

**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 Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY AND NOTES TO DESIGNER**

- A. This Section includes freestanding, prepackaged, power distribution units for transforming, conditioning, and distributing electrical power.
- B. Provide units with dual inputs where required by engineering considerations.
- C. Isolated ground and electrostatic shielding are not typically used at the airport. Provide electrostatic shielding and isolated ground equipment where PDU is serving highly sensitive data and audio/visual loads.

**1.3 DEFINITIONS**

- A. SPD: Surge suppression device.
- B. UPS: Uninterrupted power supply.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For power distribution units. Include system description, ratings, capacities, and performance characteristics.
- B. Shop Drawings: Include dimensioned plans, sections, and elevations. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of power distribution unit, signed by product manufacturer.
- C. Manufacturer Seismic Qualification Certification: Submit certification that power distribution units, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. 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."
  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.
- D. Source quality-control test reports.
  1. For each factory test of power distribution units.
- E. Field quality-control test reports.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For power distribution units to include in emergency, operation, and maintenance manuals.

### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain a service center capable of providing training, parts, and emergency on-site repairs in less than eight hours' maximum response time.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain power distribution unit and associated components specified in this Section from a single manufacturer with responsibility for entire power distribution unit installation.
- D. 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.
- E. Comply with NFPA 70.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
- B. Store equipment in spaces with environments controlled within manufacturer's ambient temperature and humidity tolerances for non-operating equipment.

#### **1.9 COORDINATION**

- A. Coordinate size and location of concrete bases with actual power distribution unit provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate layout and installation of power distribution units with access flooring for proper support and seismic restraint of units.
- C. Coordinate layout and installation of power distribution units with Owner's equipment.
  1. Meet jointly with electronic equipment representatives and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
  2. Record agreements reached in meetings and distribute record to other participants.
  3. Adjust arrangements and locations of power distribution units to accommodate and optimize arrangement and space requirements of equipment.

#### **1.10 PROJECT CONDITIONS**

- A. Environmental Conditions: Units shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability.
  1. Storage Temperature Range: Minus 67 to plus 185 deg F.

2. Operating Temperature Range: 32 to 104 deg F.
3. Relative Humidity Range: 0 to 95 percent, noncondensing.
4. Altitude: Sea level to 3600 feet above sea level.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. EATON
  2. Power Distribution, Inc.
  3. United Power Corporation.

### **2.2 MANUFACTURED UNITS**

- A. Description: Integrated and coordinated assembly of power-line-conditioning and distribution components packaged in a single cabinet or modular assembly of cabinets. Include the following components:
  1. Input-power, circuit-breaker section.
  2. Isolation transformer.
  3. TVSS system.
  4. Output panelboard(s).
  5. Alarm, monitoring, and control system.
- B. Provide units that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Unit Capacity Rating: Unit shall carry indicated rms kilovolt-ampere load continuously without exceeding rated insulation temperature for the following input voltage and load current:
  1. Input Voltage: Within rated input-voltage tolerance band of unit.
  2. Load Current: Minimum of 3.0 crest factor and 85 percent total harmonic distortion.

### **2.3 INPUT-POWER, CIRCUIT-BREAKER SECTION**

- A. Description: 3-pole, shunt-tripped, thermal-magnetic-type circuit breaker, rated for indicated interrupting capacity and 125 percent of input current of unit at 100 percent rated load.

1. Dual-Input Units:
  - a. Two input circuit breakers arranged to provide transfer between two input-voltage sources.
  - b. Controls and interfaces to allow both open- and closed-transition transfer between two input-voltage sources.
  - c. Use a 120-V permissive signal from both upstream voltage sources to indicate acceptable conditions for closed-transition transfer.
  - d. Open second circuit breaker automatically after closed-transition transfer is completed.

## **2.4 ISOLATION TRANSFORMER SECTION**

- A. Description: Dry-type, electrostatically shielded, three-phase, common-core, convection-air-cooled isolation transformer.

1. Comply with UL 1561 including requirements for nonsinusoidal load-current-handling capability defined by designated K-factor.
2. Cores: Grain-oriented, non-aging silicon steel, one leg per phase.
3. Coil Material and Insulation: Copper windings with a 220 deg C insulation class.
4. Temperature Rise: Designed for 115 deg C rise above 40 deg C ambient.
5. Output Impedance: 3.5 plus or minus 0.5 percent.
6. Regulation: 2 to 4 percent maximum, at full-resistive load; 5 percent maximum, at rated nonlinear load.
7. Taps: 6 full-capacity compensation taps at 2.5 percent increments; 2 above and 4 below nominal voltage.
8. Full-Load Efficiency: Minimum 96 percent at rated nonlinear load.
9. Audible Noise: Comply with NEMA ST 20.
10. Where required by engineering consideration, Electrostatic Shielding shall comply with the following: Independently shield each winding with a double-copper, electrostatic shield arranged to minimize interwinding capacitance.
  - a. Coil leads and terminal trips shall be arranged to minimize capacitive coupling between input and output connections.
  - b. Shield Terminal: Separate and marked "Shield" for grounding connection.
  - c. Common-Mode Noise Attenuation: 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
  - d. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.
11. Neutral Rating: 2 times the system full-load ampere rating.

## **2.5 SPD SYSTEM**

- A. Description: Integrated SPD system complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," to protect unit panelboard, and having the following features:

1. Disconnect Device: Manual, three-pole, fused disconnect switch to de-energize SPD system while permitting power distribution units to continue operation. Fuses are rated at 200-kA interrupting capacity.
2. Nonlinear Loading: System shall accommodate rated-load current with a minimum 3.0 crest factor and 85 percent total harmonic distortion.

## **2.6 OUTPUT PANELBOARDS**

- A. Description: Panelboards complying with Section 262416 "Panelboards" except for mounting provisions. Mount in front of power distribution units behind flush doors. Include the following features:
1. Construction: 42 pole minimum, 208 V, 3 phase; capable of accepting branch circuit breakers rated to 100 A.
  2. Panelboard Rating: 225 A, with main circuit breaker.
  3. Panelboard Phase, Neutral and Ground Buses: Copper, with neutral bus at least 2 times the nominal phase bus rating.
  4. Isolated Ground Bus: Copper, adequate for branch-circuit equipment ground conductors; insulated from supports. Provide if required by contract drawings.
  5. Branch Circuit Breakers: Bolt on.
  6. Cable Racks: Removable and arranged for supporting and routing cables for panelboard entrance.
  7. Access Panels: Arranged so additional branch-circuit wiring can be installed and connected in the future.

## **2.7 POWER DISTRIBUTION UNIT CONTROLS**

- A. Include the following control features:
1. Emergency, power-off switch integral with power distribution unit.
  2. Emergency, power-off input terminals for connection to remote power-off switch.
  3. Over-under alarm for the following alarm conditions:
    - a. High temperature.
    - b. High and low input or output voltage.
    - c. Phase loss.
    - d. Ground fault.
    - e. Reverse phase rotation.
  4. Ground-fault protection.
  5. Alarm Contacts: Electrically isolated, Form C (one normally open and one normally closed), summary alarm; contact set shall change state if any monitored function goes into alarm mode.
  6. Remote Power-Off Control: Control circuit with connection to shunt trip of power distribution unit main power circuit breaker and terminals for connection to one or more remote power-off, push-button stations.

## **2.8 MONITORING, STATUS, AND ALARM ANNUNCIATION**

- A. Description: Microprocessor-based monitoring, status, and alarm annunciation panel mounted flush in front of power distribution unit to provide status display and failure-indicating interface for the following:
1. Power Monitoring: Comply with Section 262713 "Electrical Power Metering"
    - a. Input Voltage: Line to line, rms.
    - b. Output Voltage: Line to line, rms.
    - c. Output Voltage: Line to neutral, rms.

- d. Output current.
- 2. Status Indication: Unit on.
- 3. Alarm Annunciation:
  - a. High temperature.
  - b. High and low input voltage.
  - c. High and low output voltage.
  - d. Phase loss.
  - e. Ground fault.
  - f. Frequency.
  - g. Phase rotation.
  - h. SPD module failure.
- 4. Audible Alarm and Silencing Switch: Alarm sounds when alarm indication occurs. Silencing switch shall silence audible alarm but leave visual indication active until failure or other alarm conditions are corrected.

## **2.9 SOUND LEVEL**

- A. General: Fully assembled products comply with minimum sound-level requirements in NEMA ST 20 for transformers of corresponding ratings when factory tested according to IEEE C57.12.91.

## **2.10 FINISHES**

- A. Manufacturer's standard finish over corrosion-resistant pretreatment and primer.

## **2.11 SOURCE QUALITY CONTROL**

- A. Factory Tests: Design and routine tests shall comply with referenced standards.

# **PART 3 - INSTALLATION**

## **3.1 EQUIPMENT INSTALLATION**

- A. Arrange power distribution units to provide adequate access to equipment and circulation of cooling air.
- B. Anchor or restrain floor-mounting power distribution units according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Identify equipment and install warning signs according to Section 260553 "Identification for Electrical Systems."

### **3.2 CONNECTIONS**

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Separately Derived Systems: Make grounding connections to grounding electrodes as indicated; comply with NFPA 70.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for circuit breakers, molded case; and for transformers, dry type, air cooled, low voltage, small. Certify compliance with test parameters.
  - 2. Perform functional tests of power distribution units throughout their operating ranges. Test each monitoring, status, and alarm function.
- C. Remove malfunctioning units, replace with new units, and retest as specified above.
- D. Infrared Scanning: Two weeks after Substantial Completion and before Final Acceptance, perform an infrared scan of conductor and bus connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. The Port shall have the option of performing its own infrared inspection.
  - 3. Prepare a certified report identifying connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### **3.4 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Verify that power distribution units are installed and connected according to the Contract Documents.



2. Verify that electrical wiring installation complies with manufacturer's submittal and with written installation requirements in other electrical Sections.
3. Complete installation and startup checks according to manufacturer's written instructions.

### **3.5 ADJUSTING**

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- B. Adjust power distribution units to provide optimum voltage to equipment served throughout normal operating cycle of loads served. Record input and output voltages and adjustment settings, and incorporate into test results.

### **3.6 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power distribution units. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 262600