Issues with the use of semi-conductive insulation

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What happened?

1. An electrical failure in a transportable substation high voltage enclosure room at a surface coal mine blasted the locked door off its hinges. The mine site's investigation found that after undertaking a phase direction change, 6600V cables with a semi-conductive outer screen were left in contact with the top of exposed 6600V terminals. This caused a phase to phase short circuit fault and arc blast sometime after the terminals were later energized. Photo 1 shows multi cores and a single track mark.
2. On the surface of an underground coal mine an electrical failure on a new installation caused a power outage, resulting in methane build up in an underground panel. This necessitated a controlled withdrawal of coal mine workers. The mine site's investigation found that when terminating cables at an 11000V isolator, semi-conductive insulation was left in contact with the termination lugs. This caused phase to phase overcurrent which tripped the electrical overcurrent protection. Photo 2 shows 1 core with 'spidering' near its termination point.

Comments

High voltage insulated single core cables regularly use semi-conductive insulation screens as a form of stress relief. As each individual screen is connected to earth near the cable terminations, it helps prevent ionisation and partial discharge (PD). PD can form ozone which deteriorates cable insulation.

High voltage trailing cables may also use semi-conductive insulation earth screens to ensure that the first fault with a cable is to ground and not phase to phase. The electrical resistance of these screens is much lower than semi-conductive insulation screens used for stress relief.

Investigations into the incidents found:

- Electrical work practices had not identified and managed the conductive nature of semi-conductive insulation screens and semi-conductive insulation earth screens.
- The semi-conductive insulation screen initially did not allow enough current to flow to operate the earth fault protection devices.

Recommendations

1. Ensure electrical tradespersons understand the conductive characteristics of semi-conductive insulation screens and semi-conductive insulation earth screens.
2. Provide appropriate instructions and ensure they are followed during work involving semi-conductive insulation screens.
3. Maintain appropriate creepage and clearance distances when semi-conductive insulation screens are used.

4. Place appropriate warning signs where semi-conductive insulation screens can be inadvertently placed within the minimum creepage and clearance distances of energised equipment.

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