

SUMMER 2012

# NEW **MINING** TECHNOLOGY

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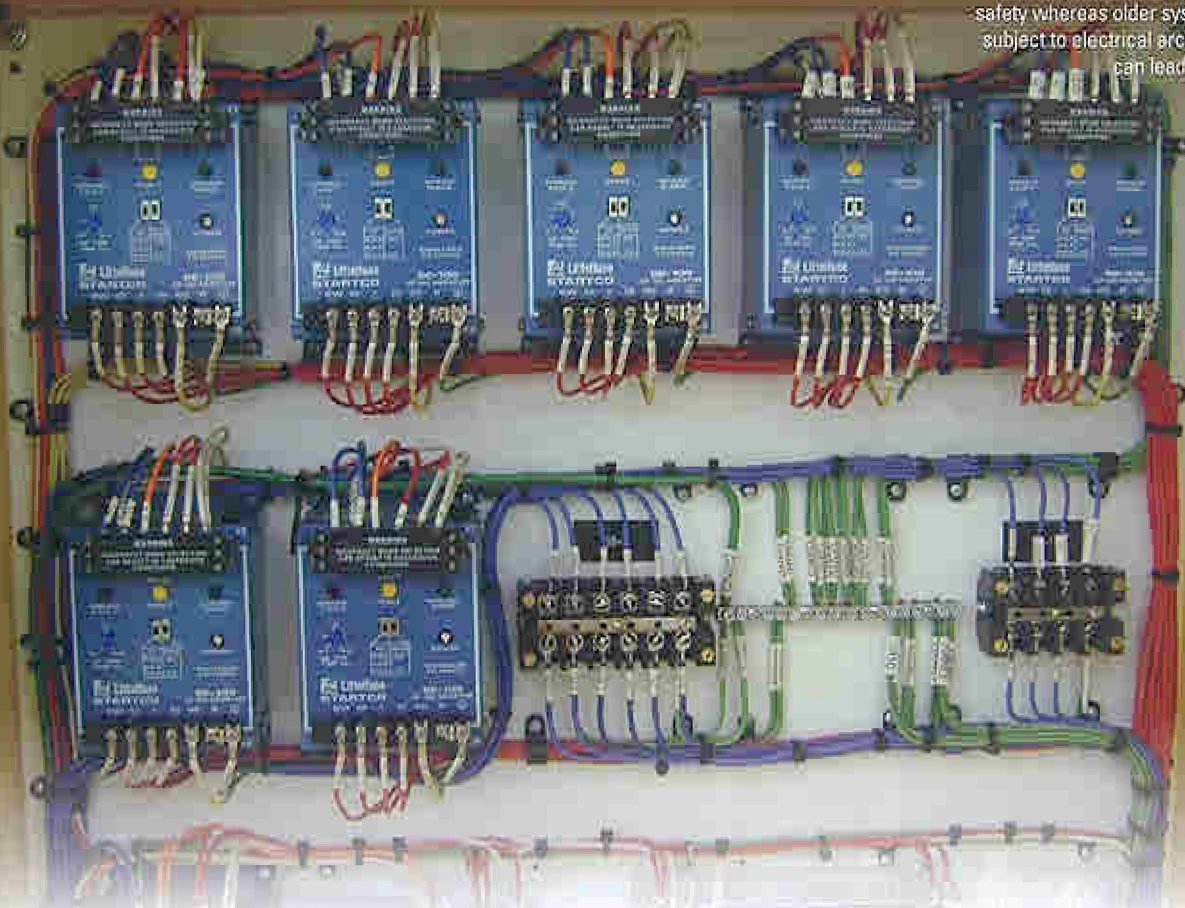
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# Arc-flash relays help mine reduce accidents

By Mervin Savostianik\*

Properly installed and equipped electrical systems are essential to mine safety whereas older systems can be subject to electrical arc flashing that can lead to disasters.



**M**ine operators are well aware of the need for ground-fault protection for mining equipment, which is covered by CSA Standard M421 Use of Electricity in Mines. This standard requires ground-fault-current limitation (typically achieved using neutral-grounding resistors) and electrical ground-fault protection in underground and surface mines, where a ground fault could spark a disaster. For more than 20 years the mining industry has led in the use of sensitive ground fault relays (GFRs) on electrical mining equipment to improve safety by detecting and interrupting ground-fault current.

While the mining industry leads in ground-fault protection and the use of resistance grounding, there is one thing these products can't do: protect personnel and equipment from the catastrophic effects of arc-flash events that occur when a live phase conductor is shorted to another phase where a ground is not involved.

Short circuits that initiate arc-flash events can be caused by cable or equipment damage or failure, a misplaced voltmeter probe, improper installation, dropped tools or even the accumulation of conductive dust on insulators. These events can occur during maintenance operations in power generation and distribution equipment, and in portable substations and motor control centers frequently accessed by maintenance personnel. An

arc flash creates a huge amount of current that ionizes the air surrounding the associated conductors. This energy release often causes catastrophic equipment damage, and can result in terrible burns and fatalities to nearby personnel.

In the U.S., according to the NIOSH Office of Mine Safety and Health Research, arc-flash burns are the leading cause of non-fatal electrical injuries, accounting for 35 per cent of lost workdays due to electrical injuries in mining between 1990 and 2001. The average number of lost workdays per incident was 21, and over all of these incidents the total number of lost workdays during the 11-year study period was about 12,000.

An arc flash also generates toxic smoke and fumes from vaporized copper and other materials. And while these should eventually be removed by the mine's ventilation system, the arc flash could disable the ventilation system.

In addition to arc-flash events in underground equipment, these events can also occur above ground in a surface-mining operation or in the process plant, particularly when equipment is not protected with GFRs or resistance grounding. Although high-level ground faults may blow fuses or open circuit breakers, before that happens the current will travel through electrical components. Furthermore, the fault current often travels through wires or con-



ductors not designed for such high levels of energy, causing fires. Therefore, some method of mitigating arc-flash events is needed for both above- and below-ground equipment.

While the Canadian mining industry may have recognized the possibility of arc-flash events in electrical equipment, protecting workers against these occurrences has not been a federal requirement until recently. Now, with publication of the second (2012) edition of the CSA Z462 standard, protection against an arc flash is specifically covered. CSA-Z462 is based in part on (U.S.) NFPA 70E and reflects Canadian legal requirements and workplace conditions. Safe work practices designed to prevent arc-flash incidents are contained in the revised Standard.

Previously, some companies followed the practices detailed in NFPA 70E anyway, perhaps because it is a recognized Standard and because arc-flash events are addressed legislatively in other ways at both provincial and federal levels. At the federal level, Bill C-45 (31 March 2004) established a duty for employers, managers and supervisors to ensure workplace health and safety. Failure to do so is covered by the Criminal Code. The Courts have levied substantial fines on employers that violate health and safety statutes. In addition, individuals, organizations and corporations can be convicted of criminal negligence under Section 217.1 of the Criminal Code for failure to take reasonable steps to protect the lives and safety of workers and the public.

All provincial occupational health and safety acts have a general duty clause requiring employers to take reasonable precautions to ensure their employees' health and safety. In some cases, provinces specifically require worker protection against an arc flash. One example is Ontario's Construction and Industrial Regulations, which require worker protection against electrical shock and burns while working on or near exposed parts of live electrical equipment and conductors. In Alberta, the Occupational Health and Safety Code states that workers exposed to electrical equipment flashover must wear flame-resistant outerwear and use other personal protective equipment (PPE) appropriate for this hazard.

NFPA 70E and CSA Z462 stipulate requirements for identifying and assessing hazardous equipment, and for the development of safe work procedures around such equipment. These standards also



provide guidance on the selection of PPE and protective clothing for electrical workers. Still, they say nothing about reducing the severity of an arc flash once it has been triggered by fault current.

Protecting personnel from arc-flash events with PPE is both appropriate and necessary, as are procedures that reduce the possibility of having such an event in the first place. In addition, taking steps to reduce the amount of energy released can lessen equipment damage, personnel hazard, and the chance of incurring a personal injury lawsuit, which can be extremely costly.

Fortunately there are electrical protective devices available that reduce the amount of current and energy released due to an arcing electrical fault. Called arc-flash relays, they have been widely used for the past several years. Compared to the costs associated with a full-blown arcing fault, these devices are inexpensive. **NMT**

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