

**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**

**1.01 SUMMARY**

- A. The following specifications cover the requirements for providing complete lineups of freestanding assemblies containing circuit breakers, instrumentation, control devices and appurtenances. The connection cabinet described herein supports the following generator power systems:
  - 1. The generator connection cabinet will provide for connection of the Port's existing trailer mounted engine-generator set. No paralleling provisions required.
- B. Related Sections/Requirements:
  - 1. 26 05 19 Low Voltage Electrical Power Conductors and Cables
  - 2. 26 05 26 – Grounding and Bonding for Electrical Systems
  - 3. Section 26 05 48 - Seismic Controls for Electrical and Communications Work for equipment base and mounting.
  - 4. Section 26 05 73 – Power System Studies
  - 5. Section 26 24 13 - Switchboards
  - 6. Section 26 05 53 – Identification of Electrical Systems
  - 7. Section 26 05 53a – Labeling Guidelines
  - 8. Section 26 28 16 – Enclosed Switches and Circuit Breakers

## **1.02 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
1. ANSI C39.1 Requirements for Electrical Analog Indicating Instruments
  2. IEEE C2 National Electrical Safety Code
  3. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
  4. NEMA ICS 6 Industrial Control and Systems, Enclosures
  5. NFPA 70 National Electrical Code
  6. NFPA 110 Emergency and Standby Power Systems
  7. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

## **1.03 QUALITY ASSURANCE**

- A. The generator connection cabinet shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, UL, IEEE, NFPA, and NEMA.
- B. Each individual section of the generator connection cabinet line-up, including all internal components mounted, shall withstand rating of 65,000 amperes symmetrical for four (3) cycles minimum.
- C. Refer to specification Section 01 46 00 and Section 26 05 48 for pertinent seismic design requirements.
- D. Spare Parts: Maintain a permanent parts and service facility within 50 miles of Sea-Tac International Airport (the site) from which parts and service may be obtained in necessary quantities at any time during the day or night. This facility must be a factory-authorized dealer.

## **1.04 SUBMITTALS**

- A. Comply with Section 01 33 00 - Submittals.
- B. Shop Drawings: Submit shop drawings, prior to starting work on the engine generator control switchboard, for review as specified.
1. Complete Structural Drawings showing:
    - a. Arrangement.

- b. Dimensional plan and elevation, front views, side views, and other pertinent elevation views.
    - c. Conduit entrance locations and dimensions for both bottom and top entrance.
    - d. Dimensions and weights of shipping splits.
    - e. Base plan, show dimensions of base with anchoring.
  - 2. System Description:
    - a. System operation.
  - 3. Provide listing and part numbers of sub-assemblies and devices.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around connection cabinet where pipe and ducts are prohibited. Show connection cabinet layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Manufacturer's catalog data for all connection cabinet components.
- E. Qualification Data: For professional engineer.
- F. Seismic Qualification Certificates from Manufacturer: For enclosures, cabinets, and conduit racks and their mounting provisions including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 3. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
  - 4. Submit final seismic certification for Generator connection cabinet after installation to ensure installation meet all seismic requirements.
- G. Source quality-control reports.
- H. Field quality-control test reports.

#### **1.05 OPERATION AND MAINTENANCE DATA**

- A. Comply with section 01 78 23.13 - Operation and Maintenance Data.
- B. Provide all documentation required by paragraph 1.04, updated to As-built status.

- C. As-built drawings: Drawings that depict the as-constructed condition of the installation, upon acceptance of the diesel-generator set installation.
- D. Instructions: The manufacturer's pre-start checklist and precautions; running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall be weatherproof, laminated in plastic, and posted where directed.
- E. Touchup Paint: One pint container of paint matching enclosure's exterior finish packaged with protective covering for storage and identified with labels.
- F. Original copies of Certified test reports.

#### **1.06 STORAGE AND INSTALLATION**

- A. The Contractor shall properly protect material and equipment, in accordance with the manufacturer's recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, conduits and similar openings shall be capped to keep out dirt and other foreign matter.

### **PART 2 PRODUCTS**

#### **2.01 GENERATOR CONNECTION CABINET**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.
  - 2. Square D; a brand of Schneider Electric
  - 3. ABB
  - 4. Or Approved equal
- B. Cabinet shall be UL listed as Service Entrance Equipment.
- C. Comply with Section 26 24 13 Switchboards and Section 26 28 16 Enclosed Switches and Circuit Breakers
- D. Fabrication and Features
  - 1. Enclosure: Stainless steel, NEMA Type 3R or 4. Fully hinged lockable door with three-point latch enclosing overcurrent protective devices. Hinged trap door to maintain 3R or 4 rating with plug and wire connecting to receptacles. Dead front with door(s) open or closed.

2. Finish: Factory applied outdoor finish in manufacturer's standard color, (ANSI 61 Grey) including undersurfaces treated with corrosion-resistant undercoating.
3. Front and side accessible: Equipment shall be front and side accessible with fixed, individually mounted devices. Cabinet shall be provided with front drip hood/shield to prevent water egress while opening the front door. Front door to be provided with inner gasket.
4. Outgoing Load Connection: The outgoing load connection compartment shall be capable of providing either side or rear entry for outgoing load cable to feed particular power center main distribution switchboard location. No top cable entry/exit is allowed for generator connection cabinet.
5. Space Heaters: Factory installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point. Thermostats to maintain temperature of each section above expected dew point.
6. Control Power source: 120 Volt external branch circuit.
7. Buses and Connections: Three-phase, four-wire, unless otherwise indicated. Include the following features:
  - a. Main Bus: Amperage rating as shown on design drawings.
  - b. Load Termination: Receptacles.
  - c. Ground Bus: Drawn-temper copper of 98 percent conductivity, arranged for the following ground cable connections:
    - 1) Ground jumper from panel-mounted generator ground receptacle.
    - 2) Ground jumper from driven ground rod.
    - 3) Bonding jumper from neutral, arranged to be installed as field option.
  - d. Contact surfaces of Buses: Silver plated.
  - e. Bracing: Indicated fault current for 30 cycles.

E. Overcurrent Protective Devices

1. Insulated Case Circuit Breaker: LSIG, 100% current rated, with interrupting capacity to meet available fault currents.
  - a. Electronic Trip Unit: RMS sensing, field-replaceable rating plug. With the following field adjustable settings:
    - 1) Long- and short-time pickup levels.
    - 2) Long- and short-time time adjustments.

- 3) Instantaneous, Adjustable pick-up 200-600%.
  - 4) Ground-Fault pickup level, time delay, and I2t response.
  - 5) Display with amperes, volts, kW, kVA, line to line and line to neutral.
  - 6) Ground-fault protection: Integrally mounted or remote-mounted relay, push-to-test feature, and ground-fault indicator.
  - 7) Circuit Breaker settings shall be as per noted in the coordination and short circuit studies. Refer to section 26 05 73 – Power system studies.
- b. Features and Accessories: Standard frame sizes and trip ratings.
- 1) Three-poles for interrupting phases A, B, and C.
  - 2) Lugs: Mechanical or compression style, suitable for number, size, trip ratings, and material of conductors. Application Listing: Appropriate for application.
  - 3) Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent for rated voltage.
  - 4) 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.
  - 5) Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation, key shall be removable only when circuit breaker is in off position. Interface with key interlock of Medium Voltage Pad Mounted Vacuum Interrupter Switchgear

**F. Receptacles for Connection of Portable Generator**

1. Provide panel-mounted, sequential receptacle system arranged for field connection for portable generator cables.
  - a. Cam receptacle system shall be Crouse-Hinds Posi-Lok Panels E0400 Series, or approved equal. Female receptacles must match cable plug assemblies currently in use by the Port.
  - b. Cam receptacles rated 400 amperes continuous at 600 volts. Provide multiple sets as required to meet service rating.
  - c. System shall require plugs to be connected in sequential order with ground connected first, neutral second and then phases A, B and C. Disconnection shall be made in opposite order.
  - d. Receptacles shall be color-coded to match cable plugs.

Verify existing site color-coding is Green/Ground, White/Neutral, Black/A- phase, Red/B-phase and Blue/C-phase. Group each set of 5 paralleled receptacles horizontally on single panel. Vertically stack paralleled receptacle panels.

- e. Receptacles shall be electrically interlocked with main circuit breaker to prevent connection or disconnection actions unless breaker is open.

Design and provide permissive close circuit to achieve this requirement.

G. Instrumentation

- 1. Provide Instrument and Instrument Transformers to comply with NEMA E1 21.1, IEEE C57.13, and the following:
  - a. Current Transformer for neutral and Ground-Fault Current-Sensing: Integral to breaker.

H. Control Wiring: Type SIS with insulated locking spade terminals, minimum 16 AWG.

**2.02 CABLE STORAGE BOX**

- A. Sized to allow coiled rack mounted storage for portable cables. Hoffman, Aqua Shield or Equal.
- B. NEMA 3R, fully hinged lockable doors with three-point latch. Aluminum roof, walls, and access panels shall be 0.050/18 gauge complying with ASTM B209. Hardware and reinforcement shall be type 316 stainless steel.
- C. Internal heaters and controller designed to keep interior temperature above dew point, with a minimum exterior temperature of 0°F. 120VAC, max 20-amp circuit.
- D. Insulation shall be a closed cell polyisocyanurate foam core laminated to heavy, black glass fiber reinforced facers each side. The insulation shall have the following properties:
  - 1. R-Value – 10.0
  - 2. Dimensional Stability - 2% Linear Change
  - 3. Compressive Strength - 20 psi and 25psi
  - 4. Product Density - Nominal 2.0 pcf,
  - 5. Water Absorption – <1% By Volume
  - 6. Service Temperature – (-100°F to +250°F)
  - 7. Moisture Vapor Transmission – < One (1) Perm

- 8. Flame Spread – 25\*\*
- 9. Insulation shall be 1.5" thick
- E. Anchoring provisions for securing to concrete pad.
- F. Security contact for door open alarm, 10A, 300V, tied to generator annunciator.
- G. Finish: Factory applied outdoor finish in manufacturer's standard color, (ANSI 61 Grey) including undersurfaces treated with corrosion-resistant undercoating.
- H. Internal stainless steel or fiberglass reinforced polyester racks for coiled storage of connection cables. Ceramic, PVC or fiberglass saddle supports for cables on top of racks.
- I. Convection heater with humidistat control to prevent condensation. Heater shall have heavy duty construction with perforated case and internal baffles.

### **2.03 PORTABLE CABLES**

- A. Comply with Section 26 05 19 - 600 Volt or Less Wire and Cable, as augmented herein.
- B. Suitable for connecting a trailer mounted generator to the generator cabinet.
- C. Copper conductor, EPR insulation, 90°C continuous rating, UL listed Type DLO, 600 Volts, 4/0 nominal size with a minimum of 500 strands for flexibility, overall mechanical tough jacket, suitable for use in wet or dry locations.
- D. Terminations:
  - 1. Each Connection cable shall have Male connector on one end to plug into the Generator Connection Cabinet, other end shall have a Female connector to plug into generator.
  - 2. Manufacturer: Crouse-Hinds Posi-Lock, or Approved equal. Connectors must be compatible with existing Port portable generator and Generator Connection Cabinet.
  - 3. Single Pole cam type, UL 498 listed for Attachment Plugs and Receptacles and UL 1691.

### **2.04 NAMEPLATES**

- A. Nameplates shall be laminated plastic and attached with bolts.
- B. Reference Section 26 05 53 – Identification for Electrical Systems and 26 05 53a – Labeling Guidelines.



- C. Provide nameplate indicating phase rotation (CW or CCW).
- D. Provide nameplate indicating "FED TO DISTRIBUTION SWITCHBOARD (Identify Panel ID and name of Power Center and Room ID)".

## **2.05 SOURCE QUALITY CONTROL**

- A. Factory Testing
  - 1. The Connection cabinet shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete cabinet shall be tested to assure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities.
  - 2. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.
  - 3. A certified test report of all standard production tests shall be shipped with each assembly.
- B. The Port's representative may witness factory tests outlined above.
  - 1. Provide notification to the Resident Engineer two weeks prior to the date the tests are to be performed.
  - 2. Provide arrangements with the manufacturer to accommodate Port's representative (3 total – airfare and hotel costs included) to witness testing.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Installation shall comply with NFPA 70, NFPA 110, IEEE C2, and Section 26 00 00 - Electrical Work General.
- B. Verify that cabinet dimensions are compatible with available spacing and building dimensions.
- C. Installation of conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the cabinet.
- D. Comply with manufacturer's recommended installation practices. Anchor to concrete pad to meet and satisfy seismic requirements.

### **3.02 FUNCTIONAL PERFORMANCE TESTING**

- A. Coordinate all functional performance testing procedures and schedule with the Engineer and the Commissioning Agent. Refer to Section 01 91 00 - Commissioning. Engineer will document testing including test procedures, results, and initials of witnessing personnel. Tests will be witnessed by Commissioning Agent and performed by the Engineer, Electrical Contractor, equipment manufacturer's representative and the Electrical Testing subcontractor.
- B. Generator Connection Cabinet tests:
  - 1. Prepare for functional performance tests as follows:
    - a. Test insulation resistance for each cabinet bus, component, connecting supply, feeder, and control circuit.
    - b. Use 1000-volt megger for 480-volt systems and 500-volt megger for 208-volt systems.
    - c. Test continuity of each circuit.
- C. Electrical Testing Firm: Provide a qualified independent electrical testing firm to perform Functional Performance Testing.
  - 1. Electrical Contractor shall accompany the electrical testing firm field service technician and assist as required during field tests.
- D. Provide certification in writing from a factory-trained manufacturer's representative that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- E. Submit certification and field test reports, include in Operations and Maintenance manuals.
- F. Testing: After installing cabinet and after electrical circuitry has been energized with respective engine-generator set, demonstrate product capability and compliance with requirements.
  - 1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS and as described in 26 08 00 - Acceptance Testing. Certify compliance with test parameters.
    - a. Connection cabinet: Perform tests and inspections stated in NETA ATS, Section 7.1 and as described in 26 08 003.01. C.2.
    - b. Circuit Breakers: Perform tests and inspections stated in NETA ATS, Section 7.6 and as described in 26 08 003.01. D.3.
    - c. Instrument Transformers: Perform tests and inspections stated in NETA ATS, Section 7.10 and as described in 26 08 003.01. C.2.5.

- d. Metering and Instrumentation: Perform tests and inspections stated in NETA ATS, Section 7.11 and as described in 26 08 003.01.C.6.
  - e. Ground-Fault Systems: Perform tests and inspections stated in NETA ATS, Section 7.14 and as described in 26 08 003.01.C.7.
- 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 3. Verify proper operation of heaters in outdoor connection cabinet.
- 4. Inspect outdoor connection cabinet for leaks.
- 5. Verify proper phase rotation of main bus.
- 6. Verify integrity of all ground connections.
- G. Interlocks: Verify proper operation of all electrical, mechanical, and key interlocks.
- H. Infrared Scanning: Comply with Requirements of Section 26 01 28 Thermography. Perform an infrared scan of Connection cabinet during load bank testing of the generator. Make bus joints and connections accessible to a portable scanner and perform scanning during a period of normal working load as advised by Port.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies Connection cabinet checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- I. Control Scheme Tests: Test all electrical controls via trial operation of control equipment after all wiring is completed. Verify that each interlock and control function operates to conform to the sequence of operation, as indicated in the schematic diagrams and the manufacturer's operating instructions.

### **3.03 DEMONSTRATION AND TRAINING**

- A. Training: Engage a factory-authorized service representative to train Port maintenance personnel as specified below:
  - 1. Provide training session to three maintenance shifts, with minimum 10 persons per training session.
  - 2. Train Port maintenance personnel on troubleshooting, servicing,

- adjusting, and maintaining equipment and schedules.
- 3. Review data in maintenance manuals. Refer to Section 01 78 23.13 - Operations and Maintenance Data.
- 4. Schedule training with the Port with at least seven days' advance notice.
- 5. Comply with all requirements of Specification Sections 01 79 00 and 01 91 00.
- 6. Review data in maintenance manuals. Refer to Section 01 78 23.13 - Operations and Maintenance Data.
- B. Training shall include instructions on the following:
  - 1. Safety precautions.
  - 2. Features and construction of project generator Connection cabinet and accessories.
  - 3. Routine inspection, test, and maintenance procedures.
  - 4. Routine cleaning.
  - 5. Features, operation, settings and maintenance of integral disconnect switches and protective devices.
  - 6. Interpretation of readings of indicating and alarm.

**END OF SECTION 262817**