

## ELECTRICAL ENGINEERING SAFETY | INFORMATION SHEET NO.4

# Removal & restoration of power

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**Information Sheets are developed by the inspectors of electrical engineering in response to issues identified during site electrical engineering audits at extractive mines and questions raised by the mine operators. They are provided as guidance material for mine operators in the development of electrical safety standards.**

### Purpose

This information sheet is intended to assist operators at small extractive mine operations to develop procedures for the safe removal and restoration of electric power. Incorrect or unauthorised operation of electrical switching apparatus, including the resetting of electrical protection devices following a protection trip, can expose persons to unacceptable levels of risk.

The outcomes sought to be achieved by this information sheet are to protect people and property from the risks associated with the removal and restoration of power at extractive operations including:

- uncontrolled removal and restoration of power.
- electrocution.
- electric shock.
- electrical burn injuries.
- arc blast injuries.
- injuries sustained through operation of the switching apparatus.
- unintended operation of plant.
- fire

### Scope

This information sheet extends to small extractive operations in NSW. The information is intended to assist mines to develop procedures for the removal and restoration of power at all locations at the operations including:

- surface areas
- site buildings and structures
- process plants

Removal and restoration of power procedures should apply to all sources of electric power.

Arrangements for the removal and restoration of power at extractive operations must form part of the site's Mine Safety Management Plan.

This information sheet does not cover practices for isolation to allow work to be carried out on electrical power circuits.

### Removal and restoration of power procedures

Electrical power is removed (switched off) and restored (switched on) for various reasons including:

- operational requirements
- electrical safety

Procedures for the removal and restoration of power are intended to provide information in the safe removal of power at the mine, such as:

- Removal of power at the completion of the work day (shut site generator down).
- Safe access to plant for mechanical maintenance/repair in accordance with the site isolation procedures, and
- Removal of electrical power source under electrical fault conditions, that is, the operation of electrical protection devices.

The procedures for the restoration of power are intended to provide information for the safe application of power to electrical circuits, following the removal of power, as a controlled process, such as:

- Starting process for the generator at the start of the work day (start-up procedures)
- Procedure for removing isolation to re-power the plant following mechanical maintenance / repair, and
- Reset procedures to restore power after an electrical protection device has tripped.

There are increased risks to operators and maintenance personnel if the process of switching off and switching on is not carried out in a systematic and rigorous manner. Any process developed for the removal and restoration of power at the operation should form part of the Mine Safety Management Plan as a control for the safe use of electricity.

#### Removal of power

There are three methods for the removal of power, Manual – Whole Current, Manual – Remote Switching, and Automatic:

1. Manual - whole current – this is where switch devices are physically operated to switch the power supply off (the phase conductors have a physical gap).
2. Manual - remote switching – this is where control switches (stop switches, emergency stop switches, conveyor lanyards) are operated to stop the plant. Note: The use of remote switching must not be relied on for isolation purposes when doing mechanical maintenance and repair work.
3. Automatic – this is where switching devices (generally, these are circuit breakers) are operated and tripped by electrical protection systems (overload, short circuit and earth fault protection).

#### Restoration of power

The process used to restore power is determined by the means by which the power was removed. That is, power is removed by one of three methods, manual – whole current, manual – remote switching, or automatic:

The restoration of power should address each method and require the person restoring the power supply to check and confirm the circuit is safe to re-power:

1. Manual – whole current the restoration of power could be the reverse action used in removing the power.
2. Manual – remote switching the restoration of power could be the reverse action used in removing the power.
3. Automatic - Where the power is removed AUTOMATICALLY, the restoration of the power should incorporate an investigation into the cause of the power trip and, if required, electrical testing by a licensed electrician, to determine that it is safe to power.
  - a. *Overload trip* - Restoration of power after an overload trip should be carried out by trained personnel once an investigation has been conducted to identify the cause and remedial actions taken. An example would be a blocked and overloaded crusher - a trained and competent operator or supervisor would identify the blockage, effect manual whole current isolation to the crusher and associated input and output conveyors (and any other energy sources), organise the clearing of the blockage. On completion of the remedial work ensure all personnel were clear and in a safe location, replace all guarding and when safe to do so, reclose the whole current isolator, reset the overload and restart the crusher.

- b. *Short circuit trip and/or earth leakage trip* – Such a trip is an indication that there is a major problem with the electrical circuit. Restoration of power following a short circuit trip and/or earth leakage trip should only be carried out by a qualified electrician only after the electrician has:
- i. Electrically tested the circuit to identify and locate the fault.
  - ii. Repaired the fault.
  - iii. Carried out further electrical testing and determined that the circuit to be safe for the restoration of the power supply.
- c. *Circuit breaker reset* - If the cause of a circuit breaker trip is not able to be identified as an overload trip the circuit breaker should not be reclosed and an electrician called. Where the cause of a circuit breaker trip is identified as a short circuit fault or earth leakage fault the circuit breaker should not be reclosed and an electrician called. If a proper investigation into the cause of a trip is not done, power could be restored onto a fault. This can have very high consequences of injuring people, catastrophically damaging equipment or initiating fires. The electrician will need to ensure that the device that has tripped is actually rated for reclosing after such a trip. **Note:** Some devices may only be rated for a specific number of trips or may need specific checks and maintenance actions to be taken after a trip – this is particularly important for short circuit trips.
- d. *Blown fuse* – A blown fuse could indicate a short circuit, motor overload or a fatigued fuse.
- i. Fuse replacement - Fuse elements should be replaced with an element of equivalent rating and characteristics.
  - ii. Where the restoration of power involves the replacement of a fuse, the mine must manage the risk of replacing the fuse by isolating the power source to the fuse holder. Fuses shall not be fitted to live fuse holders.
  - iii. The replacement of fuses should only be undertaken by qualified electrical workers.

To manage the application of restoration of power procedures, the site procedure for resetting circuit breakers and replacement of fuses should be posted at each distribution and control panel containing circuit breakers and fuses. **Note:** Restoration of power following electrical installation, maintenance or repair should only be carried out by a qualified electrician only after the electrician has carried out appropriate verification tests as described in AS/NZS 3000 and determined that the circuit(s) is safe to restore power.

### Access to switchgear

All methods of removal and restoration of power require access to some form of switchgear or control gear. Some access will need to be restricted to competent and authorised people. Where access is restricted, a conspicuous, durable and legible sign is to be posted in appropriate positions to warn of the restrictions. Restriction could be applied to switch rooms and electrical enclosures. If access to a switch room is restricted to authorised persons, the mine should develop and issue a formalised authorisation form to persons authorised to enter the restricted areas.

### HV switching

At some stage access to high voltage switchgear will be necessary. High voltage switching should only be carried out by qualified competent electrical workers. Where high voltage switchgear is part of the infrastructure of the mining operation, all switching of high voltage circuits should conform to a high voltage management plan developed for the site.

### Training of personnel

People involved in the process of the removal and restoration of power should be instructed/trained/inducted in the application of the site procedures. People who operate switch gear as part of their role should receive training in the operational safety requirements of the switchgear. This training should be competency based. Site procedures and training material should be periodically reviewed by the operation and used for ongoing retraining and refresher training.

All people working at a mine (employees and contractors) should be trained in the switching of electricity in the area of their work. Such training should include normal operational shutdown and emergency shutdown procedures.

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