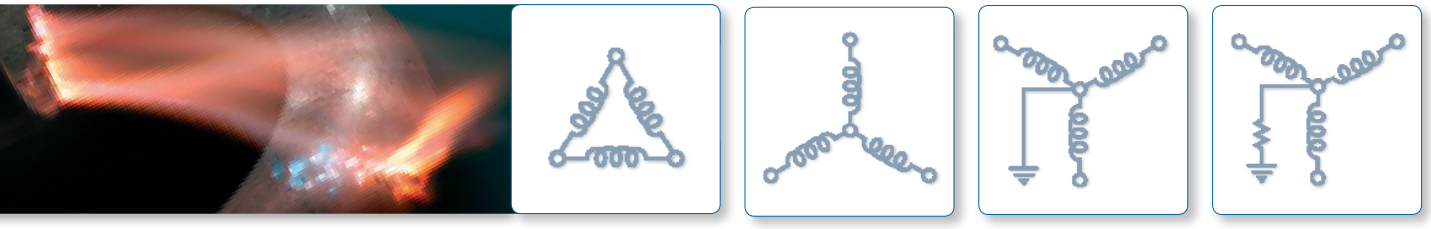
GARD

Unparalleled Protection

Ground Fault Protection

CONSULTANT SPECIFICATION GUIDE



C-398EA Consultant Specification Guide, November 2014

ABOUT I-GARD

I-Gard's commitment to electrical safety provides both industrial and commercial customers with the products needed to protect their electrical equipment and the people that operate them.

As the only electrical-safety focused company whose product portfolio includes neutral grounding resistors, high-resistance grounding systems and optical arc mitigation, we take pride in our technologies that reduce the frequency and impact of electrical hazards, such as arc flash and ground faults.

For those customers who have purchased from us over the last 30 years, you know us for the quality and robustness of our products, our focus on customer service and technical leadership. We build on this foundation by investing in developing new products in electrical safety education - including EFC scholarship program - by actively participating in the IEEE community programs on technical and electrical safety standard, and working with local universities at discovering new technologies. We remain unrelenting in our goal of improving electrical safety in the workplace.

Our commitment to excellence is validated by long-standing relationships with industry leaders in fields as diverse as oil and gas, hospitals, automotive, data centers, food processing, aerospace, water and waste water plants, and telecommunications. We provide them with the product and application support required to ensure that their electrical distribution system is safe and reliable.

TABLE OF CONTENTS

1. GROUND FAULT RELAYS & ALARMS

	UNGROUNDED	SOLIDLY GROUNDED	LOW RESISTANCE	HIGH RESISTANCE	FAULT LOCATING CAPACITY	FAIL SAFE RESISTOR PATH	RESISTOR MONITORING	ARC FLASH MONITORING	BUILT-IN NGR
VIA	X			X					
MGFR	X	X	X	X					
SENTRI	X	X	X	X					
mGARD10				X					
SIGMA			X	X			X		
SENTRI-ARC	X	X	X	X				X	
ARC-I-TEC	X		X	X			X	X	
STOPLIGHT				X					X
NGR			X	X					X
NTR			X						X
FUSION		X							X
SLEUTH				X	X				X
GEMINI				X	X	X			X
GARDIAN	X		X	X			X	X	X
DSP-OHMNI				X	X		X		
SENTINEL				X	X		X		X

1. STOPLIGHT & STOPLIGHT-RM HIGH RESISTANCE GROUNDING

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

1.1 GENERAL

SCOPE

A. This specification covers the basic requirements for ground fault relay system for resistance grounded;
   1. Mount external to electrical distribution equipment (new or retrofit applications).
   2. Assembled and integrated into low voltage equipment, such as panel-board, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To provide early warning on ground fault.
   2. To provide visual indication on the occurrence of a ground fault.
   3. To provide auxiliary contacts for external indication.
   4. To ground the neutral of a three phase power system using a power resistor.
   5. To limit the magnitude of the ground fault to a predetermined non damaging level.
   6. To reduce the frequency and number of arc flash and arc blast hazard.
   7. To monitor neutral grounding resistor to ensure its functionality. (RM Option Only)

C. Electrical system parameters
   1. Wye or Delta connected, three phase, three wire resistance grounded or ungrounded systems,
   2. System line-to-line voltage to be 480V AC or 600V AC.
   3. System line-to-neutral voltage to be 277V or 347V
   4. If installing on three phase, three wire ungrounded system, artificial neutral assembly also required and installed to create reference point for HRG system.

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems
C. NEMA 250: Enclosures for Electrical Equipment
D. NFPA 70: National Electrical Code
E. NFPA 70E: Standard for Electrical Safety in the Workplace
F. UL 50: Enclosures for Electrical Equipment
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors
H. UL 508: Industrial Control Equipment
I. UL 1053: Ground-Fault Sensing and Relaying Equipment
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistor Assemblies

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:

1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems
2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems
3. NFPA 70 – National Electrical Code
4. UL 50 – Enclosures for Electrical Equipment
5. UL 508 – Industrial Control Equipment
6. UL 1053 – Ground – Fault Sensing and Relaying Equipment

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following:
(a) Routine maintenance requirements for all installed components.
(b) Manufacturer's written instructions for testing.

D. The submittals shall also include:

1. Dimensional drawing of each enclosure.
2. Internal component bill of materials and details.
3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

DELIVERY, STORAGE, AND HANDLING

A. Deliver high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.2 PRODUCT

HIGH RESISTANCE GROUNDING SYSTEM

A. Inclusive, one wall mounted NEMA 2 enclosure containing both the high resistance grounding resistor as well as the controls (or) separately mounted NEMA 4 or NEMA 12 enclosure housing the controls for a remotely mounted high resistance neutral grounding resistor.

B. Power resistor to limit current flow to (5 amps or 10 amps) during a single phase to ground fault condition. The resistor shall be constructed from low temperature coefficient material such that the resistance shall vary less than 10% throughout the temperature range the resistor is designed for.

C. The ground fault detection relay shall be capable of detecting fault current between 0.5A and 10A with adjustable time delay between 0.5s and 10s.

D. Microprocessor based digital ground fault relay and a zero sequence current sensor.
1. Maintain accuracy over a range of 45Hz to 65Hz.
2. Harmonic filter to eliminate nuisance tripping.

E. Indication of ground fault status shall be provided by a series of LED indicating lights.
   1. Green = No active ground faults on the system.
   2. Red = Ground fault active on system.
   3. Amber = Ground fault has occurred and is intermittent or has been cleared.
   4. Red = Resistor Fault (RM Option Only)

F. A test pushbutton on the front panel shall allow user to test the ground fault detection system and ancillary systems.

G. HRG system shall also:
   a. Provide ground fault main trip relay output form Z, 10A, 240V AC contact for remote indication.
   b. Provide ground fault alarm auxiliary relay output form C, 10A, 240V AC contact for remote indication.
   c. Auxiliary NGR Fault relay Form C (NO/NC) 10A @ 240V AC, 8A @ 24V DC, 1/2HP @ 240V AC. (RM Option Only)

H. A reset button shall be on the front panel to reset the ground fault system.

I. Provide artificial neutral assembly if installing on three phase, three wire ungrounded system to create reference point for HRG system.

J. Provide a resistor monitor function, integral to the HRG system to verify the integrity of the neutral grounding resistor (NGR) and alarm if:
   a. Resistance is more than 150% of nominal value
   b. Resistance is less than 66% of nominal value (RM Option Only)

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal)
B. Product to be I-Gard Stoplight or Stoplight-RM (or approved equal)

SYSTEM REQUIREMENTS

A. No line to neutral loads may be connected to High Resistance Ground Systems per NEC.186 (3)
B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.
B. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

2. FUSION
HIGH RESISTANCE GROUNDING

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

2.1 GENERAL

SCOPE

A. This specification covers the basic requirements for ground fault relay system for solidly grounded to resistance grounded;
   1. Mount external to electrical distribution equipment (new or retrofit applications).
   2. Assembled and integrated into low voltage equipment, such as panel-board, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To allow the protection systems to operate in solidly grounded mode under normal conditions then switch to high resistance grounding mode upon th detection of a ground fault.
   2. To provide early warning on ground fault.
   3. To provide visual indication on the occurrence of a ground fault.
   4. To provide auxiliary contacts for external indication.
   5. To ground the neutral of a three phase power system using a power resistor when a fault occurs.
   6. To limit the magnitude of the ground fault to a predetermined non damaging level.
   7. To reduce the frequency and number of arc flash and arc blast hazard.
   8. To monitor neutral grounding resistor to ensure its functionality. (RM Option Only)

C. Electrical system parameters
   1. Wye connected, three phase, three wire resistance grounded,
   2. System line-to-line voltage to be 480V AC or 600V AC.
   3. System line-to-neutral voltage to be 277V or 347V

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems.
C. NEMA 250: Enclosures for Electrical Equipment.
D. NFPA 70: National Electrical Code.
E. NFPA 70E: Standard for Electrical Safety in the Workplace.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
H. UL 508: Industrial Control Equipment.
I. UL 1053: Ground-Fault Sensing and Relaying Equipment.
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistor Assemblies

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:

1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems.
3. NFPA 70 – National Electrical Code.
4. UL 50 – Enclosures for Electrical Equipment.
5. UL 508 – Industrial Control Equipment.
6. UL 1053 – Ground – Fault Sensing and Relaying Equipment.

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following:

(a) Routine maintenance requirements for all installed components.
(b) Manufacturer's written instructions for testing.

D. The submittals shall also include:

1. Dimensional drawing of each enclosure.
2. Internal component bill of materials and details.
3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

DELIVERY, STORAGE, AND HANDLING

A. Deliver solidly grounded to high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of solidly grounded to high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

2.2 PRODUCT

SOLIDLY GROUNDED TO HIGH RESISTANCE GROUNDING SYSTEM

A. Inclusive, one wall mounted NEMA 2 enclosure containing both the high resistance grounding resistor as well as the controls (or) separately mounted NEMA 4 or NEMA 12 enclosure housing the controls for a remotely mounted high resistance neutral grounding resistor.

B. Power resistor to limit current flow to (5 amps or 10 amps) during a single phase to ground fault condition. The resistor shall be constructed from low temperature coefficient material such that the resistance shall vary less than 10% throughout the temperature range the resistor is designed for.

C. The ground fault detection relay shall be capable of detecting fault current between 0.5A and 10A with adjustable time delay between 0.5s and 10s.

D. Microprocessor based digital ground fault relay and a zero sequence current sensor.
1. Maintain accuracy over a range of 45Hz to 65Hz.
2. Harmonic filter to eliminate nuisance tripping.

E. Indication of ground fault status shall be provided by a series of LED indicating lights.
1. Green = System healthy and operating in solidly grounded mode.
2. Red = Ground fault active and system is operating in high resistance grounded mode.
3. Amber = Pulsing feature is on.
4. Red = Resistor Fault (RM Option Only)

F. A test pushbutton on the front panel shall allow user to test the ground fault detection system and ancillary systems.

G. HRG system shall also:

a. Provide ground fault main trip relay output form Z, 10A, 240V AC contact for remote indication.

b. Provide ground fault alarm auxiliary relay output form C, 10A, 240V AC contact for remote indication.

c. Auxiliary NGR Fault relay Form C (NO/NC) 10A@240V AC, 8A@24V DC, 1/2HP@240V AC. (RM Option Only)

H. A reset button shall be on the front panel to reset the ground fault system.

I. Provide fuse sized to trip on ground fault.

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal)

B. Product to be I-Gard FUSION or FUSION-PS

SYSTEM REQUIREMENTS

A. No line to neutral loads may be connected to High Resistance Ground Systems per NEC.186 (3)

B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.

B. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

3.1 GENERAL

SCOPE

A. This specification covers the basic requirements for ground fault relay system for solidly grounded to resistance grounded;
   1. Mount external to electrical distribution equipment (new or retrofit applications).
   2. Assembled and integrated into low voltage equipment, such as panel-board, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To allow the protection systems to operate in solidly grounded mode under normal conditions then switch to high resistance grounding mode upon th detection of a ground fault.
   2. To provide early warning on ground fault.
   3. To provide visual indication on the occurrence of a ground fault.
   4. To provide auxiliary contacts for external indication.
   5. To ground the neutral of a three phase power system using a power resistor when a fault occurs.
   6. To limit the magnitude of the ground fault to a predetermined non damaging level.
   7. To reduce the frequency and number of arc flash and arc blast hazard.
   8. To monitor neutral grounding resistor to ensure its functionality. (RM Option Only)

C. Electrical system parameters
   1. Wye connected, three phase, three wire resistance grounded,
   2. System line-to-line voltage to be 480V AC or 600V AC.
   3. System line-to-neutral voltage to be 277V or 347V

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems.
C. NEMA 250: Enclosures for Electrical Equipment.
D. NFPA 70: National Electrical Code.
E. NFPA 70E: Standard for Electrical Safety in the Workplace.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
H. UL 508: Industrial Control Equipment.
I. UL 1053: Ground-Fault Sensing and Relaying Equipment.
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistor Assemblies submitted for review ten days prior to the bid date.

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:

1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems.
3. NFPA 70 – National Electrical Code.
4. UL 50 – Enclosures for Electrical Equipment.
5. UL 508 – Industrial Control Equipment.
6. UL 1053 – Ground – Fault Sensing and Relaying Equipment.

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following:
(a) Routine maintenance requirements for all installed components.
(b) Manufacturer's written instructions for testing.

D. The submittals shall also include:
1. Dimensional drawing of each enclosure.
2. Internal component bill of materials and details.
3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

DELIVERY, STORAGE, AND HANDLING

A. Deliver solidly grounded to high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of solidly grounded to high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.2 PRODUCT

PULSING HIGH RESISTANCE GROUNDING SYSTEM

A. Inclusive, one wall mounted NEMA 2 enclosure containing both the high resistance grounding resistor as well as the controls (or) separately mounted NEMA 4 or NEMA 12 enclosure housing the controls for a remotely mounted high resistance neutral grounding resistor.

B. Power resistor to limit current flow to (5 amps or 10 amps) during a single phase to ground fault condition. The resistor shall be constructed from low temperature coefficient material such that the resistance shall vary less than 10% throughout the temperature range the resistor is designed for.

C. The ground fault detection relay shall be capable of detecting fault current between 0.5A and 10A with adjustable time delay between 0.5s and 10s.

D. Microprocessor based digital ground fault relay and a zero sequence current sensor.
   1. Maintain accuracy over a range of 45Hz to 65Hz.
   2. Harmonic filter to eliminate nuisance tripping.
   3. Pulsing power resistor (size confirmed by factory) to limit current flow to 5 amps during a single phase to ground fault condition:
      A: Pulsing characteristic to cyclically limit the fault current to 100%, 75% and 50% of the available ground fault current (5 amps) to allow tracing the faulted circuit to the point of the fault.
   4. A: Voltmeter with range of 0-500 volts.
      B: Ammeter with range of 0-5 amps.

E. Indication of ground fault status shall be provided by a series of LED indicating lights.
   1. Green = No active ground faults on the system.
   2. Red = Ground fault active on system.
   3. Amber = Pulsing is active.
   4. Red = Resistor Fault (RM Option Only)

F. A test pushbutton on the front panel shall allow user to test the ground fault detection system and ancillary systems.

G. HRG system shall also:
   a. Provide ground fault main trip relay output form Z, 10A, 240V AC contact for remote indication.
   b. Provide ground fault alarm auxiliary relay output form C, 10A, 240V AC contact for remote indication.
   c. Auxiliary NGR Fault relay Form C (NO/NC) 10A @ 240V AC, 8A @ 24V DC, 1/2HP @ 240V AC. (RM Option Only)

H. A reset button shall be on the front panel to reset the ground fault system.

I. Provide artificial neutral assembly if installing on three phase, three wire ungrounded system to create reference point for HRG system.

J. Provide a resistor monitor function, integral to the HRG system to verify the integrity of the neutral grounding resistor (NGR) and alarm if:
   a. Resistance is more than 150% of nominal value
   b. Resistance is less than 66% of nominal value (RM Option Only)

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal)
B. Product to be I-Gard Sleuth or Sleuth-RM (or approved equal)

SYSTEM REQUIREMENTS

A. No line to neutral loads may be connected to High Resistance Ground Systems per NEC.186 (3)
B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.
B. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

4. GEMINI & GEMINI-PS
HEALTH MONITORED HIGH RESISTANCE GROUNDING

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

4.1 GENERAL

SCOPE

A. This specification covers the basic requirements for ground fault relay system for resistance grounded;
   1. Mount external to electrical distribution equipment (new or retrofit applications).
   2. Assembled and integrated into low voltage equipment, such as panel-board, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To provide early warning on ground fault.
   2. To provide visual indication on the occurrence of a ground fault.
   3. To provide auxiliary contacts for external indication.
   4. To ground the neutral of a three phase power system using a power resistor.
   5. To limit the magnitude of the ground fault to a predetermined non damaging level.
   6. To reduce the frequency and number of arc flash and arc blast hazard.
   7. To provide a method for locating the phase to ground fault allowing the user to correct the problem or allow for an orderly shutdown of the process. (PS Option Only)
   8. To monitor neutral grounding resistor to ensure its functionality.
   9. To provide a second neutral to ground, high resistance path to maintain ground fault current to a non damaging level in the event of an open resistor failure.

C. Electrical system parameters
   1. Wye or Delta connected, three phase, three wire resistance grounded or ungrounded systems,
   2. System line-to-line voltage to be 480V AC or 600V AC.
   3. System line-to-neutral voltage to be 277V or 347V
   4. If installing on three phase, three wire ungrounded system, artificial neutral assembly also required and installed to create reference point for HRG system.

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems.
C. NEMA 250: Enclosures for Electrical Equipment.
D. NFPA 70: National Electrical Code.
E. NFPA 70E: Standard for Electrical Safety in the Workplace.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
H. UL 508: Industrial Control Equipment.
I. UL 1053: Ground-Fault Sensing and Relaying Equipment.
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistor Assemblies

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:

1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems.
3. NFPA 70 – National Electrical Code.
4. UL 50 – Enclosures for Electrical Equipment.
5. UL 508 – Industrial Control Equipment.
6. UL 1053 – Ground – Fault Sensing and Relaying Equipment.

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following:

(a) Routine maintenance requirements for all installed components.
(b) Manufacturer's written instructions for testing.

D. The submittals shall also include:

1. Dimensional drawing of each enclosure.
2. Internal component bill of materials and details.
3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

DELIVERY, STORAGE, AND HANDLING

A. Deliver high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

4.2 PRODUCT

HEALTH MONITORING HIGH RESISTANCE GROUNDING SYSTEM

A. Inclusive, one wall mounted NEMA 2 enclosure containing both the high resistance grounding resistor as well as the controls (or) separately mounted NEMA 4 or NEMA 12 enclosure housing the controls for a remotely mounted high resistance neutral grounding resistor.

B. Power resistor to limit current flow to (5 amps or 10 amps) during a single phase to ground fault condition. The resistor shall be constructed from low temperature coefficient material such that the resistance shall vary less than 10% throughout the temperature range the resistor is designed for.

C. The ground fault detection relay shall be capable of detecting fault current between 0.5A and 10A with adjustable time delay between 0.5s and 10s.

D. Microprocessor based digital ground fault relay and a zero sequence current sensor.
1. Maintain accuracy over a range of 45Hz to 65Hz.
2. Harmonic filter to eliminate nuisance tripping.

E. Indication of ground fault status shall be provided by a series of LED indicating lights.
1. Green = No active ground faults on the system.
2. Red = Ground fault active on system.
3. Amber = Ground fault has occurred and is intermittent or has been cleared.
4. Red = Resistor Fault (PS Option Only)

F. A test pushbutton on the front panel shall allow user to test the ground fault detection system and ancillary systems.

G. HRG system shall also:
   a. Provide ground fault main trip relay output form Z, 10A, 240V AC contact for remote indication.
   b. Provide ground fault alarm auxiliary relay output form C, 10A, 240V AC contact for remote indication.
   c. Auxiliary NGR Fault relay Form C (NO/NC) 10A@240V AC, 8A@24V DC, 1/2HP@240V AC. (PS Option Only)

H. A reset button shall be on the front panel to reset the ground fault system.

I. Provide artificial neutral assembly if installing on three phase, three wire ungrounded system to create reference point for HRG system.

J. Provide a resistor monitor function, integral to the HRG system to verify the integrity of the neutral grounding resistor (NGR) and alarm if:
   a. Resistance is more than 150% of nominal value
   b. Resistance is less than 66% of nominal value (PS Option Only)

K. Pulsing power resistor (size confirmed by factory) to limit current flow to 5 amps during a single phase to ground fault condition:
   A: Pulsing characteristic to cyclically limit the fault current to 100%, 75% and 50% of the available ground fault current (5 amps) to allow tracing the faulted circuit to the point of the fault.(PS Option Only)

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal)
B. Product to be I-Gard GEMINI or GEMINI-PS (or approved equal)

SYSTEM REQUIREMENTS

A. No line to neutral loads may be connected to High Resistance Ground Systems per NEC.186 (3)
B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.
B. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

5. SENTINEL
ADVANCED HIGH RESISTANCE GROUNDING SYSTEM WITH CRITICAL FEEDER PROTECTION AND PULSING

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

5.1 GENERAL

SCOPE

A. This specification covers the basic requirements for the high resistance grounding (HRG) equipment;
   1. Mount external to electrical distribution equipment (new or retrofit applications).
   2. Assembled and integrated into low voltage equipment, such as panelboard, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To ground the neutral of a three phase power system using a power resistor.
   2. To limit the magnitude of the ground fault to a predetermined non damaging level.
   3. To reduce the frequency and number of arc flash and arc blast hazard.
   4. To give immediate indication when a ground fault occurs.
   5. To provide individual feeder monitoring and protection.
   6. To provide a method for quickly locating the phase to ground fault, allowing the user to correct the problem or allow for an orderly shutdown of the process.
   7. To monitor neutral grounding resistor to ensure its functionality.

C. Electrical system parameters:
   1. System line to line voltage to be 480V AC 600V AC.
   2. System line to neutral voltage to be 277V AC or 347V AC.
   3. Resistor to be connected between neutral and ground.

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems.
C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
D. NFPA 70: National Electrical Code.
E. NFPA 70E: Standard for Electrical Safety in the Workplace.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
H. UL 508: Industrial Control Equipment.
I. UL 1053: Ground-Fault Sensing and Relaying Equipment.
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistors Assemblies

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:
   1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems
   2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems
   3. NFPA 70 – National Electrical Code
   4. UL 50 – Enclosures for Electrical Equipment
   5. UL 508 – Industrial Control Equipment
   6. UL 1053 – Ground – Fault Sensing and Relaying Equipment

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following
   (a) Routine maintenance requirements for all installed components.
   (b) Manufacturer's written instructions for testing.

D. The submittals shall also include
   1. Dimensional drawing of each enclosure.
   2. Internal component bill of materials and details.
   3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70

DELIVERY, STORAGE, AND HANDLING

- Deliver high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.
- Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

5.2 PRODUCT

ADVANCED HIGH RESISTANCE GROUNDING SYSTEM

A. Configuration via a central display of all critical feeder protection & pulsing HRG system components.

B. Pulsing power resistor (size confirmed by factory) to limit current flow to 5 amps during a single phase to ground fault condition.

1. Pulsing characteristic to cyclically limit the fault current to 100% and 50% of the available ground fault current (5 amps) to allow tracing the faulted circuit to the point of the fault.

C. Monitor each individual critical feeder breaker via zero sequence sensor for local and remote indication.
   1. Monitor up to 50 critical feeders per advanced HRG system.
   2. Assign priority level (0-15) for each monitored critical feeder for 2nd ground fault condition.
   3. Sensors to be rated 1000V AC.

D. An individual feeder module shall be provided for each monitored critical feeder. The feeder module shall:
   1. Provide local ground fault indication via a red indicator on front of module.
   2. Provide a trip signal directly to associated critical feeder breaker shunt trip during the 2nd phase to ground fault when identified as the lowest priority faulted feeder.
   3. Provisions for future system expansion by adding additional feeder modules and zero sequence sensors.

E. System to assist in locating fault by annunciating via an LCD display indication of:
   1. Alarm of 1st and 2nd phase-to-ground fault.
   2. Faulted phase.
   3. Individual feeder ID.
   4. Magnitude of ground fault for:
      a. Overall system.
      b. Individual feeder locations.
   5. Feeder “trip” ID due to 2nd phase-to-ground fault.
   6. Feeder assigned priority levels.
   7. Status of NGR.
   8. Loss of phase voltages.

F. Advanced HRG system shall also:
   a. Provide Modbus RTU protocol for communication of information noted in Section 2.01.E above.
   b. Monitor phase to ground voltages.
   c. Provide ground fault alarm auxiliary relay output form C, 10A, 240V AC contact for remote indication.
   d. Interlock system with 200m sec delay to prevent nuisance tripping due to large surges.
   e. Provide harmonic filtering for high frequency noise and current attenuation above 90Hz.

G. All system components, including resistor to mounted in a single NEMA 2 rated enclosure. Note: Individual zero sequence sensors are mounted at individual critical feeder locations.

H. Provide a resistor monitor function, integral to the advanced HRG system to verify the integrity of the neutral grounding resistor (NGR) and alarm if:
   a. Resistance is more than 150% of nominal value
   b. Resistance is less than 66% of nominal value

I. Provide ground fault system data logging capabilities, including time and date stamping of up to 99 most recent events.

J. Provide Main-Tie-Main interlocking of HRG system to prevent closing tie into phase to phase to ground fault.

K. Hand held pulse tracing sensor allows user to follow pulses to field locate the ground fault without de-energizing the load.

OPERATION OF ADVANCED HRG SYSTEM

A. During the 1st phase to ground fault, the customer will have the option to:
   1. Alarm only - allowing the user to correct the problem or allow for an orderly shutdown of the process.
   2. Trip with time delay adjustable from 0-99 minutes.

B. During the 2nd phase to ground fault, the advanced HRG system will provide selective feeder trip by initiating a trip signal directly to the shunt trip of the critical feeder breaker identified as the faulted feeder with the lowest assigned priority.

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal)

B. Product to be I-Gard Sentinel Series, using DSP-OHMNI components (or approved equal)

SYSTEM REQUIREMENTS

A. No line to neutral 277 volt loads may be connected to High Resistance Ground Systems per NEC.186 (3)

B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.

B. All feeder modules shall be individually tested and witnessed.

C. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

6. DSP-OHMNI
ADVANCED HIGH RESISTANCE GROUNDING SYSTEM WITH CRITICAL FEEDER PROTECTION AND PULSING

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

6.1 GENERAL

SCOPE

A. This specification covers the basic requirements for the advanced high resistance grounding (HRG) equipment;
   1. Assembled and integrated into low voltage equipment, such as panelboard, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To ground the neutral of a three phase power system using a power resistor.
   2. To limit the magnitude of the ground fault to a predetermined non damaging level.
   3. To reduce the frequency and number of arc flash and arc blast hazard.
   4. To give immediate indication when a ground fault occurs.
   5. To provide individual feeder monitoring and protection.
   6. To provide a method for quickly locating the phase to ground fault, allowing the user to correct the problem or allow for an orderly shutdown of the process.

C. Electrical system parameters
   1. System line to line voltage to be 480V AC or 600V AC.
   2. System line to neutral voltage to be 277V AC or 347V AC.
   3. Resistor to be connected between neutral and ground.

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems.
C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
D. NFPA 70: National Electrical Code.
E. NFPA 70E: Standard for Electrical Safety in the Workplace.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
H. UL 508: Industrial Control Equipment.
I. UL 1053: Ground-Fault Sensing and Relaying Equipment.
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistor Assemblies

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:
   1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems

2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems
3. NFPA 70 – National Electrical Code
4. UL 50 – Enclosures for Electrical Equipment
5. UL 508 – Industrial Control Equipment
6. UL 1053 – Ground – Fault Sensing and Relaying Equipment

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following
(a) Routine maintenance requirements for all installed components.
(b) Manufacturer's written instructions for testing.

D. The submittals shall also include
1. Dimensional drawing of each enclosure.
2. Internal component bill of materials and details.
3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70

DELIVERY, STORAGE, AND HANDLING

- Deliver high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.
- Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

6.2 PRODUCT

ADVANCED HIGH RESISTANCE GROUNDING SYSTEM

A. Configuration via a central display of all critical feeder protection & pulsing HRG system components.

B. Pulsing power resistor (size confirmed by factory) to limit current flow to 5 amps during a single phase to ground fault condition.
   1. Pulsing characteristic to cyclically limit the fault current to 100% and 50% of the available ground fault current (5 amps) to allow tracing the faulted circuit to the point of the fault.

C. Monitor each individual critical feeder breaker via zero sequence sensor for local and remote indication.
   1. Monitor up to 50 critical feeders per advanced HRG system.
   2. Assign priority level (0-15) for each monitored critical feeder for 2nd ground fault condition.
   3. Sensors to be rated 1000VAC.

D. An individual feeder module shall be provided for each monitored critical feeder. The feeder module shall:
   1. Provide local ground fault indication via a red indicator on front of module.
   2. Provide a trip signal directly to associated critical feeder breaker shunt trip during the 2nd phase to ground fault when identified as the lowest priority faulted feeder.
   3. Provisions for future system expansion by adding additional feeder modules and zero sequence sensors.

E. System to assist in locating fault by annunciating via an LCD display indication of:
   1. Alarm of 1st and 2nd phase to ground fault.
   2. Faulted phase.
   3. Individual feeder ID.
   4. Magnitude of ground fault for:
      a. Overall system.
      b. Individual feeder locations.
   5. Feeder “trip” ID due to 2nd phase to ground fault.
   6. Feeder assigned priority levels.
   7. Status of NGR.
   8. Loss of phase voltages.

F. Advanced HRG system shall also:
   a. Provide Modbus RTU protocol for communication of information noted in Section 2.01.E above.
   b. Monitor phase to ground voltages.
   c. Provide ground fault alarm auxiliary relay output form C, 10A, 240Vac contact for remote indication.
   d. Interlock system with 200msec delay to prevent nuisance tripping due to large surges.
   e. Provide harmonic filtering for high frequency noise and current attenuation above 90Hz.

G. All system components are mounted on a DIN rail except through panel mounted display module. Note: Individual zero sequence sensors are mounted at individual critical feeder locations.

H. Provide ground fault system data logging capabilities, including time and date stamping of up to 99 most recent events.

I. Provide Main-Tie-Main interlocking of HRG system to prevent closing tie into phase to phase to ground fault.

J. Hand held pulse tracing sensor allows user to follow pulses to field locate the ground fault without de-energizing the load.

OPERATION OF ADVANCED HRG SYSTEM

A. During the 1st phase to ground fault, the customer will have the option to:
   1. Alarm only - allowing the user to correct the problem or allow for an orderly shutdown of the process.
   2. Trip with time delay adjustable from 0-99 minutes.

B. During the 2nd phase to ground fault, the advanced HRG system will provide selective feeder trip by initiating a trip signal directly to the shunt trip of the critical feeder breaker identified as the faulted feeder with the lowest assigned priority.

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal).
B. Product to be I-Gard Sentinel Series, using DSP-OHMNI components.

SYSTEM REQUIREMENTS

A. No line to neutral 277 volt loads or 347 volt loads may be connected to High Resistance Ground Systems per NEC.186 (3)

B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.

B. All feeder modules shall be individually tested and witnessed.

C. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

7. GARDIAN
ARC FLASH & NGR HEALTH MONITORED HIGH RESISTANCE GROUNDING

NOTE TO ENGINEER: EACH OF THE FOLLOWING OPTIONS SHOULD BE CHOSEN WITH CARE.

7.1 GENERAL

SCOPE

A. This specification covers the basic requirements for ground fault relay system for resistance grounded;
   1. Mount external to electrical distribution equipment (new or retrofit applications).
   2. Assembled and integrated into low voltage equipment, such as panel-board, motor control center, switchboard or switchgear.

B. These devices are used:
   1. To provide early warning on ground fault.
   2. To provide visual indication on the occurrence of a ground fault.
   3. To provide auxiliary contacts for external indication.
   4. To ground the neutral of a three phase power system using a power resistor.
   5. To limit the magnitude of the ground fault to a predetermined non damaging level.
   6. To reduce the frequency and number of arc flash and arc blast hazard.
   7. To provide a method for locating the phase to ground fault allowing the user to correct the problem or allow for an orderly shutdown of the process. (PS Option Only)
   8. To monitor neutral grounding resistor to ensure its functionality.
   9. To provide a second neutral to ground, high resistance path to maintain ground fault current to a non damaging level in the event of an open resistor failure.
   10. To detect the presence of an arc flash and provide a trip signal to the main breaker.

C. Electrical system parameters
   1. Wye or Delta connected, three phase, three wire resistance grounded or ungrounded systems,
   2. System line-to-line voltage to be 480V AC or 600V AC.
   3. System line-to-neutral voltage to be 277V or 347V
   4. If installing on three phase, three wire ungrounded system, artificial neutral assembly also required and installed to create reference point for HRG system.

REFERENCED STANDARDS

A. IEEE Standard 32-1972: Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
B. IEEE Standard 142-1991: Recommended Practices for Grounding of Industrial and Commercial Power Systems.
C. NEMA 250: Enclosures for Electrical Equipment.
D. NFPA 70: National Electrical Code.
E. NFPA 70E: Standard for Electrical Safety in the Workplace.
F. UL 50: Enclosures for Electrical Equipment.
G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
H. UL 508: Industrial Control Equipment.
I. UL 1053: Ground-Fault Sensing and Relaying Equipment.
J. UL 891: Switchboards
K. CSA TIL D-31 Neutral Grounding Resistor Assemblies

REFERENCES

A. High resistance grounding system shall be designed and manufactured in accordance with the following standards:
   1. ANSI/IEEE Standard 32-1972 – Requirements, Terminology and Test Procedures for Neutral Grounding of Industrial and Commercial Power Systems.
   2. IEEE Standard 142-1991 – Recommended Practices for Grounding of Industrial and Commercial Power Systems.
   3. NFPA 70 – National Electrical Code.
   4. UL 50 – Enclosures for Electrical Equipment.
   5. UL 508 – Industrial Control Equipment.
   6. UL 1053 – Ground – Fault Sensing and Relaying Equipment.

B. The manufacturer of the high resistance grounding equipment shall have produced similar electrical q equipment for minimum period of 5 years.

C. The manufacturer of the high resistance grounding equipment shall be ISO 9001 certified.

SUBMITTALS

A. Product data and manufacturer's installation instructions for non-approved manufacturers shall be submitted for review ten days prior to the bid date.

B. Product Data: For each type of high resistance grounding system, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Operation and Maintenance Data: For high resistance grounding systems and components to include in operation and maintenance manuals. In addition to items specified in Division 1, include the following:
   (a) Routine maintenance requirements for all installed components.
   (b) Manufacturer's written instructions for testing.

D. The submittals shall also include:
   1. Dimensional drawing of each enclosure.
   2. Internal component bill of materials and details.
   3. Schematic and wiring diagrams of interconnection.

QUALITY ASSURANCE

A. Installer Qualifications: Qualified and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain high resistance grounding systems and accessories through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for high resistance grounding equipment including clearances between high resistance grounding equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

DELIVERY, STORAGE, AND HANDLING

A. Deliver high resistance grounding systems in sections or lengths that can be moved past obstructions in delivery path.
B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

COORDINATION

Coordinate layout and installation of high resistance grounding system components with other construction, including conduit, piping, equipment, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

7.2 PRODUCT

ARC FLASH & NGR HEALTH MONITORING HIGH RESISTANCE GROUNDING SYSTEM

A. Inclusive, one wall mounted NEMA 2 enclosure containing both the high resistance grounding resistor as well as the controls (or) separately mounted NEMA 4 or NEMA 12 enclosure housing the controls for a remotely mounted high resistance neutral grounding resistor.

B. Power resistors in two parallel paths limit current flow to (5 amps or 10 amps) during a single phase to ground fault condition and provide the ability to pulse ground fault current. The resistor shall be constructed from low temperature coefficient material such that the resistance shall vary less than 10% throughout the temperature range the resistor is designed for.

C. The ground fault detection relay shall be capable of detecting fault current between 0.5A and 10A with adjustable time delay between 0.5s and 10s.

D. Microprocessor based digital ground fault relay and a zero sequence current sensor.
1. Maintain accuracy over a range of 45Hz to 65Hz.
2. Harmonic filter to eliminate nuisance tripping.

E. Indication of ground fault status shall be provided by a series of LED indicating lights.
1. Green = No active ground faults on the system.
2. Red = Ground fault active on system.
3. Amber = Resistor Fault
4. White = Arc Flash detected
5. Red = System tripped

F. A test pushbutton on the front panel shall allow user to test the ground fault detection system and ancillary systems.

G. HRG system shall also:
   a. Provide ground fault main trip relay output form Z, 10A, 240V AC contact for remote indication.
   b. Provide ground fault alarm auxiliary relay output form C, 10A, 240V AC contact for remote indication.
   c. Auxiliary NGR Fault relay Form C (NO/NC) 10A@240V AC, 8A@24V DC, 1/2HP@240V AC. (PS Option Only)

H. A reset button shall be on the front panel to reset the ground fault system.

I. Provide artificial neutral assembly if installing on three phase, three wire ungrounded system to create reference point for HRG system.

J. Provide a resistor monitor function, integral to the HRG system to verify the integrity of the neutral grounding resistor (NGR) and alarm if:
   a. Resistance is more than 150% of nominal value
   b. Resistance is less than 66% of nominal value (PS Option Only)

K. Pulsing power resistor (size confirmed by factory) to limit current flow to 5 amps during a single phase to ground fault condition:
   A: Pulsing characteristic to cyclically limit the fault current to 100% and 50% of the available ground fault current (5 amps) to allow tracing the faulted circuit to the point of the fault.
   B: Pulsing activated and deactivated by means of a front mounted rotary switch.

MANUFACTURERS

A. Approved vendors: I-Gard Corporation (or approved equal)
B. Product to be I-Gard Gardian (or approved equal)

SYSTEM REQUIREMENTS

A. No line to neutral loads may be connected to High Resistance Ground Systems per NEC.186 (3)
B. TVSS (Transient Voltage Surge Suppressors) shall be listed for use on High Resistance Grounded Systems per NEC 285.3 (2).

TESTING

A. Upon commissioning the installing contractor shall test the system operation in the presence of the owner's representative to verify alarming and/or tripping according to the design.
B. Contractor shall document the system charging current at the time of commissioning.

CLEANING

On completion of installation, inspect interior and exterior of high resistance grounding systems. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

NOTES

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