NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Technical Reference
Electrical Engineering Safety
EES-013

NSW DPI Technical Reference
Electrical Engineering Safety – Guide to the Mine Health and Safety Regulation 2007 and Occupational Health and Safety Regulation 2001

Mine Health and Safety Act 2004
Mine Health and Safety Regulation 2007
Occupational Health and Safety Regulation 2001
Occupational Health and Safety Act 2000

July 2008 (version 1)

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PREFACE

The mining industry is increasing consumption of electricity and its use of electrical technology with consequent increases in size (power rating) and complexity. With this comes a changing risk profile. To adequately manage the safety risks posed by electrical equipment and technology the hazards, risks and risk controls need to be thoroughly understood.

This Technical Reference will be used by Mine Safety Operations to assess the effectiveness of mining operation management of Electrical Engineering Safety.

This Technical Reference can also be used by mine operators as guidance to manage Electrical Engineering Safety at the operation.

Use this Technical Reference to assess the "health" of your Electrical Engineering Safety.

John Francis Waudby
Senior Inspector of Electrical Engineering

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Chapter 1 Establishment

1.1 Title

This is the DPI Electrical Engineering Safety Technical Reference – Electrical Engineering Safety – Guide to the Mine Health & Safety Regulation 2007 & Occupational Health and Safety Regulation 2001

Purpose

This Technical Reference is intended to provide a framework for DPI officers to assess the management of Electrical Engineering Safety at mining operations. It can also be used by mine operators as guidance material for implementing, managing or reviewing their Electrical Engineering Safety arrangements.

This Technical Reference identifies issues required to be addressed to achieve safety measures equivalent or better than those expressed in electricity safety legislation. Some of the aspects included in this document may not be specifically nominated in the current climate of "non-prescriptive legislation" but are relevant and worthy of acceptance in an effort to protect people and property from harmful effects of electricity.

This Technical Reference describes acceptable arrangements that can be tailored to suit the particular needs of an operation. It is the responsibility of each mine operator to identify any hazards associated with the use of electrical energy at a mine. The extent of control measures will be commensurate with the risk identified at each particular site. It identifies some of the core hazards, risks and control measures relevant to electrical circuitry. It is intended to protect the safety of workers, others in the workplace and property.

The outcomes sought to be achieved by this Technical Reference are to protect people and property from the hazards occurring during the use of electrical equipment failures, these include:

- Electrocution.
- Electric shock.
- Electrical burn injuries.
- Arc blast injuries.
- Injuries sustained through operation of the equipment.
- Unintended operation of the equipment.
- Ignitions of flammable mixtures of gas or dust.
- Fire

1.2 Scope

This Technical Reference extends to all non-coal mining operations in New South Wales. The areas within a mining operation include general surface, treatment plants and underground. The Technical Reference deals with high voltage, low voltage, and extra low voltage equipment, it applies to mains supplied plant, privately owned generating plants, installations supplied by

privately owned generating plant, self contained electrical equipment and electric welding equipment (including the welding “work” circuit)

The degree to which particular parts of this reference will apply to a particular mining operation will depend upon an electrical hazard assessment. It is acknowledged that operations will vary from large to small and from complex to elementary. Operators are invited to use this reference to identify electrical hazards and risk controls to reduce risk at the operation.

This Technical Reference is supplemented by the following references some of which were designed for coal mining applications, but still contain valuable reference material for electrical engineers in the non-coal sector:

Technical References:

EES002 NSW DPI Technical Reference - Control and Supervision of Electrical Work

EES004 NSW DPI Technical Reference – Practices for Portable Electrical Apparatus

EES005 NSW DPI Technical Reference - Electrical Protection and Earthing

EES006 NSW DPI Technical Reference - Removal and Restoration of Power

EES011 NSW DPI Technical Reference - Technical Principles for the Design of Electrical Systems at NSW Mines (Coal and Metals) and Extractives Operations
EES014 NSW DPI Technical Reference - Technical Principles for the Use of “Stand Alone” Generators at NSW Mines (Coal and Metals) and Extractives Operations

1.3 Authority

This is an Electrical Engineering Safety Technical Reference and is recommended by the Department of Primary Industries.

1.4 Definitions

Mining operation is defined in the Mine Health and Safety Act 2004 and broadly includes underground mines, open cut mines, treatment plants, quarries, dredging operations and in some cases other types of plant (cement works). A document that specifies the boundaries of a mining operation should be referenced in the Mine Health and Safety Management Plan.

Competent person for any task means a person who has acquired through training, qualification, experience, or a combination of them, the knowledge and skills to carry out the task.

Hostile operating environment means an operating environment at a place of work where an electrical article is in its normal use subjected to operating conditions that are likely to result in damage to the article and for example includes an operating environment that may:

- Cause mechanical damage to the article.
- Expose the article to moisture, heat, vibration, corrosive substances or dust that is likely to result in damage to the article.

Employee means an individual who works under a contract of employment or apprenticeship.

Employer means a person who employs persons under contracts of employment or apprenticeship. Note: in some chapters of the Regulation the term ‘employer’ includes a self-employed person in relation to duties to other persons.

IT system Power systems having the earthable point not connected to earth, or connected to earth through an impedance (resistor or reactor), the exposed conductive parts of the

installation being connected to earth electrodes which may be the same as those used for the earthing resistor or reactor[1]. In a mining operation context this consists of an earthing system which involves earthing through an impedance to the neutral point of the supply transformer .

Plant includes any machinery, equipment or appliance.

Residual current device (RCD) means a device intended to isolate supply to protected circuits, socket outlets or electrical equipment in the event of a current flow to earth which exceeds a predetermined value.

TN system Power systems having the earthable point directly connected to earth and the exposed conductive parts of the installation being connected by protective conductors to the earthable point of the power system[2]. In a mining operation context this is an earthing system where the distribution system is directly connected to earth at the neutral point of the supply transformer with the exposed conductive parts are connected to the earthed point of the distribution system—at the MEN connection.

Trailing Cable: A cable designed to provide power to equipment that moves as part of its operation (not hand held). The cable has the power source at its point of attachment to a fixed installation.

Voltage:

Extra-low voltage Not exceeding 50 V a.c. or 120 V ripple free d.c**.**

Low voltage Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

High voltage Exceeding low voltage.

Information Note: References to voltage levels such as 240 V need to be placed in the context that AS60038-2000 specifies the standard voltage as 230 V

1.5 Applicable legislation

The Occupational Health and Safety Act 2000

The Occupational Health and Safety Regulation 2001

The *Mine Health and Safety Act 2004*

The *Mine Health and Safety Regulation 2007*

1.6 Referenced Gazette Notices

1.7 Referenced Standards and Guidelines

AS/NZS 2081 Series Electrical equipment for coal and shale mines - Electrical protection devices

AS/NZS 3000: Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS 3007 Series - Electrical installations - Surface mines and associated processing plant

AS 4024.1 Series - Safety of machinery

[1] AS3007.2:2004 Electrical installations – surface mines and associated processing plant. Part 2: General protection requirements, p19

[2] AS3007.2:2004 Electrical installations – surface mines and associated processing plant. Part 2: General protection requirements, p19

AS 4242 Earth-moving machinery and ancillary equipment for use in mines - Electrical wiring systems at extra-low voltage

AS 60038-2000 : Standard voltages

AS/NZS 4871 Series Electrical equipment for coal mines, for use underground

AS 61508 Series - Functional safety of electrical/electronic/programmable electronic safety-related systems

AS 62061 Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems

Australian Standards Handbook, HB187 Guide to selecting a safe multimeter

NSW Minerals Industry Safety Handbook

EES002 NSW DPI Technical Reference - Control and Supervision of Electrical Work

EES004 NSW DPI Technical Reference - Practices for Portable Electrical Apparatus

EES005 NSW DPI Technical Reference - Electrical Protection and Earthing

EES006 NSW DPI Technical Reference - Removal and Restoration of Power

EES011 NSW DPI Technical Reference - Technical Principles for the Design of Electrical Systems at NSW Mines (Coal and Metals) and Extractives Operations

EES013.2

EES013.3

MDG15 Technical References for Mobile and Transportable Equipment for Use in Mines

MDG25 Guideline for Safe Cutting and Welding Operations at Mines

MDG 40 Guideline for Hazardous Energy Control (Isolation or Treatment)

Workcover Code of Practice for Overhead Power Lines.

NSW Service and Installation Rules

1.8 Acronyms

AS – Australian Standard

AS/NZS – Australian New Zealand Standard

ALARP - As Low As Reasonably Practicable, as used in risk allocation

CAT – Category: Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behaviour in the fault condition.

DNSP – Distribution Network Service Provider

ELV – Extra Low Voltage

IEC – International Electrotechnical Commission

IT – Refer to **IT system** in definitions and the note below.

OH&S – Occupational Health and Safety

RTO – Registered Training Organisation

SEP – Standard of Engineering Practice

SIL – Safety Integrity Level

TN - Refer to **TN system** in definitions and the note below.

TNSP - Transmission Network Service Provider

Note: The codes used in the description of the systems have the following meaning:

(a) First letter - The relationship of the earthable point of the power system to earth, as follows:

(i) T = direct electrical connection (minimum practical impedance) to earth.

(ii) I = no connection (all live parts isolated from earth) or connected to earth through an impedance (resistor or reactor) or equivalent circuit.

NOTE: In three-phase systems, the earthable point is commonly the neutral point of the

generator or transformer.

Second letter The relationship of the exposed conductive parts of the electrical installation to earth, as follows:

(i) T = direct electrical connection (minimum practical impedance) to earth, independently of any connection to the earthable point of the power system.

(ii) N = direct electrical connection (minimum practical impedance) to the earthable point of the power system.

1.9 Other referenced legislation

The *Electricity (Consumer Safety) Act 2004*

The *Home Building Act*

1.9.1 ELECTRICITY SAFETY LEGISLATION

The industries that provide electricity, construct and maintain the equipment that conveys electricity and supply electrical articles are highly regulated in Australia and around the world because of the potential for electricity to injure and kill and to destroy property.

The legislation that regulates electricity safety in NSW, the *Electricity (Consumer Safety) Act 2004*, is administered by the Minister for Fair Trading.

The *Electricity (Consumer Safety) Act 2004* meets its consumer protection objectives by requiring, encouraging and promoting the supply of safe electrical articles (consumer appliances) and safe practices for electrical wiring work. It aims to do this in all situations whether at home or in commercial, industrial or agricultural environments. This act defines electrical installations as NOT including electrical equipment in or about a mine. As such, electrical installations at mines are excluded from the application of the *Electricity (Consumer Safety) Act 2004. Broadly equivalent requirements are included in the Mine Health and Safety Regulation 2007.*

The arrangements at mining operations for Electrical Engineering Safety should contain adequate controls to meet the objectives and targets for electrical engineering safety set by the Department of Primary Industries and meet the expectations of legislation consistent with non-mining workplaces, in particular, the NSW Service and Installation Rules.

1.10 Who is affected by this Technical Reference?

All operators of mining operations in New South Wales where there is an electrical installation that is connected to the network of an distribution Network Service Provider (DNSP) or where there is an electrical installation where the source of electricity is a stand-alone power system such as photovoltaic cells (solar panels), inverters, batteries, wind or water turbines, diesel or petrol generators.

All individuals, unincorporated businesses and corporations involved in utilizing electricity at NSW mining operations including those who design, install and implement electrical safety systems and those who commission, test, operate, maintain, repair and de-commission the systems.

Opal Mines can use this document or EES013.2 or 3 as appropriate.

Chapter 2 Mine Safety Management Plans and Electrical Engineering Safety

2.1 Introduction

Arrangements for electrical engineering safety must be included in the Mine Safety Management Plan. The extent of these arrangements will depend on the size, type and complexity of the electrical installations and plant used at the operation.

Mine Health and Safety Act 2004, Section 27 – Duty of operator to prepare mine safety management plan

Requires that a mining operation prepare a Mine Safety Management Plan. The Plan must make provision for a range of matters detailed in the regulations, including electricity.

Mine Health and Safety Act 2004, Section 28 – No work directly related to mining without mine safety management plan

Requires that work that is directly related to mining is not carried out unless a compliant Mine Safety Management Plan has been implemented.

Every mining operation must prepare and implement a Mine Safety Management Plan. Work not directly related to mining (that is, the actual extraction of product and associated strata that is removed to access the product) can be carried out whilst the Mine Safety Management Plan is being developed and implemented, however this type of work must be done using safe systems of work and in compliance with the OH&S Act and regulations and the Mine Health and Safety Regulation 2007. For example, where a mining operation is being constructed from a "greenfield" site and there is no work directly related to mining, the operator is still required to comply with all the Electrical safety requirements specified in clauses 58 to 68, Mine Health and Safety Regulation 2007.

Mine Health and Safety Act 2004, Section 28 – Duty of operator to ensure compliance with mine safety management plan

Requires that all types of work carried out, is done in accordance with the Mine Safety Management Plan. The Plan must make provision for a range of matters detailed in the regulations, including electricity.

Mine Health and Safety Act 2004, Section 29 – Contents of mine safety management plan

The Plan must make provision for a range of matters detailed in the regulations, including electricity.

Electrical Engineering decisions are critical to attaining safe production at mine sites. To achieve safety these decisions must be of the highest quality. A specific requirement to be included in the Mine Safety Management Plan is the management structure, which must include competent persons with appropriate engineering competence. For matters relating to Electrical

Engineering Safety it is expected that the electrical engineering competence will be directly related to the size and complexity of the electrical plant used at an operation.

Arrangements for Electrical Engineering Safety must be present and effective at every stage of the equipment and mines life cycle and must be effectively supported by the organisational culture. If any element is deficient or there is ineffective support from the organisational culture safe production is left to chance.

The electrical engineering safety arrangements must be an integral part of the Health and Safety management plan.

	**The Mine Health and Safety Regulation, clause 67 – Persons to have appropriate electrical qualifications** (a) Requires that certain electrical installations and plant are designed and periodically reviewed by a qualified electrical engineer. These are high voltage electrical installations and electrical plant, or where the total connected power exceeds 1000 kilowatts (at any voltage).

	**The Mine Health and Safety Regulation, clause 109 – Functions to which of the Act applies and evidence of competence to perform those functions**, (2) Defines a qualified electrical engineer as an electrical engineer who is registered on the National Professional Engineers Register administered by the Institution of Engineers Australia.

For mine operations that utilize high voltage or the total connected power exceeds 1 MWatt, the installation must be designed by an electrical engineer on the National Professional Engineers Register. The installation and associated electrical plant must also be periodically reviewed by an electrical engineer on the National Professional Engineers Register register. The purpose of the review is to establish that the installation and plant are in compliance with the legislation and safe to use.

The qualified electrical engineer may be nominated in the management structure by the operator to fulfill the role of a person with appropriate engineering competencies. Refer to Section 2.2 below for Mine Safety Operations recommendations on the employment of competent electrical engineers within the management structure.

Mine Safety Operations recommendation: Where the electrical installation is high voltage or where the total connected power exceeds 1000 kilowatts (at any voltage). ALL electrical engineering safety arrangements (fit for purpose equipment, competency requirements, procedures and management system elements) should be developed, implemented and periodically reviewed through consultation with a qualified engineer or competent electrical engineering organisation who employs a qualified electrical engineer.

2.2 Management Structure

The Mine Health and Safety Act 2004, section 35 – Operator must prepare management structure

(2)(b) Requires that the operator prepares a management structure, and that structure must include persons with appropriate engineering competence.

Each operation should have a documented management structure detailing positions, incumbents, responsibility and accountability for the electrical engineering safety arrangements.

Where electricity is used at a mine, the operator must make a determination of the level of competence required to meet the needs of the operation. At most mines this requires a person to be nominated to develop and oversee safe commissioning, operation, maintenance and use of electrical plant.

A qualified electrical engineer may be nominated in the management structure by the operator to fulfill the role of a person with appropriate engineering competencies.

Mine Safety Operations recommendation: Underground operations and surface operations utilising high voltage or where the total connected power is greater than 1000 kilowatts, nominate a person with appropriate engineering competencies in the management structure that is a "full time" position.

Mine Safety Operations recommendation: Appropriate engineering competencies for persons nominated in the management structure are those that satisfy requirements for registration on any of the registers administered by the Institution of Engineers Australia, that is; Professional Engineer or Engineering Technologist. Other appropriate competencies are those that satisfy the requirements of the Institution of Engineers Australia to be admitted at Member Grade as a Professional Engineer, Engineering Technologist or Engineering Officer.

It is recognised that at smaller operations with little electrical infrastructure (those that do not utilise high voltage or where the total connected power is less than 1000 kilowatts) the management structure may not provide for full time engineering supervision.

Mine Safety Operations recommendation: These smaller operations should have their installations and electrical engineering safety arrangements audited by a competent organisation at least every three years. The audit must include an electrical installation compliance check against AS/NZS3000 and AS3007. The audit must also include a compliance check for ALL electrical plant against the legislation. The audit must include follow up actions to rectify non-conformances. Note: For very small operations that use a single phase generator, the electrical installation will generally include the generator, switchgear and socket outlets fed from the generator.

2.3 Mine Safety Management Plan

2.3.1 PLANT SAFETY

Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan

(b) The Mine Safety Management Plan make provision for the arrangements for the acquisition of fit for purpose plants and its safe commissioning, operation, maintenance and use. Also it must make arrangements for compliance with Occupational Health and Safety Regulation 2001, Chapter 5 Plant Safety

It is the responsibility of the mine operator to provide plant that is adequately rated for the activity and fit for purpose in the proposed working environment. The operator may need to seek advice from qualified electrical personnel so that the selection of electrical plant is preceded by an assessment to identify all safety requirements.

Purchasing and hiring of electrical equipment is a particularly important issue, this is often done by “non electrical” people. The Mine Safety Management Plan must make provision for electrical equipment only being acquired after consultation with a qualified electrical person. Depending on the type of equipment this may be a qualified electrical engineer or a qualified electrical tradesperson.

The selection of portable electrical tools is not just a matter of purchasing a tool from a local hardware store, the purchase should be preceded by an assessment of the activity and environment. Where possible battery operated tools should be used in preference to mains powered. Where generators or inverters are used, the operator should obtain advice to ensure a safe outcome.

It is recognised that some electrical equipment at an operation for use in small kitchens, offices and recreation areas may be typical domestic type equipment. This type of equipment when used at home is often a “declared article” pursuant to the Electricity (Consumer Safety) Act 2004. These declared articles must meet specified standards and they are marked with an approval mark. Details of declared articles can be found in Government Gazette No 103, dated 24 August 2007, pages 5952 – 5959.

Mine Safety Operations recommendation: Where equipment (other than domestic type appliances, office equipment etc) is acquired that has electrical components for power, control or provision of safeguards, then processes requiring review and acceptance (sign off) by a qualified electrical person are used.

Mine Safety Operations recommendation: Processes define when a qualified electrical engineer must review and accept proposed purchase or hire of electrical equipment.

Mine Safety Operations recommendation: For smaller operations, replacement parts or equipment for extending installations may be signed off by a qualified electrical tradesperson.

Occupational Health and Safety Regulation 2001, Chapter 5

This applies to ALL plant (equipment, apparatus, tools, machinery etc). It requires a life-cycle approach to the safety of plant. Responsibilities of persons dealing with any aspect of plant are prescribed. Information flow for life-cycle management of the safety is important. Certain plant must be

	registered.

These requirements encompass electrical installations and electrical plant.

Chapter 5 of the OH&S Regulation has extensive requirements for plant safety. All electrical powered equipment and electrically controlled equipment is covered by these requirements and they need to be integrated within the Mine Safety Management Plan, which will need to have arrangements whereby checks are made to establish that designers, suppliers, manufacturers, trade agents and hirers of plant have fulfilled their obligations. Also, the mine operator needs to be sure that their obligations have been fulfilled, such as a mine operator who contracts out the design of plant must ensure that the person who is engaged to design the plant is provided with all relevant information about matters relating to the plant that may affect health and safety.

Information Note: This extends to ALL types of plant. For example a designer of an electrical control system for a processing plant is required to comply with these requirements in relation to the control system and the equipment being controlled as far as it can be affected by the control system.

All people and organisations in the supply chain have responsibilities. An end user should be able to establish that any foreseeable hazards that may arise during the life-cycle have been identified, risks assessed, risks eliminated or controlled, information has been provided and plant is not used in conditions likely to give rise to electrical hazards.

	**Occupational Health and Safety Regulation 2001, Clause 64 - Electricity – particular risk control measures.** 2(b) plant is not used in conditions likely to give rise to electrical hazards.

This relates to electrical installations and plant not being used in locations or environments where damage can forseeably occur or where environmental conditions will cause deterioration in electrical characteristics.

It also relates to “non-electrical” plant being used in locations or in a manner that can contact energised electrical plant or installations, an obvious example is the operation of “non-electrical” plant near overhead power lines (OHL’s) and in digging / excavation where eklectrical services may be buried.

2.3.1.1 Information Relating to Plant Safety

The information must be able to establish full compliance with legislation. As such Chapter 5 of the OH&S Regulation must be extensively referenced in plant specifications, SEP’s and checklists used within the auspices of the Mine Safety Management Plan.

The information must encompass:

- All available information concerning health and safety about the plant provided by the manufacturer.
- The purpose for which the plant is designed.
- Testing or inspections to be carried out on the plan.

- Installation, commissioning, operation, maintenance, inspection, cleaning, transport, storage and, if the plant is capable of being dismantled, dismantling of the plant.
- Systems of work necessary for the safe use of the plant.
- Knowledge, training or skill necessary for persons undertaking inspection and testing of the plant.
- Emergency procedures.
- Any document relating to the testing and inspection of the plant.

Information Note: Each operation should have equipment dossiers or safety files. In particular for high risk areas, including:

- HV Installation Dossier.
- Hazardous Area Equipment Dossiers.
- Underground Mobile Plant Dossiers.
- Mine Winding System Dossiers (Safety File).
- Radio Controlled Equipment Dossier (This to include operating frequencies, control of surface operations, testing of transmitters).
- Safety File for any equipment identified as requiring a SIL.

Information Note: Mining machinery is becoming more complex and the use of programmable systems is common place. With this type of machinery come more detailed information requirements. For this type of plant information is required on:

- Compliance with AS/NZS4024, AS 61508, AS 62061.
- Programmable Electronic Devices - Security/Access, Change Management, Routine verification, SIL levels.

2.3.1.2 Plant Registration

There are plant registration requirements in the OH&S Regulation including specific requirements for mines. The Mine Safety Management Plan must encompass this and regularly review whether plant is registered, remains registered or if there are special conditions of use as a result of registration. With regard to plant with electrical elements the following have to be registered:

- Powered winding systems

2.3.2 RISK MANAGEMENT

Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan

(c) The Mine Safety Management Plan makes provision for hazard ID, RA, risk control and conduct of regular site inspections.

Mine Health and Safety Regulation 2007, Clause 4 – Obligation to control risk & Occupational Health and Safety Regulation 2001, Clause 5 – Meaning of "control" risks

Requires the application of the hierarchy of risk controls. To minimise the risk for following measures have to be taken in the order specified:

	• Firstly substitute the hazard with a hazard of lesser risk, • Isolate the hazard from the person, • Engineering risk controls, • Administrative means, • PPE.

	**Occupational Health and Safety Regulation 2001, Clause 64 – Electricity particular risk control measures** (1) An employer must ensure that any risk of injury from electricity at a place of work is eliminated or, if elimination is not reasonably practicable, the risk is controlled.

To eliminate the risk of injury from electricity, alternative energy sources would need to be used. Where these alternative energy sources have a lesser risk than electricity then they should be used. In reality electricity will be widely used. Where electricity is used the risks must be controlled. In controlling the risks, the hierarchy of risk controls must be applied. It is generally the case that ELV electrical installations and equipment present a lesser hazard than low voltage, which in turn presents a lesser hazard than high voltage.

Many types of electrical plant have control circuits with field devices that are accessible to workers. These types of devices are a major source of electric shock incidents. The application of the hierarchy of risk controls is easily and readily applied by operating such control circuits and / or field devices at extra low voltage (a lesser hazard than low voltage). The use of screened or armoured cable also reduces the risk of direct or indirect contact with electricity.

Mine Safety Operations recommendation: On new installations where control circuits have field devices that can be touched whilst energised, the control circuit shall be supplied at ELV.

Mine Safety Operations recommendation: On existing installations where control circuits have field devices that can be touched whilst energised the control circuit shall be protected by an earth leakage device (RCD) having a trip setting at 10 milliamps. Where that is not feasible, up to 30 milliamp RCDs protection may be used if the risks are demonstrably ALARP. At the first opportunity (e.g. plant upgrade) these non-ELV control circuits should be replaced with ELV control circuits.

Mine Safety Operations recommendation: Where hand held power tools are used, they should be extra low voltage battery operated, not 240 volt.

Mine Safety Operations recommendation: Welding equipment should have an ELV output.

Mine Safety Operations recommendation: The Mine Safety Management Plan should specify the tolerable risk level and how appropriate safety integrity criteria are specified.

Mine Safety Operations recommendation: Earthing systems are of an inherently safer design, that is, maximum potential rise of an earth grid should be below 55V.

The OH&S risk assessment can not be used as an excuse not to comply with the requirements of the regulation.

Mine Health and Safety Regulation 2007, Clause 3 – Definitions

Electricity is defined as a prescribed hazard.

Mine Health and Safety Regulation 2007, Part 4 – OH&S risk assessments relating to prescribed hazards, Clause 35 - General considerations

(1) Specifies general considerations when doing OH&S risk assessments in relation to a prescribed hazard.

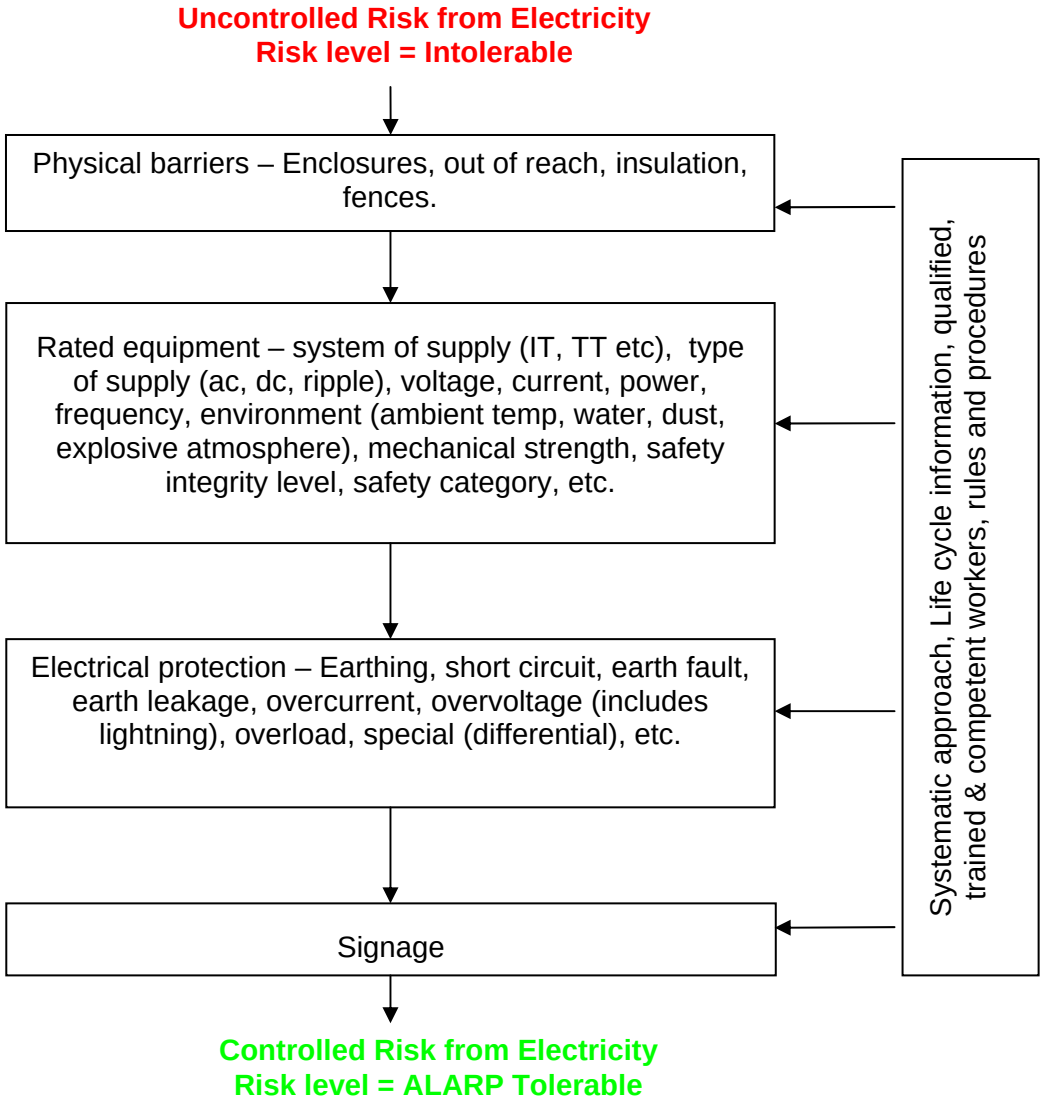
(1)(d) Specifies that when doing OH&S risk assessments in relation to a prescribed hazard the skills and experience of persons dealing with the hazard are important factors.

When doing the OH&S risk assessment related to the prescribed hazard of electricity, skills and experience of people dealing with the prescribed hazard must be considered.

Mine Safety Operations recommendation: OH&S risk assessments conducted in regard to electricity must include electrically qualified people as defined in Clause 109.

The uncontrolled risk from electricity is intolerable and is in the highest risk category. In reality there are well established risk controls that bring the risks from electricity down to a tolerable level. This is shown in Figure 1.

Figure 1.



Mine Safety Operations recommendation: Operations either specify a tolerable risk level, or identify authoritative good practice that reduces the risk to a tolerable and ALARP (As low as reasonably practicable).

Mine Health and Safety Regulation 2007, Clause 42 specifies absolute minimum requirements when considering the risks from electricity.

Mine Health and Safety Regulation 2007, Clause 42 - Electricity

The Operator must take into consideration as a minimum the risks from:

- Life-cycle operation of HV installations.
- Injury to people from sources of electrical energy.
- Gas or dust explosions ignited by electricity.
- Uncontrolled fires ignited by electricity.

	• Unintended operation of plant. • The use of electrical safeguards with appropriate safety integrity.

Life-cycle is defined in clause 42(2) and basically encompasses the plant from concept through to disposal.

High Voltage Installations. High voltage installations are identified as a particular area for attention and supplementing any risk assessment are the requirements imposed by DNSP, where high voltage customers are required to have an integrated Customer Installation Safety Plan. Even when a mine does not utilize high voltage, the risks can still be present on mine sites from infrastructure owned by DNSP & TNSP, in particular OHL's crossing or adjacent to the mine and its access.

Injury to people from sources of electrical energy. Electrical energy can cause death and injury from electric shock, burns from direct contact with electric arcs, radiation burns from electric arcs, arc blast, shrapnel from catastrophic failure of electrical plant (exploding), ingestion of arcing and arc blast products, also the electric shock may initiate falls or similar. All of these injury mechanisms can occur at high voltage and low voltage and many can occur at ELV (it is generally accepted that appropriate ELV circuits will not result in electrocution or serious injury from electric shock). All of these aspects need to be considered when conducting OH&S risk assessments.

Gas or dust explosions ignited by electricity. Areas flammable gases or flammable concentrations of dust can accumulate are termed "hazardous areas", if these exist at a mining operation and special precautions are not taken, electricity can ignite these concentrations. It is important to establish whether hazardous areas exist at a mining operation.

Uncontrolled fires ignited by electricity. Electrical energy can cause fires where electrical equipment is not properly rated or where faults occur on electrical circuits. It should be noted that the higher the electrical current that flows when a fault occurs, the more likely it is that a fire or catastrophic failure of electrical equipment will occur. A particular issue is earth moving equipment tyres exploding after contact with OHL's or lightning.

Unintended operation of plant. Electrical control circuits are commonly used to control the movement of fixed and mobile plant, if not designed properly unplanned start up, unplanned movement, failure to stop can easily occur.

The use of electrical safeguards with appropriate safety integrity. Often electrical circuits and sensors are used to detect malfunction of many types of plant (electrical, mechanical, shotfiring, chemical processes etc) and to initiate actions to bring the plant to a safe condition. Where the risk is high, the more reliable the electrical safeguard needs to be, that is the higher the risk, the higher the safety integrity.

	**Mine Health and Safety Regulation 2007, Clause 44 – Preparation of documentation & Clause 45 – Keeping of documentation** The OH&S risk assessments for electricity must be documented if they are high risk and this documentation must be kept for the period of currency of the risk assessment.

The uncontrolled risk from the use of electricity is of the highest category.

Mine Safety Operations recommendation: All risk assessments related to the prescribed hazard of electricity must be documented. Records of implementation and review must be kept.

2.3.3 INSTRUCTION AND TRAINING

It is not envisaged that this provision will exclude the use of 240 volt and 415 volt tools and other plant by trained persons however competency training will be necessary so that the plant is used in accordance with the manufacturer's instructions and site safe work practices. The user should also be competent to assess whether the plant is adequately rated for the activity and fit for purpose in the proposed working environment.

Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan

(d) The Mine Safety Management Plan must provide for the provision of adequate instruction, training and information.

The Mine Safety Management Plan shall identify the training needs for Electrical Engineering Safety matters to be addressed. The legislation is quite specific about competency requirements when doing electrical work on electrical installations and plant (other than ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less).

Mine Health and Safety Regulation 2007, Clause 67 – Persons to have appropriate electrical qualifications

(b) The Operator must ensure that installation, commissioning, maintenance and repair of electrical installations and plant (other than ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less) are undertaken by or supervised by a qualified electrical tradesperson or qualified electrical engineer.

The identified training should be supplementing the above minimum requirements.

A qualified electrical tradesperson is defined in the legislation.

Mine Health and Safety Regulation 2007, Clause 109 – Functions to which Part 9 of Act applies and evidence of competence to perform those functions
Specified function
Functions of a qualified electrical tradesperson.
Specified evidence of competence
Both an electrical trades certificate and a Qualified Supervisor Certificate (issued by the Department of Commerce), or
Employment as an electrical tradesperson at a mine for a period of not less than 2 years prior to the commencement of this clause.

Mine Safety Operations recommendation: An electrical tradesperson who has been employed at a mine for not less than two years. The two years must have been achieved doing electrical work as an electrical tradesperson. Work undertaken as an apprentice is NOT included. The two years can be at a number of different mines. Where the experience is at a number of different mines, evidence of competence via an electrical work practice report should be able to verify that two years of electrical work has been undertaken, or a letter from a mining

operation representative that attests to the doing of two years electrical work. The two years must be prior to 1 September 2008.

For electrical work on ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less, then the work has to be undertaken by a competent person or be supervised by a qualified electrical tradesperson or qualified electrical engineer.

It is not envisaged that this provision will exclude the replacement of minor parts with a like equivalent.

Mine Health and Safety Regulation 2007, Clause 67 – Persons to have appropriate electrical qualifications

(c) the Operator must ensure that installation, commissioning, maintenance and repair of ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less) are undertaken by a competent person or a person supervised by a qualified electrical tradesperson or qualified electrical engineer.

The Mine Safety Management Plan must specify the competencies required for such types of work and where necessary ensure the appropriate training and instruction is given.

Mine Safety Operations recommendation: For ELV automotive, the competencies should be an automotive electrician or a properly trained service mechanic or technician authorised by the plant supplier.

Mine Safety Operations recommendation: For 240 volt plug in type equipment, this could be a qualified electrical tradesperson or a qualified electrical engineer, or a properly authorised service technician, or a person with a restricted electrical license, or someone deemed competent by a Registered Training Organisation for the testing and tagging of 240volt equipment.

It is not envisaged that this provision will exclude the use of 240 volt tools and other plant by lay persons however some competency training will generally be necessary so that the plant is used in accordance with the manufacturers instructions, site safe work practices. The user should also be competent to assess whether the plant is rated for the activity and fit for purpose in the proposed working environment.

2.3.4 SUPERVISION

Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan

(e) The Mine Safety Management Plan must make arrangements for supervision at the mine.

The Mine Safety Management Plan must incorporate the supervisory requirements specified in Clause 67 Mine Health and safety regulation 2007

Mine Health and Safety Regulation 2007, Clause 67 – Persons to have appropriate electrical qualifications

(b) The Operator must ensure that installation, commissioning, maintenance and repair of electrical installations and plant (other than ELV automotive

	plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less) are undertaken by or supervised by a qualified electrical tradesperson or qualified electrical engineer.

	**Mine Health and Safety Regulation 2007, Clause 67 – Persons to have appropriate electrical qualifications** (c) the Operator must ensure that installation, commissioning, maintenance and repair of ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less) are undertaken by a competent person or a person supervised by a qualified electrical tradesperson or qualified electrical engineer.

Refer to EES002 NSW DPI Technical Reference for the Control and Supervision of Electrical Work

2.3.5 COMMUNICATION

	**Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan** (f) The Mine Safety Management Plan must make arrangements for communication at the mine.

Electrical engineering safety matters are included in these obligations requiring:

- Minimum communication of day to day Electrical Engineering Safety matters.
- Electrical persons in the management structure to communicate specific Electrical Engineering Safety issues that may arise from time to time.

All other communication matters in the regulations to be considered in relation to Electrical Engineering Safety.

In particular for underground mines voice communication systems such as telephones must be provided at strategic points underground and on the surface.

Mine Safety Operations recommendation: Telephonic / radio means of communication is provided at:

- Every underground entrance to a shaft or outlet for ingress or egress.
- Every place underground where plant is regularly serviced or charged.
- A reasonably accessible place in each underground production area.
- A place in proximity to underground switch-gear.
- Places in proximity to every underground conveyor belt drive head and transfer or loading point.
- Emergency fresh air base / refuge chamber.

2.3.6 SITE SAFETY RULES

Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan

(g) The Mine Safety Management Plan must make arrangements for the provision of information about site safety rules.

Electrical engineering safety matters are included in these site safety rules. A typical example is the well recognised issue of electrical cord extension sets. Any electrical cord extension sets, flexible cables or fittings are located where they are not likely to be damaged (including damage by liquids) or are protected against any damage and are not laid across passageways or access ways unless they are suitably protected. The use of screened extension leads with a minimum of IP56 rated plugs is highly recommended. Isolation, out of service tags and danger tag rules are particularly important.

2.3.7 DOCUMENT CONTROL AND RECORDS

Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan

(g) The Mine Safety Management Plan must make arrangements for document control and record keeping.

Electrical engineering safety documents are to be controlled via the document control system. Records of electrical testing, safety and compliance certificates and the like are to be part of the records kept at the mine.

Information Note: Refer to the Section on Installation, Commission and maintenance for specific details of electrical records. Verification and testing records for electrical work done are particularly important.

2.4 Other matters

2.4.1 CONTRACTOR MANAGEMENT

Mine Health and Safety Regulation 2007, Division 3 – Duties relating to contractors

With regard to contractors engaged to do electrical work the Mine Safety Management Plan must provide electrical content and or actions to be undertaken.

In particular:

- Pre-assessment of contractor electrical engineering health and safety arrangements (including safety management, competence of people and fitness for purpose of equipment) prior to engagement.
- Pre-assessment of electrical contractor's competency.
- Site induction relating to Electrical Engineering Safety requirements for contractors, contractor employees and subcontractors.

- Monitoring of contractor compliance with site Electrical Engineering Safety health and safety requirements, including legislative compliance.

Although specific types of contractors are excluded by regulation the Mine Safety Management Plan must make provision for Electrical Engineering Safety health and safety requirements of all persons whose activities may involve the use of electrical equipment or to be in proximity to part of an electrical installation:

- Delivery contractors – typical matters may cover OHL hazards, fuel delivery, delivery of large equipment, use of remote control vehicle cranes, power systems on board delivery vehicles etc.
- Office equipment service contractors – typical matters will be competency, isolation, use of meters etc. **NO LIVE LINE WORK.**
- Office cleaning contractors – typical matters are fit for purpose equipment and testing and tagging of equipment.
- Catering contractors particularly where electrically powered equipment is used on site
- Other contractors engaged in similar work.

2.4.2 EMERGENCY MANAGEMENT

Mine Health and Safety Regulation 2007, Clause 32 – Contents of emergency plan

Identifies matters to be addressed in the emergency plan

The emergency management plan will have Electrical Engineering Safety content. In particular it is required to cover the treatment of electric shock victims (electric shock protocol) and the treatment of electrical burns (electrical burns protocol). It also required addressing the training of persons providing such treatment.

Mine Health and Safety Regulation 2007, Clause 32 – Contents of emergency plan

(1)(h) requires that the emergency plan address the treatment of electric shock and burns and for the training of persons providing such treatment

Any person receiving an electric shock above extra low voltage must seek professional medical diagnosis and treatment, as such the training of persons giving professional medical treatment is outside the scope of any Mine Emergency Plan – this is a matter for the medical profession. However persons giving first aid to electric shock victims must be adequately trained.

Mine Safety Operations recommendation: All electric shock victims should be transported to the nearest professional medical facility and the victim shall be assessed by a medical professional, and in particular a 12 lead ECG shall be used to diagnose the potential impact of the electric shock on the victim's health. The protocol should identify the notifiable incident reporting requirements.

Mine Safety Operations recommendation: Electric burn protocols should encompass arc blast injuries, ingestion of arcing products and arc blast products. The protocol should identify the notifiable incident reporting requirements.

Other emergency responses to consider are “electrical fires” and electrical related responses to other emergency situations e.g. mine winders, explosions, machinery accidents etc.

Liaison with electricity network providers will be an important element.

Further the legislation requires there to be a mechanism to warn of an emergency at a mine. Where this alarm is electrically powered or controlled it must have appropriate safety integrity.

Other matters to consider within the emergency plan are available information on critical electrical and communication infrastructure.

Sufficient transport or alternate means of escape in combination with escape equipment to allow the safe evacuation of people (electrical matters may include provision of alternate power supplies for safety critical infrastructure such as ventilation fans, winders and communications).

The regular testing as to the effectiveness of the emergency provisions to be part of life cycle management of electrical equipment.

Any associated ***escape and rescue plan*** of the underground parts of the operation to include location of high voltage and low voltage fixed cables and switchgear, location of communication devices and interconnecting cable routes, location of monitoring devices and associated cable routes.

Mine Safety Operations recommendation: Electrical requirements are included in any specification for rescue chambers. Where oxygen is stored or generated as part of the rescue chambers, the specification must consider the increased risk of fire and explosion from oxygen enrichment.

2.4.3 FIRE AND EXPLOSION

Mine Health and Safety Regulation 2007, Subdivision 5 – Fire and explosion, Clause 53, - Preventative measures

Requires appropriate measures are taken to prevent, detect and suppress fires and unintended explosions**.**

Where the detection and suppression are electrically powered or controlled, they are considered to be electrical safeguards and must be designed with appropriate safety integrity.

Mine Safety Operations recommendation: Fire and explosion provisions to include:

- safe removal of power,
- specific fire fighting requirements (including training) for electrical installations,
- provision of communication systems,
- signage and plans.

Mine Safety Operations recommendation: Identification and classification of hazardous areas (areas where there is potential for an explosive concentration of gas and or dust) and the use of properly certified electrical plant in those hazardous areas.

Properly designed and life-cycle managed electrical installations and plant should prevent the initiation of unintended explosions of flammable atmospheres from electrical ignition sources.

Properly designed and life-cycle managed electrical installations and plant should prevent the initiation of fires from electrical ignition sources.

Properly designed and life-cycle managed electrical shotfiring plant should prevent the initiation of unintended explosions from explosives.

Properly designed and life cycle managed electrical installations, in particular earthing and lightning protection should prevent the initiation of unintended explosions from explosives.

2.4.4 CONSULTATION

Occupational Health and safety Regulation 2001, Chapter 3 – Workplace consultation

Specifies requirements for OH&S consultation with the workforce

The consultation arrangements at the mining operation shall provide for Electrical Engineering Safety matters to be addressed. It is expected that significant consultation will be required in relation to electrical work and where actions by "non-electrical" people such as mining engineers, production managers, mechanical engineers and purchasing officers can influence the acquisition of fit for purpose equipment – electrical engineering aspects of equipment acquisition must be considered at the specification phase and be part of the Mine Safety Management Plan.

Consultation must occur when:

Changes that may affect health, safety or welfare are proposed to the:

- Work premises
- Systems or methods of work
- Plant or substances used for work

- Assessing the risks to health and safety arising from work
- Decisions are made about the measures to be taken to eliminate or control those risks
- Introducing or altering the procedures for monitoring risks
- Decisions are made about the adequacy of facilities for employee welfare
- Decisions are made about the procedures for consultation

Note 1: For more details about the obligations to consult refer to the WorkCover *Guideline: Occupational Health and Safety Consultation.*

Note 2: Electrical Engineering Safety must be a specified element within the above points.

2.4.5 CONSTRUCTION WORK

Occupational health and Safety Regulation 2001, Chapter 8 – Construction work

Specifies what construction work is and also specifies particular arrangements for construction work.

Construction work as defined in the OH&S Regulation may occur outside a construction zone. Electrical installations and electrical plant used in construction work must comply with the OH&S Regulation 2001 and the Mine Health and Safety Regulation 2007.

Mine Safety Operations recommendation: As well as compliance with the regulations, electrical installations and equipment must comply with AS3012 and the Workcover Code of Practice – Electrical Practices for Construction Work.

2.4.6 CONSTRUCTION ZONES

Mine Health and Safety Regulation 2007, Clause 77 – Construction zones

requires construction zones to be designated where construction or demolition is being undertaken

The requirements for electricity specified in the legislation are applicable in a construction zone.

Mine Safety Operations recommendation: As well as compliance with the regulations, electrical installations and equipment must comply with AS3012 and the Workcover Code of Practice – Electrical Practices for Construction Work.

2.4.7 HANDLING OF EXPLOSIVES (Clause 41)

Consideration must be given to:

- Electrical requirements and life-cycle management of plant used to store and transport explosives.
- SIL requirements for electronic detonators and shotfiring equipment.

2.4.8 OTHER OH&S REGULATION REQUIREMENTS

Other electrical engineering safety matters to be considered within the Mine Safety Management Plan

Requirements for lasers to be used in accordance with Australian Standard AS 2397-1993 *Safe use of lasers in the building and construction industry*, and that Class 3B or Class 4 lasers or laser products as defined in AS/NZS 2211.1:1997 *Laser safety: Equipment classification, requirements and user's guide*, are not used.

Identify the electrical equipment containing asbestos and ensure the register is kept up to date with regard to its location and condition and that the register complies with the specified requirements of the OH&S regs.

Use of Places of Work provisions particularly in relation to switch rooms, substations, switchyards and places where electrical equipment is located, especially underground. Typical matters are fire suppression, emergency egress, adequate access, pressure relief venting, provision for remote switching and authorisation to enter.

Working Space provisions particularly in relation to switch rooms, substations, switchyards and places where electrical equipment is located, especially underground and on mobile plant. Many standards specify minimum requirements.

Lighting provisions.

Personal Protective Equipment provisions in particular clothing for electrical work, special clothing for switching operations and height safety.

Consider the requirements for electrical equipment and personnel with regard to the OH&S provisions for:

- **Heat and cold.**
- **Noise management.**
- **Atmospheric contaminants.**
- **Levels of oxygen.**
- **Ventilation (localised).**
- **Protection against entry into a contaminated atmosphere or unsafe levels of oxygen.**
- **Atmospheric monitoring (localised).**
- **Working at heights (OHL's, lighting towers are a particular electrical issues, the issue of electric shock causing a fall and pole top rescue must be considered).**
- **Falling objects.**
- **Lifts.**
- **Brittle or fragile tops / backs.**
- **Building maintenance.**
- **Fire and explosion.**
- **Working in confined spaces.**
- **Manual handling.**
- **Hazardous substances:**
  - Asbestos (can be found in dc motors, old switchboards, old meter panels, old switchgear).
  - PCB's.
  - Electrical solvents.
  - Inclusion on the register of hazardous substances at the operation.
  Information note: SF6 is an insulant used in some types of electrical switchgear, especially HV circuit breakers. Once subject to arcing SF6 can be a hazardous substance and should be treated as such.
- **Dangerous goods – particularly electrical ignition sources and identification and classification of hazardous areas.**
- **Spray painting - particularly electrical ignition sources and identification and classification of hazardous areas and use of any booths.**

2.4.9 NOTIFICATION OF CERTAIN ACTIVITIES

Mine Health and Safety Regulation 2007, Clause 144(1)(f) – Notification of certain activities and operations

requires that for the purposes of Section 69(1) of the Mine Health and Safety Act 2004, the operator of a mine must notify the Chief Inspector of an intention to introduce an electricity supply to the mine before such a supply is introduced. The notification must be in writing and must be made within 14 days of the intention.

Note: Section 6 of the Mine Health and Safety Act defines where the act applies and states "**6 Application of Act**
(1) This Act applies to the following places of work (which are called ***mines*** in this Act):…"

Where a mine operator intends to introduce an electricity supply to anywhere that is specified in Section 6 then notification must be made to the Chief Inspector within 14 days before the electricity supply is introduced. There are two methods of introducing an electricity supply:

1) Mains supply is introduced to the mine from a local supply authority.
2) Free standing supply (generally a transportable generator set).

For mains fed installations: Notification is expected 14 days before the local supply authority switches on the electricity supply to the mine for the first time. Where electricity supplies are disconnected / discontinued by the DNSP, and at some later date it is intended to introduce the electricity supply again, notification is required.

Mine Safety Operations recommendation: The notice includes the following information:

1. Voltage level of the supply.
2. Fault level at the point where the mine takes responsibility for the electricity supply.
3. Connected load of the installation.
4. Capacity of the installation.
5. Where the electrical installation connected to the supply exceeds a 1Mwatt capacity or is high voltage, a statement from a qualified electrical engineer that the electrical installation to which the supply is connected, complies with AS/NZS3000, AS3007, the requirements of the applicable safety legislation, and the requirements of the local supply authority.
6. Where the electrical installation connected to the supply has a capacity less than 1Mwatt and is at a voltage less than high voltage, a statement from a qualified electrical engineer or a qualified electrical tradesperson that the electrical installation to which the supply is connected, complies with AS/NZS3000, AS3007, the requirements of the applicable safety legislation, and the requirements of the local supply authority.

For free standing installations: Notification is expected 14 days before the free standing installation is energized for the first time. Where the free standing supply is periodically re-located within the mine, no further notification is required. Where the free standing supply (generator) is replaced by an alternative and equivalent generator no additional notification is required. Where the generator is replaced by an alternative generator and the capacity increases above 1Mwatt or the voltage is increased to high voltage, then re-notification is required.

Mine Safety Operations recommendation: The notice includes the following information:

1) Voltage level of the free standing installation
2) Fault level at the terminals of the free standing supply (generator terminals).
3) Capacity of the free standing supply (generator kVA)
4) Where the electrical installation connected to the supply exceeds a 1Mwatt capacity or is high voltage, a statement from a qualified electrical engineer that the electrical installation to which the supply is connected, complies with AS/NZS3000, AS3007, the requirements of the applicable safety legislation.
5) Where the electrical installation connected to the supply has a capacity less than 1Mwatt and is at a voltage less than high voltage, a statement from a qualified electrical

engineer or a qualified electrical tradesperson that the electrical installation to which the supply is connected, complies with AS/NZS3000, AS3007, the requirements of the applicable safety legislation.

Opal mines. The registration of a mining claim may be considered to include a notification of intention to use electricity. Details of the proposed installation of a generator are not required to be submitted. Mine operators workshop and opal miners safety course include sections on selection and safe operation of opal mining electrical plant. The mine operator should take advice from a qualified electrical tradesperson for the initial set up of the proposed mine. Equipment should be capable of connection by the user through plugs and sockets. Where connections of wiring are necessary, a qualified electrical tradesperson should be consulted.

Chapter 3 Electrical Engineering Safety – Regulatory Risk Controls

3.1 Objectives

The purpose of the risk controls specified in the Mine Health and Safety Regulation 2007 are to give effect to the Mine Safety Management Plan in the area of Electrical Engineering Safety, in particular to:

- To prevent injury to people from sources of electrical energy.
- To prevent uncontrolled fires where electrical energy is the ignition source.
- To prevent initiation of gas or dust explosions by electrical energy.
- To prevent unintended operation of plant.
- To provide electrical safeguards for electrical and non-electrical hazards with an appropriate safety integrity level.
- To generally provide the means by which the safety of electrical plant is managed including requirements of the Act and this Regulation and relevant plant safety requirements under the *Occupational Health and Safety Regulation 2001*.

The Electrical Engineering safety arrangements must encompass the life cycle of electrical plant and installations and electrical engineering practices at the mining operation.

It is expected the Electrical Engineering Safety arrangements will have a positive impact on other matters and be fully integrated within the Mine Safety Management Plan and other management systems utilized at the mining operation, such as maintenance management systems.

3.2 Compliance with AS/NZS 3000 and AS 3007

Mine Health and Safety Regulation 2007, Clause 58 - Compliance with standards

All electrical installations at the mining operation are to comply with AS/NZS 3000: 2007 (known as the Australian/New Zealand Wiring Rules) and AS 3007 applicable to those installations.

These standards are definitely applicable to all electrical installations located on the surface of a mining operation; many of the matters dealt with in these standards could be applicable to underground installations.

Note: AS/NZS3000:2007 replaced the 2000 version in mid 2008.

3.3 Switching Electrical Power

Mine Health and Safety Regulation 2007, Clause 66 - Installation of switch gear & Clause 59 - Safe work procedures

Requires suitable switchgear to be provided and provisions to be made for the safe removal and restoration of power.

Suitably rated and designed switchgear has to be provided at strategic locations as a means of removing danger to any person. It should be provided at the incoming supply point (or at the generator, as the case may be). The electrical reticulation system should be sectionalised so that specific parts of the system can be isolated without affecting other parts and facilitate inspection, maintenance, testing (minimal disruption to the part of the installation not being maintained) and fault finding.

The switchgear must be able to be operated without endangering the switchgear operator. Particularly the risks from arc blast injuries need to be considered. This may require remote switching capabilities.

The switchgear should be adequately rated with regard to voltage, frequency, temperature, normal operating current, overload current, ability to make and break the maximum prospective fault current, ability to withstand the maximum prospective through fault current, working environment, electromagnetic compatibility and the ability to withstand electromagnetic radiation interference.

Special training and competencies are required for people operating high voltage switchgear.

Mine Safety Operations recommends: Installation requirements for this switchgear should be determined and specified by a qualified electrical engineer – in particular in underground locations. This should include adequate signage and circuit and distribution diagrams.

Mine Safety Operations recommends: NO automatic reclose of switchgear after an electrical fault trip or after supply loss (black out) or a ”loss of phase (brown out).”.

Mine Safety Operations recommends: Removal and restoration of power procedures must provide for the removal of electric power in any of the following circumstances:

- Restoration of power only by people competent to operate the switchgear.
- Restoration of power after an electrical fault trip (earth leakage or short circuit trips) only after a proper investigation by a qualified electrical person has determined it is safe to restore the power.
- Removal in the presence of flammable gas where the level of gas exceeds one tenth of the LEL.
- Removal if inspections required by the inspection program have not been conducted.
- Removal in the event of an electrical fault.
- Removal if there has been a failure to maintain equipment in accordance with the regulation.
- Removal unsafe electrical equipment or practices have been detected.

Opal mines. Mine operators workshop and opal miners safety course include sections on selection and safe operation of opal mining electrical plant.

3.3.1 ISOLATION ARRANGEMENTS

	**Occupational Health and Safety Regulation 2001, Clause 64(2) (c)- electricity – particular risk control measures** appropriate work systems are provided to prevent inadvertent energising of plant connected to the electricity supply
	**Occupational Health and Safety Regulation 2001, Clause 207- Electrical work on electrical installations – safety measures** Requires: Any electrical work on an electrical installation to be carried out using a safe system of work Electrical work is not carried out while the circuits and apparatus are energised This electrical work does not include testing done in a proper manner The safe system of work must include: Checks to ensure that the circuit is de-energised before work starts and remains de-energised until the work is complete Measures to eliminate or control the risk of the person carrying out the work inadvertently contacting any part of the installation that remains energised The regulation goes further and provides for exceptions to the above requirements. It states: "Despite the above the regulation permits live work where the safety risk of not doing the work are greater than doing it."

IT IS NOT ENVISAGED THAT SITUATIONS WILL ARISE AT MINING OPERATIONS WHERE THE RISK OF HARM FROM OTHER MATTERS IS GREATER THAN WORKING ON ENERGISED CONDUCTORS.

NO LIVE LINE WORK.

The Mine Safety Management Plan must provide for the development and implementation of isolation arrangements so that electrical sources of energy are isolated, proved dead and earthed. Where other energy sources are involved as well these must be isolated and the stored energy dissipated or isolated.

Information Note: It is not acceptable to plug and unplug restrained plugs at voltages exceeding ELV whilst relying solely on pilot or earth continuity control circuitry for isolation.

Information Note: Clause 207 **Electrical work on electrical installations—safety measures** of the OH&S Regs do not apply to electrical work done as part of a plan required to be lodged under the *Electricity Supply (Safety and Network Management) Regulation 2002*.

- Refer to MDG 40 Guideline for Hazardous Energy Control (Isolation or Treatment)
- Refer to NSW Minerals Industry Safety Handbook, Sections 4.8.1 & 4.8.2

- Refer to EES011 NSW DPI Technical Reference - Technical Principles for the Design of Electrical Systems at NSW Mines (Coal and Metals) and Extractives Operations

Mine Safety Operations recommendation: For high voltage distribution systems a "permit to work" system must be used and records kept.

Mine Safety Operations recommendation: Working on live conductors is prohibited except where the voltage is not greater than ELV.

Mine Safety Operations recommendation: Even with ELV precautions to prevent electric shock must be taken. Where the electrical work is being done in a wet or humid environment the circuit should be de-energised and properly isolated. Some ELV circuits have the potential for thousands of amperes to flow if an accidental short circuit occurs. The work should only be undertaken in a clean dry environment and special insulated tools and PPE must be used.

3.4 Electrical Work and Practices

3.4.1 QUALIFICATIONS

Clause 67, Mine Health and Safety Regulation 2007 requires persons to have appropriate electrical qualifications to do electrical work.

Mine Health and Safety Regulation, Clause 67 – Persons to have appropriate electrical qualifications

(a) Requires that certain electrical installations and plant are designed and periodically reviewed by a qualified electrical engineer. These are high voltage electrical installations and electrical plant, or where the total connected power exceeds 1000 kilowatts (at any voltage).

The Mine Health and Safety Regulation, clause 109 – Functions to which of the Act applies and evidence of competence to perform those functions

(2) Defines a qualified electrical engineer as an electrical engineer who is registered on the National Professional Engineers Register administered by the Institution of Engineers Australia.

For mine operations that utilize high voltage or the total connected power exceeds 1 MWatt, the installation must be designed by an electrical engineer on the National Professional Engineers Register. The installation and associated electrical plant must also be periodically reviewed by an electrical engineer on the National Professional Engineers Register. The purpose of the review is to establish that the installation and plant are in compliance with the legislation and safe to use.

The qualified electrical engineer may be nominated in the management structure by the operator to fulfill the role of a person with appropriate engineering competencies.

Mine Safety Operations recommendation: Where the qualified electrical engineer is not employed full time by the operation and is not nominated in the management structure, the review should be conducted annually.

Mine Safety Operations recommendation: For operations that fall below the above thresholds, they should have their installations and electrical engineering safety arrangements audited by a competent organisation at least every three years. The audit must include an electrical installation compliance check against AS/NZS3000 and AS3007. The audit must also include a compliance check for ALL electrical plant against the legislation.

	**Mines Health and Safety Regulation 2007, Clause 67 - Persons to have appropriate electrical qualifications** (b) The Operator must ensure that installation, commissioning, maintenance and repair of electrical installations and plant (other than ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less) are undertaken by or supervised by a qualified electrical tradesperson or qualified electrical engineer.

	**Mines Health and Safety Regulation 2007, Clause 67 Persons to have appropriate electrical qualifications** (c) the Operator must ensure that installation, commissioning, maintenance and repair of ELV automotive plant, or electrical plant fed via plug and socket outlets at a voltage of 240 volts or less) are undertaken by a competent person or a person supervised by a qualified electrical tradesperson or qualified electrical engineer.

All electrical work related to installation, commissioning maintenance and repair of installations and plant (other than ELV automotive or plug and socket equipment operating at less than or equal to 240 volts) can only be undertaken by qualified “electrical” people or under the direct supervision of a qualified “electrical” person. Qualified “electrical” people are a qualified electrical engineer or a qualified tradesperson as defined in the legislation.

For work on ELV automotive equipment and 240 volt plug / socket equipment) this must be done by a competent person, or by a person under the supervision of a qualified electrical person.

Mine Safety Operations recommendation: For ELV automotive, a competent person must be a qualified automotive electrician, a properly trained service mechanic or technician authorised by the plant supplier / plant maintainer / service provider.

Mine Safety Operations recommendation: For 240 volt plug in type equipment, this could be a properly authorised service technician, or a person with a restricted electrical license, or someone deemed competent by an RTO for the testing and tagging of 240volt equipment.

- Refer to EES002 NSW DPI Technical Reference for the Control and Supervision of Electrical Work

3.4.2 USE OF ELECTRICAL TEST INSTRUMENTS

Occupational Health and Safety Regulation 2001, Clause 208- Electrical testing on electrical installations – safety measures

Requires:
Doing a risk assessment in respect of the tests to be done.
Implementing measures to eliminate or control the risk of the persons conducting the tests inadvertently contacting ANY part of the installation that is energised.
Provision and use of appropriate test equipment.
Done only by appropriately trained persons.
Provision and use of appropriate personal protective equipment
Where necessary (as determined by the risk assessment) the tests are conducted in the presence of a safety observer who is competent to assist the persons who are conducting the tests and who is competent in electrical rescue and cardio-pulmonary resuscitation.

Live testing using hand held instruments should be an absolute last resort and is strongly discouraged in mining operation environments. It should only be done after a risk assessment, in particular the risks from arc flash and arc blast injuries must be evaluated and controlled. PPE is an essential risk control and the type of PPE will depend on the risks from arc flash and arc blast.

Mine Safety Operations recommendation: Where testing is carried out a safety observer is present at all times.

Mine Safety Operations recommendation: Where tests are routinely carried out as part of maintenance, calibration and fault finding the equipment must be fitted with appropriate diagnostics and/or protected test points that are only accessible to qualified electrical people.

- Refer to EES004 NSW DPI Technical Reference for Electrical Practices for Portable Apparatus
- Refer to HB187 Guide to selecting a safe multimeter

3.5 Electrical Protection and Earthing

Mines Health and Safety Regulation 2007, Clause 62 - Electrical cut-outs

Requires electrical protection to be fitted to all circuits and to interrupt the supply when a fault occurs.

Whilst the title of this clause is Electrical cut-outs is not a recognised term used in electrical engineering safety, it is actually dealing with electrical protection, which is a widely recognised competent terminology for this purpose.

- Refer to EES005 NSW DPI Technical Reference for Electrical Protection and Earthing
- Refer to EES011 NSW DPI Technical Reference - Technical Principles for the Design of Electrical Systems at NSW Mines (Coal and Metals) and Extractives Operations

Mine Safety Operations recommendation: Instantaneous short circuit, overcurrent and earth leakage protection be fitted to every circuit and sub-circuit.

Mine Safety Operations recommendation: Overload protection is provided on every final load circuit.

Mine Safety Operations recommendation: 500milliamp or less RCD's be fitted to ALL circuits as a "back-up" protection device. Note: One device may protect a number of sub-circuits.

Mine Safety Operations recommendation: Where possible, 10 milliamp, or 30milliamp maximum RCD's be fitted to 240 V socket outlet and lighting circuits and transportable/portable (cartable) plant circuits (such as pumps that may be handled whilst energised e.g. 1000 V small flygt pumps)

Mine Safety Operations recommendation: 10milliamp RCD's be fitted to 240 V socket outlet circuits where there is a potential for ingress of moisture in the working area.

Mine Safety Operations recommendation: Final load earth leakage settings not to have any intentional time delay.

Mine Safety Operations recommendation: Short circuit protection detects and clears arcing faults (A maximum setting should be less than 50% of the prospective short circuit current).

Mine Safety Operations recommendation: IT systems for:

- Mine operated HV circuits, where there is a transformer at the point of supply (eg 33kV incoming supply transformed down to 11kV for mine site distribution – earth fault limitation is required at the 11kV neutral point),
- Mobile equipment, and
- Underground mine distribution.

Mine Safety Operations recommendation: For IT systems the protection devices to comply with AS/NZS 2081.

Mine Safety Operations recommendation: For IT systems the earth leakage sensitivity must be a maximum of 10% of any earth fault limitation.

Mine Safety Operations recommendation: For IT systems, earth fault limitation should be resistive devices to comply with AS/NZS 2081.

Mine Safety Operations recommendation: For IT systems, earth fault limitation levels should be in accordance with AS/NZS2081.

Mine Safety Operations recommendation: For IT systems, earth fault limitation should be a maximum of 25 amperes for surface HV systems.

Mine Safety Operations recommendation: Trip circuits must have a very high reliability and not to be able to be inadvertently left in an inoperable condition.

Mine Safety Operations recommendation: Information detailing protection studies, fault level studies and a single line diagrams are essential.

Mine Safety Operations recommendation: Operations identify sources of electrical induction or capacitive connection, in particular from HV OHL's to metallic structures running parallel (conveyors, pipes, wire fences) and earth the parallel metallic structures appropriately, or in some circumstances (where the structures are located underground) shield the structure by proper earthing arrangements.

Opal mines. Mine operators workshop and opal miners safety course include sections on selection and safe operation of opal mining electrical plant.

3.5.1 SPECIAL ELECTRICAL PROTECTION – MOBILE OR PORTABLE PLANT SUPPLIED BY FLEXIBLE REELING OR TRAILING CABLES

Mines Health and Safety Regulation 2007, Clause 63 - Earth continuity protection

Requires earth continuity protection be provided on circuits that supply mobile or portable plant by a flexible reeling or trailing cable at a voltage at or above 415 volts.

The earth continuity protection must detect when the earth connection between the source of supply and the portable or mobile plant is deficient. On detection, the power must be automatically disconnected and not be capable of being restored until an authorized person has reset the protection. The earth connection becomes deficient when there is an open circuit or the resistance of the earth path is such that excessive touch voltage can occur (AS/NZS3000:2007 Appendix B4 for wet areas for excessive touch voltages).

Mines Health and Safety Regulation 2007, Clause 64 - Prevention of connection in the event of an earth fault

Requires the prevention of the connection of power if there is an earth fault on any flexible reeling or trailing cable that supplies mobile or portable plant.

Mine Safety Operations recommendation: Earth fault lock-out protection is provided so that power can not be restored to a circuit with an earth fault on it. This should be provided on circuits using flexible reeling or trailing cables that supply mobile or portable plant at a voltage of 415 volts or above. Operations should also consider the use of this type of protection where equipment is used in harsh conditions or where there is excessive vibration.

Mine Safety Operations recommendation: Removal and restoration of power procedures require a proper investigation by a qualified electrical person before earth leakage or short circuit trips are reset and power restored. This applies on all circuits (even those with earth fault lock out protection installed)

Mines Health and Safety Regulation 2007, Clause 65 - Effective earthing.

Requires the provision of effective earthing so that:

- The risk from touch, transfer and step voltages is minimised,
- The effects of lightning (overvoltages and ground currents) are not transferred into underground workings,

	• Certain circuits to have earth fault limitation installed, - electrical circuits in underground mines, polyphase mobile or portable plant fed via flexible trailing or reeling cables.

AS3007 prescribes maximum touch voltage and clearance times.

Mine Safety Operations recommendation: When designing earthing systems, an inherently safe design should be the first option that is the maximum earth potential rise is below 25 V (refer touch voltage clearance time curves in AS/NZS3000:2007 Appendix B4 for wet areas).

Mine Safety Operations recommendation: When determining touch voltages, the maximum prospective earth fault current shall be used to determine the touch voltage, irrespective of the settings of earth leakage protection devices.

Mine Safety Operations recommendation: Transfer voltages are limited to the same value as touch voltages prescribed in AS/NZS3000:2007 Appendix B4 for wet areas. Step voltages should not exceed 100 volts/metre.

Properly installed earthing at the surface of the mine and properly coordinated and installed surge divertors should prevent the effects of lightning from being transferred underground.

Information Note: Separation of the mine earth and the earth used for the lightning protection is an accepted practice.

Mine Safety Operations recommendation: In addition to lightning protection devices it will be necessary to take additional engineering precautions to prevent higher primary voltages from being directly imposed on lower secondary voltages at transformers.

Earth fault limitation will greatly assist in the control of touch voltages.

Mine Safety Operations recommendation: For voltages less than 4000 volts the maximum earth fault limitation should be 5 amperes. For voltages greater than 4000 volts the maximum earth fault limitation should be 25 amperes, provided the touch voltage does not exceed the requirements of AS/NZS3000:2007 Appendix B4 for wet areas.

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➢ Refer to EES005 NSW DPI Technical Reference for Electrical Protection and Earthing

3.6 Safe Access for DNSP & TNSP Workers

	**Mines Health and Safety Regulation 2007, Clause 68 - Co-operation with electricity supply authority (DNSP & TNSP)** Requires the operator to co-operate with electricity supply authorities to ensure the safety of the workers undertaking maintenance of the DNSP &/or TNSP infrastructure on the mining operation.

Electrical transmission and distribution systems often cross mining operations. Where these do not directly supply electricity for mining activities the responsibility for working on this infrastructure lies solely with the DNSP &/or TNSP. The DNSP &/or TNSP need safe access to maintain and repair this infrastructure and have legal obligations to do so. Any work done on this infrastructure is required to be done in accordance with the DNSP &/or TNSP's work procedures as part of a plan required to be lodged under the *Electricity Supply (Safety and Network Management) Regulation 2002*.

The mining operation must cooperate with the DNSP &/or TNSP and provide safe access to the supply authority's infrastructure. The mining operation must also ensure that the supply authority workers are not put at risk from the mining operation's activities.

Where the electricity distribution system is under the day to day control of the mining operator and the DNSP &/or TNSP is contracted to do work or has an obligation to do work on that distribution system then ALL of the provisions of the mining legislation apply.

3.7 Overhead Power Lines / Cables & Buried Cables

Occupational Health and Safety Regulation 2001, Clause 64 – Electricity – particular risk control measures

(d) Where excavation work is carried out all available information concerning the location of buried cables must be provided.

(e) Persons or plant don't come into close proximity of overhead lines.

Mine Safety Operations recommendation: Buried cable management must be an integral part of the Mine Safety Management Plan and provide:

- Site plan showing the location of all buried cables.
- Site plan must be readily accessible to supervisors.
- The risk from buried cables must be considered in risk assessments.
- Procedures must be developed for excavation near buried cables.
- Safe distances must be maintained between buried cables and excavation machinery.
- Provision of signs warning of buried cables and indicating the depth.
- Regular review and maintenance of signs

Mine Safety Operations recommendation: Overhead Power Line management must be an integral part of the Mine Safety Management Plan and provide:

- Site plan showing the location of all overhead power lines and cables.
- Site plan must be readily accessible to supervisors.
- The risk from overhead power lines and cables must be considered in risk assessments.
- Procedures must be developed for work near overhead power lines and cables.
  Information Note: this generally precludes storing materials, mining product or the like under overhead lines and cables. It may also preclude the movement of some types of vehicles or mining machinery near OHL's.
- Safe distances must be maintained between overhead lines, cables and machinery.
- Provision of signs warning of overhead lines and cables.
- Provision of height barriers.
- Provision of proximity devices or propulsion interlocks on machinery such as rear dump truck's in relation to dump trays being raised.

- Also consider installation of warning devices on cranes, rear dump trucks and drill rigs to operate when too close to overhead lines.
- **Information Note:** Fatalgrams from the US Department of labour, Mine Health and Safety administration have a number of recommendations for working with lifting equipment near OHL's, they also recommend power pole anchor guy wires are located free from moving traffic and away from maintenance personnel and that the guy wire ground anchor points are clearly marked, they also recommend the examination of areas surrounding power poles and other electrical installations for potential hazards before commencing any type of work, including bush clearance or weed trimming.

➢ Refer to the NSW Minerals Industry Safety Handbook

➢ Refer to the Workcover Code of Practice for Overhead Power Lines

3.8 Signage and Plans

	**Occupational Health and Safety Regulation 2001, Clause 64 – Electricity – particular risk control measures** (g) Requires adequate signage to warn of hazards and if necessary restrict access to areas where there is a risk of exposure of persons to the hazards of electricity

Mine Safety Operations recommendation: The placing of appropriate signage, notices, plans and electrical distribution diagrams at electrical switchgear and other prominent positions that:

- Warn of the presence of electricity.
- Provide advice on what to do in the event of a fire on electrical equipment.
- Provide advice on what to do in the event of an electric shock and other electrical injuries.
- Provide advice on the isolation point for the electrical equipment.
- Provide advice on what electrical equipment the switchgear supplies.
- Show the location of all high voltage cables and switchgear on a mine plan.
- Show all points of isolation available on the electrical distribution system.

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3.9 Electrical Cords

	**Occupational Health and Safety Regulation 2001, Clause 64 –Electricity – particular risk control measures** (f) Electrical cord extension sets, flexible cables or fittings are located so they don't get damaged or they are suitably protected.

This basically applies to 240 volt power leads. They must be located clear of moving traffic, walkways, water, chemicals, heat sources and anything else that can damage them. Where the

lead crosses a trafficable area it should either be hung up or protected by a suitably robust device that is easily seen.

Mine Safety Operations recommendation: Extra low voltage power sources and equipment be used in lieu of 240 volt equipment – extra low voltage equipment is readily available for most circumstances. The use of screened or armoured cable also reduces the risk of direct or indirect contact with electricity where the use of extension leads cannot be avoided and the risk is demonstrably ALARP

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3.10 Welding Machines

Occupational Health and Safety Regulation 2001, Chapter 5 –Plant Safety

Chapter 5 deals with all plant which includes welding machines.

In applying the hierarchy of risk controls, it is recognised that dc welders are less hazardous thatn similarly rated ac welders.

Mine Safety Operations recommendation: DC welders are used in preference to ac welders.

Mine Safety Operations recommendation: Hazard Reduction Devices are fitted to ALL welders where the open circuit voltage can exceed 25 V a.c or 35V d.c..

Some diesel/petrol driven welding machines have 240 V outlets fitted. This type of machine should have the welding machine winding and the 240 V supply winding properly segregated as per the principle of AS/NZS3000, so as to avoid potentially lethal 240 V being applied to welding equipment. To avoid electric shocks from 240 Volt equipment the 240 V outlet and equipment used from it must be properly managed.

Mine Safety Operations recommendation: Only one 240 V outlet per welding machine and only one appliance or tool per machine is allowed to be used. Where 240 Volt outlet supplies are not properly segregated, they should be disconnected, wiring removed and 240 V windings properly terminated.

Chapter 4 Commissioning & Maintenance of Electrical Installations

4.1 Commissioning and Testing

Occupational Health and Safety Regulation 2001, Clause 64(2) (a) - Electrical installations at places of work

all electrical installations at a place of work are inspected and tested, after they are installed and prior to their energising for normal use, by a competent person to ensure they are safe for use,

Mines Health and Safety Regulation 2007, Clause 60 - Testing of electrical installation

A commissioning, testing and notification process is required to be carried out before the initial application of power to circuitry.

- The tests must be as prescribed in AS/NZS3000.
- The tests must be undertaken or supervised by a qualified electrical person.
- The person undertaking or supervising the testing must provide the operator with a certificate that attests to compliance with AS/NZS3000
- The operator must maintain a record of the results of the test

This process is similar to the requirements for the non-mining industry. The process has to comply with section 8 of AS/NZS3000: 2007 (section 6 of AS/NZS 3000: 2000 Electrical Installations).

This is not intended to apply to ELV automotive circuits. However a similar requirement for the provision of a statement that the automotive circuits are safe and comply with the mine's specified requirements (which should include compliance to MDG15, AS4242 or AS/NZS4871.6)

Tests must be done by a licensed electrician or qualified electrical engineer.

Mine Safety Operations recommendation: A certificate of compliance is used for ALL electrical work.

A typical form that can be used to attest to compliance with AS/NZS3000 is shown on page 44, titled Certificate of Compliance – Electrical work.

Information Note: For work done at mining operations, this Certificate of Compliance DOES NOT have to be provided to the DNSP or Office of Fair Trading (OFT), unless it is determined that the Electricity (Consumer safety) Act and Regulations applies at the mining operation. It does have to be retained by the operator.

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

CERTIFICATE OF COMPLIANCE – ELECTRICAL WORK

Customer COPY

CERTIFICATE NO: 0587612

CUSTOMER DETAILS

Name

Site Address

Cross Street | Postcode

Telephone Contact

Meter No:

NMI (if applicable)

INSTALLATION WORK DETAILS Indicate the type of installation and types of work performed under this Notice					
Type of Installation	☐ Residential	☐ Commercial	☐ Industrial	☐ Rural	☐ Other
Special Conditions	☐ over 100 amps	☐ High Voltage	☐ Hazardous Area	☐ Generator	☐ Unmetered Supply

CERTIFICATE MUST BE ISSUED TO THE CUSTOMER FOR ALL ELECTRICAL WORK

Work of the following type must ALSO be notified to the **ELECTRICITY DISTRIBUTOR (DNSP)**

☐ New Installation
☐ Additions or alterations to a switchboard or associated equipment
☐ Network connection or metering
☐ Defect Rectification No:

DETAILS OF EQUIPMENT *Describe the equipment and estimate load increase of the work affected by this Notice. If insufficient space attach separate sheets.*

EQUIPMENT	RATING	No.	PARTICULARS OF WORK
☐ Switchboards			
☐ Circuits			
☐ Lighting			
☐ Socket-outlets			
☐ Appliances			
Estimated increase in load A/ph			☐ Increased load is within capacity of installation/service mains
☐ Work is connected to supply			☐ Work is not connected to supply pending inspection by DNSP

The work has been carried out or supervised by:

Licence No:

TEST REPORT *Indicate the relevant tests and checks that have been performed on the work. If test records are provided attach as separate sheets.*

☐ Earthing system integrity Ω	☐ Residual current device operation
☐ Insulation resistance MΩ	☐ Visual check that installation is suitable for connection to supply
☐ Polarity	☐ Stand-alone power system complies with AS 4509
☐ Correct circuit connections	☐ Fault loop impedance (if necessary)

I confirm that I have carried out the above tests and visually checked that the installation work described in this Certificate complies with AS/NZS 3000 and is suitable for its intended use.

Name:

Licence No:

Signature:

Date of Testing:

CERTIFICATION

I, the Electrical Contractor give notice to the Customer and _____ (Name of DNSP or OFT), that the work described in this Certificate has been completed in accordance with the Electricity (Consumer Safety) Regulation 2006

Name:

Licence No:

Signature:

Date of Notice:

Address:

Telephone No. or Other Contact

ELECTRICITY DISTRIBUTOR (DNSP) REMARKS

Inspected by:

Date

Comments:

neca

Mine Safety Operations recommendation: For plug in equipment rated at 240 volts or less inspection, testing and recording results must be in accordance with AS3760 and must be done by a person deemed competent or by a qualified electrical person.

Occupational Health and Safety Regulation 2001, Clause 135 - Installation, erection and commissioning of plant—particular risk control measures

(a) the plant is erected, installed or commissioned having regard to the instructions of the designer and manufacturer, or to instructions developed by a competent person, in so far as they relate to health and safety, and

(b) a competent person undertakes the installation, erection or commissioning and is provided with all information necessary to enable plant to be installed and commissioned so as to eliminate risks to health and safety or, if this is not practicable, to control them, and

(c) the plant is installed, erected and commissioned in a location that is suitable for the operation being undertaken and the type of plant being used, and

(d) plant that is designed to be operated in a fixed position is positioned on and, if necessary, fixed to, a secure base in order to prevent inadvertent movement when power is applied or while the plant is in operation, and

(e) there is sufficient clear space around the plant to allow the plant to be used and repaired, and

(f) there is sufficient space for access to and egress from parts of the plant that require cleaning and maintenance, and

(g) emergency lighting, safety doors and alarm systems are provided if access to plant is required as part of normal operation and persons may be trapped and exposed to increased risk due to heat, cold or lack of oxygen, and

(h) interim safeguards are used during testing, if the final means of safeguarding are not in place, and

(i) as far as can be determined by commissioning, the plant is safe for transfer into active service

4.2 Maintenance of Electrical Installations

Occupational Health and Safety Regulation 2001, Clause 64(2) (a1) – (a4) & (3)

(a1) **Electrical installations at places of work** - all electrical installations at a place of work are maintained by a competent person to ensure they remain safe for use, and

a2) **Electrical articles used in construction work -** all electrical articles

	that are used in construction work are regularly inspected, tested and maintained by a competent person to ensure they are safe for use if the articles are supplied with electricity through an electrical outlet socket, and (a3) **Electrical articles that may be affected by hostile environment -** all electrical articles that are supplied with electricity through an electrical outlet socket that are at a place of work where the safe operation of the electrical article could be affected by a hostile operating environment are regularly inspected, tested and maintained by a competent person to ensure they are safe for use, and (a4) **Electrical installations and articles found to be unsafe -** all electrical installations and electrical articles at a place of work that are found to be unsafe are disconnected from the electricity supply and are repaired, replaced or permanently removed from use, (3) In this clause, ***hostile operating environment*** means an operating environment at a place of work where an electrical article is in its normal use subjected to operating conditions that are likely to result in damage to the article, and, for example, includes an operating environment that may: (a) cause mechanical damage to the article, or (b) expose the article to moisture, heat, vibration, corrosive substances or dust that is likely to result in damage to the article.

	**Mines Health and Safety Regulation 2007, Clause 61 - Maintenance of electrical installations** Requires the operator to maintain electrical installations in a safe state. In particular, maintenance has to: • prevent interference, • detect damage ageing and wear, • ensure insulation and barriers are effective, • earthing remains effective, • the installation remains within its electrical ratings, and • is not a significant potential cause of fire.

Mine Safety Operations recommends: Electrical installations and plant must be incorporated in the operations plant maintenance scheme. A register of all electrical plant and installations must be kept at the mine. This register must be supported by:

- Accurate electrical installation plans
- Accurate installation circuit diagrams
- Accurate electrical plant circuit diagrams
- Accurate plans of earth grids, including measured resistances, maximum prospective touch, transfer and step voltages
- A register of electrical protection devices and settings
- Records of all testing, compliance certificates, maintenance actions and defects detected and repaired.

Mine Safety Operations recommends: All parts of an electrical installation must be maintained in compliance with the regulation and to ensure that:

- Protection Devices will perform as expected by utilizing regular testing.

- Earthing systems will perform as expected by utilizing regular testing.
- Any electrical explosion protected equipment is maintained in an explosion protected condition.
- Electrical safeguards are functional and their SIL is maintained and verified

Mine Safety Operations recommends: The maintenance scheme should be developed implemented and periodically reviewed by a ***qualified electrical engineer***.

Mine Safety Operations recommends: Maintenance actions on electrical installations and plant should only be undertaken by:

- A qualified engineer;
- A qualified tradesperson; or
- Persons under the supervision of a qualified engineer or tradesperson.
- For ELV automotive, a competent person must be an automotive electrician, a properly trained service mechanic or technician authorised by the plant supplier.
- For 240 volt plug in type equipment, this could be a properly authorised service technician, or a person with a restricted electrical license, or someone deemed competent by an RTO for the testing and tagging of 240volt equipment and complying with the OEM's recommendations.

Opal mines. Mine operators workshop and opal miners safety course include sections on selection and safe operation of opal mining electrical plant.

Occupational Health and Safety Regulation 2001, Clause 137 - Maintenance and repair of plant—particular risk control measures

- The necessary facilities and systems of work are provided and maintained so as to minimise risks to health and safety of persons maintaining, inspecting, altering, repairing or cleaning the plant.
- Inspections, maintenance and cleaning are carried out having regard to procedures recommended by the designer or manufacturer or developed by a competent person.
- All safety features and warning devices of plant are maintained and tested. **Information Note**: This will be an integral part of maintaining the SIL and will require the identification of safety related functions and systems.
- If plant has been damaged to the extent that its operation or condition is impaired and the risk to health or safety is increased a competent person assesses the damage and provides advice on:
  - The nature of the damage.
  - Whether the plant is able to be repaired and, if so, what repairs must be carried out to minimise risks to health and safety.
  - Repair, inspection and, if necessary, testing is carried out by a competent person.
  - Repairs to the plant are carried out so as to keep the plant within its design limits.

	• If access to plant is required for the purpose of maintenance, cleaning or repair the plant is stopped and one or more of the following measures is used to control risks: o Lockout or isolation devices. o Danger tags. o Permit to work systems.

4.3 Records

	**Mine Health and Safety Regulation 2007, Clause 14 – Additional contents of mine safety management plan** (g) The Mine Safety Management Plan must make arrangements for document control and record keeping.

	**Occupational Health and Safety Regulation 2001, Clause 65 – Maintainance of records - electricity** A record is made and kept of all inspections and tests made and maintenance carried out on electrical articles and electrical installations. The following information is to be recorded: The name of the person who made the inspection or carried out the test or maintenance. The date on which or dates over which the inspection was made or the test or maintenance was carried out. The result or outcome of the inspection, test or maintenance. The date by which the next inspection and test must be carried out.

	**Mines Health and Safety Regulation 2007, Clause 60 - Testing of electrical installation** The operator must maintain a record of the results of the test

Mine Safety Operations recommends: Records of tests must be kept for the "life" of the installation or the "life" of the plant.

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Chapter 5 Underground Electrical Installations

5.1 Switchgear and Transformer Sub-stations

- Should be housed in a room or cuddy set aside for the purpose.
- Should be fitted with fire alarms and fire extinguishing equipment – automatic fire detection and suppression may be required where electrical equipment contains flammable fluids.
- Should have appropriate signage installed.
- Should have provision for the removal of power in an emergency (emergency stop on the intake side of the room or cut through).
- The location shall have good tops/backs and side support.
- The location shall be well ventilated.
- The location shall be well clear of moving traffic.
- The location shall be such that persons operating, inspecting or maintaining the switchgear shall be well clear of moving traffic.
- There shall be adequate access to the switchgear for operational, inspection and maintenance purposes.
- The area shall be free of slip trip and fall hazards.
- There shall be two egress points or there shall be sufficient space from the switchgear to effect safe egress.
- Permanent lighting shall be provided.
- High Voltage switchgear and transformers are not to be located in wet areas in particular near or in pools of water.
- There shall be no combustible material stored in the room or cut through.
- Where the equipment contains combustible liquid the ventilation should have provision for short circuiting to the return airway in the event of a fire.
- Access shall be for authorised personnel only.

5.2 Vehicle / Machinery Battery Charging Stations

- Shall be housed in a location specifically set aside for the purpose.
- Should be fitted with fire alarms and fire extinguishing equipment.
- Should have provision for the removal of power in an emergency (emergency stop on the intake side of the charging station).
- Should have appropriate signage installed.
- Should have eye wash safety equipment nearby (this will need to be suitable for the size and type of the batteries)

- The location shall have good tops/backs and side support.
- The location shall be well ventilated and any gases liberated from the battery during charging shall be ventilated directly to a return airway.
- The location shall be subject to a hazardous area classification study.
- Where hazardous areas are identified any electrical equipment used in those areas shall be certified suitable for the appropriate gas grouping.
- The location shall be well clear of moving traffic other than for the vehicle having its battery charged.
- The location shall be such that persons operating, inspecting or maintaining the charging equipment are well clear of moving traffic.
- There shall be adequate access to the charging equipment for operational, inspection and maintenance purposes.
- The area shall be clean and free of slip trip and fall hazards.
- There shall be two egress points or there shall be sufficient space from the charging equipment and equipment being charged to effect safe egress.
- Permanent lighting shall be provided.
- Adequate drainage shall be provided to prevent pooling of water.
- There shall be no combustible material stored in the room or cut through.

5.3 Fixed Cable Installations

Low Voltage and High Voltage Cables shall be:

- Of a design that considers the harsh mining environment, rating, capacity, termination, regular testing, installation and retrieval.
- Hung clear of the floor for their entire length.
- Adequately supported (sufficient cable hanging points).
- Be at a height above that of the profile of the largest machine or vehicle that may pass in the vicinity.
- Clear of moving traffic where the cables enter electrical switchgear – consideration of vehicles/machinery losing control and potentially striking cables shall be taken into account.
- High voltage cables shall have warning signs or tapes fitted at regular intervals.
- Cable joints shall be adequately supported.
- Where cables cross roadways with regular vehicular traffic they shall be either well clear of the travelling profile of the largest vehicle or mechanically protected from damage. Signs and / or adequate lighting shall also be installed
- Where cables cross any roadways they shall be clearly signed.
- Unused cables shall not have any exposed conductors whilst in situ.

- The use of screened or SWA power cables to reduce the possibility or either direct or indirect shock is highly recommended.

Communication and Data Transmission Cables shall be:

- Of a design that considers the harsh mining environment, rating, capacity, termination, regular testing, installation, retrieval and where necessary suitable for any intrinsically safe applications.
- Hung clear of the floor for their entire length.
- Adequately supported (sufficient cable hanging points).
- Be at a height above that of the profile of the largest machine or vehicle that may pass in the vicinity.
- Clear of moving traffic where the cables enter communication and data transmission equipment.
- Cable joints shall maintain any intrinsic safety properties.
- Where the cables are part of safety critical or emergency management equipment, consideration of maintaining a high reliability shall be given.
- Unused cables shall not have any exposed conductors whilst in situ.

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Chapter 6 Electrical Accident Investigation and Reporting

GUIDANCE NOTE, GNM-002 Notification of Incidents gives further advice on notifiable incidents.

Typical electrical causes for injuries are:

- Electric shock, a fall as a result of an electric shock, arc blast, plasma, severe electrical burns, unplanned movement of equipment.

  Information Note: all electric shock victims should receive medical care from a health care professional.

Mines Health and Safety Regulation 2007, Clause 145 – Notification of certain incidents at mines

Specifies the type of incidents that have to be reported, pursuant to Section 88(1)(b) of the Mine Health and Safety Act 2004, to the Chief Inspector

The following incidents are prescribed for the purposes of section 88 (1) (b) of the Act, the hi-lighted parts are incidents that commonly require investigation of the electrical plant.

(a) an injury to a person that results (at any time after the injury) in any of the following:

(i) the amputation of one or more fingers or toes or any other part of a hand or foot,
(ii) any fracture other than a fracture of a finger, toe, hand or foot,
(iii) loss of sight of an eye,
(iv) an internal haemorrhage requiring hospital treatment,
(v) the injection of fluid under pressure,
(vi) asphyxia, (smoke, toxic fumes from electrically initiated fires)
(vii) loss of consciousness caused by impact of physical force, exposure to hazardous substances, electric shock or lack of oxygen, (loss of consciousness may be caused by matters secondary or after the receipt of the shock)

(b) an event that results (at any time after the injury) in the admission of a person to hospital as an in-patient, (every electric shock victim should receive professional medical assessment – sometimes this will necessitate admission to hospital)

(c) any of the following events or circumstances that present an immediate threat to life or of permanent incapacitating injury:

(i) damage to any plant, equipment, building or structure,
(ii) imminent risk of explosion or fire, (electricity as an ignition source for flammable materials, violent failure of electrical plant)
(iii) entrapment of a person,
(iv) serious burns to a person, (radiation burns, arc blast burns)
(v) the unintended activation or movement of vehicles or machinery, (electrical control systems)

(d) any incident involving electricity:

(i) as a consequence of which a person suffers injury, receives medical treatment or is unable (on medical advice) to attend work for any period of time, or
(ii) where a vehicle, machinery or other plant makes contact with an energised high voltage source involving a risk to any person, or

(iii) where a person receives an electric shock from a source operating above extra low voltage (as defined by AS/NZS 3000),

(e) an uncontrolled explosion or fire, , (electricity as an ignition source for flammable materials, violent failure of electrical plant, fires in or initiated by electrical plant, batteries exploding)
(f) an escape of fluid under high pressure that endangers a person,
(g) an uncontrolled issue of gas or fluids,
(h) an abnormal inrush of fluid materials,
(i) a collision involving a vehicle or other machinery that results in substantial damage, or impedes safe operations, at the mine,
(j) the loss of control of a vehicle or other machinery at the mine,
(k) the overturning of a vehicle or other machinery at the mine,
(l) ejection of fly rock so that it falls outside a blast exclusion zone (being the area below, at or above ground level from which all unauthorised persons are excluded during blasting),
(m) failure of any part of a powered winding system or damage to a shaft or shaft equipment,
(n) an unplanned fall of ground that impedes passage, disrupts production or ventilation or involves failure of ground support where persons could be present,
(o) an airblast,
(p) the burial of machinery such that it cannot be recovered under its own tractive effort.

Mines Health and Safety Regulation 2007, Clause 146 – Notification of certain incidents at or in relation to mines

Specifies the type of incidents that have to be reported, pursuant to Section 88(1)(c) of the Mine Health and Safety Act 2004, to the Chief Inspector

The following incidents are prescribed for the purposes of section 88 (1) (c) of the Act, the hi-lighted parts are incidents where it is possible that investigation of the electrical plant is necessary.
(a) an injury to a person that results in the person being unfit, for a continuous period of at least 7 days, to attend the person's usual place of work, to perform his or her usual duties at his or her place of work or, in the case of a non-employee, to carry out his or her usual activities (where that unfitness is supported by a medical certificate),
(b) an illness of a person that is related to work processes and results in the person being unfit, for a continuous period of at least 7 days, to attend the person's usual place of work or to perform his or her usual duties at that place of work (where that unfitness is supported by a medical certificate),
(c) any incidence of violence at a place of work that results in an employee being unfit, for a continuous period of at least 7 days, to attend the employee's usual place of work or to perform his or her usual duties at that place of work (where that unfitness is supported by a medical certificate),

- (d) a spill or incident resulting in exposure or potential exposure of a person to a notifiable carcinogenic substance or a prohibited carcinogenic substance, (A spill or incident resulting in exposure or potential exposure of a person to a notifiable carcinogenic substance or a prohibited carcinogenic substance, PCB's or asbestos in electrical equipment.)

(e) a significant misfire of explosives, (electronic detonation systems)
(f) a progressive stope or progressive pillar collapse,
(g) a problem or fault in an explosive product or accessory. (electronic detonation systems)

The Mine Safety Management Plan should identify the requirements for the investigating and reporting electrical incidents and accidents.

Some electrical incidents will be reportable or notifiable to the Department of Primary Industries.

Some electrical incidents may need to be reported to the Director-General of the Department of Water and Energy under section 63R of the Electricity Supply Act.

Any incidents involving DNSP &/or TNSP infrastructure should be notified to the DNSP or TNSP.

In some cases, where an incident is related to an electrical article, an operator may wish to make a report to the Department of Fair Trading.

In any case the Mine Safety Management Plan should include requirements for responding to electrical incidents.

These requirements should include:

- Measures for ensuring the safety of persons and property.
- Measures for removal of a trapped or injured person or to remove a body.
- Incident scene preservation.
- Statutory reporting requirements.
- Internal investigation requirements.
- Remedial actions.
- Dissemination of information.

The Mine Safety Management Plan should include contact details for the local DNSP and TNSP office or officers.

The Mine Safety Management Plan should specify the minimum competencies for persons who have a duty under this chapter.

Generally when a person receives an “indirect” shock there has been a failure of multiple barriers especially earthing arrangements, protection arrangements, selection (environment) issues and maintenance issues – systemic failures that must be addressed

Where back up protection operates to clear a fault – this implies the first level of protection has failed – need to determine if this is the case.

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

FEEDBACK SHEET

Your comments will be very helpful in reviewing and improving this document.

Please copy and complete the Feedback Sheet and return it to:

Senior Inspector Electrical Engineering
Mine Safety Operations
NSW Department of Primary Industries
PO Box 344
MAITLAND NSW 2310
Fax: (02) 4931 6790
Phone: (02) 4931 6641

How did you use, or intend to use, this Technical Reference?

What do you find most useful about this Technical Reference?

What do you find least useful?

Do you have any suggested changes to the Technical Reference?

Thank you for completing and returning this Feedback Sheet.

Chapter 7 NSW DPI Contact Details

NSW DPI Mineral Resources offices located in mining regions

Armidale
NSW Department of Primary Industries
Earth Sciences Building (C2)
University of New England
Armidale NSW 2350
Phone: (02) 6738 8500
Fax: (02) 6772 8664

Lightning Ridge
Lot 60 Morilla Street
Lightning Ridge NSW 2834
PO Box 314
Lightning Ridge NSW 2834
Phone: (02) 6829 0678
Fax: (02) 6829 0825

Maitland
516 High Street
Maitland NSW 2320
PO Box 344
Hunter Regional Mail Centre NSW 2310
Phone: (02) 4931 6666
Fax: (02) 4931 6790

Lithgow
Suite 1, 1st Floor, 184 Mort Street
Lithgow NSW 2790
Phone: (02) 6350 7888
Fax: (02) 6352 3876

Singleton
Level 1, 1 Civic Avenue
Singleton NSW 2330
PO Box 51
Singleton NSW 2330
Phone: 02 6572 1899
Fax: 02 6572 1201

Wollongong
Level 3, Block F, 84 Crown Street
Wollongong NSW 2500
PO Box 674
Wollongong NSW 2520
Phone: (02) 4222 8333
Fax: (02) 4226 3851

Broken Hill
Level 2, 32 Sulphide Street
Broken Hill NSW 2880
PO Box 696
Broken Hill NSW 2880
Phone: (08) 8088 9300
Fax: (08) 8087 8005

Cobar
Government Offices
62-64 Marshall Street
Cobar NSW 2835
PO Box 157
Cobar NSW 2835
Phone: (02) 6836 4392
Fax: (02) 6836 4395

Orange
161 Kite Street
Orange NSW 2800
Locked Bag 21
Orange NSW 2800
Phone: (02) 6360 5333
Fax: (02) 6360 5363