PART 1  GENERAL

1.01  SCOPE

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

1.02  RELATED SECTIONS

A. Section 16346 – Metal-Clad Switchgear (VacClad-W) – Medium Voltage
B. Section 16341 – Metal-Enclosed Bus – Medium Voltage

1.03  REFERENCES

A. The high resistance grounding system, when applied with medium voltage metal-clad switchgear, shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA SG-4 and SG-5, and IEEE 37.20.2.

1.04  SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:
   1. Master drawing index
   2. Front view elevation
   3. Floor plan
   4. Top view
   5. Single line
   6. Schematic diagram
   7. Nameplate schedule
   8. Component list
   9. Conduit entry/exit locations
  10. Assembly ratings including:
       a. Short-circuit rating
       b. Voltage
       c. Continuous current
       d. Basic impulse level for equipment over 600 volts
  11. Major component ratings including:
       a. Voltage
       b. Continuous current
       c. Interrupting ratings
  12. Cable terminal sizes

B. Where applicable, the following additional information shall be submitted to the Engineer:
1.05 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 1.04, and shall incorporate all changes made during the manufacturing process
      2. Wiring diagrams
      3. Certified production test reports
      4. Installation information including equipment anchorage provisions
      5. Seismic certification as specified

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

1.07 REGULATORY REQUIREMENTS

1.08 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.

B. HRG system assembly shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. HRG system assembly shall be equipped to be handled by crane. Where cranes are not available, it shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

C. Equipment being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors indoor equipment shall be covered and heated, and outdoor equipment shall be heated.

1.09 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.

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2.02 RATINGS

A. The assembly shall be suitable for maximum service voltage and the type of power system as indicated on the drawings.

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 *______ amperes.

C. The assembly shall be UL approved and supplied with the UL label.

2.03 CONSTRUCTION

A. The assembly shall consist of a free standing NEMA 1 enclosure. The sides and rear shall be covered with removable bolt-on covers. Front and rear access are required. All edges of front covers or hinged front panels shall be formed. Provide 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 provided 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 equal to Eaton type C-HRG high-resistance grounding equipment utilizing grounding transformers and resistors as herein specified or as required.

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.

2.04 BUS

A. A 1/4-inch x 2-inch copper ground bus shall be firmly secured to the assembly. Provide terminals for connection of the system grounding conductor, suitable for #8 AWG to 500 kcmil, copper or aluminum.

2.05 WIRING/TERMINATIONS

A. The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10% spare terminals shall be provided. One control circuit cutout device shall be provided in each control circuit. Switchgear secondary wire shall be #14 AWG, type SIS rated 600 volt, 90 degrees C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

B. *[Phase terminals for delta connected system] [Neutral terminal for wye connected system] shall be suitable for #4 AWG to 500 kcmil power cables. The power cable (supplied by owner) shall enter HRG enclosure from *[top] [bottom].

* Note to Spec. Writer – Insert data in blanks
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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 to NORMAL from the TEST position

3. Reset control selector switch with AUTO/MANUAL/RESET positions. Switch shall spring-return to MANUAL 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 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 time as the pulsing contactor, at an adjustable rate of 3 to 60 pulses per minute

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: [A single set point ground voltage meter relay, with two pointers, one for voltage indication and an adjustable pointer for ground voltage pickup level. [Set point adjustment shall be front mounted knob on the meter] [A dual set point ground voltage meter relay, with one set point output contact set shall be wired to terminal blocks for field connection as shown on the drawings. Set point adjustments shall be via front-mounted knobs]

8: An alarm horn with an alarm silence pushbutton and re-alarm timer. The horn shall be a heavy-duty, high-decibel type, adjustable from 78 to 103 db. 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 defeated via any control device

B. Provide the following control devices and features:

1. One normally open and one normally closed ground fault alarm contact each rated 10 amps at 240 volts AC

2. A test circuit shall be included to functionally test all controls of the fault indication and pulsing circuitry. The test shall be inhibited if the system is sensing a fault

3. A pulsing contactor, controlled by an adjustable recycle timer, allowing a momentary increase of approximately 4 amperes above ground current

4. Terminal shall be supplied to accommodate owner furnished 120 V 60 Hz control power supply

5. Dead-front pull-out type fuse block with fuses for control power disconnect

6. Tapped resistors with taps wired out to a convenient front accessible terminal block. Taps shall provide 3 to 6 amperes of ground current in 1 ampere increments.
Resistors shall be heavy-duty industrial type, \textit{[edgewound] [wirewound]} design. Each resistor tube shall have a stamped steel rating nameplate. The resistor assembly shall be interconnected with suitable wire size as required for the circuit current.

7. All control wiring shall be #14 AWG type SIS minimum.

8. A detailed schematic shall be furnished that accurately and completely describes the control and grounding circuits. All wire designations, terminal points, control device, 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.

9. When the power system source has a neutral terminal, as indicated on the contract drawings, a single phase distribution type transformer of proper kVA and voltage rating shall be connected from power system neutral to ground, with the required resistor assembly inserted in the secondary circuit of that transformer. When the power system source has no neutral point, WYE-broken DELTA distribution transformers shall be furnished in the assembly to provide a neutral point, and required resistor assembly shall be inserted across the broken DELTA secondary of those transformers.

2.07 ENCLOSURES

A. The HRG system described in these specifications shall be indoor construction, with devices arranged as shown on contract drawings.

2.08 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all control devices 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. Furnish master nameplate giving HRG system designation, voltage and ampere ratings, manufacturer's name, catalog number, and general order number.

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. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.
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 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.

2. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground in accordance with ANSI C37.20.2.

B. A certified test report of all standard production tests shall be available to the Engineer on 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 MANUFACTURER’S CERTIFICATION

A. A qualified factory-trained manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer’s representative’s certification.

3.04 TRAINING

A. 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. Training program shall include instructions on the assembly, protective devices, and other major components.

3.05 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer’s recommendations and contract drawings.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

3.06 FIELD ADJUSTMENTS

* Note to Spec. Writer – Insert data in blanks
A. The relays shall be set in the field by:
   1. The Contractor in accordance with settings designated by the engineer
      -- OR --
   1. The Contractor in accordance with settings designated in a coordination study of
      the system as required elsewhere in the contract documents
      -- OR --
   1. A qualified representative of the manufacturer, retained by the Contractor, in
      accordance with settings designated in a coordinated study of the system as required
      elsewhere in the contract documents

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