

SECTION 16451B

HIGH RESISTANCE GROUNDING SYSTEM – LOW VOLTAGE

PART 1 GENERAL

1.01 SCOPE

- A. The contractor shall furnish and install, where indicated on the drawings, a high resistance grounding system as specified herein and as shown on the contract drawings.

1.02 REFERENCES

- A. The high resistance grounding system, when applied with metal-enclosed low voltage switchgear, shall be designed, tested, and manufactured in accordance with the latest applicable following standards:
 - 1. ANSI-C37.20.1 (Switchgear Assemblies)
 - 2. NEMA SG-5 (Switchgear Assemblies)
 - 3. UL 1558 (Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear)
- B. The high resistance grounding system, when applied with low voltage switchboards, shall be designed, tested, and manufactured in accordance with the latest applicable following standards:
 - 1. UL 891 (Deadfront Switchboards)
 - 2. NEMA PB-2 (Deadfront Distribution Switchboards)

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the engineer:
 - 1. Master drawing index
 - 2. Front view and plan view of the assembly
 - 3. Three-line diagram
 - 4. Schematic diagram
 - 5. Nameplate schedule
 - 6. Component list
 - 7. Conduit space locations within the assembly
 - 8. Assembly ratings including:
 - a. Short circuit rating
 - b. Voltage
 - c. Continuous current rating
 - 9. Major component ratings including:
 - a. Voltage
 - b. Continuous current rating
 - c. Interrupting ratings
 - 10. Cable terminal sizes

11. Product data sheets

1.04 SUBMITTALS -- FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed in Paragraph 1.03, and shall incorporate all changes made during the manufacturing process
 2. Wiring diagrams
 3. Certified production test reports
 4. Installation information
 5. Seismic certification as specified

1.05 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. *Provide Seismic tested equipment as follows:
1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the [latest International Building Code (IBC)] [latest California Building Code (CBC) with OSHPD Amendments]. [The equipment shall have OSHPD Special Seismic Certification (OSP) Pre-Approval.]
 2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
 3. The IP rating of the equipment shall be 1.5
 4. The Structural Engineer for the Site will evaluate the SDS values published on the [Manufacturer's] [OSHPD] website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
 5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 - c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered

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achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.06 REGULATORY REQUIREMENTS

- A. The assembly shall bear a UL label.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. * _____
- C. * _____

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

- A. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum ac service.
- B. The assembly shall be rated to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current *[of (30,000) (42,000) (50,000) (65,000) (85,000) (100,000) (200,000) amperes symmetrical at rated voltage] [as shown on the drawings].
- C. All ratings shall be tested to the requirements of ANSI C37.20.1 and UL witnessed and approved.

2.03 CONSTRUCTION

- A. The assembly shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers.

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All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the roof of the switchgear to ensure adequate ventilation within the enclosure.

- B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to *[contractor supplied floor sills to be set level in concrete per manufacturer's recommendations] [the floor without the use of floor sills providing the floor is level to 1/8 inch per 3-foot distance in any direction]. Base of assembly shall be suitable for rolling directly on pipes without skids.
- C. The assembly shall be Eaton type C-HRG high resistance grounding equipment utilizing grounding resistors and/or grounding transformers as herein specified or approved equal.
- D. Each vertical steel unit forming part of the assembly shall be a self-contained housing having an instrument compartment and a resistor compartment. The control compartment shall be segregated from the resistor compartment by means of steel barriers or, if indicated on the drawings, the resistor assembly shall be a separately mounted component furnished in its own ventilated enclosure.
- E. The assembly shall be fully front accessible. Rear or side access shall not be required for installation or maintenance.

2.04 BUS

- A. A copper ground bus shall be firmly secured to the assembly. It shall be *[silver-plated copper] [tin-plated copper]. Provide terminals for connection of the system grounding conductor, suitable for #6 AWG to 500 kcmil copper or aluminum.

2.05 WIRING/TERMINATIONS

- A. Small wiring, necessary fuse blocks and terminal blocks within the switchgear shall be furnished as required.
- B. All control wire insulation shall be type SIS. Wire bundles shall be secured with nylon ties and anchored to the assembly without the use of adhesive-only wire anchors. All current transformer secondary leads shall first be connected to front accessible short-circuiting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires shall be provided with terminal blocks with suitably numbered strips. Provide machine printed wire marking at three inch intervals along all control wiring.

2.06 METERING AND CONTROLS

- A. Provide a separate control compartment with front hinged door that includes the following:
 - 1. A switchboard type ground current ammeter, 1% accuracy, 250-degree scale, 0 to 10 A ac
 - 2. System control selector switch with PULSE/NORMAL/TEST positions. Switch shall spring-return from the test position
 - 3. Reset control selector switch with AUTO/MANUAL/RESET positions. Switch shall spring-return from RESET position. The AUTO position shall cause the ground fault relay to automatically reset when a ground is no longer detected. The MANUAL position shall

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cause the ground alarm relay to latch and remain latched until the selector is moved to the RESET position by the operator

4. A green lamp to indicate that the system is in normal condition, a red lamp to indicate that a ground fault has been detected, and a white lamp that flashes at the same rate and at the same time as the pulsing contactor
5. An instruction nameplate that provides the operator with a step-by-step procedure for operating the controls
6. A rating nameplate that states the maximum ground current, maximum pulse current and duty rating of the equipment at maximum current levels
- 7.*An alarm horn with an alarm silence pushbutton and re-alarm timer. The horn shall be a high-decibel type. Alarm silence control shall reset when ground relay is reset. Alarm shall automatically re-sound at the end of a 2- to 48-hour field-settable time interval if alarm has been silenced but ground fault still exists. Re-alarm timer shall not be defeatable via any control device

B. Provide the following control devices and features:

1. Ground fault relay with harmonics filter to prevent nuisance tripping on systems with high harmonic currents created by variable frequency drives. Ground fault relay shall have a UL 1053 label
2. One normally open and one normally closed ground fault alarm contact
3. Test loops (for convenient attachment of a snap-on hand-held ammeter) in the ground current and test current circuits
4. A test circuit protected by a current-limiting fuse rated 200,000 amperes and operated by the system control switch via a panel-mounted test circuit relay. The test circuit shall connect phase B to ground through a current-limiting resistor. The test circuit shall not be direct-wired to the door-mounted test switch. The test circuit relay shall be constrained from operating if a ground fault is presently being detected
5. A pulsing contactor, controlled by an adjustable timer. The timer shall allow an adjustment range of 0-10 seconds
6. 120 Vac control power transformer for self-contained operation. The control power transformer shall have current limiting primary fuses rated 200,000 AIC at the system voltage
7. Primary disconnect switch mounted ahead of test and control power fuses
8. Tapped resistors with taps wired out to a convenient front accessible terminal block. Taps shall provide 1 to 5 amperes of ground current in 1 amp increments. Resistors shall be heavy-duty industrial type, edgewound or wirewound design. Each resistor tube shall have a stamped steel rating nameplate. The resistor assembly shall be interconnected with 200 degree C rated #8 AWG wire. All connections to the resistor assembly shall be #8 AWG SIS wire
9. All wiring in the grounding circuit from the neutral point to the system ground terminal shall be #8 AWG type SIS minimum. All control wiring shall be #14 AWG type SIS minimum
10. A detailed schematic shall be furnished that accurately and completely describes the control and grounding circuits. All wire designations, terminal points, control device

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and selector switch contact developments shall be shown. The schematic and the accompanying wiring diagrams shall be amended as required after final testing at the factory. An as-built copy of the schematic, wiring diagrams and material list shall be packed with the unit prior to shipment. Provide a drawing pocket secured by screws or weldment for drawing storage within the assembly

11. When the power system source has a neutral terminal, as indicated on the contract drawings, the grounding resistors shall be connected to that neutral. When the power system source has no neutral point, *[Zig-Zag] [Wye-broken delta] transformers shall be furnished in the assembly to provide a neutral point

2.07 ENCLOSURES

A. NEMA 1 Enclosure

B. *Outdoor Non-walk-in Enclosure

1. Assembly shall be enclosed in an outdoor NEMA 3R enclosure conforming to all applicable requirements of UL. The enclosure shall have a roof sloping toward the rear
2. The enclosure shall be provided with a front hinged door with provisions for padlocking. Ventilating openings shall be provided complete with removable air filters

2.08 NAMEPLATES

- A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum.
- B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.09 FINISH

- A. All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the assembly shall be the manufacturer's standard.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 1. Completely test the high resistance grounding system for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment

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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

- B. *A certified test report of all standard production tests shall be available to the engineer upon request.

3.02 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and startup of the equipment specified under this section for a period of * ____ working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.03 TRAINING

- ** The Contractor shall provide a training session for up to five (5) owner's representatives for * ____ normal workdays at a job site location determined by the owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the high resistance system.

3.04 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- C. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:
 1. Check to ensure that the pad location is level to within .125 inches
 2. Secure assembly to foundation or floor channels
 3. Install and check all interconnecting wiring
 4. Set all protective devices according to coordination studies as specified in Sections 16015A & B
 5. Conduct performance testing of ground fault system. Document results on ground fault test record form supplied with the equipment and turn over the test records to the customer

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