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NERM Reference Manual

NERM Panels

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Installation and Maintenance Manual for Dimako NERM Panels

REV 4



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Installation

Dimako Neutral Earthing Resistor Monitor (NERM) panels are designed to endure the arduous operating conditions experienced in a mining environment. However so as not to compromise the functionality of the following points shall be taken into consideration:

1. System Voltage and Earth restriction levels should conform to the rating of the panel
2. Cable connections, insulation & conductor sizes, cable glands shall be adequately rated to withstand full calculated fault conditions.
3. To avoid possible de rating of design specifications it is essential to ensure adequate heat dissipation is allowed. Adequate space must be allowed around the panel for this purpose, especially if the panel is subject to external heat sources; eg Transformer heat dissipation. If there is any doubt as to the application please contact the factory. The ambient temperature should not exceed 40 °C.
4. The NERM panel shall be securely mounted. Sufficient bracing and securing of the panel must be in place to withstand full calculated fault conditions as well as the rigorous conditions and forces, which are encountered especially for mobile applications
5. The panel should be mounted a convenient height to allow good visibility of the various meters and indications. If sunlight can impinge directly on Dimako Bargraph Type meter, if fitted, a cover should be installed to protect the front face of the meter.
6. Ensure that the assembly is located in a clean, dry non-corrosive area which is clear of moving traffic, and where damage to the panel is unlikely to occur. Ensure that the roof and sidewalls in the vicinity are in good condition. The location should be such that the accumulation of dust or water is minimised.
7. Ensure that adequate space is allowed around the assembly to provide the following:
 - Easy installation and removal of incoming and outgoing cables
 - Uninhibited access to the assembly to allow for regular inspection of status indications, meters, labelling and access to panel covers and doors.
8. Unauthorised access to the panel internals and relay settings should be prevented by keeping the panel pad locked and or password protected.
9. Ensure that earth bonding of panel equipment complies with specific mine requirements. The conductor size should be suitably rated for mechanical endurance.
10. Ensure that the cables are suitably anchored or positioned so as to prevent undue tension or twisting of the cable under operating conditions. Particular care should be taken to prevent personnel from standing on the connection cables.
11. Adequate lighting should be available to allow for reading of labels and location test and reset push buttons.
12. The panels do generate heat under fault conditions and should not be mounted directly onto oil tanks or near flammable or hazardous substances.
13. The Neutral Earthing Panel is not explosion protected and may not be used in the hazardous area of a fiery mine when used as an external unit.
14. Ensure that fire fighting equipment and statutory notices are available, legible and in position.
15. A logbook should be provided to record all switching operations, isolations and trip occurrences.



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Connection

1. Drawings Electrical and Mechanical layout drawings for the Neutral Earthing Resistor assembly must be available to allow for easy identification of components and their connection detail.
2. The terminals for the resistor and resistor monitor relay should be separate. These must be individually connected to the neutral point of the transformer secondary winding and physically connected as close to the transformer star point as possible. Use of an insulated cable of at least 16mm² in cross sectional area is recommended for mechanical reliability. (This only applies where the neutral restriction level is below 10 Amps. For higher restriction amperages cables with larger cross sectional areas are required). Terminate the cable with appropriately sized ring lugs that fit easily but not loosely onto the terminals.
3. The earth terminal of the Neutral Earthing Resistor must be solidly connected to the earth and transformer frame. Do not connect the neutral of the transformer to the earth.
4. All connection cables should be properly glanded and well secured on the gland plate provided
5. Dimako Neutral Earthing panels are normally configured to accept a number of safety tripping regimes. Ensure that the correct regime is wired for the particular installation and that the cable sizes are adequate. Also check that the respective tripping coil voltages of other equipment conforms to the chosen NER tripping regime.
6. Ensure that there is a reference wiring diagram for the complete installation

Pre-Power-up Inspection

1. Once the equipment has been positioned and connected as detailed above open the panel doors ensure that internal components, cables and connections are in place, secure and free from damage.
2. Protection settings shall be correctly configured and set for the specific installation. (With some panels that contain electronically preset relays it is only possible to check these settings after energisation of the panel).
3. For the Earth Fault Alarm level, if fitted, the preferred trip level is typically 25% of the restriction level with an instantaneous or 0.5 Second time delay. This level is not prescriptive and may vary according to mine standards.
4. For Earth fault trip relays the preferred trip level is 50% of the restriction level with a 2 Second delay. This level is not prescriptive and may vary according to mine standards.
5. Measure the resistance of the NER and make sure that it is within 10% of the value stated on the nameplate. The monitor wire to the NERM relay from neutral should generally be disconnected for this test. Remember to reconnect after completing the test.
6. Before switching ON ensure that the connections are in accordance with relevant diagram. Pay particular attention to control supply voltages and tripping circuit voltages which need not necessarily be the same.



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Special Precautions

1. During earth fault conditions the terminals of the NER and the NERM relay are elevated to the system phase voltage. NEVER work inside the Neutral Earthing Panel when the power is connected.
2. When the equipment is installed in a hazardous location, the correct lockout, isolation and make safe procedures must be followed.

Power up

1. Once all of the above inspections are satisfactory the system can be powered up.
2. It is important to test the back tripping of the MV circuit breaker, (or other tripping regime). This can be done by using the test push buttons provided on the front of the panel. Two tests are required to prove the system.
 - a. NERM test : This test has a fairly long time delay before operation. The test push button must be continuously depressed whilst the test is active
 - b. Earth Fault Test. There is a short two second delay before this circuit activates. Once again the push button must be continuously depressed during the test.

If an earth fault alarm relay is fitted to the panel the alarm should momentarily sound prior to the back trip initiated in b.

Whilst doing the test in b. observe the indication on the Earth Fault Bar-graph meter. The earth fault test should provide a reading of between 75% to 100% of the full scale deflection. If an earth fault alarm relay is present the two readings on the meters can be compared and should be the same.

Both of the above tests should activate the appropriate tripping regime, power will have to be reapplied after each trip.

Typical System Response to fault conditions:

CONDITIONS	EXPECTED RESPONSE
An earth fault occurs downstream on the system	The first earth leakage relay upstream from the fault will trip the appropriate circuit breaker clearing the fault before the NER panel trips. The NER panel will however indicate the magnitude of the fault on the bar-graph meter.
An Earth fault occurs downstream and the downstream earth leakage relays fail to clear the fault.	The NER panel will sense the fault and trip the HV circuit breaker after the preset time delay on the bar-graph meter. The fault will be indicated by the "Earth Fault" latching mechanical flag or lamp which in some cases is battery backed up to provide indication in the absence of power. The trip relay must be manually reset.
During an earth fault or at any other time the neutral earthing resistor fails to high resistance or open circuit.	The NERM relay inside the NER panel will detect the fault and activate a system trip. The trip is latching and will either activate a mechanical flag or battery backed up indication. The trip relay must be manually reset.
An earth fault occurs anywhere on the LV side of the transformer before any other earth leakage relays.	The NERM relay inside the NER panel will detect the fault and activate a system trip. The trip is latching and will either activate a mechanical flag or



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CONDITIONS	EXPECTED RESPONSE
	battery backed up indication. The trip relay must be manually reset
An Earth fault occurs but the protection fails to clear the fault.	The NER will conduct the fault current continuously. The bar-graph meter on the NER panel should indicate the value of the current. If an alarm level meter is fitted the alarm should sound.

Routine Maintenance

Weekly / monthly Inspections: These checks are limited to checking the panel from outside the panels with the power on.

1. Visually inspect the panels from outside for signs of damage. Check for the integrity of the earth wire and check that the incoming and outgoing cables are secure in their glands and show no signs of deterioration.
2. When used in hazardous locations, carry out the explosion protected mandatory inspections as per end-user procedures.
3. Ensure the area is safe before any panel access doors are opened.
4. Check that the power ON indicator is functional.
5. Check that system Healthy indications are functional.
6. Check the alarm and trip earth fault bar-graph meters for total system earth leakage. If low level faults are visible these should be traced and attended to as soon as possible. If high level faults are visible and the system does not trip, the earth faults must be remedied immediately. The system tripping regime must also be checked and fixed.
7. Cautiously feel the external temperature of the resistor enclosure. If an earth fault is present the resistor will be elevated in temperature, which requires remedial action. Dimako panels are protected against physical contact of high temperature parts of the resistor, but caution must always be exercised.
8. Check the panel for accumulation of dust. In coal mines dust that gathers is coal based and therefore flammable or at lower temperatures it can smoulder. In the interest of safety the panels should be kept clean and free of such dust. In other mines it is also advisable to keep the NER panel clean as dust will impede the effectiveness of the cooling arrangement of the resistors.
9. Check the panels for sign of water ingress. If it is evident that there is a presence of water or excessive condensation the system should be de-energised and panels opened and dried out if necessary. Silica Gel can be employed to combat small amounts of condensation.
10. Record inspection status and faults found in the log book

Monthly / Quarterly Inspections: These are more demanding inspections and will require de-energisation of the system for some tests.

1. Perform all of the inspections described above in the weekly / monthly schedule.
2. Test the current monitoring trip circuit by depressing the current monitoring test button. Make sure that the current monitor trip is operational and that the bar-graph meters indicate the level of the injection test.



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Compare this to previous readings recorded in the log book. Any variance may indicate faulty system protection. Check that indicator flags or battery lights indicate the fault.

3. Perform a NERM test. Make sure that the current NERM trip regime is operational. Check that indicator flags or battery lights indicate the fault.
4. **TURN OFF THE POWER FOR THE REMAINING TESTS. TEST THAT THERE IS NO POWER ON THE NER PANEL BEFORE CONTINUING. IT IS POSSIBLE THAT EVEN THOUGH THE MAIN TRANSFORMER IS ISOLATED AN AUXILIARY POWER SOURCE CAN BE CONNECTED TO THE NER PANEL. CHECK THE SYSTEM DRAWING FOR DETAILS OF THE INSTALLATION.**
5. With the power off open the panel doors to inspect the internal condition of the control panel and clean out any dust.
6. If silica gel cartridges are used to control moisture check that the crystals are still blue. If they show signs of turning pink replace the cartridges with fresh Silica Gel.
7. Check for signs of water ingress and take the appropriate action if present.
8. Check all cable connections are tight.
9. Check cable terminations for signs of overheating or arcing.
10. Test the resistors and ensure that they are in good order and within 10% of their rated value. This can be done by measuring between the transformer neutral and earth. The NERM relay monitor wires should be disconnected for this test as it will influence the reading. Reconnect the NERM monitor wire after doing the test. An easy way of doing this without disconnecting wires is to depress the NERM test push button whilst taking the Neutral to Earth resistance reading. Remember this test is done with the power OFF.
11. The panel doors can be closed after the above tests are successful and power can be reapplied.
12. Record details of tests performed and faults found in the system log book.

Should you have any areas of doubt or uncertain in any way of the system operation, contact Dimako Industries for assistance.