

MINE SAFETY INVESTIGATION UNIT

INFORMATION RELEASE

Fatality

Incident date 27 August 2014

Event Fatality in a residence

Location Cudal Limestone Quarry, Cudal (near Orange), NSW

Overview

A woman was found deceased in a house near the Cudal Limestone Quarry. The house was supplied with electricity from the quarry's electrical supply. The deceased woman appeared to have suffered a fatal electric shock.

Image 1: Photograph of the quarry crushing plant taken by an investigator on 15 September 2014.



The mine

The Cudal Limestone Quarry is about 35km west of Orange, NSW. The quarry extracted limestone by open cut methods and produced crushed limestone by means of a primary crushing plant at the site. The house is about 250 metres from the crushing plant.

The incident

The primary crushing plant was supplied by a three-phase overhead line to a 11kV/415V substation adjacent to the main switchboard and metering room. The timber-clad house (circa 1998) was built on a concrete slab and was supplied by a three-phase and neutral supply cable from the main switchboard at the quarry to the switchboard at the house.

On the morning of the incident, the primary crushing plant was being operated. About 10.30 am a quarry operator who lived at the house found the deceased woman in the bathroom. A post mortem identified burn marks on both hands of the woman. The injuries were consistent with a fatal electric shock.

The crushing plant

The main crusher is powered by a 90kW electric motor that was connected to a star/delta starter via two armoured three core and earth PVC insulated cables. The cables to the motor were partially buried, partially ducted above ground and partially suspended from the motor in the air.

Initial electrical integrity testing identified that when the electrical supply was on and the crushing plant was not operating, no fault issues were identified at the house.

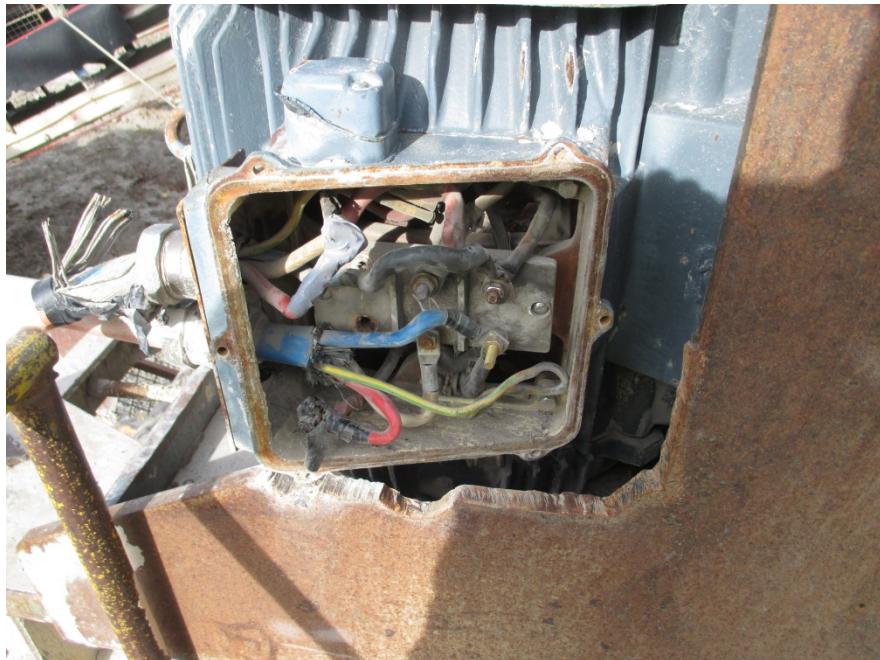
Further electrical testing identified that when the electrical supply was on and the crushing plant was operating, excessive voltage appeared at the house earth stake and water pipes.

A phase to earth fault was identified on a motor supply cable. The protective insulation was damaged inside the motor terminal box and there was evidence of arcing and high temperature damage to a motor supply cable at a metal support arm near the terminal box.

Image 2 & 3: Photographs of the crushing plant motor power supply taken by an investigator on 15 September 2014.



Image 4: Photograph of the crushing plant motor terminal box wiring taken by an investigator on 15 September 2014.

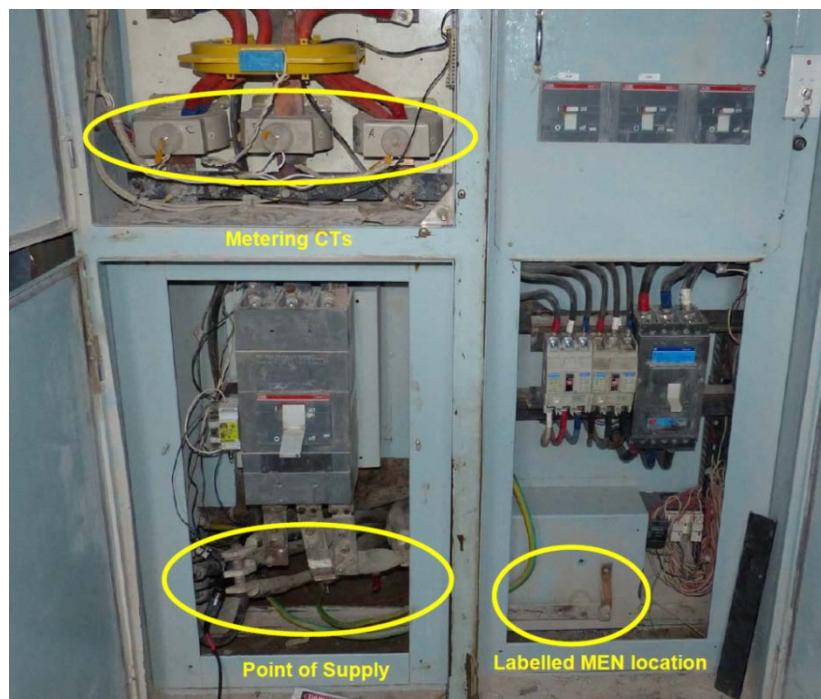


The quarry switchboard

At the main switchboard, it was observed that no earth to neutral link (E-N link) was fitted. The absence of the E-N link at the main switchboard resulted in an increase in the earth fault loop impedance from the motor of the crushing plant to the supply transformer. This increased fault loop impedance resulted in a voltage rise on the neutral conductors throughout the quarry supply system during an electrical fault condition.

The earth leakage relay did not activate during the fault event.

Image 5: Photograph of the quarry main switchboard taken by investigating consultants.



The quarry house

The voltage rise on the quarry supply system neutral was transferred to the quarry house via the neutral conductor of the supply cable. The neutral voltage rise at the house was transferred to the house's protective earth via the MEN link. The voltage rise appeared on all earthed equipment at the house including the earth stake, water pipes and bathroom fittings.

Observations

Electrical installations at the surface of a mine are required to comply with AS/NZS 3000 (the wiring rules). The absence of the earth to neutral link at the quarry switchboard does not meet the requirements of the wiring rules for a MEN earthing system.

The method of support for the motor cables, including a cable clamping bracket, had not adequately supported the weight of the cable. This resulted in damage to the cable where the cable passed over a metal bracket.

One of the cables to the crusher motor was not terminated correctly into the cable gland, allowing movement of the cable and resulting in damage to the insulation inside the motor termination box.

Mine operators must ensure that electrical plant is not likely to cause electrical injury, either during normal operations or under fault conditions. A properly engineered and maintained electrical installation will have multiple barriers to electric shock.

The selection and combination of these barriers into an effective electrical engineering safety strategy is a matter for qualified electrical practitioners. The measures only remain effective if properly maintained and inspected, and used in combination with competent personnel and safe operating procedures.

Relevant Australian Standards include:

- AS/NZS 3000:2007, 'Electrical installations' (known as AS/NZS Wiring Rules),
- AS/NZS 3007:2013, 'Electrical equipment in mines and quarries – surface installations and associated processing plant',
- AS/NZS 2067:2008, 'Substations and high voltage installations exceeding 1kV AC'

Further information

A technical Safety Alert in respect of this incident will be released in the near future.

Issued by:

Steve Orr, Acting Manager, Investigation Unit

About this information release

The Mine Safety Investigation Unit has issued this information to draw attention to the occurrence of a serious incident in the mining industry. The investigation is ongoing. Further information may be published as it becomes available.

The information contained in this publication is based on knowledge and understanding at the time of writing. However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the appropriate officer of the Department of Trade and Investment, Regional Infrastructure and Services or the user's independent adviser.

Information about the Investigation Unit and its publications can be found at: www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health/major-investigations

For information about health and safety regulation on mine sites contact a mines inspector at one of our local offices
www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health/mine-safety-offices