POWEROHM RESISTORS, INC.

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR HIGH RESISTANCE GROUNDING SYSTEMS

IMPORTANT: READ INSTRUCTIONS THROUGHLY BEFORE UNPACKING

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EQUIPMENT APPLICATION

Powerohm Resistors High Resistance Grounding Systems are an economical means of improving a three-phase ungrounded power system by providing the following advantages:

System Protection: Offers protection by providing a ground-to-neutral connection for a three-phase power system, while still allowing to operate as an “ungrounded system,” When the neutral of a system is not grounded, the system is vulnerable to potentially damaging ground faults.

Transient Over-voltage Reduction: A high resistance grounding system reduces the magnitude of transient over-voltages that may occur during arcing ground faults. High transient over-voltages may cause failure of equipment or insulation at locations on the system other than at the point of the fault.

Ground Fault Detection Warning: Instantly provides a warning when the first ground fault occurs through an alarm signal. Form C contacts can be used to activate external alarms or annunciators. An optional audible horn or red warning beacon is available.

Ground Fault Location Simplified: A pulsing contactor allows the ground fault location to be quickly located by use of a portable clamp-on current detector. The ease and swiftness of ground fault location eliminates the need to trace faults by opening and closing secondary feeders, branch circuits and individual loads one at a time.

Uninterrupted Service: A single line-to-ground fault left in operation may develop into a phase to phase fault, this is caused by the occurrence of a second ground fault on another phase before the first fault is cleared, considerable damage may be caused by the high line-to-line fault current. The potential for quickly locating and removing faults before damage occurs to critical processes minimizes outages, and costly manufacturing shutdowns.

Improved Personnel Safety: Reducing transient over-voltages, equipment arcing, fault levels, insulation failures and fault tracing through circuit isolation schemes decreases hazards to personnel.

EQUIPMENT OPERATION

Always refer to the drawings supplied with your high resistance grounding equipment to review design parameters. Drawings will include initial set up instructions pertaining to your specific unit. Also, resistor tap information, alarm contact detail and power connection requirements should be outlined in some detail. Feel free to contact the factory for Powerohm Resistors if you need assistance.

Standard equipment operation is as follows:

Normal Operation: Under normal operating conditions there is no ground fault present on the system and only a small capacitance charging or magnetizing current flows. During this condition, there is no appreciable voltage present across the resistor. An illuminated green indicating light, located on the front door, verifies normal operating conditions and proper control power.

Ground Fault Condition: During a ground fault condition a red indicating light, located on the front door, will illuminate and the alarm contacts will activate. Note that the red indicating light and the alarm contacts will remain activated until the ground fault is removed. During a ground fault, voltage will appear across the resistor. The voltage across the resistor will be sensed by the meter relay. The resistor is designed to limit the ground fault current to a low, acceptable value. Multiple taps are included with the resistor to adjust the fault current to a value slightly greater than the system magnetizing current, The resistance taps can be factory set or adjusted at time of equipment installation,

Ground Fault Location: To locate the ground fault, simply activate the pulse contactor by turning the selector switch, located on the front door, from the “Normal” position to the “Pulse” position. This activates a cycle of 30-40 pulses per minute to alternate the ground fault current between the fault and pulse current settings. A portable clamp-on ammeter (optional) can be used to follow the fluctuating fault current through the system to the location of the fault source. After removing the ground fault, the selector switch should be returned to “Normal” position to stop the pulsing cycle and the “Reset” pushbutton pressed to return to normal. The green indicating light should illuminate to indicate that the system has returned to normal.

Equipment Test: To test the system under normal operating conditions, press the “Test” pushbutton until the red indicating light illuminates. The alarm contacts can be now checked to verify correct operation. Note that unless the test resistor option has been purchased this does not test the grounding resistor or optional ammeter circuit, The “Reset” pushbutton should be pressed to return the system to normal.

SHIPPING

After the final inspection, Powerohm Resistors High Resistance Grounding Systems are securely fastened, in an upright position, onto a wooden skid. In some cases, additional bracing and/or banding is added to insure a safe shipment. The units are then completely wrapped with plastic to protect the finish and keep the outer surface free of dirt and moisture. Depending on certain criteria, units are shipped either "open" or crated. All crates are constructed with 1" thick lumber. The finished package is easily handled with a forklift or hand truck.

All crates are clearly marked with the correct shipping information and requested customer marks. A copy of the packing list is securely fastened to the package in clear view.

NOTE: Each unit is provided with a copy of the certified test report (the originals are kept on file at the factory).

Normally, all crates are loaded by forklift into the enclosed van of a common carrier. At this point, it is the responsibility of the carrier to provide proper handling to the destination.

RECEIVING

Upon receipt, the crated unit should be unloaded and inspected immediately to insure that proper handling was practiced during transit. Report any apparent damage to the crate that could have harmed the contents.

NOTE: Great care is taken to properly package your resistor, therefore, it is recommended that the unit remains crated until it reaches the job site.

All packaged neutral grounding resistors are suitable for prolonged storage. Always store the unit in the upright position (as shipped). Setting the crate on its side or top will likely cause damage to the resistor. Avoid stacking anything on top of the crate.

INSPECTION

Inspect the exterior of the enclosure for damage paying particular attention to the control panel and meter faces. Open the front door and inspect the resistor and control panel for damaged components. Medium voltage units have a step-down transformer in the bottom compartment. Inspect that the transformer is still securely fastened and has not been damaged.

NOTE: If any damaged parts are found, contact the factory immediately. Energizing the unit may damage the resistor and create a shock hazard to personnel.

Finally, check all electrical connections to ensure tightness.

INSTALLATION

When ready for installation at the jobsite, uncrate the resistor using care not to damage the enclosure finish and/or operator controls. Next, open the front door to remove the bolts which fasten the enclosure to the skid.

It is recommended that a hoisting device be used to lift the unit with the aid of the eyebolts on the top of the enclosure. If a hoisting device is not available, a forklift can be used, protection of the finish on the bottom of the enclosure should be provided. The enclosures may be top heavy and must be secured from falling if handled by the bottom of the enclosure.

Powerohm Resistors High Resistance Grounding Systems should be mounted on a concrete pad, or similarly supported. Always mount the unit in the upright position. The unit should be bolted to the mounting surface using the 5/8" diameter holes provided at each bottom corner of the enclosure. Expansion type anchors are recommended for concrete pad mounting.

NOTE: The enclosure should always be securely grounded to prevent a shock hazard to personnel.

Powerohm Resistors High Resistance Grounding Systems are packaged in several different configurations depending on the electrical ratings and customer requirements. Please refer to the supplied drawings for equipment size, weight and lifting provisions.

Receiving: When received, the high resistance grounding equipment should be unloaded and carefully moved by overhead crane or forklift, At this point, a preliminary inspection of the crate should be made to ensure proper handling was practiced during shipment. Should any damage be detected, contact the carrier immediately to report and file a claim if needed.

Handling: Freestanding units are supplied with removable lifting eyes for use with an overhead crane. Do not attempt to move or lift the equipment at points over than the lifting eyes or skid base. Never position the unit on its side or top, which may cause damage to the unit. Wall mounted units or open panels should also be handled with care to prevent damage to external components. Do not stack,

Equipment Grounding: To reduce the possibility of electrical shock, appropriate grounding practices must be adhered to. Prior to making any system connections, ground the equipment (a lug or ground strip is provided with all equipment). Ensure that all ground conductors are sized per NEC and applicable standards.

Line and Control Connections: Refer to furnished drawings that accompany the unit. Generally, the line connections are made through either the top or bottom of the enclosure to the proper internal terminals. Space is provided for line cables to run down the side without cable bends. Control power and auxiliary device connections are made to marked terminal blocks.

As a final check, inspect all wiring to verify that connections are made properly and tightened adequately.

Equipment Adjustments: Adjust the resistor at installation so that the ground fault current is greater than the system capacitance charging current, Given an industrial power system where the design and components are known, the charging current can be estimated with reasonable accuracy. Refer to the “Grounding Resistor Connection Table” on your drawings for determining the correct tap configuration to obtain the desired ground fault current. Set the meter relay such that the high set point (right side needle) is at the fault trip setting and the low set point (left side needle) is just higher than the voltage across the neutral ground resistor due to the system charging current. Also, it should be noted that the control voltage must be within 107- 127 volts or the meter relay will not operate.

How to measure the capacitance on a power system to set the taps on your high resistance grounding system.

WARNING: TESTING FOR SYSTEM CAPACITANCE LEAKAGE CURRENT REQUIRES THAT ALL SYSTEM LOADS BE CONNECTED. TAKE ALL NECESSARY SAFETY MEASURES AND FOLLOW SAFETY PRACTICES TO AVOID INJURY.

1. Connect and turn on the high resistance grounding system with the factory settings or the settings based on calculations.

2. All normal loads need to be connected or their contribution to the system capacitance will not be measured.

3. Verify that no ground faults are indicated by the HRG. Look at more than the presence of an alarm indication. Ensure there is no current thru the grounding resistor. If the unit is equipped with a test resistor, use it to verify the HRG is functioning correctly. Clear any grounds before proceeding.

4. At this point, turn off the HRG system before proceeding to Item 5.

5. Connect a #8 ground wire from one phase of a disconnect, fused at 5 amps, to ground. For safety, the fuse must be a current limiting fuse rated higher than the system voltage. The disconnect and fuse shall be enclosed. The ground wire can have a loop of 10 turns of wire to increase the sensitivity of the reading. Use a clamp on ammeter on the loop of 10 turns. The meter will read a value that is 10 times the actual current.

6. Close the disconnect and read the current on the clamp on ammeter. Open the disconnect. Do not leave the disconnect closed longer than is necessary to get the reading on the ammeter. If a ground develops on a phase different than the one you are grounding, the blowing of the 5 amp fuse is the only protection from a phase to phase fault.
7. Remove the ground wire.

8. Use the ammeter reading, corrected to its actual value, and the HRG drawing recommendation to set the taps for the fault current and the pulse current.

9. Occasionally (annually) repeat the reading to keep the fault current setting above the measured system capacitance leakage current, as over time additional loads may be added to the system. Maintaining the fault setting higher than the system capacitance leakage current allows the HRG to limit transient overvoltages should an arcing fault develop on the system. Fault current settings higher than recommended by the drawing allows more damage to occur at the point of fault, damage that may be more expensive to repair or subject an employee at the point of fault to injury.

10. If you have any questions on this procedure contact Powerohm Resistors at info@powerohm.com or call 859-384-8088.

NEUTRAL CONNECTION

The neutral lead from the transformer or generator is connected to a terminal strip or neutral terminal (refer to the supplied drawing for terminal location):

The connection is made directly to an internal terminal point via rigid conduit connected to the enclosure. On medium voltage units the neutral cable is terminated with a compression type lug (customer supplied) to a NEMA two hole terminal which is labeled for easy identification. Location and termination of the conduit is the customer's responsibility.

NOTE: The factory supplied drawing identifies the neutral and ground Connection points.

In all cases, the neutral terminal is tagged for easy identification and the proper connection is shown schematically on the drawing.

Check all electrical connections to ensure they have not loosened in shipment.

DELTA PHASE CONNECTIONS

The phase leads from the transformer or generator are connected to a terminal strip on low voltage units (refer to the supplied drawing for terminal location):

On medium voltage units the connection is made directly to the neutral deriving transformers via rigid conduit connected to the enclosure. The cables are terminated with compression type lug (customer supplied) to the transformer H1 terminals. Location and termination of the conduit is the customer's responsibility.

NOTE: The factory supplied drawing identifies the phase and ground Connection points. This grounding equipment is not phase rotation sensitive. Any phase can connect to any H1 terminal.

Check all electrical connections to ensure they have not loosened in shipment.

GROUND CONNECTION

The ground lead from the resistive element to ground may be connected one of two ways:

1. On low voltage units the connection is made directly to a control panel mounted ground bus.

2. Medium voltage units have separate grounds for the high voltage ground and a low voltage ground to the secondary of the step-down transformer(s). The HV ground connection is made directly to an internal ½" ground stud via rigid conduit connected to the enclosure. The ground terminal is labeled for easy identification. A compression type lug is used for ground connection (customer supplied). The low voltage secondary ground connection is made directly to a control panel mounted ground bus. Location and termination of the conduit is the customer's responsibility.

NOTE: The factory supplied drawing identifies the neutral and ground connections.

Check all electrical connections to ensure they have not loosened in shipment.

MAINTENANCE

Normally, no maintenance is necessary on the neutral grounding resistor. However, periodic inspections for damage are needed to ensure that the resistor is still capable of protecting the system. Damage may occur from lightning, earthquakes, overloads or extended service life. Basically, it is necessary to ensure that the resistive element has not burned open and that the element is still properly isolated from ground.

The following procedure is recommended for periodic field inspections.

1. Isolate the high resistance grounding system with the disconnect switch. Note that medium voltage systems do not disconnect the high voltage neutral connection to the step-down transformer which will still feed voltage to the terminal strip and line side of the disconnect switch. For complete protection the system must be de-energized. These precautions are recommended to prevent a shock hazard to maintenance personnel and to prevent the system from being operated without proper grounding.

2. Inspect and test as required components of the control panel.

3. Carefully check the resistor assembly for cracked ceramics or damaged insulators. A Meggar or Hi-Pot test is the most reliable method of ensuring that

the porcelain insulation is still providing the necessary electrical isolation. Ground connections must be disconnected to perform this test.

4. Check the resistive element for continuity. An ohmmeter reading made between the neutral and the ground side of the resistor should be within 10% of the drawing values. If the resistance of the element is more than 15% off from the nameplate value, the resistors should be replaced.

5. Check all internal connections for tightness. Check wiring for signs of damage from heat or overloads.

6. Drawings can be supplied by email or fax if we are furnished with complete nameplate information. Finally check the mounting bolts for tightness.

Note: Any work on this equipment should be performed by qualified electrical personnel in compliance with national, and local safety regulations. NEC requires qualified and trained electrical personnel to be available to supervise the operation of this equipment.