Bender Series 3 Advanced High Resistance Grounding System with Selective Second Ground Fault Protection Guideform Specification

To specifying engineers: the square brackets are used to notify the specifier when a selection is available.

Please choose the selection that best suits the project.

For any clarification or assistance please contact your Bender sales representative or inside sales technical support.

1.1 Submittals

1. Submit shop drawings for products specified in this Section. The submittal should include but not be limited to the following:
    a. Manufacturer's bill of material.
    b. Manufacturer's installation instructions with schematic and wiring diagrams.
    c. Product dimensional drawings.
    d. Manufacturer's testing and commissioning instructions.
2. Submit Operation and Maintenance manuals.

1.2 Standards

1. The latest versions of the following codes and standards used by the authority having jurisdiction shall apply during design and manufacturing.

Electrical codes:

    a. CSA C22.1 – Canadian Electrical Code
    b. NFPA 70 – National Electrical Code

Enclosure standards:

    c. CSA C22.2 No. 94.1 – Enclosures for electrical equipment, nonenvironmental considerations
    d. CSA C22.2 No. 31 – Switchgear assemblies
    e. UL 50 – Enclosures for Electrical Equipment
    f. NEMA ICS 6 – Industrial Control and Systems: Enclosures
    g. NEMA 250 – Enclosures for electrical equipment (1000 Volts Maximum)
    h. ANSI/IEC 60529 – Degree of protection provided by enclosures (IP Code)
    i. ANSI Z535.4 – Safety labels

Industrial control equipment standards:

    k. C22.2 No. 14 – Industrial Control Equipment
    l. ANSI C19.3 – Industrial Control Apparatus – General
    m. UL 508 – Industrial Control Equipment

Neutral grounding devices standards:

    n. IEEE 32 – Requirements, Terminology, and Test Procedure for Neutral Grounding Devices
    o. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
    p. IEEE C57.32 – IEEE Standard for Requirements, Terminology, and Test Procedures for Neutral Grounding Devices
    q. CSA C22.2 No. 295 – Neutral Grounding Devices, and other applicable CSA Standards
    r. CSA M421 – Use of Electricity in Mines

Ground fault relay standards:

s. UL 1053 – Standard for Ground-Fault Sensing and Relaying Equipment
t. CSA C22.2 No. 14 – Industrial Control Equipment
u. CAN/CSA C22.2 No. 144 – Ground Fault Circuit Interrupters

Part 2 – Products

2.1 Intent

1. This specification provides design and performance details of the Bender Advanced High Resistance Grounding Second Ground Fault Protection system (B2GFP). The supplied system shall meet or exceed the requirements of this specification.

2.2 Scope of Work

1. Provide a Bender B2GFP system to high-resistance ground, and detect and locate ground faults on, an electrical power distribution system, while providing protection on the occurrence of a second-phase ground fault. The scope of work includes but is not limited to the following:
   a. Review of proposed electrical power distribution system equipment design with a Bender technical representative prior to submission of pricing. Ensure proposal meets the full requirements to complete work, meets owner's requirements, and addresses the manufacturer recommendations.
   b. Review conductor and bussing sizes, if requested, to verify that correct ground-fault current transformer types, sizes and quantities are selected.
   c. Identification of components and equipment.
   d. Test the system as recommended by Bender.

2.3 High Resistance Grounding System

The B2GFP system is supplied as a pre-engineered package that grounds the power-distribution system and limits ground-fault current to a level that allows continuous operation during a single-phase-to-ground fault. The B2GFP system detects and annunciates the location of a ground fault, and automatically trips the lower-priority load when a second-phase fault occurs on another feeder. Local indication and remote communication as described below should be provided. The HRG system shall meet the following:

1. System Controls

   a. Shall be mounted [internal and integrated into the power distribution equipment / external as stand alone equipment].
   b. NGRM700 Neutral-Grounding-Resistor Monitor and RCMS490 multi-channel ground fault relays shall be used for power-system monitoring functions.
   c. Shall provide local and remote indication of the occurrence of ground fault by local LED lamps, dry contacts, HMI interface and Modbus communication.
   d. Three levels of ground fault indication and protection are to be provided: first-fault pre-alarm warning, first-fault alarm, and second-fault selective trip.
   e. Ground-fault information including neutral current, neutral voltage, DC content, harmonic analysis of ground fault current, and phase voltage is displayed with a color touchscreen HMI.
   f. Shall monitor up to 120 feeders and allow 99 levels of priority settings for tripping in a second-fault situation.
   g. Shall be compatible with power systems with up to two bus-tie circuit breakers.
   h. Data logging of the previous 1000 incidents with time stamp shall be available.

2. Alternating-Current Current Transformers (AC CT)

a. Detect AC ground faults.
b. AC CTs, when specified, are to be installed to monitor individual feeders or loads.
c. CT integrity and connections shall be continuously monitored.
d. AC CT configurations include toroidal, rectangular, and split-core rectangular and have the designations of W, WR, and WS series. The correct configuration(s) shall be used to match application requirements.
e. The AC CT shall be rated for 600 V.
f. AC and AC/DC CT's can be used in combination in a B2GFP system.

3. AC/DC Current Transformers (AC/DC CT)

When the power system has a combination of both AC and DC components, as in the case of VFD and UPS applications, that portion of the system should be monitored with AC/DC CT's.

a. Protects the electrical power system's DC and mixed AC/DC components against ground faults.
b. AC/DC CT's, when specified, are to be installed to monitor individual feeders or loads.
c. CT integrity and connections shall be continuously monitored.
d. AC/DC CTs are toroidal in shape and have the designation of W-AB series.
e. The AC/DC CT shall be rated for 600 V.
f. AC and AC/DC CT's can be used in combination in a B2GFP system.

4. Neutral Grounding Resistor (NGR)

a. The NGR shall be [internal as an integral component of the System Controls / external and remote as stand alone equipment].
b. Ground neutral(s) of three phase electrical power distribution system(s) using NGR(s). Refer to the single-line drawing or specifications for required NGR ratings.
c. If the power-system neutral is not available or accessible, or a neutral is required on the system bus, a zig-zag transformer must be specified to create an artificial neutral. [A zig-zag transformer is to be supplied in the HRG System Controls / A zig-zag transformer is to be supplied in the external HRG Control/ A zig-zag transformer is to be supplied by others.]
d. The NGR limits ground-fault current to the designed value. A pulsing function is included.
e. Resistive elements are to be made of stainless steel. Wire-wound and edge-wound types are acceptable.
f. The enclosure of a separately enclosed NGR shall be NEMA [1 / 2 / 3R] of galvanized steel and be painted ANSI 61 grey.

5. Grounding Resistor Monitor

The integrity of the resistance grounding path shall be monitored by an NGRM700. NGR and grounding-connection resistance-alarm settings shall have a 10 to 200% of nominal-resistance range.

a. Detect both open and shorted grounding path. When measured resistance exceeds the NGRM700 setting (high or low), the general alarm contact changes state, the Resistor Fault lamps are turned on, and the resistor failure status is displayed on the HMI screens.
b. The relay shall be able to provide a wide ground fault detection range including AC/DC fault detection. Harmonic analysis of neutral current and voltage are required.
c. Ground-fault detection shall remain active with an open NGR.
d. Any products that do not meet the above shall not be used.

6. System Operation

LED lamps and a touchscreen HMI display operational conditions. Pushbuttons allow setting of operational parameters including feeder prioritization, faulted feeder indication, alarm configuration setting, substation configuration, and protection targets.
Ground fault information including DC content, harmonic analysis of ground fault current, and phase voltage is displayed through color HMIs with LCD displays.

a. First-Fault Alarm & Second-Fault Protection
   i. Upon detection of a first ground fault at the pre-alarm level:
      - Ground fault lamp on the front door blinks, the general alarm dry contact changes state and the HMI screen displays the fault condition.
      - The electrical power distribution system functions uninterrupted.
   ii. When a fault exceeds the first-ground-fault level:
      - Ground fault lamp stays on, ground fault auxiliary relay is energized, both general alarm dry contact and first ground fault dry contact change state and the HMI screen displays the fault condition.
      - The power distribution system can operate with the first fault indefinitely and it is continuously monitored for a second-phase fault.
   iii. The pulsing function can be activated to locate a ground fault on the still-energized feeder. Locating the ground fault should be performed soon after the occurrence of the first fault.
   iv. Upon detection of second ground fault (a phase-to-ground-to-phase fault), the lower-priority feeder shall be tripped within 100 ms, returning the system to first-fault status. Products with trip times longer than 100 ms shall not be used.
   v. The lower priority feeder shall have two methods of tripping:
      - Simultaneously:
        If, while the first fault is present, a second ground fault occurs in a different phase and feeder, the lower-priority feeder(s) will trip.
      - Sequentially:
        If two or more same-phase ground faults on same-priority feeders are present and a second-phase ground fault on a same-priority feeder occurs, the feeder(s) will trip sequentially in no particular order, until the system returns to a first-fault condition.
   vi. For bus-tie systems, the second-ground-fault system must be compatible with normally open and normally closed tie-breaker control schemes.

7. Indication and Communication

Local and remote communication shall be provided. The following must be included as minimum.

a. Alarm contacts for remote annunciation of faulted conditions.
b. Trip contacts for tripping the lower priorities of the two faulted feeders.
c. Modbus TCP and web interface over Ethernet

8. Miscellaneous

a. [Include portable ground detector with a split-core type ammeter and multiple range switch. The clamp must be capable to enveloping a minimum 6” diameter for locating ground fault. / Delete this paragraph if this equipment is not required.]
b. [Delete this paragraph if not required / In the case of outdoor NEMA3R rated NGR enclosure, an anti-condensation heater shall be provided.]
c. The product(s) covered by this specification shall be warranted by the manufacturer to be free of manufacturing defects for 24 months from the ship date.