

## *Variable Speed Drive Ground Fault Protection Guidelines*

1) Purpose: This document provides the technical specification that shall be followed pertaining to the required Ground Fault Protection (GFP) methods applied to any Variable Speed Drives (VSD) used on equipment in underground coal mining operations within the Commonwealth of Pennsylvania. All equipment shall be approved as required the Safety Laws of Pennsylvania for Underground Bituminous Coal Mines, Act 55, Section 350. The technical basis for approval is outlined below and any applicable national and/or international standards shall apply.

2) Scope: Any 3-phase equipment utilizing a VSD:

- a. Stationary
- b. Mobile
- c. Portable

3) General Conditions:

- a. All methods shall fail safe and initiate a shutdown
- b. All ground fault protective devices shall be certified by a nationally/internationally recognized or third-party testing agency.
- c. All devices shall be rated for AC/DC/Switched or pulsed DC
- d. All devices shall have self-diagnostics 'state of health' functionality
- e. The system shall lock-out upon any fault and require human intervention to reset
- f. The frame of the equipment containing the protective devices shall be bonded to the VSD controller. If the protective devices and the VSD controller are located on separate physical frames the bonding conductor shall be monitored. If the protective device(s) are on a different frame than the VSD controller the equipment containing the protective device(s) and the VSD controller must be approved and/or modified as a system.
- g. Current sensing or voltage sensing shall be permitted
- h. Two levels of protection are required: Independent primary and secondary/redundant devices.
- i. The internal VSD GF protection may be utilized if it meets the following conditions:
  1. Complies with Items 3) a thru d
  2. Shall not be field adjustable
  3. Must be set at a value less the 50% of the associated Neutral Grounding Resistor current limiting value.

4) Functionality:

- a. A fault in these locations shall be detected and initiate a shutdown:
  1. VSD supply power circuit feeder
  2. DC bus (positive or negative)
  3. VSD output to motor
- b. Two independent points of interruption shall be required.
- c. Time delays:
  1. A time delay shall be allowed upon energization. Duration shall be reviewed based on the application.
  2. The secondary/redundant device is permitted to have a time delay for coordination.

*Approved by the Task Force [Established by authority of ACT 55 Section 350 (d)]*

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