SWITCHES
AND CIRCUIT BREAKERS**

POS SEA-TAC INTERNATIONAL AIRPORT

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: The Port shall have the option of performing its own infrared inspection.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

Except as noted below:
Double Ended Unit Substation One-Line