Trade & Investment
Mine Safety

DRAFT NSW CODE OF PRACTICE | WHS (MINES) LEGISLATION

Electrical engineering control plan

For public comment

This code applies to all mines other than underground small gemstone mines, opal mines and tourist mines.

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Draft NSW Code of Practice: Electrical engineering control plan

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Public comment on draft NSW Electrical Engineering Control Plan Code of Practice

This code of practice is being released as part of public comment under the NSW *Work Health and Safety (Mines) Act 2013*.

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the work health and safety laws. This code of practice provides practical guidance for a mine operator on how to prepare and implement an Electrical Engineering Control Plan required under the *Work Health Safety (Mines) Regulation 2014*.

This code supplements the NSW Code of practice: *Safety Management Systems in Mines that* provides general guidance on establishing a safety management system for a mine. This includes principal mining hazard management plans (such as for fire or airborne contaminants) and principal control plans, including the electrical engineering control plan code, as part of the system.

Comments are sought on the guidance contained in the codes.

General feedback is sought on whether the draft code:

- is helpful and easy to understand
- reflects current state of knowledge and technological developments in relation to managing the risks of electricity
- has an appropriate level of information (for example is it too detailed or too general, too technical or not technical enough), and
- requires additional examples or case studies to provide clarification (please provide relevant examples and case studies that should be included, where possible).

In addition to general feedback comment is sought as to whether the following matters are adequate and clear:

- Chapter 2 on planning to prepare an electrical engineering control plan and a competent person to develop and review it
- The content for an electrical engineering control plan in chapter 4
- Chapters 4 and 5 on managing hazardous atmospheres, hazardous areas and hazardous zones
- The implementation of the control plan in chapter 6
- Referring to legislation and explaining how to satisfy requirements, so as to avoid inserting legislative extracts in a grey box and increasing the length of the document

How to make a submission

You can provide a submission or comment as an individual or you may wish to contribute to a joint submission through your employer or union organisation, professional association, safety group or community forum.

Submissions must be received by Tuesday **7 April 2015.**

Submission templates in Microsoft Word and Excel formats are available at:

www.resourcesandenergy.nsw.gov.au/safety

Please send submissions by email to consult.minesafety@trade.nsw.gov.au.

If you do not have access to email, please send submissions to:

Mail: Manager Mine Safety Policy and Legislation
Strategy, Policy and Co-ordination
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Hunter Region Mail Centre NSW 2310

Email: consult.minesafety@trade.nsw.gov.au

Fax: 02 4931 6790

All submissions will be made publicly available. If you do not want your personal details released, please indicate this clearly in your submission. Any information that you do not wish to be made available to the public should be clearly marked 'IN CONFIDENCE'.

Submissions are subject to all relevant laws such as the *Government Information (Public Access) Act 2009* and the *Privacy and Personal Information Protection Act 1998*. NSW Trade & Investment may provide extracts of submissions to other stakeholders for comment during the review of public submissions.

Contents

Foreword

This draft *NSW Code of Practice: Electrical engineering control plan* is proposed to be an approved code of practice under section 274 of the *Work Health and Safety Act 2011* (the WHS Act)

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act, W*ork Health and Safety Regulations 2011* (the WHS Regulations) *Work Health and Safety (Mines) Act 2013* (WHS (Mines) Act) and the *Work Health and Safety (Mines) Regulation 2014* (WHS (Mines) Regulations)[1].

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS legislation, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues, but do not cover all hazards or risks that may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS laws. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the WHS legislation may be achieved by following another method, such as a technical or industry standard, if it provides an equivalent or higher standard of work health and safety.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

The development of this code of practice

This Code of Practice has been developed under the 'Inter-Governmental Agreement for Consistency or Uniformity of Mine Safety Legislation and Regulations in NSW, Queensland and Western Australia' and forms part of the mining safety legislative framework for these states. Under this agreement, tri-state model legislation was developed, although designed to be structured and customised differently in each of these states.

This code was also developed in consultation with the Non-Core (tri-state) Legislative Working Group representing the following stakeholders from the mining industry in the tri-states including:

- NSW Minerals Council
- Cement Concrete & Aggregates Australia (CCAA)
- Construction Forestry Mining and Energy Union (CFMEU) – NSW and QLD
- NSW Trade & Investment Mine Safety
- Queensland Resources Council
- Queensland Department of Natural Resources and Mines
- Western Australia Department of Mines and Petroleum
- Various industry organisations, such as contracting firms like Monadelphous

[1] It will sometimes be convenient to refer generally to 'WHS laws', which includes:

- WHS Act
- WHS (Mines) Act
- WHS Regulations
- WHS (Mines) Regulations

NSW Trade & Investment developed this NSW version of the code for the WHS laws. Any public comment and feedback from mining stakeholders will be considered in finalising the code.

The code will be then be reviewed as required or when legislation is reviewed.

Scope and application

The code of practice provides guidance for mine operators to prepare, implement and review an Electrical Engineering Control Plan (EECP) to control risks to health and safety associated with electricity at a mine, as required under the WHS laws. Risks associated with electricity may exist across the mining operation and involve other plans, hazards and controls.

Details are also provided in this code on sources of guidance that may help develop an EECP and select control measures.

This code may also be relevant for other duty holders involved with electrical matters at the mine, such as designers and suppliers of plant or contractors, hirers at the mine as well as workers and their representatives.

To provide appropriate guidance on technical matters, the advice given in some parts of this code assumes a basic level of electrical engineering competence as expected of an electrical tradesperson.

This code is intended to apply to all mines (except those listed below) where electricity is used, for the control plan to manage risks to health and safety associated with electricity at the mine. Chapter 5 of this code provides additional information for underground coal mines

This code does not apply to the following types of mines under clause 184 of the WHS (Mines) Regulations, as they are not required to have an EECP:

- opal mines
- an underground small gemstone mine (see definitions in clause 3 of the WHS (Mines) Regulations)
- tourist mines

How to use this code of practice

This code includes references to both mandatory and non-mandatory actions. The references to legal requirements contained in the WHS Act and Regulations, and the WHS (Mines) Act and Regulations are not exhaustive and are included for context only.

This code has been prepared to be consistent with the WHS legislation as at the date of publication and should be interpreted, to the extent that there is any ambiguity, in a manner that is consistent with the WHS legislation.

To ensure you comply with your legal obligations you must refer to the latest legislation, which is available on the NSW legislation website (www.legislation.nsw.gov.au).

This publication does not represent a comprehensive statement of the law as it applies to particular problems or to individuals or as a substitute for legal advice. You should seek independent legal advice if you need assistance on the application of the law to your situation.

References to publications in the code are to be assumed to be to the current version of the document. For example, Australian or International Standards are referred to without a year or amendment number so they are the current version. However, where the WHS laws require compliance with an Australian, Australian/New Zealand or International Standard, you should check whether this requires compliance with the standard as per the year specified, or as amended from time to time. For example, the requirements in clause 32 of the WHS (Mines) Regulations to comply with AS/NZS 3000:2007 *Electrical Installations*, referred to as the 'Wiring Rules', are to that particular standard. See the References section for further details.

The words ‘must’, ‘requires’ or ‘mandatory’ indicate that legal requirements exist and must be complied with. The word ‘should’ indicates a recommended course of action, while ‘may’ indicates an optional course of action.

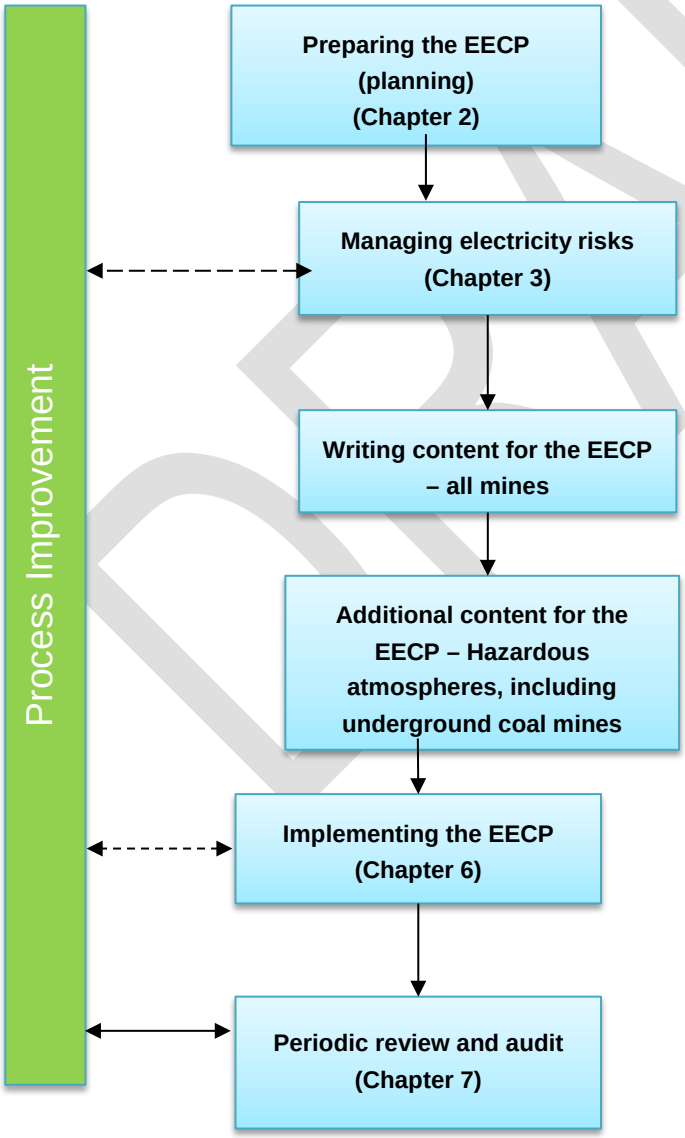
Unless otherwise indicated in the text, lists of points in the code should not be read as exhaustive. Useful information and samples provided in Appendix C is based on specific mining environments and available guidance material. Every process developed or document prepared for a mine should be developed to suit the nature, complexity and location of the particular mining operation and the risks associated with that mining operation.

Some samples or examples are drawn from practices existing prior to the commencement of the WHS (Mines) Act and Regulations in NSW, and/or from other jurisdictions. Therefore some of the content and terminology used in these appended examples/samples are referrable to statutory requirements under previous or interstate legislation and do not represent a statement of the law as it currently applies in NSW.

Code of practice structure

This code of practice follows a structured approach to preparing, implementing and periodically reviewing an EECP. This is reflected in figure 1 below for the structure of the code:

Figure 1: Code of practice structure



1 Introduction

The EECP is a principal control plan (PCP) used to manage risks associated with electricity at a mine.

The electrical aspects of plant or installations represent a significant risk that can cause death and injury in workplaces, including mines if not adequately controlled. The consequences of these electrical risks may be caused either directly or indirectly, and include:

- electric shock causing injury or death (electrocution)
- arcing, explosion or fire causing burns or death
- toxic gases causing illness or death
- unintended operation of electrically controlled plant or equipment may cause crush injuries or entrapment resulting in injury or death.

Other injuries or illnesses may include muscle spasms, palpitations, nausea, vomiting, collapse and loss of consciousness.

Workers using electricity may not be the only ones at risk. Faulty electrical equipment and poor electrical installations can lead to the transfer of hazardous voltages to locations remote to the faulty equipment. This may also cause fires that may result in death or injury to others.

Electricity is used in virtually all mining enterprises, and an EECP, as part of the overall safety management system for the mine, is an important tool for establishing a systematic way of acquiring, operating, maintaining and working on the plant and installations.

There are significant risks of workplace death and injury associated with using plant and installations, typically resulting from insufficient control of electricity through:

- the use of plant that is not **fit for the purpose** for which it is being used
- the lack of safe systems of work
- workers who are not **competent** in the task they are undertaking

Further advice on electrical risks is contained in Chapter 3 for risk management and Chapters 4 and 5 for content of the EECP and specific control measures.

1.1 What is an electrical engineering control plan (EECP)?

An electrical engineering control plan sets out how the mine operator will manage the risk to the health and safety associated with electricity at the mine, and forms part of the safety management system for the mine. It includes information on how the mine operator will ensure that any plant developed, purchased or modified is fit for purpose and safe to use; is installed correctly; and is operated safely and maintained in a safe condition by workers who are competent in its safe use.

1.2 Who has duties in relation to the EECP?

The mine operator has the duty to prepare and implement the EECP for the management of controls for the risks arising from hazards posed by electricity at the mine. They must also ensure the EECP is developed and periodically reviewed by the required person:

WHS (Mines) Regulations

26 Principal control plans

...

(5) **Electrical engineering control plan**

The mine operator of a mine in which there is a risk to health and safety associated with electricity at the mine:

(a) must prepare and implement an electrical engineering control plan for the mine that sets

out the means by which the mine operator will manage those risks in accordance with clause 9, and

(b) must ensure that the plan is developed and periodically reviewed by a person who is, or who is under the supervision of:

(i) the individual nominated to exercise the statutory functions of electrical engineering manager or electrical engineer at the mine, or

(ii) if no person is required to hold either of those positions at the mine, a competent person.

…

In practice most mines use electricity, whether mains fed or generator supplied, so most mine operators will need to prepare an EECP.

When developing the EECP, it is important that the relevant electrical technical matters are understood and taken into account. This will require a competent person who can provide appropriate electrical technical knowledge.

1.3 What needs to be included in the EECP?

The EECP should provide for compliance with the WHS laws, so far as they relate to managing risks associated with electricity at a mine.

The detailed matters that must be addressed in the EECP are set out in Schedule 2 of the WHS (Mines) Regulations, which are summarised and extracted below:

- Clause 3(1) sets out a range of overarching considerations that must be taken into account.
- Clause 3(2) sets out five specific risks to health or safety associated with electricity in plant and installations.
- Clause 3(3) sets out a range of matters that must be considered when developing control measures to manage the risks in clause 3(2).

Chapters 4 and 5 of this code provide guidance on these requirements.

WHS (Mines) Regulations

Schedule 2 Principal control plans – matters to be addressed (Clause 26)

3 Electrical engineering control plan

1. The mine operator must, in preparing an electrical engineering control plan, take the following into account in determining the means by which the mine operator will manage the risks to health and safety from electricity at the mine:

(a) the overall life cycle of the electrical aspects of plant and electrical installations at the mine,

(b) the reliability of electrical safeguards used at the mine to protect persons from electrical or other hazards,

(c) the electrical engineering and electrical work practices to be employed at the mine,

(d) the competency required by workers to safely work on electrical plant or electrical installations at the mine.

2. An electrical engineering control plan must set out the control measures for the following risks to health and safety associated with electricity at the mine taking into account the matters set out in subclause (3):

(a) injury to persons caused by direct or indirect contact with electricity,

(b) injury to persons caused by working on electrical plant or electrical installations,

(c) the unintended initiation of gas or dust explosions,

(d) the unintended operation of plant,

(e) the occurrence of uncontrolled fires.

The following matters must be taken into account when developing a control measure referred to in subclause (2):

(a) the location of the electrical plant and electrical installations at the mine,

(b) the rating and design of plant for the prospective electrical fault level, electrical load, operating frequency, operating voltages and arc fault control,

(c) the design and operation of any electrical plant that contains flammable liquid,

(d) the carrying out of the selection, installation and use of electrical cables and electrical cable accessories at the mine,

(e) the control of static electricity at the mine, including preventing the ignition of flammable gas,

(f) the impact of lightning on the mine (especially on an underground mine) including the effect on electrical systems,

(g) the need for reliable circuit interruption for all points in the mine's electrical distribution system when faults occur taking into account the operating time and tripping current of circuit protection devices,

(h) the type of earthing system used, including levels of earth fault limitation,

(i) the potential for persons to contact electricity indirectly,

(j) the prospective touch, step and transfer voltage,

(k) variations in operating conditions,

(l) preventing persons inadvertently contacting energised parts of electrical plant and electrical installations,

(m) the consultation, co-operation and co-ordination of activities between persons conducting businesses or undertakings at the mine (including the mine operator) and persons conducting businesses or undertakings installing, maintaining or carrying out work on an electricity supply authority's infrastructure,

(n) the procedures for the following:

(i) the use of electrical welding plant,

(ii) the use of electrical test instruments,

(iii) work near overhead power lines and cables,

(iv) the treatment of electric shocks and electric burns,

(v) accessing and working on high voltage electrical installations,

(o) signage and notices in relation to the risks arising in relation to particular electrical plant and electrical installations such as electrical switchgear,

(p) the security and maintenance of the mine's electrical control system software and control circuits,

(q) the use of lasers and fibre optic equipment at the mine,

(r) the construction, installation and maintenance of battery powered vehicles and battery charging stations at the mine,

(s) the supply of electricity in hazardous atmospheres and, in the case of underground coal mines, in hazardous zones,

(t) the use of electrical plant in hazardous atmospheres and, in the case of underground coal mines, in hazardous zones,

(u) safe work systems for persons dealing with electrical plant and electrical installations including the isolation, dissipation and control of all electrical energy sources from the electrical plant or electrical installation,

(v) the use of switchgear and electrical protection devices that can automatically detect an electrical fault in a circuit and disconnect the supply of power to the circuit.

1.4 Does the EECP need to be documented?

The EECP must be documented and must, so far as is reasonably practicable, be set out and expressed in a way that is readily understood by people who use it (clause 26(2) WHS (Mines) Regulations). Workers who may be affected by risks associated with electricity, such as those who operate or work on electrical plant or installations, must be able to understand the requirements of the EECP as it relates to the particular work being carried out. This may require technical content for electrical workers and non-technical content for others.

The EECP, as with all PCPs, must be readily accessible to all workers at the mine.

1.5 What consultation is required?

The mine operator has a duty to consult with workers on matters that relate to work health and safety that are, or are likely to be directly affected (section 47 of the WHS Act). In particular, this involves implementing a safety role for workers to consider control measures for risks to be managed under the principal control plans. It also involves consulting with workers in conducting risk assessments for the principal control plans (clauses 120 and 121 WHS (Mines) Regulations).The mine operator must, so far as is reasonably practicable, consult, cooperate and coordinate with other people who also have a duty to consult, including in relation to the risks associated with electricity at the mine. This includes other PCBUs and workers (sections 46 and 47 of the WHS Act).

Consultation, coordination and cooperation between the mine operator and other PCBUs, especially contractors, is critical in ensuring that all risks associated with the electricity are identified and managed in a consistent way.

General guidance on the duty to consult under the WHS Act can be found in the *NSW Code of Practice: Work health and safety consultation, cooperation and coordination* and for mines specifically in the *NSW Code of Practice: Safety management systems in mines*.

1.6 Other duties in relation to the electrical plant and installations

1.6.1 Primary duty

The mine operator (as well as any other PCBUs at a mine) has a primary duty under section 19 of the WHS Act to ensure, so far as is reasonably practicable, that workers and other people are not exposed to health and safety risks arising from the business or undertaking. This duty includes ensuring, so far as is reasonably practicable:

- the provision and maintenance of safe plant and installations, and
- the safe use, handling, and storage of plant.

1.6.2 Management or control of plant

A PCBU with the **management or control of fixtures, fittings or plant at a workplace**, including the mine operator, has a duty under section 21 of the WHS Act to ensure, so far as is reasonably practicable, that the fixtures, fittings and plant are without risks to the health and safety of any person.

The WHS Regulations (Chapter 5, Part 5.1, Division 7) includes specific duties in relation to plant, other than plant that relies exclusively on manual power for its operation and designed to be primarily supported by hand (for example, a screwdriver). This includes requirements for PCBUs with the **management or control of plant** to (among other things):

- manage the health and safety risks associated with such plant
- prevent unauthorised alterations to, or interference with, such plant
- use plant only for the purpose for which it was designed, unless the proposed use does not increase the risk to health or safety.

1.6.3 Design, manufacture, import and supply

Designers, manufacturers, importers and suppliers of plant, substances and structures have duties under sections 22-25 of the WHS Act that will also apply to a mine operator if they design, manufacture, import or supply plant, substances or structures. In relation to plant, substances and structures these duties may be summarised as a duty to ensure, so far as is reasonably practicable, that the plant, substance or structure is without risks to the health and safety of people at a workplace who:

- use the plant, substance or structure for a purpose for which it was designed or manufactured
- handle the substance
- store the plant or substance
- construct the structure
- carry out any reasonably foreseeable activity in relation to:
  - the manufacture, assembly or use of the plant for a purpose for which it was designed or manufactured or the proper storage, decommissioning, dismantling or disposal of the plant, or
  - the manufacture or use of the substance for a purpose for which it was designed or manufactured or the proper handling, storage or disposal of the substance, or
  - the manufacture, assembly or use of the structure for a purpose for which it was designed or manufactured or the proper demolition or disposal of the structure, or
- are at or in the vicinity of the workplace and who are exposed to the plant, substance or structure at the workplace or whose health or safety may be affected by a use or activity referred to above.

1.6.4 Calculation, analysis, testing or examination

Designers, manufacturers, importers and suppliers must also carry out, or arrange for the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed by sections 22-25 of the WHS Act, or alternatively, in the case of importers and suppliers, ensure that such calculations, analysis, testing or examination have been carried out.

1.6.5 Information to be provided

Designers, manufacturers, importers and suppliers must also give adequate information to each person to whom they provide the design, plant or structure (and subsequently upon request): concerning:

- each purpose for which the plant, substance or structure was designed or manufactured

- the results of any calculations, analysis, testing or examination referred to above, including, in relation to a substance, any hazardous properties of the substance identified by testing
- any conditions necessary to ensure that the plant, substance or structure is without risks to health and safety when used for a purpose for which it was designed or manufactured or when carrying out any activity discussed in the previous list .

1.6.6 Install, construct or commission plant

PCBUs that **install, construct or commission plant or structures**, including the mine operator, have a duty under section 26 of the WHS Act to ensure, so far as is reasonably practicable, that the way the plant or structure is installed, constructed or commissioned ensures the plant or structure is without risks to the health and safety of people who:

- install or construct the plant or structure at a workplace
- use the plant or structure at a workplace for a purpose for which it was installed, constructed or commissioned
- carry out any reasonably foreseeable activity at a workplace in relation to the proper use, decommissioning or dismantling of the plant or demolition or disposal of the structure
- are at or in the vicinity of a workplace and whose health or safety may be affected by a use or activity referred to above.

1.6.7 Supply of second-hand plant

Mine operators and other PCBUs may acquire or be suppliers of second-hand plant. Suppliers of second-hand plant, other than hand-held, manually operated plant, must ensure, so far as is reasonably practicable, that any faults in the plant are identified. A written notice outlining the condition of the plant, any faults identified and, if appropriate, that the plant should not be used until the fault is rectified, must be provided to the person to whom the plant is supplied.

If second-hand plant is to be used for scrap or spare parts, the supplier must tell the person they are supplying it to that the plant is being supplied as scrap or spare parts and that the plant in its current form is not to be used as plant. This must be done in writing or by marking the item of plant.

1.7 Interaction of EECP with other plans

Principal control plans (PCPs) together with principal mining hazard management plans (PMHMP – see Glossary for meanings) form part of the SMS for a mine.

PCPs cover hazards and controls that exist across the mining operations for a particular matter, such as risks from the electrical aspects of plant and installations.

PHMPs deal only with the identified principal mining hazards (PMH), that is, hazards that have a reasonable potential to result in multiple fatalities in a single incident or a series of recurring incidents. PMHs may exist only in a certain part of the mining operations, such as ground instability where extraction is taking place.

PCPs manage specific hazards that may be part of or affect principal mining hazards and controls, and consequently the plans for them. A PMHMP, for example, may directly refer to the EECP in relation to preventing fires and explosions arising from electrical plant or installations. The EECP may also directly refer to other plans and/or specify electrically related standards and controls for them. The mine operator may find it appropriate to have one plan that combines the legislated content of several control plans and PMHMPs.

The mine operator may also create additional PCPs to manage other specific risks or hazards, as long as any specific controls or other legislative requirements are satisfied. For example, a mine operator may want to use a PCP for processes such as chemical treatment for water or mineral extraction.

The mine operator may also choose to have their EECP be made up of sub plans or to reference additional control plans. For example, sub plans for particular types of electrical plant and

installations, or sub plans for particular types of plant and installations (for example, switchyards) or for particular activities such as construction.

Figure 2 below shows the mine safety management system and the relationship of PCPs, PMHMPs and specific control measures.

Figure 2: Mine Safety Management System

1.8 Registered plant

Certain plant designs and items of plant must be registered with either WorkCover NSW or NSW Trade & Investment. The EECP should provide for the management of the plant registration requirements, in conjunction with the mechanical engineering control plan, so that electrical requirements are considered in the risk management of the plant. This should include a process to ensure only registered plant is used.

Appendix A provides further information on plant registration requirements.

2 Preparing the EECP

2.1 General

Before writing the EECP, the mine operator should consider how the EECP is to be prepared, implemented and integrated within the mine SMS (including other PCPs and PMHMPs). The development and review of the EECP must be undertaken by or under the supervision of the electrical engineering manager, electrical engineer or a competent person (see section 2.2). The preparation should also involve consultation with relevant workers.

Before an EECP is prepared, the mine operator should consider the matters in sub sections 2.1.1 to 2.1.7 of this code.

2.1.1 Relevant WHS information, Australian Standards and other guidance

The effectiveness of the EECP will be enhanced if all relevant matters are considered.

Gathering information about WHS law requirements and recommended controls will help make the process as efficient, yet comprehensive, as possible. Legislation, codes of practice, standards, safety alerts, safety bulletins, published incident data, original equipment manufacturer (OEM) information and general WHS guidance may all help identify requirements, foreseeable hazards, risks and controls. The relevant parts of these types of documents should be considered in the preparation of the EECP.

Relevant standards may include those published by Australian Standards (AS), International Electrotechnical Commission (IEC) or the International Organization for Standardization (ISO).

Guidelines produced by various regulatory authorities, including NSW Trade & Investment and electricity supply authorities, may also aid in the identification of risks associated with a hazard, along with providing recommendations for methods of management of those risks.

It is important to note that compliance with a standard or a guideline, either in part or in full, does not necessarily manage all risks associated with a particular hazard.

2.1.2 Nature and complexity of the mining operation

Different mines, depending on their level of risk and complexity, will have differing hazards and risk controls to identify and implement in the EECP. As part of the safety management system, the EECP must contain a level of detail that is appropriate to the mine, having regard to the particular risks at the mine and the nature, complexity and location of the mining operation (refer clause 14(2)(a) WHS(Mines) Regulations).

Mines differ considerably in their nature and complexity of operation. For example, a small mine may have only two to three items of plant, whereas a large mine may have more than 200 items of plant. Likewise, mines will vary in complexity. For example, a quarry will have different risks and control measures compared with an underground coal mine. There will also be differences in the risk profiles of mines of the same type. For example, a quarry with long steep gradients will be different to a quarry operating on a level surface.

2.1.3 Intended audience

The plan must be able to be readily understood by the people who use it (refer to clause 26(2) of the WHS (Mines) Regulations). The mine operator should determine the level of competence of people who will read and use the plan, or parts thereof, how they will use it, and when. For example, not all people with duties under the plan will possess competence to the level of an electrician, and not all electricians have the same level of competence, unless provided with appropriate training. The plan may contain technical content for electrical workers and non-technical content for others. The mine operator should consider levels of literacy of workers and language limitations in determining minimum skill requirements for workers to be able to use the plan. The mine operator may also need to consider if translation into different languages is necessary for the workforce.

Mine operators may prepare an introduction to the plan to assist with the reading and understanding it. In the case of larger and/or more complex mines with a substantial plan, an overview document may explain how the plan interfaces with other plans and operates as a whole. This may include referenced documents and summaries/outlines.

2.1.4 Identification of plant and its intended use

The mine operator must prepare the EECP in relation to the risks from electricity associated with all plant at a mine, not just the mine operator-provided plant. Therefore, the mine operator must ensure the risks from all plant, including in relation to plant provided or introduced by contractors, other PCBUs and workers are identified and considered in the EECP.

A common cause of risk in relation to plant is plant being used for a purpose for which it was not designed and it is therefore not fit for purpose. Assumptions are sometimes made about which plant is capable of being used in a particular way because it is being used elsewhere without understanding that it has been specifically modified for that use or that the circumstances of its use are different. Identifying the intended use and operating environment of plant is critical in managing the risks associated with plant.

2.1.5 Existing plans and procedures

Any existing documents created before the commencement of the WHS (Mines) Regulations setting out how electrical risks are managed at the mine can provide a helpful starting point for the preparation of an EECP. Risk assessments, safe work method statements, documents of controls and engineering standards for the mine, should all be considered for inclusion in the EECP. Mines may have existing plans that may assist in the development of the EECP, such as electrical engineering management plans for coal mines. It is critical that any existing documents are reviewed before being included in the EECP to ensure they are still relevant to the risks and practices at the mine as well as meeting requirements under the WHS legislation.

2.1.6 Use of generic plans

Larger organisations may prepare and implement a generic plan that is applied across multiple mines. Although the use of generic plans may provide consistency for the organisation across several mines, these may need to be changed for each mine as the mine operator must ensure the EECP is prepared to suit the nature, complexity and location of the particular mining operation and the risks associated with that mining operation. Consultation with workers at each mine must occur so site-specific issues are identified and are appropriately managed.

2.1.7 Responsibilities for plant and installations at the mine

As the EECP sets out how hazards are managed, requirements of the individual position holders within the mine management structure who are responsible for the day-to-day implementation of the plan, or parts of it, should be set out in the plan. This should include the relationships between people with responsibilities in the EECP and other plans, together with details of how any interaction issues will be resolved.

2.2 Who can develop and review an EECP?

The mine operator must ensure the plan is developed and periodically reviewed by a person who is, or is under the supervision of the person in the statutory position of:

- (for an underground coal mine) the electrical engineering manager
- (for coal mines other than underground coal mines and for other mines where total connected power at the mine is greater than 1000 kilowatts or where high voltage is used) the electrical engineer
- (for other mines where total connected power at the mine is not greater than 1000 kilowatts and where high voltage is not used) a competent person.

Refer to clause 26(4) of the WHS (Mines) Regulations that is contained in section 1.2 of the code and statutory electrical functions in 2.3.

The electrical engineering manager, the electrical engineer or competent person should have an active role in the implementation of the EECP, as their skills and knowledge will help ensure technical aspects of the plan are fully understood and introduced effectively. Where a plan, or portion of the plan, is developed by a person under the supervision of the statutory position holder, then some form of endorsement or approval arrangement must be in place to confirm the statutory position holder is satisfied with the EECP and that technical matters have been properly addressed.

2.3 Statutory electrical functions for mines

2.3.1 General

Where a function exists to develop, supervise, monitor and review the electrical engineering standards and procedures forming part of mining operations at the mine, the mine operator must only nominate people to perform the statutory electrical functions at the mine if the individuals meet the requirements set out in Schedule 10 of the WHS (Mines) Regulations. The competence required to obtain the certificate of competence for the statutory functions are set by NSW Trade & Investment as the regulator, on advice from the NSW Mining Competence Board.

In all cases listed below, a person who is acting under the supervision of the statutory person may also develop the plan or sections of the plan. In this situation the statutory position holder must still approve the plan, or the sections of the plan developed by others.

The electrical engineering manager or an electrical engineer also has a function to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine. The mine operator must determine the level of supervision that is to be provided. This should be determined taking into consideration the supervisory functions of any qualified electrical tradespersons.

Note: Where two people have the same function, that is, supervision, both people are required to exercise that function. It should not be considered that if one person is exercising the function that the second person can ignore the function.

2.3.2 Underground coal mines

For underground coal mines, Schedule 10, clauses 4 and 15 of the WHS (Mines) Regulations requires the following statutory positions to carry out specified functions:

(4) Electrical engineering manager

(1) The statutory functions of electrical engineering manager are:

(a) to develop, supervise, monitor and review the electrical engineering standards and procedures forming part of mining operations at the mine, and

(b) to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory functions is that the individual nominated must hold a current practising certificate that authorises the exercise of the statutory functions.

(15) Qualified electrical tradesperson

(1) The statutory function of qualified electrical tradesperson is to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory function is that the individual nominated must:

(a) have a supervisor certificate that authorises the doing of electrical wiring work, or

(b) have a proficiency certificate (issued by State Training Services) in an electrical trade, or

(c) have been continuously employed as an electrical tradesperson at a coal mine since

21 December 2004.

2.3.3 Surface coal mines

For coal mines other than underground mines, Schedule 10 clauses 20 and 22 of the WHS (Mines) Regulations requires the following statutory positions to carry out specified functions:

20 Electrical engineer

(1) The statutory functions of electrical engineer are:

(a) to develop and review the standards and procedures for the installation, commissioning, maintenance and repair of electrical plant and installations at the mine, and

(b) to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory functions is that the individual nominated must:

(a) hold an electrical engineer certificate of competence (surface coal) or electrical engineering manager certificate of competence (coal) that is in force, or

(b) have evidence of compliance with Australian Engineering Competency Standards Stage 2 in respect of mining operations at a mine and be:

(i) a professional electrical engineer who is registered on the National Professional Engineers Register, or

(ii) an electrical engineering technologist who is registered on the National Engineering Technologists Register, or

(iii) an electrical engineering associate who is registered on the National Engineering Associates Register.

22 Qualified electrical tradesperson

(1) The statutory function of qualified electrical tradesperson is to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory function is that the individual nominated must:

(a) have a supervisor certificate that authorises the doing of electrical wiring work, or

(b) have a proficiency certificate (issued by State Training Services) in an electrical trade, or

(c) have been continuously employed as an electrical tradesperson at a coal mine since 21 December 2004.

(1) The statutory function of qualified electrical tradesperson is to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory function is that the individual nominated must:

(a) have a supervisor certificate that authorises the doing of electrical wiring work, or

(b) have a proficiency certificate (issued by State Training Services) in an electrical trade, or

(c) have been continuously employed as an electrical tradesperson at a coal mine since 21 December 2004.

2.3.4 Underground mines other than coal mines

For underground mines (other than coal), Schedule 10, clauses 28 and 29 of the WHS (Mines) Regulations stipulates:

28 Electrical engineer (only required if total connected power at mine is greater than 1,000 kilowatts or if high voltage is utilised)

(1) The statutory functions of electrical engineer are:

(a) to develop and review the standards and procedures for the installation, commissioning, maintenance and repair of electrical plant and installations at the mine, and

(b) to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory functions is that the individual nominated must:

(a) hold an electrical engineering manager certificate of competence (coal) or electrical engineering manager certificate of competence (surface coal) that is in force, or

(b) have evidence of compliance with Australian Engineering Competency Standards Stage 2 in respect of mining operations at a mine and be:

(i) a professional electrical engineer who is registered on the National Professional Engineers Register, or

(ii) an electrical engineering technologist who is registered on the National Engineering Technologists Register, or

(iii) an electrical engineering associate who is registered on the National Engineering Associates Register.

29 Qualified electrical tradesperson

(1) The statutory function of qualified electrical tradesperson is to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory function is that the individual nominated must:

(a) have a supervisor certificate that authorises the doing of electrical wiring work, or

(b) have a proficiency certificate (issued by State Training Services) in an electrical trade, or

(c) have been continuously employed as an electrical tradesperson at a mine since 20 December 2005.

2.3.5 Surface mines other than coal mines

For mines other than underground or coal mines, Schedule 10 and clauses 33 to 34 of the WHS (Mines) Regulations stipulates:

33 Electrical engineer (only required if total connected power at mine is greater than 1,000 kilowatts or high voltage is utilised)

(1) The statutory functions of electrical engineer are:

(a) to develop and review the standards and procedures for the installation, commissioning, maintenance and repair of electrical plant and installations at the mine, and

(b) to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory functions is that the individual nominated must:

(a) hold an electrical engineering manager certificate of competence (coal) or an electrical engineering manager certificate of competence (surface coal) that is in force, or

(b) have evidence of compliance with Australian Engineering Competency Standards Stage 2 in

respect of mining operations at a mine and be:

(i) a professional electrical engineer who is registered on the National Professional Engineers Register, or

(ii) an electrical engineering technologist who is registered on the National Engineering Technologists Register, or

(iii) an electrical engineering associate who is registered on the National Engineering Associates Register.

(3) This clause does not apply to a mine at which the total connected power to the mine is 1,000 kilowatts or less unless voltages greater than 1,000 volts AC or 1,500 volts DC are used at the mine.

34 Qualified electrical tradesperson

(1) The statutory function of qualified electrical tradesperson is to supervise the installation, commissioning, maintenance and repair of electrical plant and installations at the mine.

(2) The requirement for nomination to exercise the statutory function is that the individual nominated must:

(a) have a supervisor certificate that authorises the doing of electrical wiring work, or

(b) have a proficiency certificate (issued by State Training Services) in an electrical trade, or

(c) have been continuously employed as an electrical tradesperson at a mine since 20 December 2005.

For all other mines that have not been referred to directly in 2.3, a competent person is required (refer to 2.3.2 above).

2.3.6 Competent person

For mines that are not required to nominate either an Electrical Engineering Manager or an Electrical Engineer, a competent person must be used to develop and periodically review the EECP. Competence requirements for a competent person to prepare the plan may vary according to the size, complexity and risks of the mining operations. The mine operator should consider the needs for experience, skills and qualifications, depending on the hazards at the mine.

One way to demonstrate competence is for a person to hold a recognised certification or qualification, such as a certificate of competence to be the electrical engineering manager or electrical engineer at a coal mine, or national units of competence relevant to the area of work being undertaken. Another way for a person to demonstrate that they have an appropriate level of competence for the development and review of the EECP may be registration or eligibility for registration with Engineers Australia as an:

- Engineering Associate
- Engineering Technologist
- Professional Engineer.

A person may also be able to provide evidence of compliance with Australian Engineering Competency Standards Stage 2 in respect of electrical engineering at mining operations.

The mine operator may determine that additional competencies (not alternative competencies) are required by a person who is on one of the engineering registers for their mine. For example, a person with appropriate competence in operating and maintaining mine winding systems would be needed at a mine with a mine winding system.

While it is a requirement for the statutory position holder or, where that position is not required, a competent person to carry out the development and periodic review of the EECP, this person does not have to be an employee of the mine operator.

Details of the competencies required for the competent person who is involved in carrying out this statutory function and other involved people should be included in the plan. These competencies may be detailed against a position rather than a person, and where other people are developing parts of the plan should clearly detail the reporting requirements back to the competent person.

3 Managing electrical risks

3.1 Managing risks

The EECP must set out how the mine operator will manage the risks associated with electricity at the mine in accordance with clause 9 of the WHS (Mines) Regulations.

Part 3.1 of the WHS Regulations sets out general obligations for managing of risks to health and safety while Subdivision 1, Division 1 of Part 2 of the WHS (Mines) Regulations (including clause 9 above) sets out additional general obligations for the management of risk at mines. At a mine, the PCBU must conduct risk assessments for hazards with a competent person and record the details either in the mine safety management system or a contractor work health and safety plan if prepared (whichever is applicable).

Both the general requirements and any specific requirements for managing or controlling a particular risk must be complied with such as in:

- chapter 5 of the WHS Regulations in relation to plant and structures
- chapter 4 of the WHS Regulations in relation to hazardous work, in particular Part 4.7 ‘General electrical safety in workplaces and energised electrical work’
- clause 32 Electricity of the WHS (Mines) Regulations, and in relation to underground coal mines clauses 78-80 and 82-83
- mining plant specific requirements in the WHS (Mines) Act and Regulations, such as plant registration.

The EECP should use the mine’s existing risk management processes, including assessment, so the plan manages risk as required by WHS legislation. This should ensure that the EECP is consistent with other plans, such as a fire and explosion principal mining hazard management plan, for all risks associated with electricity at the mine.

This risk management process involves four steps:

- identify hazards – find out what could cause harm
- assess risks – understand the nature of the harm that could be caused by the hazard, how serious the harm could be and the likelihood of it happening
- control risks – implement any mandatory control measures or the most effective control measure that is reasonably practicable in the circumstances
- review control measures to ensure they are working as planned

Each of these steps is discussed in the following sections of this chapter as they relate to developing the EECP for controlling risks. It is essential that any risk management process be undertaken having regard to the specific circumstances or context in which the risk is being considered. When assessing the risks associated with electrical aspects of plant or installations, someone with appropriate electrical engineering competence should be involved in, or possibly conduct, the risk assessment.

For general guidance material about conducting the risk management process, refer to references at the end of this code and *NSW Code of practice: How to manage work health and safety risks*.

3.2 Hazard identification

All reasonably foreseeable hazards associated with electricity must be identified. Identifying hazards in the workplace involves finding things and situations that could potentially harm people.

Where electricity is used or is present, a hazard exists. Electricity also includes stored energy such as lightning, static discharge, electro-magnetic devices, batteries and so on.

Hazards generally arise from the following aspects of work and their interaction:

- physical work environment
- plant, installations and energy sources
- work tasks and how they are performed
- work design and management

The *AS 4024 Safety of machinery* series of standards contains useful guidance material for designers and users of plant in ways to identify hazards and provide risk control measures.

The table below lists categories of hazards associated with electricity. This list is not exhaustive, but may help in identifying hazards associated with mining plant or installations.

Figure 3: Possible electrical and related categories of hazards at a mine.

Energy/hazard	Mechanism	Potential harm
Electricity	Direct contact, indirect contact, electrostatic phenomena, loss of control from inadequate design, inappropriate use, age of electrical equipment and unsafe work carried out on electrical items and so on.	Electrocution (death), electric shock, fire, explosion, unintended operation
Chemical energy	Self-heating, self-ignition, uncontrolled exothermic reaction, fire, explosion.	Burns, death
Gravity	Impact, falls.	Breakages, internal injuries, shock, death
Kinetic energy	Friction, overheating, impact, falling objects, unexpected movement, collision with operator, accumulation of oil and lubricants, fires from sparks, explosions.	Burns, breakages, internal injuries, death
Potential/stored energy	Unexpected movement, uncontrolled operation.	Breakages, internal injuries, shock, death
Noise	Exposure to harmful noise levels.	Hearing loss
Pressure (including fluid)	Explosion, fire.	Fluid injection injury, burns, death
Heat	High temperatures, hot surfaces, fire, explosion.	Burns, dehydration, death
Vibration (this must be considered as part of a Hazardous	Posture, exertion, repetition, duration of task (refer to Human Factors Management in References for more information and clauses 60	Musculoskeletal disorders including vision impairment and circulation disorders

Energy/hazard	Mechanism	Potential harm
Manual Task, as defined in clause 5 WHS Regulations)	to 61 of the WHS Regulations)	
Radiation	Exposure to radiation.	Radiation burns, death
Toxic gases and substances	Explosion, fire.	Exposure to toxins, burns, asphyxiation, death
Flammable gases and substances	Ignition of flammable mixtures of gas or dust, explosion, fire.	Burns, asphyxiation, death

The mine operator may include details of these other related hazards to electricity and their control measures in the EECP or reference their details from another appropriate document such as the mechanical engineering control plan.

There are different methods for undertaking hazard identification and risk assessments. One method is to do a 'broad brush' risk assessment as a first step in identifying the risks which the EECP should address. A broad brush risk assessment is a type of risk assessment used to identify general hazards so that priorities can be determined for further risk identification and action. This should be followed by an engineering focused hazard identification and risk assessment to identify all the risks associated with the identified hazards on plant or structures (refer to References for more details).

3.3 Assessment of risks

The WHS (Mines) Regulations clause 9 requires that PCBUs at a mine ensure that a risk assessment is conducted by a competent person and is recorded (with exceptions). For mine operators it must be recorded as part of the mine's safety management system, and for contractors in the contractor health and safety management plan (if applicable). The record must also include the control measures implemented to eliminate or minimise any risk that was identified through the risk assessment.

In undertaking a risk assessment, the person must have regard to the:

- nature of the hazard or risk
- likelihood of the hazard affecting the health or safety of a person
- severity of the potential health and safety consequences.

Other matters that should be considered in assessing risks are:

- the effect of different operating conditions - normal or abnormal (for example shut down and

start-up, weather and possible misuse of equipment due to human error)

- past incidents and potential emergency situations
- past, current and planned activities
- the reliability and adequacy of existing technology used to control risk i.e. engineering controls
- state of knowledge (what the industry knows) about the hazard or risk and how to eliminate or minimise them.

In some cases, further risk assessment of the hazards may be required using an appropriate technique. For example, fault tree analysis, failure modes and effects analysis, human error analysis, bow tie analysis or other techniques. Guidance on these techniques is available in AS/NZ 4204-1201 and 1302; as well as SA/SNZ-HB 89-2013 (see References).

The degree of risk associated with electricity is directly related to the level of voltage and to the level of energy that may be released under either normal or abnormal conditions.

Note: Risks that must be addressed in the EECP and the factors to be considered in developing control measures, are set out in sections 4.4 to 4.8 and Chapter 5 below.

3.4 Control of risks

Hazard identification and risk assessment is undertaken to lead to the development of appropriate controls to eliminate the risks so far as reasonably practicable or, if that is not reasonably practicable, to minimise risks so far as is reasonably practicable (refer to clauses 33 to 36 of the WHS Regulations for requirements).

3.4.1 Specific controls

Any specific control measures required in the WHS Regulations or the WHS (Mines) Regulations in relation to electricity must be complied with and should be included in the EECP. This code identifies many specific control measures required, particularly controls required under the WHS (Mines) Regulations, where they relate to plant and installations. However these references are not exhaustive.

The WHS Regulations in Chapter 4, Part 4.7 'General electrical safety in workplaces and energised electrical work' contain specific controls that must be implemented at mines, including:

- inspection and testing of electrical equipment
- work on energised electrical equipment
- residual current devices
- overhead and underground electric lines.

In the WHS (Mines) Regulations Division 4 of Part 2 'Specific control measures – all mines' contains clause 32 Electrical safety. The specific control measures listed in clause 32 are discussed in chapter 4 of this code.

Chapter 5 of the WHS Regulations (clauses 203 to 226) contains a number of specific controls for plant including:

- installation and commissioning risks
- prevention of unauthorised alteration or interference
- the proper use of plant and controls
- operational controls
- emergency stops
- warning devices
- maintenance and inspection of plant
- powered mobile plant
- industrial robots
- lasers
- plant with presence sensing safeguarding systems.

The *NSW code of practice: Managing electrical risks at the workplace* is a good starting point for managing risks associated with plant and for information about requirements for registration of the design or certain types of plant or certain items of plant. The *NSW code of practice: Safe design of structures* provides guidance on design, commissioning and undertaking construction work.

3.4.2 Hierarchy of controls

There are many ways to control risks, and various control options must be considered. This may involve a single control measure or a combination of controls that together provide the required

level of protection (risk minimisation). Sometimes a single control is not adequate on its own to control a risk under all foreseeable circumstances, or if the reliability of a single control is uncertain.

The hierarchy of risk controls ranks the effectiveness of controls from the highest level of protection and reliability (most effective) to the lowest (least effective) to either eliminate or minimise risks as shown in the figure below. The mine operator and other PCBUs are required to work through this hierarchy when managing risk under clause 36 of the WHS Regulations.

Figure 4 – Hierarchy of control measures

Control measure	Effectiveness
Elimination	**Best**
• Substitution • Isolation • Implementation of engineering controls	Effectiveness does not depend on human behaviour
• Administrative controls	Effectiveness depends on human behaviour
• Use of Personnel Protective Equipment (PPE)	Does not control the risk directly. It controls the possible harm to a person

The aim is to eliminate a hazard, which is the most effective action. If this is not reasonably practicable, risk must be minimised by working through the other alternative measures in the hierarchy, as prescribed in Part 3.1 of the WHS Regulations.

Risk controls can be classified as either preventative controls or as mitigation controls. Preventative controls are those that prevent the unwanted event from occurring. Mitigation controls are those that reduce the effects of an unwanted event following its occurrence. Where it is not reasonably practicable to eliminate a risk, a combination of both preventative and mitigation controls is required in response to the identified risk.

The primary focus should be implementation of preventative controls where possible.

Importantly, risks must be managed throughout the life-cycle of plant and installations. The control measures selected should have the appropriate reliability. Refer to section 4.2.2 below in this code for more information on control reliability.

3.5 Maintenance of control measures

Control measures implemented to control risks presented by hazards at a mine must be maintained to ensure their continuing effectiveness under clause 37 of the WHS Regulations:

WHS (Mines) Regulations

37 Maintenance of control measures

A duty holder who implements a control measure to eliminate or minimise risks to health and safety must ensure that the control measure is, and is maintained so that it remains, effective, including by ensuring that the control measure is and remains:

(a) fit for purpose, and

(b) suitable for the nature and duration of the work, and

(c) installed, set up and used correctly.

The EECP should identify the methods and systems required to maintain the control measures thereby ensuring they remain effective.

An important part of maintaining control measures is dealing with change. Change management should be applied at a mine in circumstances where new or different plant or installations are being introduced. The EECP should integrate with other management systems, such as procurement, to minimise the effect of changes when new plant and installations are being introduced. Any changes required should be managed through mine change management processes to identify changes that may be required to engineering practices and competencies.

The EECP should also identify requirements for monitoring the effectiveness of the controls implemented, including processes for identifying, reviewing and responding to uncontrolled events, such as near-miss incidents. This may include maintenance regimes, pre-start and scheduled inspections.

Monitoring of control measures may be carried in different ways, such as the development of trigger action response plans (TARPs). A TARP is an example of a risk management tool that triggers a planned early response to prevent 'normalisation', i.e. accepting slow deterioration as 'normal' as there is little variation from day to day. If there is no planned response in place for these particular hazards, a decision to put a risk control in place may be delayed until the hazard cannot be easily controlled. Examples of where a TARP may be applicable are:

- Monitoring the condition of motor bearings. A TARP may trigger if vibration levels exceed a set point such that further investigation is carried out.
- Monitoring the temperature of electrical connections (thermography). A TARP may trigger if temperatures exceed a set point such that further investigation is carried out.
- Monitoring insulation resistances of circuits. The TARP may initiate additional maintenance actions if the insulation resistance drops below a predetermined value.

3.6 Review of control measures

Clause 10 of the WHS (Mines) Regulations (which refers to clause 38 of the WHS Regulations) requires the mine operator and other PCBUs to review and where necessary revise implemented control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risk to health or safety. These provisions are copied in full and discussed in chapter 7 below as part of the overall review requirements for the EECP.

If the mine operator becomes aware of circumstances where a control measure provided by designer, manufacturer or supplier does not control the risk it was implemented to control, the mine operator should notify the designer, manufacture or supplier of the plant or installation. This may be done by submitting the issue to the designer, manufacturer or supplier as a non-conformance through their quality management systems.

4 Content of the electrical engineering control plan – all mines

This chapter provides guidance on the matters that need to be addressed by the EECP for all mines (4.2) and other specific risk controls that relate to plant and installations in the mine (4.2 and 4.3). Additional guidance for underground coal mines is provided in chapter 5, but must be considered in addition to the information in this chapter.

4.1 Overview of the EECP

The EECP must set out how risks associated with electricity will be managed at the mine. Specific matters that must be considered are set out in Schedule 2 clause 3 (refer to section 1.3 for a complete extract of the schedule) and are examined in more detail below.

To assist in managing these risks the EECP must identify how (such as through procedures, training, identification of elements of fit-for-purpose plant and installations or other systems) the mine operator will ensure the risks associated with use of electricity, including the fitness, maintenance and operation of any electrical plant, installation or structures are managed.

In summary this will involve:

- identifying all electrical plant and installations on the mine including contractor plant
- identifying foreseeable hazards associated with the use (including maintenance and disposal) of electrical aspects of the plant and installations
- assessing these risks
- providing reliable safeguards (risk control measures) to protect workers from the hazards posed by electrical plant and electrical installations including:
  - selecting and commissioning plant and installations so they are suitable for the intended use
  - ensuring plant and installations are operated safely and within their design limits
  - providing safe systems of work for operating, maintaining and working on plant and installations
  - ensuring plant and installations are inspected, tested and maintained so they remain in a safe condition of use
  - providing for competent workers to carry out work safely on plant and installations
  - providing for competent electrical engineering supervision.

4.2 Matters to be taken into account when preparing an EECP

When determining the means by which the mine operator will manage the risks to health and safety from electricity used in plant and installations at the mine, the following matters from Schedule 2 clause 3 of the WHS (Mines) Regulations must be taken into account:

- Subclause (1) sets out a range of overarching considerations that must be taken into account, see 4.3
- Subclause (2) sets out certain risks to health or safety associated with electricity in plant and installations, see 4.4
- Subclause (3) sets out a range of matters that must be considered when deciding on the control measures that will be set out in the plan for the risks in subclause 2, see 4.5.

Guidance is provided for each of these provisions in 4.3 – 4.5 below.

4.3 Overarching considerations

4.3.1 Lifecycle

WHS (Mines) Regulations

Schedule 2 Principal control plans – matters to be addressed (clause 26)

3 Electrical engineering control plan

(1) The mine operator must, in preparing an electrical engineering control plan, take the following into account in determining the means by which the mine operator will manage the risks to health and safety from electricity at the mine:

a) the overall life cycle of the electrical aspects of plant and electrical installations at the mine,

The overall life cycle of plant and installations involves the following phases:

- design
- manufacture
- installation

- commissioning
- operation
- maintenance (including repair and overhaul)
- decommissioning

It is preferable to eliminate and/or minimise the risks from plant and installations during the design phase by eliminating hazards and risks before plant is introduced in the workplace. Consideration should be given during the design phase to the risks that may arise in the other life cycle phases. For example, designing guards that allow routine maintenance activities to be undertaken without having to remove the guard.

The mine operator should provide relevant information to designers, manufacturers, importers and suppliers about the intended use of the plant or structure, its intended operating environment and conditions, together with any specific controls required by the mine and legislation. This will help the mine operator meet their obligations in relation to the EECP and other duties relating to plant and structures.

Refer to Appendix B for additional information explaining lifecycle and its application to the EECP.

4.3.2 Reliability of electrical safeguards

> b) the reliability of electrical safeguards used at the mine to protect persons from electrical or other hazards,

Electrical safeguards are those controls that use electrical technology to manage risks.

A control provided for a particular risk should be expected to perform with a predictable level of reliability. Where it is identified that a control does not have the required level of reliability, then other additional controls will need to be provided, either to provide additional layers of protection or to provide indication that the control has failed. Where there is only a single control for a risk, then the fault indication should cause the plant to be brought automatically to a safe state. This is normally a stop condition.

Where there are several independent layers of control for a risk, the failure of a control should, where possible initiate alarms to warn operators that the control has failed and allow for operators to bring the plant or installation to a safe state. A layer of control for a risk is only independent from another layer if, in the event of it failing, it does not impact upon the effectiveness of the other layer to enable the plant to be brought to a safe state.

Electrical controls are often provided to control risks associated with hazards other than electricity. A list of other hazards is provided in figure 3 of section 3.2 of the code. The hazards identified in figure 3 will normally be assessed under a different management or control plan where the need for the electrical safeguard will be identified by persons other than electrically competent persons. It is important that where these electrical safeguards are identified that they are then analysed, as per any other electrical safeguard in accordance with the requirements of the EECP, to ensure that they will adequately control the potential risk and provide the necessary level of reliability. For example, light curtains are used to stop movement of plant if persons enter a restricted work space.

4.3.3 Electrical engineering and electrical work practices

> c) the electrical engineering and electrical work practices to be employed at the mine,

Electrical engineering practices are the activities undertaken during for the lifecycle of electrical plant and installations to implement and maintain risk controls. These practices include how to work safely with the plant and installations (such as isolation procedures), permit to work systems, testing of electrical installations and access to electrical installations by qualified persons. Electrical engineering and work practices control risks by providing for each phase of lifecycle (see 4.3.1 above).

Further details of engineering practices undertaken during the lifecycle of plant and installations are contained in Appendix B.

4.3.4 Competency of workers

(d) the competency required by workers to safely work on electrical plant or electrical installations at the mine.

Performing electrical work requires competent workers who are able to recognise risks associated with the use of electricity, understand the actions necessary to work safely and have appropriate standards of workmanship.

The EECP should specify:

- minimum experience, qualifications and skill levels for electrical workers for various types of work
- arrangements for varying levels of supervision for electrical work
- competency requirements to undertake work on hazardous area plant and installations, referring to documents such as AS/NZS 4761
- qualifications and competency requirements for a person who is to carry out the statutory function of electrical engineering manager or electrical engineer, if required at the mine (see Schedule 10 of the WHS (Mines) Regulations)
- qualifications and competency requirements for persons to undertake or supervise electrical work, where an electrical tradesperson is required (see Schedule 10 of the WHS (Mines) Regulations), or in any other case.

Note: For a definition of electrical work refer to clause 146 of the WHS Regulations and the *NSW Code of Practice: Managing Electrical Risks in the Workplace*.

Other matters that the EECP should consider addressing are:

- legislative requirements to be met in terms of Schedule 10 for statutory functions (see above in 2.3 of code)
- some tasks may not require qualifications, such as PLC programming, but will have to be undertaken under supervision of qualified persons and in accordance with management systems for the mine, such as Change Management
- Appropriate supervision, depending on the level of risk and the competence of the people involved in a task
- for underground mines, (apprentices and trainees aged over 16 years but under 18 years) clause 36 of the WHS (Mines) Regulations has specific requirements regarding permitted work and supervision requirements
- competence requirements for positions to be involved in implementing the EECP, such as national units of competence (see http://training.gov.au.). This may include competencies for risk management for workers such as electricians, auto electricians, plant mechanics and mechanical fitters. An assessment system may be necessary to provide for competencies to be current. Refresher training should be considered, particularly when activities are undertaken infrequently.
- that the mine operator must ensure each worker is trained and competent in basic risk management techniques used at the mine (refer to clause 104(3) WHS (Mines) Regulations).

4.4 Risks for which controls must be set out in the EECP

The EECP must set out control measures for the following risks to health and safety associated with electricity at the mine, as set out in Schedule 2 clause 3(2) of the WHS (Mines) Regulations:

Schedule 2 Principal control plans – matters to be addressed

3 Electrical engineering control plan

...

(2) An electrical engineering control plan must set out the control measures for the following risks to health and safety associated with electricity at the mine taking into account the matters set out in subclause (3):

(a) injury to persons caused by direct or indirect contact with electricity,

(b) injury to persons caused by working on electrical plant or electrical installations,

(c) the unintended initiation of gas or dust explosions,

(d) the unintended operation of plant,

(e) the occurrence of uncontrolled fires.

Electrical risks stated in this provision can be summarised as involving the following consequences:

- Electric shock causing injury or death
  - may be received by direct contact with an energised conductor
  - may be received through indirect contact, such as tracking through or across a medium, or by arcing, that is a part that is not normally energised becomes energised due to a fault (for example metal frame covering of a welding machine, fence, wet or damp surfaces)
  - from 'step-and-touch' potentials resulting either directly from an electrical fault or transferred from an electrical fault at a different location
  - causing falls from height, for example scaffolding, following an electric shock.
- Arcing, explosion or fire causing burns or death, resulting from
  - arcing, explosion or both, occurring when high fault currents are present
  - plasma and molten metals being ejected from the arc
  - concussive injuries from the pressure wave associated with an explosion/blast
  - fire related to an electrical fault.
- Toxic gases causing illness or death, resulting from
  - vaporisation of metals and other materials
  - burning and arcing of electrical insulation materials.
- Unintended operation of electrically controlled plant or equipment may cause crush injuries or entrapment resulting in injury or death, possibly through the incapacity of the operator, defective design, interference from external sources (EMI) or a circuit fault and so on.

Other injuries or illnesses may include muscle spasms, palpitations, nausea, vomiting, collapse and loss of consciousness. There may also be other injuries if these events occur while a person is working at heights e.g. falls.

Consideration should also be given to human factors when assessing these risks and developing controls such as any one or more of the following items:

- managing human failures such as errors and violations for example not following procedures
- making procedures user friendly
- fatigue from shift work and extended working hours

- safety critical communications
- design of the work environment and plant for people use, for example ergonomics, alarms, lighting

For more information on human factors, refer to the UK regulator for WHS (http://www.hse.gov.uk/humanfactors/).

4.5 Matters to be taken into account when developing control measures

When developing control measures for the risks set out in Schedule 2 clause 3(2)(a)-(e) above in 4.3 to be implemented through the EECP, the matters in Schedule 2 clause 3(3)(a)-(v) set out below must be taken into account:

Schedule 2 Principal control plans – matters to be addressed

3 Electrical engineering control plan

(3) The following matters must be taken into account when developing a control measure referred to in subclause (2)

(a) the location of the electrical equipment and electrical installations at the mine,

Electrical plant and installations at the mine should be located so that they are not prone to damage. Damage may result from impact, ingress of water, chemicals or dust, temperature extremes, vibration or radiation and so on.

The EECP should identify the requirements to be considered in determining the location for electrical plant or installations that will minimise the likelihood of damage. Consideration should also be given to minimising the requirements for people to access these electrical installations to minimise the likelihood of injury in the event of catastrophic equipment failures. Locations should also provide for adequate room to enable people to work safely on the plant and installations.

People may refer to the mine survey plans or mine plans (Part 5 clauses 122-123 of the WHS (Mines) Regulations) for details (as applicable) of other services, workings and facilities at the mine that may impact on where electrical equipment electrical installations are located at the mine.

In developing controls in relation to this matter, consideration should be given to the following:

- AS/NZS 3000 *Wiring Rules*,
- AS/NZS 3007 *Electrical equipment in mines and quarries – Surface installations and associated processing plant*, and
- AS 2067 *Substations and high voltage installations exceeding 1 kV a.c.*

For underground operations there are no published Australian or international standards. However, the above principles can be applied in an underground situation.

(b) the rating and design of plant for the prospective electrical fault level, electrical load, operating frequency, operating voltages and arc fault control,

The purpose of providing switchgear and other electrical plant and installations that is rated and designed appropriately is to minimise the possibility of injury to switchgear operators and other workers, and minimise the catastrophic failure of the switchgear from fires caused by overheating or arcing that results in arc flash or blast.

The EECP should identify the design requirements for electrical plant and installations and provide for:

- switchgear and cables that are capable of carrying the maximum prospective fault current for appropriate time durations. Ratings should be based on the settings of the backup protection devices and not the primary protection devices.

- the rating of various components being suitable for the required operating conditions, including ambient temperatures, relative humidity, dust and so on.
- selection of cables that are designed and installed to minimise the effects of higher order frequencies associated with harmonics and switching frequencies associated with variable speed drives.
- electrical plant and installations having appropriate voltage ratings, including switching transients and under fault conditions.
- control of electromagnetic emissions to within acceptable limits.

(c) the design and operation of any electrical equipment that contains flammable liquid,

Flammable liquids used in association with electrical equipment may create other hazards that will require the development of additional specific controls. For example, insulating and cooling fluids may present the risk of fire and potential for noxious gases to be given off during combustion.

The EECP should detail the safety measures required for the safe installation, use and handling of any flammable liquids in and around electrical plant and installations. Considerations should include measures to control:

- the likelihood of a fire occurring
- the consequences if a fire occurs, including management of noxious and toxic gases that result from overheating or fires
- direct contact with fluid.

In developing controls in relation to this matter for surface electrical installations, consideration should be given to the following:

- AS/NZS 3000
- AS/NZS 3007
- AS 2067

For underground operations, the principles contained in the above standards should also be considered.

For additional information refer to the Queensland *Recognised Standard 01. Underground electrical equipment and electrical installations.*

(d) the carrying out of the selection, installation and use of electrical cables and electrical cable accessories at the mine

For underground coal mines, there are additional requirements in relation to cables, particularly in a hazardous zone. See 5.2.6 ‘Cables’ of this code.

The selection and installation of different types of cables can have significant impact on the safe operation of plant and installations at the mine. The method of installation and the characteristics of the electrical supply network will greatly impact the types of cables required to be selected. Refer to element (b) above for guidance on rating factors to be considered.

The EECP should identify the types of cables and accessories suitable for use with the plant and installations at the mine. This should include factors to be considered in determining the ratings of cables. Consideration should also be given to the following:

- the use of reeling, trailing and flexible feeder cables with individual conductor screening and the use of phase barriers in associated cable accessories

Note: This has proven to be a reliable risk control at underground coal mines.

- reeling and trailing cables that conform to AS/NZS1802 or to AS/NZS 2802

Note: Where load currents exceed 20 amps, starting and/or normal running conditions may result in the voltages being induced in earthing conductors of reeling or trailing cables of mobile equipment. Consideration should be given to the use of symmetrical cables to minimise any potential touch voltages at the machine end of the cable.

- voltage rating of cable insulation to withstand transient voltage rise associated with earth faults on earth fault current limited systems

Note: Phase voltage will rise to equal line voltage when an earth fault occurs in an earth fault current limited system.

- cable accessories for use with reeling, trailing or flexible feeder cables should comply with AS/NZS1299 or AS/NZS1300
- guidance on selection criteria for general use cables in mine installations can be found in AS/NZS 3000, AS/NZS 3007 and AS 2067.
- for cable selection for low voltage systems, also refer to AS/NZS 3008 part 1

(e) the control of static electricity at the mine, including preventing the ignition of flammable gas

Where it may be possible to have flammable gases (which may create an explosive gas atmosphere) present at a mine, measures must be taken to prevent the generation of static electricity, which can act as a potential ignition source.

The EECP should identify control measures to prevent the discharge of static electricity such as:

- earthing and bonding on plant
- the use of items of plant with proven antistatic properties
- testing of other items of plant to establish anti-static properties.

This also includes non-electrical plant and other items such as clothing, compressed air equipment and hoses, piping and conveyor belting and accessories that may also create a static electricity risk.

For underground coal mines, there are specific requirements relating to static charges (see 5.1 of the code below for more details).

(f) the impact of lightning on the mine (especially on an underground mine) including the effect on electrical systems,

Due to the risks from lightning, including possible presence of flammable or explosive gases in a mine, measures must be taken to prevent its consequences.

Lightning also has the potential to create an electric shock hazard. This can occur in the underground parts of a mine as well as the surface parts.

Lightning can also cause unintended operation of equipment due to overvoltage on electronic components or by overcurrent and overvoltage surges. Overvoltage can also result in damage to insulation of both power systems and electronic components.

The EECP should identify the methods required to prevent or minimise the effects of lightning being transferred to any underground workings or to the supply systems.

In developing controls in relation to the impact of lightning on the mine, consideration should be given to the following:

- *AS 1768 Lightning protection*. This includes guidance in the undertaking of risk assessments associated with lightning.
- AS/NZS 3007 Electrical installations – Surface mines and associated processing plant.
- ACARP Report C22003 for potential lightning impacts in underground coal mines.

(g) the need for reliable circuit interruption for all points in the mine's electrical distribution system when faults occur taking into account the operating time and tripping current of circuit

protection devices,

Electrical circuits at a mine may be subject to electrical faults at some time during their lifecycle. An electrical fault can be considered an uncontrolled release of electrical energy. Reliable detection of this uncontrolled release and the automatic disconnection of the electricity supply is essential to minimise the risk to people and damage to plant and installations.

Reliable circuit interruption (which includes switchgear and the means of detecting a fault) must be fitted to all circuits to interrupt the supply when a fault occurs on any circuit or sub-circuit at the mine (refer to clause 32(n) of the WHS (Mines) Regulations).

The EECP should identify protection equipment and switchgear specifications and ratings to achieve reliable circuit interruption under normal operating conditions and under fault conditions that may occur in the different circuits and sub-circuits in the mine's electrical distribution system.

Circuit fault detection and protection devices should include:

- short circuit protection on all circuits and sub-circuits
- over current protection on all circuits and sub-circuits
- earth leakage protection on all final sub-circuits
- earth fault protection on all circuits other than final sub-circuits

Note: Earth fault protection may be provided through the use of correctly rated fuses on solidly earth supply systems. Earth leakage protection cannot be provided through the use of fuses.

- earth continuity protection on circuits that supply mobile or transportable plant fed via reeling or trailing cables
- RCD protection should be provided on all low voltage (LV) circuits and sub-circuits rated at 20 amps or less. (refer to clause 32(2)(o) below for more details).

There may be exceptions to the above such as:

- supply authority mains
- circuits fed at extra low voltage
- circuits that are isolated from earth

Isolated circuits provide safety only in respect of the first fault that occurs on that circuit. Subsequent faults will still present a significant risk to personnel through electric shock or unintended operation of plant where sections of a control circuit may be bypassed or defeated by the multiple faults in the circuit. Where an isolated circuit is used, the EECP should require that consideration be given to the use of insulation monitoring systems to detect if there has been a reduction in the required level of insulation resistance (the first fault) on that circuit.

The EECP should also address what protection is required on different circuit types and the settings required for the different protection devices being used.

For additional information refer to WHS Regulations and AS/NZS 3000.

(h) the type of earthing system used, including levels of earth fault limitation,

The method of connecting a power supply to an earthing system can be done in different ways:

- The transformer may be solidly connected to the earthing system.
- The power supply may be connected via a current limiting device, normally a resistor, so that the maximum earth fault current is limited to a maximum value or the power supply may be isolated from the earthing system.

Different configurations have their own particular benefits and their own particular drawbacks. One advantage of current limited systems is the significant reduction in the likelihood of arc blast incidents. Another is a reduction in prospective touch voltages during earth faults.

The EECP should require that an engineering earthing review be conducted to identify and analyse the risks that need to be controlled. It should then identify the most appropriate earthing system to be used in different situations.

Where an earth fault current limited system is used, it is important to identify the maximum value of current that is permitted to flow without creating dangerous step and touch potentials. Increases in earth fault currents will result in increased touch potentials under fault conditions, where as a decreased earth fault current may result in a failure to detect and clear a fault.

The EECP must include the specific risk controls required under clause 32(2)(l)(i) of the WHS (Mines) Regulations, that is, to ensure the magnitude of earth fault currents to all electrical plant in an underground mine, and all mobile plant fed via flexible reeling or trailing cables in any other mine is limited in order to control step and touch potentials.

In determining the type of earthing system, and the maximum value of earth fault current permissible, consideration should be given to guidance material contained in AS/NZS 3007. For underground mines, consideration should also be given to guidance material contained in AS/NZS 4871.1 for levels of earth fault limitation.

The EECP should also require that devices provided for the purpose of limiting earth fault currents be compliant with AS/NZS 2081.

(i) the potential for persons to contact electricity indirectly,

This may be caused by water or other conductive substances entering electrical equipment and providing a path across the surface of insulating materials that conducts the electricity to places and objects that are not normally energised. This path may be along a cable sheath to ground or to other equipment or across multiple layers of insulation. Common sources are light switches, motor isolators exposed to the weather, double insulated hand held tools and so on.

Effective control measures include protection from the weather, IP ratings, effective earthing of metal enclosures of electrical equipment, sensitive earth leakage and effective maintenance practices.

The EECP should identify:

- suitable locations for the installation of electrical plant (refer to sub clause 3(a) above)
- IP ratings for electrical plant and installations. This is dependent on the required locations for installation, for example equipment installed in a location exposed to the weather and high levels of dust will require a higher IP rating than equipment installed inside a sealed and air conditioned switchroom.
- suitable locations for the use of portable tools. These should not be permitted in wet environments or where perspiration may impact on the safe use of the tool
- earthing requirements for electrical enclosures
- earth fault settings on circuits supplying switch boards
- earth leakage settings on equipment fed from switch boards
- the maintenance practices necessary to maintain the electrical equipment in the designed condition. This will include visual inspections, along with detailed internal inspections and electrical circuit testing.

For additional information also refer to:

- AS/NZS 3000
- AS/NZS 3007

- AS/NZS 4871 series
- AS/NZS 3760

(j) the prospective touch, step and transfer voltage,

Prospective touch, step and transfer voltages are governed by several factors. These include prospective fault currents that can range in magnitude from tens of thousands of amps in direct earthed supply systems to only several amps in current limited earth fault systems. The resistance of the earthing systems will also impact these voltages.

Effective earthing must be provided, so far as is reasonably practicable, so that the risk from touch, transfer and step potentials are minimised, and lightning effects are not transmitted into an underground operation. The mine operator must also ensure earth fault currents to mobile plant (fed by flexible reeling or trailing cables) at any mine and underground plant are limited (clause 32(2)(l)(i) WHS (Mines) Regulations).

The EECP should identify the maximum prospective touch, step and transfer voltages for the mine. It should also identify the processes to be followed as part of:

- the design phase of electrical installations – to control touch, step and transfer potentials
- the design of conductive structures associated with, or that are in close proximity to, electrical installations – to control touch and transfer potentials
- maintenance practices required to ensure that the earthing systems continue to perform in the same manner that they were designed to perform
- the review of supply system characteristics, such as increases in prospective fault levels
- the review of electrical protection device settings to minimise the duration that faults currents may flow, thereby limiting the duration that elevated touch, step and transfer voltages may be present for.

Mine operators must have designs of earthing grids engineered to achieve the necessary level of effectiveness that will ensure that touch, transfer and step potentials experienced under fault conditions do not present a significant risk (refer to clause 32(2)(i) WHS (Mines) Regulations). A generic design of earth grid will not achieve the same level of performance in all situations.

Each earthing installation requires its own design as step, touch and transfer potentials are governed by multiple variable factors such as:

- soil resistivity
- fault currents
- the layout and positioning of the buried conductors.

Where mobile plant (fed via reeling or trailing cables) is used, the specifications for earthing should include the levels of earth fault limitation required to enable the required levels of touch or transfer voltages to be achieved. It should also provide for reliable operation of any electrical protection systems associated with the mobile plant.

An engineering earthing review should be conducted for all underground earthing systems. It may determine that the underground earthing system should or should not be connected to an earthing system at the surface of the mine. Where the point of earth connection is designed to be underground, there should be no increase in risk.

All earthing conductors should be electrically continuous and in effective electrical connection with an earthing system and the apparatus that they are intended to earth.

For additional information also refer to:

- AS/NZS 3007
- AS/NZS 3000
- AS 2067

- AS/NZS 4871.1

(k) variations in operating conditions,

Variations or fluctuations in electricity supply can result in unintended operation of electrical equipment or in the failure of insulation systems or switchgear. These effects may be caused by voltage instability associated with long runs of cables, frequency changes, switching transients or load fluctuations and may also result from weak supply networks or from undersized or faulty generators.

The EECP should consider the effects of variations in electricity supply such as:

- voltage rise
- voltage instability
- voltage droop/sag
- loss of supply

(l) preventing persons inadvertently contacting energised parts of electrical plant and electrical installations,

It is essential that physical barriers and/or electrical safeguards are put in place to protect people coming into contact with electricity, which can cause injury or death through electric shock.

The EECP should nominate the standards required to prevent the inadvertent contact with energised electrical components and electrical plant and installations. This may include a combination of guarding, interlocking and IP rating of equipment, along with effective signage.

Examples of such devices or features include:

- electrical enclosures
- shielding
- double insulation
- electrical or mechanical interlocking devices.

Note: any modifications to electrical plant and installations should comply with the relevant standards and should not result in a lower standard than that originally provided, in particular safe access to and within electrical enclosures.

For further information refer to:

- requirements of clause 208 of the WHS Regulations for guarding
- AS 2067
- AS/NZS 3000
- AS/NZS 3007
- AS/NZS 4871 series
- AS 60529.

(m) the consultation, co-operation and co-ordination of activities between persons conducting businesses or undertakings at the mine (including the mine operator) and persons conducting businesses or undertakings installing, maintaining or carrying out work on an electricity supply authority's infrastructure,

Electrical transmission and distribution systems often cross mining operations. Where these do not directly supply electricity for mining activities, they often supply the local community or are

part of the state transmission system. Electricity supply authorities will need safe access to undertake work on this infrastructure.

Under WHS laws, the mine operator must consult, cooperate and coordinate with other PCBUs who have a duty in relation to the same WHS matter. This should include relevant electricity supply authorities (and/or any other PCBU involved) in relation to persons who work on an electricity supply authorities' infrastructure who may be affected by the mining operations or the effects of the work undertaken by the supply authority impacting the mine.

The EECP should specify provisions to provide for the safe access for supply authority workers undertaking work on the supply authority's infrastructure. This means supply authority workers are not being put at risk from the mine's activities.

Communications and protocols should be established for access to and from the work site, including the development of emergency plans that are understood by all, and provisions for the supply authority to report any incidents that are notifiable under WHS laws.

Note: the plan may also cover the safe access for other utilities that may need to have access to their infrastructure at the mine, for example, electrified railways or telecommunications towers.

(n) the procedures for the following:

(i) the use of electrical welding plant,

Welding operations are often carried out at mines, where the environment increases the risk of electric shock, explosion, fire or electrocution. Selection of the most appropriate welding machines and hazard reduction devices are critical to control the risks that are created or exacerbated due to the environment. These factors may include elevated temperatures, humidity, moisture, working while in contact with the work piece or structure and so on.

The EECP should identify the minimum standards for welding plant suitable for use at the mine. These should include reference to the following:

- AS 60974.1 specifies requirements for arc welding power sources designed for professional and industrial use
- AS 60974.6 specifies requirements for limited duty arc welding and allied process power sources

The EECP should also include requirements relating to the use and maintenance of welding plant. Reference should be made to AS/NZS 1674.2 for guidance in respect of the safe use, including selection of welding plant suitable for a particular environment, and for maintenance requirements of welding plant.

Where welding is to be conducted in the hazardous zone of an underground coal mine, the EECP must require a high risk activity notification be submitted to the regulator (clause 33 and Schedule 3 clause 11 of the WHS (Mines) Regulations). Due to the risks involved with welding in underground coal mine hazardous zones, consideration should be given to whether there are safer alternative methods of equipment repair, such as moving the item to a safer location for welding.

For additional guidance information on the use of electric welding equipment refer to:

- MDG 25 *Guideline for safe cutting and welding at mines*
- TN 22 *Welding Electrical Safety,* Welding Technology Institute Australia.

(ii) the use of electrical test instruments,

Test instruments should not cause the circuit being tested to become a source of electric shock, arc flash/ blast, cause unintended operation of plant or compromise any explosion protection properties. The exception to this is for the use of insulation test instruments, which by nature of the test performed, will energise circuits to voltages greater than the nominal circuit voltage.

Where these test instruments are used, it is important to follow any instructions and warnings provided with the instrument.

The EECP should specify procedures to ensure:

- the safe use of electrical test instruments, which should include measures to eliminate or control the risk of inadvertent contact with electricity. Reference should be made to AS/NZS 4836 *Safe working on or near low-voltage electrical installations and equipment* for guidance in procedures for fault finding or testing of circuits
- that appropriate test equipment is only provided to and used by appropriately trained persons (refer to the Standards Australia Handbook 187 '*Guide to Selecting a Safe Multimeter*' and the NSW *Code of practice: Managing electrical risks in the workplace*, if necessary)
- that appropriate personal protective equipment is used by the people conducting the tests
- the maintenance of test equipment in a safe condition
- the calibration requirements for identified items.

Additionally, when undertaking testing on an energised circuit, testing must be conducted in the presence of a safety observer, where required, as per the requirements for live electrical work under clause 161 of the WHS Regulations. The safety observer must be competent to implement control measures in an emergency and rescue the worker if necessary.This should include competency in cardio-pulmonary resuscitation.

Where tests are routinely carried out as part of maintenance, calibration or fault finding, the plant and equipment should be designed with appropriate diagnostics and/or suitably protected test points that are only accessible to competent electrical people.

Where electrical test equipment is used in a hazardous zone of an underground coal mine, the EECP must require the use of electrical test equipment that complies with the requirements of clauses 78-80 and 82-83 of the WHS (Mines) Regulations (see 5.9 'Testing' in code for more information).

(iii) work near overhead power lines and cables,

Contact with overhead power lines is a source of electrocution.

The EECP should require:

- site plans showing the location of all overhead power lines and cables at the mine, which is readily accessible to workers where relevant to their work

Note: A mine operator may choose to have three dimensional plans if appropriate for their mine.

- procedures for work near overhead power lines and cables
- provision of signs warning of overhead power lines and cables
- periodic checking of travel clearance around overhead power lines and cables.

The EECP should also require management systems that restrict work activities and approach distances to the overhead lines in accordance with Section 7 of AS/NZS 3007.

Note that clause 166 of the WHS Regulations has specific requirements in relation to working near overhead and underground electrical lines – see 4.7 below.

(iv) the treatment of electric shocks and electric burns,

When contact is made with electrically energised objects, current flows through the body and can affect the rhythm of the heart. If current levels are high enough this can also cause damage to muscles including the heart, which can cause respiratory distress and cause burns to internal parts of the body and to skin. The effect of electric shock can also result in altered states of consciousness and in some instances may also result in broken bones.

Arc blast injuries can result in burns due to thermal energy, concussive injuries due to pressure shock waves, hearing damage, injuries due to flying particles and objects, and damage to airways due to hot gases and vapourised metals.

Contact with high voltage may also result in additional effects. The effects of this may be temporary but may also be irreversible, resulting in the death of cells affected. These effects are determined by factors such as the voltage level and the exposure time.

It is important that where a person has been subjected to high currents, that is earth leakage systems have tripped, or to high voltages, the values of these currents and voltages should be documented and provided to the persons undertaking the assessments. In some situations it may be prudent to seek additional medical opinion or advice.

The EECP should identify, or link to other management plans, the protocols necessary for the effective management of electric shock, electrical burns and arc blast injuries. These should require that any person that has received an electric shock be referred for immediate medical assessment. This assessment should include, as a minimum, a 12 lead Electrocardiogram (ECG) so as to detect any irregular heart rhythms. This should occur even where the person who received the electric shock does not feel unwell.

It is recommended that this should be conducted, and the results assessed, by competent medical personnel. Any abnormalities should be referred immediately for proper assessment, treatment and care by competent medical personnel. Burns and arc blast injuries require immediate medical treatment.

For further information refer to Appendix C3 –Electric shock protocol.

(v) accessing and working on high voltage electrical installations,

For high voltage installations to be operated safely throughout their lifecycle, procedures for switching and access should be established and implemented, along with procedures for safe removal and restoration of power in other circumstances.

Workers undertaking high voltage switching and access should be trained in the principles used for safe access and be assessed as competent, and authorised by the operator to undertake these switching and access activities at that mine.

The EECP should identify the competency requirements for workers, and the procedures required when switching high voltage for the purposes of accessing and working on electrical conductors. As a minimum, these procedures should require the use of switching and access permits and provide for:

- safe operation of switchgear
- testing for de-energised
- issuing and receipt of the permits, for the purposes of undertaking work and for undertaking testing of circuits and plant
- application of locks to isolation points and operator earthing facilities to prevent inadvertent energisation
- the application of permit earths and working earths.

(o) signage and notices in relation to the risks arising in relation to particular electrical plant and electrical installations such as electrical switchgear,

Even though signs are a low level risk control, they are an important reminder of hazards and provide information that is essential to effectively manage risks associated with plant and installations.

The EECP should identify what signs are to be displayed for electrical plant and electrical installations and where they are to be displayed. The signs may need to provide for one or more of the following considerations:

- clearly identify the plant
- warn of the presence of electricity and if necessary restrict access
- provide advice on what to do in the event of a fire on electrical plant and installations, including items such as emergency contact numbers
- 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 plant or installation
- for electrical switchgear, provide advice on what electrical plant and installations the switchgear supplies.

For general guidance on signage refer to:

- AS/NZS 3007
- AS/NZS 4871.

(p) the security and maintenance of the mine's electrical control system software and control circuits,

Modifications of plant control systems (software and hardware) can lead to catastrophic events if not managed in a systematic manner. For example, unintended operation of plant may lead to serious injuries to persons operating or working in proximity to the plant.

The EECP should require the use of change management procedures that provides for control system changes to be authorised by a competent person, prior to modification work commencing. The modifications and other functions that may be impacted by the modification are commissioned, documented and verified as achieving the intended outcomes.

Note: A person with the management or control of plant has a duty to ensure, as far as is reasonably practicable, that there are no unauthorised alterations or interference with plant (clause 205 of the WHS Regulations).

(q) the use of lasers and fibre optic equipment at the mine,

Lasers pose a hazard to people's vision and can also initiate an explosion due to the heating of dust particles. The risks can be associated with direct exposure to the laser light source or as a result of damage to fibre optic cables.

The EECP should address the following:

- the use of lasers in accordance with AS 2397 *Safe use of lasers in the building and construction industry*.
- prohibiting the use of Class 3B or Class 4 lasers and laser products as defined in AS/NZS 60825.1 *Safety of laser products Part 1: Equipment classification and requirements*.
- potential ignition hazards pertaining to equipment using optical radiation in explosive atmospheres, refer to AS/NZS 60079 Part 28*: Explosive atmospheres - Protection of Equipment and Transmission Systems using optical radiation*.

(r) the construction, installation, and maintenance of battery powered vehicles and battery charging stations at the mine,

Guidance is provided for each of the following areas to satisfy what factors should be taken into account in developing controls under the EECP.

Battery vehicles

Battery powered vehicles and machinery should comply with AS/NZS 4871 Parts 1 and 5.

Battery charging stations

Where installed on the surface of a mine, charging stations should:

- be placed in a suitable location as set out in AS/NZS 3000 (which references AS3011)
- be housed in a suitable location, such as a designated room or enclosure set aside specifically designed for that purpose
- be fitted with fire alarms and fire extinguishing equipment
- be assessed in accordance with AS/NZS 60079.10.1 to determine the extent and classification of any hazardous areas.

Where installed in an underground mine, charging stations should:

- have provision for the removal of power in an emergency (in an underground coal mine, an emergency stop on the intake side of the charging station)
- not be located in a hazardous zone in underground coal mines,
- be ventilated direct into a return airway
- be housed in a suitable location, such as a designated room, enclosure or cut through set aside and specifically designed for that purpose
- be assessed in accordance with AS/NZS 60079.10.1 to determine the extent and classification of any hazardous areas for the purpose of determining suitability of ancillary electrical systems such as lighting, gas monitoring and so on.
- be fitted with fire alarms and fire extinguishing equipment.

(s) the supply of electricity in hazardous atmospheres and, in the case of underground coal mines, in hazardous zones,

Electricity presents a significant hazard as an ignition source when used in a hazardous atmosphere (explosive gases, combustible dusts and so on) and in the case of underground coal mines, hazardous zones. Where it is necessary to use electricity in a potentially hazardous environment, controls such as electrical protection systems, earthing systems, explosion protected equipment and monitoring of the environment must be correctly designed and implemented to ensure the safety of workers and the installation. Workers must also be suitably trained and competent to install and maintain these electrical supply systems. This requires a high level of rigour in the development, implementation and review of management systems.

Electrical protection and earthing design are considered to be a specialist tasks. For hazardous atmospheres, the EECP should require that any electrical protection and earthing design is carried out by competent, qualified workers familiar with the constraints imposed by the particular hazardous environment.

The EECP should also detail competencies required of the workforce that will be required to install or maintain electrical plant and installations within the hazardous area.

For hazardous zones of underground coal mines, the EECP must address the requirements for earth fault current limited supply networks that are fitted with protection relays that detect and initiate tripping of power in the event of overload, short circuit or earth leakage conditions (as per clauses 32(2)(l)(i), (n) and (o) of the WHS (Mines) Regulations – refer to 4.6 below. Cables must not be used in a hazardous zone unless they comply with clause 80 of the WHS (Mines) Regulations.

For underground coal mines, refer to WHS (Mines) Regulations clauses 78-80, 82-83 for specific risk controls essential for the safe use of electricity in hazardous zones. See also Chapter 5.

(t) the use of electrical plant in hazardous atmospheres and, in the case of underground coal mines, in hazardous zones,

Electrical plant and installations in hazardous atmospheres and, in the case of underground coal mines in hazardous zones, should be fit for purpose and used in a safe manner and under competent supervision to prevent them becoming a source of ignition. This includes portable electrical equipment.

Electrical equipment on the surface of a mine is required to be installed in accordance with the requirements of AS/NZS 3000:2007 (refer to clause 32 WHS (Mines) Regulations). The EECP should address the particular requirements of that Standard in relation to installations in hazardous areas. Preventative measures should include the use of equipment that is certified as explosion-protected and is used in accordance with any conditions of certification. In certain circumstances, certified explosion protected equipment may not be available.

In hazardous atmospheres and hazardous zones, the EECP should require that where certified plant is available that performs the required functions effectively, this should be used in preference to non-certified plant, even though the non-certified plant may be exempted from the requirements to have explosion-protection properties under the WHS laws (such as certain portable electrical plant under clause 79 of the WHS (Mines) Regulations).

Where suitably certified plant is not available to perform necessary work activities, the EECP must identify control measures that minimise the likelihood of the plant becoming an ignition source and provide for more stringent control of the atmosphere it operates in. These control measures should include specific check lists that:

- consider ignition risks posed by the use of the plant to determine if suitable for use at the mine
- verify the plant is in good working order prior to use of the plant and is the same as the plant originally inspected for suitability at the mine
- verify the atmosphere and the environment in which the plant is to be used achieves the required safety levels.

In hazardous zones of underground coal mines, specific requirements must be met for electrical plant and installations to be explosion-protected (refer to clauses 78-80, 82-83 of the WHS (Mines) Regulations). In underground coal mines the EECP should include procedures for the immediate removal of plant to a safe location where the plant or the environment is found to no longer meet the requirements or exceptions in clauses 78-82 for use in a hazardous zone. In the event of the minimum ventilation requirements not being met, clause 71 stipulates that the supply of power to electrical plant must be cut off by the quickest means available (other than explosion-protected plant referred to in clause 78(4). Additionally, clause 72 requires the use of continuous methane monitors that cut supply of electricity to face machines and the face of any longwall, shortwall or miniwall operation, when certain methane levels are exceeded or the monitor malfunctions or fails.

Note: also refer to Chapter 5 below for general guidance on managing the risks in hazardous zones.

(u) safe work systems for persons dealing with electrical plant and electrical installations including the isolation, dissipation and control of all electrical energy sources from the electrical plant or electrical installation,

In relation to plant and installations, a **safe work system** provides a means of working safely and is intended to eliminate or otherwise minimise risks to health and safety, so far as is

reasonably practicable, through the provision of information that enables tasks associated with the plant or installations to be undertaken in a safe manner.

Safe systems of work identify how a mine operator considers that work activities should be done by workers, particularly with regard to hazardous work processes. They are the instructions given to workers to enable them to perform the tasks in a safe and consistent manner.

In developing safe work systems, a mine operator should consider the hazards and associated risks relating to the proposed activity to determine the level of competence required of workers to be permitted or authorised to undertake the work activity, along with procedures or work instructions that will enable the task to be performed safely. The level of detail provided in work instructions will vary depending on the competence of the workers and the complexity of the activity.

When developing safe systems of work, consideration should be given to:

- the nature of the task
- the hazardous energies involved
- the potential for human error
- the complexity of the task and its frequency
- type of plant or installation and the particular hazards associated with the work environment at the mine
- electrical competencies, training and supervision needs
- provision of notices and warning signs
- resources required such as special tools and other plant
- communication needs such as between work areas and shifts
- available information, such as the designer's information.

The EECP should require that safe systems of work for activities relating to electrical aspects of plant or installations are to:

- be developed or checked by a person with appropriate electrical engineering competence
- describe how the work is to be carried out
- identify the work activities and associated hazards
- describe the control measures that will be applied
- identify specific equipment requirements, as applicable
- identify core competency requirements and any additional training needs
- involve detailed risk assessment methods where complex tasks and hazardous energies are involved
- involve work permit systems where higher levels of overarching control are required, such as for high voltage switching and access.

The failure to isolate sources of electrical energy before undertaking electrical work exposes workers to a high level of risk from electrocution, electric shock, burns and/or injuries resulting from ignition of flammable gas or dust.

Sources of electrical energy not only originate from mains supplied systems, but can also be from stored energy systems such as capacitors, inductors, storage batteries and more. Capacitive coupling from high voltage or high frequency systems and inductive coupling associated with high current systems also present significant hazards if not properly controlled.

It is important that safe systems of work be developed, implemented and applied to ensure that workers are able to identify and safely isolate, and where necessary dissipate correctly, sources of electrical energy to prevent injury to workers.

Reference should be made to MDG 40 *Guidelines for hazardous energy control (isolation or treatment)* and the AS 4024.1 *Safety of machinery* series of standards for further guidance on energy isolation and dissipation.

See also 4.6 clause 32(2)(d) for more information on the WHS (Mines) Regulations requirements for isolation facilities and signage.

(v) the use of switchgear and electrical protection devices that can automatically detect an electrical fault in a circuit and disconnect the supply of power to the circuit

Fault conditions associated with electrical power systems can expend significant quantities of energy in extremely short periods of time and have the capacity to cause significant injuries to workers.

To minimise the possibility of injury to workers, including risks from damage to plant and installations, it is important that the sources of electrical energy are disconnected as quickly as possible. This requires the use of protection systems that are capable of detecting the different types of faults that may occur on a circuit and automatically initiate the tripping of the associated switchgear (refer to clause 32(2)(n) and (o) WHS (Mines) Regulations). This switchgear must be capable of safely disconnecting the faulted circuit from the supply system without causing or exposing workers to other risks (refer to clause 32(2)(c) WHS (Mines) Regulations).

The EECP should identify the types of electrical protection devices required to be used at the mine to detect and initiate clearing of electrical faults that have potential to cause injury to workers. The EECP should also identify the types of switchgear that are to be used to provide safe interruption of electrical faults once identified by the protection devices.

4.6 Specific risk controls – WHS (Mines) Regulations

There are a number of specific controls required under the WHS (Mines) Regulations for all mines that apply to electrical plant and electrical installations at mines. A specific risk control is a mandatory requirement that must be complied with if that type of plant or installations exists at the mine.

Clause 32 contains many specific controls for electrical safety. The EECP for a mine must detail the arrangements that are required for the mine to achieve compliance with these specific risk controls.

WHS (Mines) Regulations

32 Electrical safety

(1) In complying with clause 9, the mine operator of a mine must manage risks to health and safety associated with electricity at the mine.

(2) In managing risks to health and safety associated with electricity at the mine, the mine operator must ensure:

(a) that electrical installation work at the surface is carried out in accordance with the Wiring Rules, and

Note: the above term 'Wiring Rules' means AS/NZS 3000:2007.

The EECP must specify that the design of any new electrical installations, or the modification of existing installations, at the surface of the mine eliminates or minimises the risks to WHS. In fulfilling this duty, the mine operator must ensure the requirements of the Wiring Rules are satisfied in relation to the installation. This includes the selection and installation of electrical equipment to be installed (including cables) and the verification (inspection and testing) of the completed work.

The EECP may identify that the installation be engineered to meet the requirements of Part 1 of the Wiring Rules, or be a "deemed to comply" solution as identified in Part 2.

(b) that before a circuit is first energised at the mine, or is first energised following the circuit being recommissioned:

(i) the circuit is tested in accordance with the Wiring Rules by a competent person, and

(ii) there is a process in place whereby the mine operator (or an individual nominated to exercise the statutory functions of electrical engineering manager or electrical engineer at the mine) can be adequately notified about that testing as soon as reasonably practicable after the testing occurs, and

Before power is turned on to a new installation, or a recommissioned installation, it must be verified that it is safe for use. The notification process confirms that appropriate commissioning and testing has been done.

The EECP should specify:

- all electrical installations are inspected and tested after they are installed and prior to being put into service, to demonstrate they are safe for use. As a minimum, these tests must include the mandatory tests identified in Section 8 of the Wiring Rules,
- the training, skills and experience required of a person that is to be deemed competent to undertake the tests required above. This would normally be a qualified electrical tradesperson.

Note: The EECP may also permit the undertaking of these testing activities when conducted under the supervision of a person competent for this purpose.

- the notification process to be used to provide information to a person who is competent to verify that the appropriate commissioning and testing has been done in compliance with the EECP requirements. The notification may be for internal purposes to the persons specified (for example work completion processes) and also for external notification for bodies, where required, such as supply authorities.
- a record is made and kept of all commissioning tests and/or tests resulting from a modification.

Commissioning and test reports should be kept by the operator throughout the life of the plant (whether in a digital form or hardcopy) and used to demonstrate that the plant or installation is fit for purpose and to assist in deciding whether plant can be modified and how.

(c) that adequately rated switchgear is provided that permits power to be safely switched off and safely restored and that does not permit automatic restoration of power if there is a risk of electric shock, fire, explosion or unplanned operation of plant, and

Adequately rated switchgear is switchgear that has:

- voltage ratings suitable for the maximum operating voltage of the system that it is required to switch, including transient conditions, such as an earth fault on an information technology (IT) network or a switching spike
- current ratings suitable for the maximum current that it is required to switch. Where required, this may include the ability for the switchgear to safely open a load or fault condition (fault-break), and may also require the ability to safely close onto a load or fault condition (fault-make). This may include motor starting, overload and/or overcurrent situations, and arc fault control capabilities where energy levels are high enough.

There are further requirements for switchgear in hazardous areas and hazardous zones that are explained in chapter 5 – Additional requirements for underground coal mines.

The EECP should provide guidance and instruction for the selection of switchgear that achieves the following:

- where there is a risk of electric shock or fire, switchgear should not be fitted with automatic reclose facilities. Such risks usually arise as result of damage to cabling systems and equipment where insulation has been compromised.
- where a risk of explosion exists (for example, if the loss of ventilation in a hazardous zone or hazardous area may lead to an accumulation of explosive gases or dusts), under-volt or no-volt trip facilities should be incorporated in to the switchgear to automatically open the switchgear and prevent the automatic restoration of electrical power from the hazardous location. The switchgear should be designed so that power can only be restored once the location has been inspected and shown to be clear of explosive gases or dusts.
- where there is a risk of an unplanned operation of electrical plant, the switchgear should be fitted with facilities that cause the switchgear to automatically switch off when there is a loss or interruption of supply, or a brown out condition (a condition where there is an excessive voltage dip in the supply, but not a total loss). This may require the use of under-voltage trip units where a brown out condition may cause erratic operation of plant.

In addition, the electrical distribution system should be sectionalised so that:

- action can be taken in cases such as emergency
- it does not unnecessarily affect other parts of the mining operations that are not involved or at risk.

These arrangements should be reflected in the mine electrical drawing plans, as appropriate, for uses such as identifying where power can be isolated.

(d) that arrangements are in place for switching the power off or restoring power as part of normal operations in the event of a fault or an emergency, and

In addition to the provision of suitably rated switchgear in strategic locations throughout a mining operation, facilities should be provided to allow for the operation of that switchgear in an emergency situation. These facilities may include emergency stop buttons placed at strategic and accessible locations, such as outside a switch room or in a control room so that anyone can remove power.

Procedures should be developed and workers trained in the correct operation of these emergency shutdown facilities.

In addition, communication facilities (such as telephones) should be provided at the switchgear locations. Protocols for communication with operators of switchgear at these locations should be developed and implemented in accordance with the emergency plan for the mine.

Procedures should also be developed and workers trained in the correct manner for restoration of electrical power. These procedures should detail competency requirements for workers that are to be permitted to operate switchgear for the purposes of power restoration, along with any inspection requirements that are necessary prior to the reintroduction of power to equipment or location. These include inspections for explosive gases, testing and inspection prior to resetting of electrical protection trips such as earth leakage, overload or short circuit faults.

(e) that, for electrical plant at the mine (other than plant connected, and in close proximity, to a wall socket with a switch):

(i) an isolation facility is provided, and

(ii) the equipment is clearly identified as being isolated from electricity by the facility, and

(iii) the facility is clearly identified as the isolator for the electrical plant, and

(iv) persons required to work with the electrical plant are competent in the correct use of the facility, …

An isolation facility is also known as an isolation switch or isolator.

Signs that clearly identify the plant that is supplied through the isolator should ensure that there is no confusion when isolating the plant.

The requirements for the signs (minimum size of printing, material of construction etc) should form part of the EECP arrangements (see 4.5 above).

Training must be provided to all workers that may be required to work with the plant to ensure that they know how to identify the correct isolation facility for the plant and how to operate the isolation facility correctly. In some instances, having workers switching isolation equipment may expose those workers to an increased level of risk, in particular where the isolations relate to very large (high current) plant, high voltage plant and installations, or where multiple isolations need to be implemented to establish a safe state. In these instances, permit systems should be used requiring isolations to be implemented by trained workers. The workers should be following previously identified work instructions authorised by suitably qualified supervisors.

See 4.5 Schedule 2 clause 3(3)(u) for more information on isolation, dissipation and control of all energy sources that must be considered in developing controls under in the EECP.

(f) that plans of the mine's electrical installations showing the following matters are kept and maintained as required and are easily accessible by each worker required to access them:

(i) the location of each main electricity reticulation line,

(ii) the location of all high voltage cables, aerials and switchgear,

(iii) the location, rating, identifying label and purpose of each main isolator, substation and high voltage switchboard

(iv) any information required to perform switching programs,

(v) the location of all known buried electrical services at the mine, and

(vi) in the case of a mine (other than an underground mine), the general location of each item of high voltage mobile plant supplied with electricity by a trailing cable,

(vii) in the case of an underground mine, the location of each fixed communication device at the mine, and

Refer to guidance in 4.5 (above) for Schedule 2 clause 3(3)(a).

Note: high voltage electrical installations must be shown on a mine survey plan (if installed at the mine). The plan should be updated whenever changes have been made to enable workers to carry out their work safely.

The nature and types of plans should be determined by the mine operator according to the mine operations and risk, and may range from single line diagrams to detailed site plans showing buried services.

In addition to showing the main isolators, the plans should include details of all points of isolation available on the electrical distribution system for voltages greater than 1000V.

(g) that arrangements are in place so that mobile electrical plant fed by a flexible reeling or trailing cable:

(i) is not connected with power if there is an earth fault in the cable, and

Flexible reeling or trailing cables feeding mobile plant are exposed to arduous conditions and are regularly damaged. These cables presently supply equipment with voltages up to 22kV. Energising a damaged cable may cause arcing, with the potential to cause burns to persons in the vicinity of the cable damage, along with ignition of gas, dust, or other flammable materials. It may also result in electric shock if contact is made with the damaged section of the cable, equipment connected to the cable, or if the earthing system has been compromised.

Earth fault lockout protection is provided to detect damaged power conductor insulation by applying a low energy test voltage and measuring leakage currents while the cable is not connected to the main supply. The test is performed automatically immediately prior to the restoration of power.

The EECP should provide for this protection of flexible reeling and trailing cable circuits. The EECP should also require that earth fault lockout systems associated with mobile plant and fed via flexible reeling and trailing cables should be compliant with AS/NZS 2081.

Refer to guidance in 4.4 above.

(ii) has its power interrupted automatically if the continuity of the connection to earth is interrupted, and

The earth conductors in a reeling or trailing cable are often the only return path for fault currents in the event of an earth fault. To ensure the earth integrity of trailing / reeling cables and their associated coupling devices, the plan should provide for earth continuity monitoring systems on trailing or reeling cable circuits and any associated extension cable.

The EECP should require that earth continuity systems associated with mobile plant and fed via flexible reeling and trailing cables should be compliant with AS/NZS 2081.

For more information refer to: MESHCM/2006/9, ILO *Code of practice on safety and health in underground coalmines.*

(h) that arrangements are in place to ensure that mains powered hand-held electrical equipment used at the mine operates at no more than 250 volts and have an earth leakage of not more than 30 milliamperes sensitivity, and

Limiting voltage to no more than 250 volts and using quick acting earth leakage devices limits the voltage a person may be exposed to, and minimises the duration of exposure in the event of a fault occurring on the hand held equipment, or the cable supplying that equipment. The 30 milliamperes (mA) sensitivity minimises the likelihood of a person going into ventricular fibrillation (refer to appendix C below on electrical shock protocol).

These units operate to isolate supply of electricity to protected circuits, socket-outlets or equipment in the event of a current flow to earth, which exceeds a predetermined level.

If mains powered hand held equipment is used, the EECP must include arrangements to ensure that equipment is not supplied at voltages greater than 250 volts and that the circuit supplying the equipment is protected by an earth leakage device with sensitivity of no more than 30 mA.

A 30 mA residual current device (RCD) provides earth leakage protection with quick operation to reduce potential consequences associated with contact with energised plant. In some circumstances, consideration should be given to the use of RCDs with 10mA sensitivity.

For more information refer also to MESHCM/2006/9, ILO *Code of practice on safety and health in underground coalmines*

(i) that an effective earth system is provided at the mine to minimise, so far as is reasonably practicable:

The earthing system is comprised of the soil, the conductors that are buried in the soil, the conductors that are reticulated with power conductors and conductive structures at the mine. These may include the reinforcing metalwork associated with footings and slabs associated with coal handling plants, concentrator mills, conveyor structures, workshops and so on.

To be effective, an earthing system must be considered as a single entity.

(i) touch, transfer and step potential, and

Refer to 4.5 above for guidance on Schedule 2 clause 3(3)(j).

(ii) the effects of lightning causing the ignition of methane, the ignition of explosives or detonators or the creation of dangerous touch voltages, and

Energy associated with lightning can transfer to the underground workings of a mine either through direct or indirect methods and has the capacity to cause the ignition of methane. Coupling effects associated with lightning also has potential to initiate the firing of electrical detonators used with explosives. These lightning events can also create dangerous touch voltages on cables and exposed metal work.

The EECP should provide controls to minimise the transfer of the effects of lightning being transferred into the underground workings and causing ignition of gas explosion or dangerous touch voltages on plant and equipment.

The EECP should also link to the explosives control plant to provide controls for capacitive and inductive coupling effects that may cause initiation of detonators.

Also refer to 4.5 above for further guidance on Schedule 2 clause 3(3)(f).

(j) that all electrical installations (other than isolated circuits) have a continuous and effective connection to the earth system, and

The earthing systems of electrical supply networks perform several functions. These include:

- providing a low impedance path that provides for the reliable operation of circuit protection devices to clear faults resulting from an insulation failure to earth
- limiting touch, transfer and step voltages to a level that does not present a significant risk (this is often termed ‘protection against indirect contact’)
- providing overvoltage protection and voltage stabilization
- providing dissipation of electrostatic charge.

The EECP should identify the methods to be used to provide a secure and reliable connection to the earthing system of the mine. This will entail the use of integrated earthing conductors within supply cables. It may also require the use of supplementary earthing conductors and equipotential bonding conductors.

(k) that all isolated circuits comply with section 7.4 of the Wiring Rules

In special applications, it may be necessary to use electrical supplies that are isolated from the earthing system. Protection by electrical separation is a recognised alternative method to prevent electric shock through contact with exposed conductive parts, whether through direct contact or indirect contact. It is intended for use in individual circuits and not for general installations.

The EECP should provide for circuits that are intended to be isolated from earth to comply with the requirements of section 7.4 of the Wiring Rules.

(l) that the electricity supply to all electrical plant in an underground mine, and all mobile plant fed via flexible reeling or trailing cables in any other mine, is designed so that:

Underground electrical installations are supplied with long runs of cable with variable earthing conditions. The only earthing provided to mobile and transportable equipment that can have an acceptable level of surety is through the earthing conductors of the cables feeding back to the respective supply transformers.

Similar circumstances are applicable to mobile and transportable equipment on the surface of a mine.

(i) the magnitude of earth fault currents to the plant is limited (in order to control step and touch potentials), and

Limiting the maximum value of earth fault current minimises the prospective touch, step and transfer potentials that can occur during an electrical fault to earth. Factors that will influence the selection of earth fault limitation settings include:

- allowable step and touch potentials
- operating times of protection relays and associated circuit opening devices
- system operating voltage
- design and construction of the cables that is individually or collectively screened
- size of earthing conductors.

The EECP should identify the allowable levels of step, touch and transfer potential for different environments at the mine. Reference should be made to AS/NZS 3007 and AS/NZS 4871 for guidance in determining acceptable levels of voltage.

The EECP should identify the value(s) of earth fault current limitation necessary to control step and touch potentials to within the identified limits for different operating systems at the mine. When determining the most suitable level of earth fault current limitation, the EECP should require an engineering review by competent earthing specialists with experience in mining installations.

Reference should also be made to AS/NZS 3007 and AS/NZS 4871 for guidance, including recommendations for the magnitude of earth fault current limitations.

Also refer to 4.5 above for further guidance on Schedule 2 clause 3(3)(h) and (j).

(ii) so far as is reasonably practicable, the most likely type of electrical fault is a low energy earth fault (in order to minimise the amount of energy released), and

Energy levels associated with earth faults are lower than those where faults occur between phases. This is particularly so on earth fault current limited networks where correctly engineered insulation co-ordination and suitable creepage and clearances distances will mean damage associated with earth faults is virtually non-existent.

For electrical installations in hazardous environments, this also minimises the risk of compromising explosion protection techniques of electrical equipment.

The EECP should require that for earth fault current limited systems, earth screens should be provided on power circuit conductors where reasonably practicable. Where it is not reasonably practicable, the EECP should require the use of correctly engineered insulation co-ordination, along with suitable creepage and clearance distances.

(m) that the reliability of any electrical safeguards provided to control the risk from both electrical and non-electrical hazards is sufficient for the level of risk being controlled, and

Refer to 4.3.2 above for guidance on how the EECP is to address electrical safeguards.

Electrical control systems are often used to either:

- provide a safeguard against something going wrong with a piece of plant or an installation

  or
- to monitor a non-electrical safeguard to ensure that the non-electrical safeguard is functional

The mine operator must consider the reliability of safeguards used. For example, is guarding prone to fail? Could workers forget or ignore safe operating procedures? To understand the reliability of a safeguard it helps to consider:

i. the magnitude of the hazard

ii. the potential level of residual risk (harm and likelihood), should the safeguard not be in place or fail

iii. the required reliability of a safeguard to minimise risk where it is not possible to eliminate the risk, having regard to the residual risk

iv. the assessment and validation of the actual safeguard installed to provide the required reliability and level of protection.

Many safeguards are developed by the designer before the mine operator's involvement. When acquiring any item of plant, the mine operator may ask how the considerations above have been addressed. The mine operator should then consider each of these items as they implement appropriate safeguards or risk controls.

The integrity, or reliability, of the safeguard is essential if the safety function is to provide the level of risk control that has been determined as necessary to eliminate or minimise the likelihood of injury to persons. A reliability assessment of safeguards may be undertaken. Consideration should be given to systematic failures that could occur and the potential for reasonably foreseeable human behaviour that may adversely affect the safeguard's performance.

Where a safeguard has a failure mode that cannot be detected except through specific testing programs, additional independent safeguards should be implemented in parallel with the system that has the undetectable failure mode. Consideration should also be given to the provision of monitoring systems to identify when a fault has occurred with a safeguard. The monitoring system may initiate alarms or initiate automatic actions to bring the plant to a safe state.

In developing these safeguards, guidance on required risk reduction, required safeguard integrity and assessment (functional safety) may be sought from the following functional safety standards:

- AS 61508 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
- AS 61511 Functional safety - Safety instrumented systems for the process industry sector
- AS 4024 Safety of machinery
- ISO 13849 Safety of machinery – Safety related parts of control systems

The EECP should detail what processes are to be used to verify that electrical safeguards provided for plant or installations, whether for electrical or non-electrical hazards, provide an acceptable level of risk reduction.

It is important to note that safeguards will remain effective only if they are inspected, tested and maintained. If 'functional safety' techniques are used, inspection, testing and maintenance activities should be reflected in the EECP through a functional safety management (FSM) approach.

(n) that short circuit protection and over current protection is provided on all circuits (including sub-circuits), and

Short circuit protection is provided to identify conditions where very high levels of current may flow as a result of a circuit insulation fault. This protection may be achieved through the use of fuses or circuit breakers. In either situation, the fuses or the circuit breaker must be rated to interrupt a higher value of short circuit current than can flow in circuit under a worst case scenario.

Overcurrent protection includes overload protection, which is used to identify when the load current of the circuit has increased beyond what the circuit is designed to carry. This occurs as a result of too much load being connected to the circuit. To prevent damage to the controlling switchgear and to cabling systems through excessive heat generation, overload protection is provided to automatically trip the power from the circuit.

The EECP should identify what types of protection are to be provided on all circuits and sub-circuits, to detect and clear both short circuit and overload conditions. The EECP should also identify requirements for determining settings that achieve effective fault discrimination across circuits.

(o) that except for circuits that, are isolated from earth, and have a supply voltage that is not extra-low voltage:

(i) earth leakage protection is provided on sub-circuits, and

The intention of this subclause is that the EECP should require that earth leakage protection is to be provided on all sub-circuits except for circuits that are isolated from earth or operate at a voltage that is extra low voltage.

The EECP should identify the types of earth leakage protection devices to be used for different types of circuits, and should also identify factors to be considered in determining the required operating set points for current and time.

In identifying the types of earth leakage detection to be provided (refer to clause 2.6.3.2.1 of AS/NZS 3000), the EECP should require:

- protection by an RCD with a maximum rated residual current of 30 mA for final sub-circuits supplying socket-outlets where the rated current of any individual socket-outlet does not exceed 20 amps (A)
- final sub-circuits supplying lighting where any portion of the circuit has a rated current not exceeding 20 A
- final sub-circuits supplying directly connected hand-held electrical equipment, should do so in accordance with the Wiring Rules.

Where these socket outlets are provided in a hostile operating environment the EECP should contain details of requirements to use RCD protection in accordance with WHS Regulations clause 164 *Use of socket outlets in hostile operating environment.*

The EECP should require that earth leakage protection devices used on earth fault current limited systems be compliant with AS/NZS 2081.

Earth leakage protection fitted to earth fault current limited supply networks should have trip levels set to provide for at least a 10 to1 tripping ratio against the value of earth fault limitation current.

Reference should also be made to AS/NZS 3007 and AS/NZS 4871.1 for guidance with tripping ratios.

(ii) earth fault protection is provided on all distribution and control circuits.

Earth faults on control circuits may result in electric shock or unintended operation of plant.

The intent of this subclause is that the EECP should require that earth fault protection is to be provided on all distribution and control circuits except for circuits that are isolated from earth or operate at a voltage that is extra low voltage.

See guidance above in 4.5 regarding Schedule 2 clause 3(3)(g).

Clause 27 Communication between outgoing and incoming shifts

The EECP should identify communication requirements between outgoing and incoming shifts so far as the communication relates to electrical work on plant and installations. The EECP may provide for this or link to elsewhere in the safety management system.

Clause 34 Prohibited uses and Schedule 4

For an underground coal mine, the EECP should require that uncoated or unprotected light metal alloys or aluminium are not to be used:

- in the hazardous zone, or
- on the inbye side of the first cut-through outbye from a longwall face, or
- in any rotating component or in any component subject to impacts.

In compliance with clause 69, the EECP should also require that, so far as is reasonably practicable, items containing an exposed light metal alloy are not left underground unattended, and further requirements relating to the transport, storage, handling and removal of items containing light metal alloys from the mine.

Clause 36 Minimum age to work in mine

The EECP may provide or link to elsewhere in the safety management system to ensure a person under the age of 18 years is not engaged to carry out work in an underground mine, unless the person is over the age of 16 years and is an apprentice or trainee under direct supervision in relation to the work.

Clause 37 Inspections

The EECP should link to the inspection arrangements developed under clause 37, insofar as it relates to risks associated with the electrical aspects of plant and installations.

In the case of underground coal mines, this should extend to the additional inspection program requirements under clause 85 such as in cl 85(5)(c) regarding inspection for the presence of flammable gas prior to the supply of electric power to any underground part of the mine.

Clause 60 Monitoring and testing of ventilation system

The EECP should link to the ventilation control plan in relation to the provision of monitoring systems for the operation of the main ventilation fans of the mine and that an alarm is triggered on the surface if any such fan stops.

Clause 71 Ventilation

For underground coal mines, the EECP should link to the ventilation control plan in relation to the removal of the supply of power to electrical plant (other than electrical plant referred to in clause 78(4)). The EECP should require the power to be cut off by the quickest means available and not be restored before the supply of ventilated air is above that minimum quantity.

Clause 72 Control and monitoring of methane levels

Clause 72 requires methane monitoring plant to be installed on specified plant and locations to provide an alarm or remove power when certain levels of methane are detected in the atmosphere. The EECP should link with the ventilation control plan to provide methane detection systems and power trip interlocks with a suitable level of reliability for the control of risks associated with elevated levels of methane.

Clause 104 Duty to provide information, training and instruction

The EECP may provide for, or link to elsewhere in the safety management system, to ensure workers are provided with information and instruction in relation to the electrical aspects of plant and installations.

Clause 105 Duty to provide induction for workers

The EECP may provide or link to elsewhere in the safety management system to ensure that anyone involved with electrical works is appropriately inducted before starting work, in accordance with clause 105. This should include reviewing and assessing skills, and permitting people to undertake electrical work only in their areas of competence.

Clause 128 Duty to notify regulator of certain incidents

The EECP may provide or link to elsewhere in the safety management system to ensure the correct reporting of both high potential and other incidents so far as they relate to electrical aspects of plant and installations. **Note:** section 15 of the WHS (Mines) Act also requires reporting of 'notifiable incidents', which includes those resulting in 'serious injury or illness' and 'dangerous incidents' within the meaning of clauses 178-179 of the WHS (Mines) Regulations. Further guidance on reporting incidents is available from the regulator.

Schedule 1 Principal mining hazard management plans – additional matters to be considered, clause 4 Roads and other vehicle operating areas

Where there is a risk of collision between vehicles, the EECP should link to any principal mining hazard management plan for roads and other vehicle operating areas so far as it relates to the monitoring and control of traffic movements, such as block lights or traffic signals. This may also include the use of collision avoidance systems to assist with the management of vehicle interactions with people, other vehicles or infrastructure.

The movement of high loads and tall equipment has resulted in contact with energised overhead cables that cross roads and operating areas. The use of graders to maintain roads and vehicle operating areas may result in a reduction of depth of cover for any buried cables and other services. These events can result in injury to workers from electric shock and arc blast, damage to cables and associated infrastructure.

The EECP should link to principal mining hazard management plans for roads and other vehicle operating areas, and where overhead or underground power lines cross roads or operating areas. See guidance in 4.7 below regarding clause 166 of the WHS Regulations.

Where remote control systems are used to control plant, the EECP should refer to the relevant parts of the AS/NZS 4240 series.

Schedule 1 (PMHMPs…) clause 6 Fire and explosion

Burning of electrical insulation materials produces toxic fumes and may leave corrosive residues on surfaces affected by smoke, fire or explosion. Damage to some high voltage switchgear may also result in highly toxic residues that require correct handling and management, such as powders formed through the decomposition of SF_6 insulating gas during arc quenching. These are normally contained within the sealed switching chamber of the circuit breaker or contactor but can be released if the housing is damaged.

The EECP should link with any principal mining hazard management plan for fire and explosion so far as it relates to electrical matters. This should include the nomination of suitable fire extinguishing and suppression agents that are non-conductive, and requirements for the removal of power prior to attempting to extinguish a fire. Where fire detection and suppression systems are associated with electrical switchrooms, consideration should be given to the automatic disconnection of electrical power to the switchroom on the detection of fire.

Schedule 2 Principal controls plans – matters to be addressed, clause 2 Mechanical engineering control plan

The EECP should link with the MECP in relation to the electrical aspects of plant covered under that plan. For example, electrical control systems used in mechanical plant, such as diesel engine management systems, and electrical safeguards used to control risks associated with mechanical plant, such as guard interlocking and emergency stop systems.

4.7 Other specific risk controls – WHS Regulations

There are a number of specific controls required under the WHS Regulations that can apply to electrical aspects of plant and installations at mines. Where these controls are required and/or used to manage electrical risks, they must be set out in the EECP. The following controls may be relevant, but are not an exhaustive list.

151 Untested electrical equipment not to be used

A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that electrical equipment is not used if the equipment:

(a) is required to be tested under clause 150, and

(b) has not been tested.

WHS Regulations clause 150 requires that electrical equipment fed via an electrical socket outlet is regularly inspected and tested when used in an environment that exposes the equipment to conditions that are likely to result in damage or a reduction in its lifespan. These conditions include exposure to moisture, heat, vibration, mechanical damage, corrosive chemicals or dust.

The EECP should require that electrical equipment is not used if requirements of clause 150 have not been satisfied.

154 Electrical work on energised electrical equipment—prohibited

Subject to this Division, a person conducting a business or undertaking must ensure that electrical work is not carried out on electrical equipment while the equipment is energised.

WHS Regulations clause 146 defines electrical work as connecting electricity supply wiring to electrical equipment or disconnecting electricity supply wiring from electrical equipment, or installing, removing, adding, testing, replacing, repairing, altering or maintaining electrical equipment or an electrical installation.

WHS Regulations Part 4.7 clause 154 prohibits live electrical work unless permitted under other provisions.

The WHS (Mines) Regulations, Schedule 3 clause 2 identifies that live electrical work (excluding 'testing for de-energised') is a high risk activity and must be notified to the regulator prior to the work being undertaken.

The EECP should clearly identify what types of work may be required to be undertaken while equipment is still energised (live) at the mine, and must require that notification is made to the regulator, in accordance with clause 33 of the WHS (Mines) Regulations prior to the work being undertaken.

Further guidance on high risk activity notifications is available from the regulator.

Division 5 Electrical equipment and installations and construction work – additional duties

163 Duty of person conducting a business or undertaking

(1) A person conducting a business or undertaking that includes the carrying out of contruction work must comply with AS/NZ 3012:2010 (Electrical installations – Construction and demolition sites).

The EECP must require that the design, construction and testing of electrical installations that supply electricity to appliances and equipment associated with construction work at the mine comply, as a minimum, with AS/NZS 3012:2010 *Electrical installations—Construction and demolition sites*. The EECP must also require the in-service testing of portable, transportable and fixed electrical equipment used for construction work comply, as a minimum, with AS/NZS 3012:2010.

WHS Regulations

Division 6 Residual current devices

164 Use of socket outlets in hostile operating environment

(1) This clause applies in the following circumstances:

(a) electrical equipment is used in an environment in which the normal use of electrical equipment exposes the equipment to operating conditions that are likely to result in damage to the equipment or a reduction in its expected life span, including conditions that involve exposure to moisture, heat, vibration, mechanical damage, corrosive chemicals or dust,

(b) electrical equipment is moved between different locations in circumstances where damage to the equipment or to a flexible electricity supply cord is reasonably likely,

(c) electrical equipment is frequently moved during its normal use,

(d) electrical equipment forms part of, or is used in connection with, an amusement device.

(2) In a circumstance set out in subclause (1), a person conducting a business or undertaking at a workplace must ensure, so far as is reasonably practicable, that any electrical risk associated with the supply of electricity to the electrical equipment through a socket outlet is minimised by the use of an appropriate residual current device.

(details of penalty omitted)

(3) Without limiting subclause (2), the residual current device must have a tripping current that does not exceed 30 milliamps if electricity is supplied to the equipment through a socket outlet not exceeding 20 amps.

(4) Subclause (2) does not apply if the supply of electricity to the electrical equipment:

(a) does not exceed 50 volts alternating current, or

(b) is direct current, or

(c) is provided through an isolating transformer that provides at least an equivalent level of protection, or

(d) is provided from a non-earthed socket outlet supplied by an isolated winding portable generator that provides at least an equivalent level of protection.

Notes.

1 This clause commences on 1 January 2013 (see clause 2 (2)).

2 Residual current devices are also regulated under the Electricity (Consumer Safety) Act 2004.

165 Testing of residual current devices

(1) A person with management or control of a workplace must take all reasonable steps to ensure that residual current devices used at the workplace are tested regularly by a competent person to ensure that the devices are operating effectively.

(penalty omitted)

(2) The person must keep a record of all testing of a residual current device (other than any testing conducted daily) until the earlier of the following occurs:

(a) the device is next tested,

(b) the device is permanently removed from use.

(details of penalty omitted)

Where electrical equipment fed from a socket outlet is used in a hostile environment, that is an environment in which the normal use of electrical equipment exposes the equipment to operating conditions that are likely to result in damage to the equipment or a reduction in its expected life

span, the circuit supplying the equipment is required to be protected by an RCD or the equipment should be fed from an isolated (isolated from earth) source.

Portable tools should not be used in damp environments as moisture readily bridges multiple layers of insulation. This often occurs with double insulated power tools where the moisture, whether from damp ground or from perspiration of the operator ingresses the tool and creates a current path to the operator.

Where an RCD is fitted, it should have of a residual current operating value that does not exceed 30mA. Where there is an elevated risk of electric shock due to the environment, consideration should be given to the use of 10mA RCDs. RCDs also need to be suitable for the supply source. Some supply sources do not have pure sinusoidal current waveforms, such as some inverters units which may be integral to newer types of generators. A RCD designed for a pure AC waveform may not operate at the intended values of residual current, or fail to operate at all on pulsating DC or non-sinusoidal waveforms.

Where an isolated circuit is used to supply a portable tool, only one supply cable and tool should be connected to that isolated source at any one time. Isolated supplies achieve safety as the first fault that occurs does not create an electric shock risk. If a second fault occurs, this will probably create a short circuit fault. If the worker forms a part of one of these fault paths there is no protection that trips at low current values (30mA or less). It is therefore critical that the worker ensures that there is no damage to any of the supply cables or tools before the use of this equipment and that regular inspections are undertaken during the use of the equipment. The use of multiple supply cables and multiple tools increases the shock risk to an operator and should not be permitted.

The EECP should detail the requirements for the use of RCDs and for isolated power supplies, and the circumstances in which these may be used. The EECP should also detail inspection requirements for electrical equipment prior to use and the periodic testing requirements of the equipment at regular intervals. The EECP must detail the procedures for the testing of any RCD and the recording of the results of such tests.

For guidance information on the inspection and testing of portable electrical equipment, including testing of RCDs, reference should be made to: AS/NZS 3760 *In-service safety inspection and testing of electrical equipment.*

Note: While AS/NZS 3760 provides guidance for inspection and test frequencies, these should be reviewed against the potential risks associated with the proposed use, that is where there is an elevated risk associated with the use of electrical tools then inspection and test frequencies may need to be reduced. This should be based on risk assessments of the work activities and the environments in which they are to be undertaken.

Division 7 Overhead and underground electric lines

166 Duty of person conducting a business or undertaking

A person conducting a business or undertaking at a workplace must ensure, so far as is reasonably practicable, that no person, plant or thing at the workplace comes within an unsafe distance of an overhead or underground electric line.

(details of penalty omitted)…

Clause 166 requires that, so far as is reasonably practicable, that no person, plant or thing at the workplace comes within an unsafe distance of an overhead or underground electric line. Where it is not reasonably practicable to maintain a safe distance, a risk assessment and the implementation of further control measures are required.

In assessing whether a safe distance can be maintained, consideration should be given to response and reaction times of a spotter in realising that contact is about to occur, raise the attention of the machine operator and the machine operator to stop the movement of the machine while still maintaining a safe distance from the lines. If a safe distance cannot be

maintained, the lines should be de-energised and earthed. Before re-energising the lines, inspections to verify the lines are undamaged should be undertaken.

For overhead lines, the EECP should provide for procedures that restrict work activities and approach distances to the energised overhead lines (see 4.5 above in relation to Schedule 2 clause 3(3)(n)(iii) of the WHS (Mines) Regulations) and Section 7 of AS/NZS 3007.

The EECP should require that before excavation work is carried out in proximity of buried electrical cables that all available information concerning the position of the cables should be obtained and disseminated to the people doing the work. To assist in the provision of necessary information, the EECP should identify that:

- site plans should be maintained showing the location of all buried cables
- these plans should be readily accessible to supervisors
- procedures should be developed for work near buried cables
- safe distances should be maintained between temporarily exposed buried cables and machinery
- signs should be provided warning of buried cables and their buried depth.

213 Maintenance and inspection of plant

(1) The person with management or control of plant at a workplace must ensure that the maintenance, inspection and, if necessary, testing of the plant is carried out by a competent person.

(2) The maintenance, inspection and testing must be carried out:

(a) in accordance with the manufacturer's recommendations, if any, or

(b) if there are no manufacturer's recommendations, in accordance with the recommendations of a competent person, or

(c) in relation to inspection, if it is not reasonably practicable to comply with paragraph (a) or (b), annually.

For plant to remain in a safe condition, it is necessary for regular inspections to be undertaken on the plant. The person undertaking these inspections must have the knowledge and understanding of the protective controls incorporated in the design and manufacture of the plant.

For example, (IP ratings) must be maintained to the designed level. Door catches that are not engaged result in dust and moisture entry that will cause failures of insulation, resulting in electric shock risks and possible arcing faults. Warning signs and notices that are illegible, damaged or missing may cause workers to make incorrect decisions about allowable access or inherent dangers.

The EECP should provide guidance on the development of maintenance strategies appropriate to each item of plant at the mine. In developing the maintenance strategies, recommendations of designers and manufacturers must be followed when determining what maintenance requirements are necessary for plant.

The EECP should also provide guidance in determining the competencies required of persons that will be undertaking the maintenance activities on the plant.

4.8 Hazardous atmospheres

The requirements for identifying hazardous atmospheres apply to all mines:

WHS Regulations

Division 8 Hazardous atmospheres

51 Managing risks to health and safety

(1) A person conducting a business or undertaking at a workplace must manage risks to health and

safety associated with a hazardous atmosphere at the workplace, in accordance with Part 3.1.

Note WHS Act—section 19 (see regulation 9).

(2) An atmosphere is a ***hazardous atmosphere*** if:

(a) the atmosphere does not have a safe oxygen level; or

(b) the concentration of oxygen in the atmosphere increases the fire risk; or

(c) the concentration of flammable gas, vapour, mist or fumes exceeds 5% of the LEL for the gas, vapour, mist or fumes; or

(d) combustible dust is present in a quantity and form that would result in a hazardous area.

A common hazard in mining is an atmosphere that increases the risk of explosion. To properly manage a potentially hazardous atmosphere, the mine operator must identify the type and extent of the hazardous atmosphere. This should involve appropriate testing to confirm if explosive elements such as gas and dust are present in the atmosphere.

Explosive elements that may be present at mines may include:

- all types of mines - hydrogen sulphide, LPG, various process chemicals such as ammonia, hydrogen, fuel (such as petrol and ethanol) and dusts such as coal dust or sulphide dusts
- underground coal mines – methane and coal dust (see further details in the next chapter).

Clause 5 of the WHS Regulations defines hazardous areas in accordance with the following standards:

- AS/NZS 60079.10 *Electrical apparatus for explosive gas atmospheres - Classification of hazardous areas*
- AS/NZS 61241.10 *Electrical apparatus for use in the presence of combustible dust Part 10: Classification of areas where combustible dusts are or may be present*

For electrical installations, people must also refer to AS/NZS 3000:2007 for further guidance on the identification and classification of hazardous areas. See 5.2 below in relation to hazardous zones in underground coal mines.

Note: AS/NZS 3000 uses the term ‘hazardous areas’, whereas clause 51 of the WHS Regulations (set out above) refers more broadly to managing the risks of ‘hazardous atmospheres’, which although it includes atmospheres that are explosive, also includes other atmospheric hazards. Hazardous areas may be viewed as a subset of hazardous atmospheres so the requirements of clause 51 for hazardous atmospheres apply to them.

The EECP should require that details of areas with a potentially explosive atmosphere should be placed in mine plans, section plans and emergency plans. These plans should be readily available to electrical workers and mining supervisors. The EECP should also identify the competency requirements of people that will work on electrical installations within the identified hazardous areas and any procedures that those competent people must use.

The EECP should also identify any sign requirements required to inform other people of the hazardous location and any restrictions that are required.

In addition to the guidance provided in this code on risk management of ignition sources, people should also refer to the *NSW code of practice: Mechanical Engineering Control Plan*.

5 Additional matters for underground coal mines

In addition to the requirements outlined in Chapter 4, the EECP for an underground coal mine should provide for the following specific legislated requirements.

5.1 Specific requirements

83 Electrical safety—static charges

The mine operator of an underground coal mine must ensure that any compressed air equipment, hose or pipe is electrically bonded to earth if it has been risk assessed under clause 9 as likely to develop static electrical charges capable of causing an electric shock to a person or a spark during operation.

The EECP and the MECP should provide for the identification and assessment for the potential of electrical static charges (which may cause harm or be an effective ignition source) on parts of electrical and mechanical plant that are non-conductive (refer to 4.5, schedule 2 clause 3(3)(e) of this code for EECP requirements for all mines). Guidance on this assessment and possible control measures is given in MDG 3608 *Non-metallic materials for use in underground coal mines*. All anti-static parts should be effectively earthed.

All non-metallic compressed air equipment or pipe should be considered as likely to develop an unacceptable static electrical charge unless appropriate testing has been carried out. MDG 36–8 - *Non-metallic materials for use in underground coal mines* provides guidance on such testing. AS 2660 *Hose and hose assemblies - Air/water - For underground coal mines* provides guidance on design criteria for air hoses.

Ventilation equipment such as ducts associated with auxiliary ventilation fans are a source of significant static. Any appliances or fittings used in association with ventilation ducts and auxiliary fans must be suitably rated and tested to demonstrate that static charges will not accumulate to levels that may cause sparking. The repair of these appliances and devices must also be done in a manner that maintains the original designed anti-static properties. Methods of installation may also impact the ability of the ventilation ducts to dissipate any potential charges.

The EECP should link to other control plans, such as the ventilation control plan or the mechanical engineering control plan, to provide for suitable methods for static charge dissipation.

5.2 Managing hazardous zones

The WHS (Mines) Regulations has further requirements in relation to methane levels in underground coal mines, including the requirement to determine the location of all hazardous zones and to manage the risks associated with the ignition of methane in such zones:

WHS (Mines) Regulations

3 Definitions

hazardous zone, in an underground coal mine, means each of the

following:

(a) any part at the mine in which the concentration of methane in the general body of the air is 1.25% by volume or greater,

(b) a return airway

(c) any part of an intake airway that is on the return side of such points that are within 100 metres outbye of:

(i) the most inbye completed line of cut-throughs, or

(ii) any longwall or shortwall face, but only to the extent that the intake airway is on the intake side of that face (but not if the longwall face is an installation face at which the development of the face, and mining for development coal, have been completed and at which longwall mining has yet to commence).

The primary control of methane levels is through the provision of effective ventilation. The EECP should link with the ventilation control plan in respect of the requirements for methane

monitoring. Under clause 72 the mine operator must ensure that face machines and any longwall, shortwall or miniwall face is equipped with continuous methane monitors that raise an alarm if specified levels of methane are exceeded and, at certain methane levels, remove electrical power from plant. Such monitors must also raise an alarm and cut power supply to any plant it is monitoring if the monitor itself malfunctions or fails.

Minimum explosion protection levels are required for electrical plant when used in a hazardous zone (refer to 5.2.1 below) except as provided for in clause 79 (refer to 5.2.5 below). Power must be removed from all electrical plant that does not meet the required level of explosion protection to prevent it being a possible source of ignition.

Cables for use in hazardous zones also need to meet prescribed standards to ensure that they have the electrical properties that will minimise risks of sparking, and mechanical properties that will minimise the likelihood of damage, while being suitable for the required duties of the cables (refer to 5.2.6 below).

In the event of a fan failure, there is a significant potential for methane gas concentrations to exceed prescribed levels in an area of the mine. If the main ventilation system fails, any auxiliary fan must be switched off by the quickest means available.

The mine operator must ensure workers are aware of the location of hazardous zones. Signs detailing the start of the zone should be placed in all intake airways.

The EECP must address all of the above requirements to ensure they are met and risks are managed, as far as is reasonably practicable.

5.2.1 Explosion-protected plant in underground coal mines

The WHS (Mines) Regulations requires electrical plant used in hazardous zones to be explosion protected and certified. The EECP must include arrangements to ensure those requirements are met.

In accordance with clause 78(4), electrical plant may only be used in a hazardous zone where the concentration of methane exceeds 1.25% in the general body air if the plant has a valid certificate of conformity in one of the following categories:

- equipment protection level ‘Ma’
- intrinsically safe category ‘Ex ia’
- encapsulated – level of protection ‘Ex ma’
- for gas detectors / monitors, special protection ‘Ex s’ (zone 0)
- for cap lights, explosion protected for gas group ‘I’, as defined in AS/NZS 60079.35.1:2011 or AS/NZS 62013.1:2001

Note: caplights explosion-protected for gas group ‘I’ and which are not certified as ’Ex ia' must be withdrawn to a safe area when the flammable gas concentration exceeds 2% in the general body of air by volume).

Under clauses 78(5), other electrical plant may be used in a hazardous zone, but only in such zones where the methane level is less than 1.25%, and a valid certificate of conformity exists for them in one of the following categories:

- equipment protection level ‘Mb’
- explosion-protection of a type suitable for Group I
- plant that is intrinsically safe for Group II as associated apparatus
- In the case of restrained plugs and receptacles, the certificate of conformity must also attest to compliance with AS/NZS 1299 *Electrical equipment for mines and quarries—Explosion-protected three phase restrained plugs and receptacles for working voltages up to and including 3.3 kV* or AS 1299—1993 *Electrical equipment for coal mines—Flameproof restrained plugs and receptacles*.

Note: The reference to *plant* in clause 78 does not include cables. See 5.2.6 below regarding cables. There are some exceptions to the explosion protection requirements in relation to certain portable electrical plant – see 5.2.5 below.

5.2.2 Certificates of conformity

Clause 78(9) identifies that only a certificate of conformity issued under the ANZEx scheme, the AusEx scheme or the IECEx scheme is valid for compliance with the WHS (Mines) Regulations requirements.

The EECP must include arrangements to ensure the use of explosion protected plant in a hazardous area only where the plant has a valid certificate of conformity under the ANZEx scheme, the AusEx scheme or the IECEx scheme, or has an MDA that is recognised as being valid.

The AUS Ex Certificate of Conformity is being phased out, however currently installed plant that is maintained in accordance with its certificate of conformity is considered to meet the minimum explosion protection requirements.

In addition to the certificates of conformity that are accepted, clause 78(2) allows for plant that has been manufactured prior to 1 October 2015, and holds a Mines Department Approval (MDA) as specified in the *Explosion Protected Electrical Apparatus Approvals List* as issued by the Department of Trade and Investment, Regional Infrastructure and Services (NSW Trade & Investment) to continue to be used while ever it continues to be specified in that list.

The EECP should also provide for the periodic checking of the approvals list prior to the purchase of plant that is covered by an MDA, and that is not also covered by a valid certificate of conformity.

5.2.3 Arcing faults in explosion-protected plant to be controlled

Engineering arrangements should be made and detailed in the EECP to prevent arcing faults compromising explosion-protection properties of plant and installations (including cables). Some points to consider are:

- operational risk assessment
- limitation of earth fault currents
- fault study considerations
- protection device settings, including both current and time settings
- energy let through during clearance of a fault
- earth screening
- insulation coordination.

Further guidance information can be obtained from the Mine Electrical and Mechanical Mining Engineers Society document on arc fault control.

5.2.4 Appropriate information regarding certification to be supplied

The EECP should link to the procurement systems for the mine so a PCBU at a mine does not purchase explosion protected plant from a supplier unless certain requirements can be satisfied. The EECP must identify all necessary information that the mine operator must obtain from a supplier (refer to WHS (Mines) Regulations clause 78(7)).

Additional information may also be required to demonstrate compliance with other standards such as those for lasers and for remote controlled equipment.

The EECP should identify the storage location for all information provided for each item of plant.

All above supplier provided information should be maintained at the mine, or, where the owner of the plant is not the mine operator, at a location, determined as acceptable by the mine operator, to enable the plant to be verified as conforming to the certificate of conformity or registration or

approval, when installed, used, maintained, overhauled, and repaired. This information should also comply with the requirements of AS2290.1 '*Electrical equipment for coal mines – Introduction and maintenance Part 1 for hazardous areas*'.

5.2.5 Portable electrical plant

Despite the explosion protection requirements in clause 78, certain portable electrical plant may be used in a hazardous zone if the criteria in clause 79 is met.

WHS (Mines) Regulations

79 Exceptions to explosion-protection requirements

(1) Despite clause 78 (1), portable electrical plant may be used in the hazardous zone of an underground coal mine if:

(a) the concentration of methane in the general body of the air is 0.5% by volume or less, and

(b) the plant is powered by internal batteries, and

(c) the temperature of any surface of any component or part of the plant is not greater than:

(i) 150° Celsius, or

(ii) if the surface is wholly internal to the plant and the plant has a level of ingress protection sufficient to prevent coal dust coming into contact with the surface—450° Celsius, and

(d) the plant does not in normal operation produce hot surfaces or sparks that could ignite methane, and

(e) the mine operator has implemented control measures to manage the risk of the plant becoming an ignition source.

(2) Despite clause 78 (1), electrical equipment associated with hot work may be used in the hazardous zone of an underground coal mine if the mine operator has complied with the requirements of clause 33 (Notification of high risk activities).

(3) Despite clause 78 (1), insulation test instruments may be used in the hazardous zone of an underground coal mine if the instruments are used in accordance with the procedures for using those instruments developed under the electrical engineering control plan for the mine.

The EECP should provide for the use of portable electrical equipment to be used in a hazardous zone of an underground coal mine by requiring:

- the assessment, prior to initial use of the portable electrical plant, against the prescribed conditions in clause 79(1) and any other requirements identified through risk assessment of the proposed use of the plant at the mine
- inspection of the portable electrical plant immediately before each occasion where the plant is to be used at the mine.
- linking with the inspection plan of the mine to require the inspection of the hazardous zone environment, in particular methane levels, where the plant is to be used immediately before use, and for the regular reinspection of the environment while the plant continues to be used in the hazardous zone
- Immediate removal of the portable plant from the mine, or parts thereof, in the event of a ventilation failure in those parts of the mine
- Communications protocols with the surface of the mine in the event of an emergency situation

Additional matters to be considered in the EECP for the safe use of this electrical plant include:

- that it be fit for purpose and suitable for the work environment

- that systems should exist for the assessment and authorisation of persons as competent to safely operate the plant within the environment of the mine
- that plant should be in the control of the authorised person at all times while underground
- that batteries should be securely fastened within the apparatus so they cannot inadvertently detach from the apparatus. For example covers correctly fitted
- that charging of batteries should not be permitted in the underground workings of the mine.

See 4.5 regarding Schedule 2 clause 3(3)(t) above for additional guidance on portable electrical equipment.

5.2.6 Cables

For matters to be dealt with in the EECP in relation to cables and cable accessories at all mines, see 4.5 regarding Schedule 2 clause 3(3)(d).

The EECP must require that only electric cables that conform to the requirements of clause 80 of the WHS (Mines) Regulations be used in a hazardous zone. Among other requirements, only cables that form part of an intrinsically safe circuit or are an integral part of a caplamp and have been determined as being suitable by the mine operator, in conjunction with the Electrical Engineering Manager at the mine, can be used in the hazardous zone

Note: Only caplamps that are certified as intrinsically safe, category ‘Ex ia’ are permitted where the methane level is 1.25% or greater by volume).

Cables (other than cables that are part of intrinsically safe circuits) must conform to either AS/NZS 1802:2003 or AS/NZS 1972:2006.

The EECP must also require that where methane levels in the general body of the air are 1.25% by volume or greater, that only cables where all circuits in the cable are intrinsically safe to category ‘Ex ia’ are used.

5.2.7 Testing

The EECP must provide for the testing of circuits in a hazardous zone in accordance with the requirements of clause 82 of the WHS (Mines) Regulations.

Testing equipment must be explosion protected unless it meets a category of exemption under clause 79. For example clause 79(3) permits the use of insulation test equipment that is not explosion protected if used in accordance with the procedures developed under the electrical engineering control plan for the mine.

See 4.5 regarding Schedule 2 clause 3(3)(n)(ii) above on electrical test instruments.

5.2.8 Licenced activities

The EECP should link with the mine’s procurement and work procedures and arrangements to ensure that only persons that hold a current licence for a licensable activity to undertake that licenced activity for the mine (refer to clause 152 WHS (Mines) Regulations). In relation to electricity and electrical work, such as for plant in a hazardous zone with explosion-protection requirements (clause 78) these activities include:

- any overhauling, repairing or modifying activities that may affected the explosion-protection properties of explosion-protected plant
- any repairing of flexible reeling, feeding or trailing cables for use in a hazardous zone.

The EECP should include processes for periodic assessment by the mine to verify that the licensable activities are being carried out under and in accordance with a relevant licence (including that the cable repair work is being certified by a person competent to do so). See clause 157(5) of the WHS (Mines) Regulations.

6 Implementation

6.1 Implementing the EECP

Implementation is not a single step to be completed once only but is an ongoing activity. It involves putting into practice the requirements of the documented EECP that has been developed.

The mine operator is responsible for the ongoing implementation of the EECP.

To implement the EECP, the mine operator needs to ensure that what is set out in the EECP is followed in practice. Implementing the EECP will include ensuring that risk controls are used and maintained, for example:

- that safe work procedures are provided, understood and followed
- that equipment is maintained in its intended condition
- that required PPE is used
- that staff know how to raise safety issues relating to electrical aspects of plant and installations.

Implementation may be seen as a similar process to commissioning of plant or installations. It involves putting into practice the documented EECP that has been developed. The implementation process should include verification that actual site practices are following the documented EECP.

As part of the safety management system, the EECP must also be maintained to ensure it remains effective.

6.2 Who can implement an EECP?

The mine operator must implement the plan but ensure that the EECP is developed and reviewed by a person who is, or who is under the supervision of:

- the electrical engineering manager (for an underground coal mine)
- the electrical engineer (for all other coal mines)
- a competent person (for mines other than coal mines).

Refer to clause 26(5) of the WHS (Mines) Regulations which is contained in section 1.2 of this code.

Implementation of some aspects of the EECP may be delegated by the mine operator to persons with relevant expertise or in a relevant supervisory role. However some supervisory functions may only be carried out by persons nominated to exercise that function. Refer to 2.2 and 2.3 of the code.

6.3 Resources

The mine operator will provide resources to meet their duty to implement the EECP, under clause 26(5) of the WHS (Mines) Regulations. Resources include people with appropriate skills, adequate time, appropriate equipment, authority and financial delegation.

The mine operator must set out in the SMS the resources allocated to effectively implement and use the SMS (clause 14(1)(u) WHS (Mines) Regulations). As the EECP is part of the SMS, the EECP should state the resources to be provided to meet the legislated requirements or reference the appropriate part of the mine SMS that addresses it.

6.4 Responsibility

The roles and responsibilities for implementing the EECP should be defined, documented and communicated to the relevant people in the organisation. Details of the people in the mine management who are responsible for the implementation of the plan, or parts of it, should be set out in the EECP or the mine safety management system. This should include the relationships

between responsible people in the EECP and other plans, with details of how any interface issues are to be managed.

6.5 Documentation

The implementation process of the EECP should be documented, including the methods used, for example communication activities, training etc. Other details recorded should include those people who implemented the plan, which may be the competent person, electrical engineer or electrical engineering manager who developed the EECP. These people may supervise its implementation and may report at set intervals to the mine operator that the EECP is being implemented and is operating satisfactorily.

7 Monitoring, audit and review

7.1 Monitoring

Monitoring helps determine whether control measures are adequately designed, properly executed and effective at any given time. If controls are not effective for managing the risks, then the EECP should direct how they are to be corrected.

The EECP should detail the frequency and type of monitoring, such as inspections, assessments and audits. For each element of what the EECP covers, including controls, monitoring activities should be identified and incorporated into the plan. Monitoring activities may include:

- pre-start inspections
- visual inspections
- internal inspections
- function testing.

The EECP should identify the frequency of the different monitoring activities and incorporate these into the plan. Inspections may occur on a frequent basis, shiftly, daily, weekly and so on. In contrast, a formal audit and review process is less frequent and periodic, often to a set schedule (see further details below). The EECP should also identify the required skills and competencies for people undertaking the different monitoring activities.

For larger mines, the EECP may reference the maintenance management plan or similar document, if applicable, so that all controls are monitored as determined.

7.2 Review of control measures

The mine operator must review and revise the risk-control measures provided for in the EECP in certain circumstances, as required in clause 38 of the WHS Regulations and clause 10 of the WHS (Mines) Regulations.

7.3 Periodic review of the EECP

The EECP must also be periodically reviewed by a person specified as eligible to do so under the WHS (Mines) Regulations clause 26(5)(see 1.2 and 2.3 in this code for further explanation and legislative extracts).The purpose of a review is to determine if the EECP is effective in managing the risks posed by electricity at the mine and not just whether the plan is being carried out.

Other circumstances which may prompt a review of the EECP are changes to:

- new plant or significant changes to them
- new hazards identified, such as substances found as being hazardous after an incident or research
- amended or new legislation.

The EECP must also be reviewed as part of the Safety Management System for the mine:

WHS (Mines) Regulations

17 Review (cl 625 model WHS Regs)

(1) The mine operator of a mine must ensure that the safety management system for the mine is reviewed within 12 months of the commencement of mining operations at the mine and at least once every 3 years after that to ensure it remains effective.

(details of penalty omitted)

Note. Regular testing of the emergency plan is also required (see clause 93).

(2) In addition, if a risk control measure is revised under clause 38 of the WHS Regulations or clause 10 of this Regulation, the mine operator must ensure that the safety management system for the mine is reviewed and as necessary revised in relation to all aspects of risk control addressed by the revised control measure.

(details of penalty omitted)

In undertaking a review, the mine's workers and their health and safety representatives (and mine safety and health representatives in coal mines) must be consulted, as required under the WHS (Mines) Regulations. The following questions, during that consultation, should be considered by the mine operator and workers:

- Are all risks posed by electricity adequately managed?
- Are control measures working effectively in both their design and operation?
- How effective is the risk assessment process? Are all hazards being identified?
- Have new work methods or new plant and installations been introduced to make the job safer? What is their impact on existing hazards, risks and control measures?
- Are safety procedures being followed?
- Has instruction and training provided to workers been successful?
- If new legislation or information becomes available, does it warrant a review of current controls?
- What are the current industry best practices for compliance (and better) and whether any activities have been benchmarked against them?
- Have there been technological advances that may be of assistance in managing risks posed by electricity?
- Whether there have been any industry publications or technical reports published that may assist in managing risks posed by electricity?
- Have there been any relevant incidents and what were the outcomes of investigations?

If problems are found, the mine operator should review current information and make further decisions about risk controls to be implemented through the EECP.

7.4 Audit

The WHS (Mines) Regulations requires the mine operator to carry out audits of the EECP, as part of the safety management system:

WHS (Mines) Regulations

15 Performance standards and audit (cl 623 model WHS Regs)

The safety management system for a mine must include the following:

(a) performance standards for measuring the effectiveness of all aspects of the safety management system that:

(i) are sufficiently detailed to show how the mine operator will ensure the effectiveness of the

safety management system, and

(ii) include steps to be taken to continually improve the safety management system,

(b) the way in which the performance standards are to be met,

(c) a system for auditing the effectiveness of the safety management system for the mine against the performance standards, including methods, frequency and results of the audit process.

The mine operator must set performance standards and audit against them, such as whether procedures specified are in place and being followed, performance outcomes set are being achieved, and actions (for example corrective actions from an incident investigation) are being taken. Further details on auditing are contained in the *NSW Code of Practice: Safety management systems in mines.*

The purpose of the audit is to measure the effectiveness of the EECP against set performance standards and may include auditing whether:

- mine workers understand their responsibilities and carry them out
- training and testing has been carried out in accordance with the EECP
- electrical plant and installations required is fit for purpose, available and maintained
- inspections and tests specified have been carried out
- corrective actions have been carried out
- required reports have been completed.

Information from the audit should enable the EECP to be improved and for it to remain effective in managing the risks posed by electricity at the mine.

The audit system must include the frequency, audit methodology and results. It may also include provisions for:

- scope of the audit
- name(s) and competency of the auditor(s)
- person responsible for ensuring the audit is conducted
- reporting protocol/outcomes for the audit
- people responsible for acting on the audit report
- corporate or PCBU requirements for auditing, such as internal versus external auditors.

A mine operator may decide to carry out internal audits with people working at the mine that have the appropriate auditing competence and technical expertise, such as an electrical engineer. Alternatively, it may be decided to have an independent audit undertaken by an external person so as to be potentially more objective and gain external expertise and insights.

The EECP should require that the results of audits are communicated to the mine operator and any other persons that have responsibilities within the SMS or the EECP for the implementation of those control measures.

References

NSW codes of practice

General:

- How to manage work health and safety risks
- How to manage and control asbestos in the workplace
- How to safely remove asbestos
- Managing electrical risks in the workplace
- Managing the risk of falls at workplaces
- Managing risks of plant in the workplace
- Managing risks of hazardous chemicals in the workplace
- Excavation work
- Welding processes
- Safe design of structures

http://www.workcover.nsw.gov.au/lawpolicy/codes-of-practice/Pages/default.aspx

Mining

- NSW Safety management systems in mines
- Inundation and inrush hazard management
- Emergency planning for mines

Documents that form part of this code

Document	Application in mine	Version	Code reference
AS/NZS 1299 Electrical equipment for mines and quarries - Explosion-protected three-phase restrained plugs and receptacles for working voltages up to and including 3.3 kV	Hazardous zones in underground coal mines	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(d)
AS/NZS 1300 Electrical equipment for mines and quarries - Bolted explosion-protected three-phase cable coupling devices	Hazardous zones in underground coal mines	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(d)
AS/NZS 1674.2 Safety in welding and allied processes - electrical	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(n)(i)
AS/NZS 1802 Electric cables - Reeling and trailing -	Hazardous zones in underground coal mines	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule clause 3(3)d)

For underground coal mining purposes			
AS/NZS 1972 Electric cables - Underground coal mines - Other than reeling and trailing	Hazardous zones in underground coal mines	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(d)
AS 2067 Substations and high voltage installations exceeding 1 kV a.c.	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(a)
AS/NZS 2290.1 Electrical equipment for coal mines—Introduction, inspection and maintenance Part 1: For hazardous areas	All	As amended from time to time	Chapter 5 Additional matters for underground coal mines 5.2.4 Appropriate information regarding certification to be supplied
AS 2397 Safe use of lasers in the building and construction industry	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(q)
AS/NZS 2802 Electric cables - Reeling and trailing for mining and general use (other than underground coal mining)	Mobile plant, except those applying to underground coal mines.	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(d)
AS/NZS 3000 Electrical installations 'Wiring Rules'	All	As amended from time to time or the year stipulated by WHS laws	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(a)
AS/NZS 3007 Electrical equipment in mines and quarries – Surface installations and associated processing plant	All parts of code applying to surface of mines.	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(a)
AS/NZS 3008 Part 1 series (1.1 & 1.2) Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(d)

installation conditions			
AS/NZS 3012:2010 Electrical installations—Construction and demolition sites	Electrical installations for construction work	As amended from time to time or the year stipulated by WHS laws	Chapter 4 EECP Contents, 4.7 – – clause 163 of WHS regulations
AS/NZS 3760 In-service safety inspection and testing of electrical equipment	All	As amended from time to time	Chapter 4 EECP Contents, 4.7 – – clause 164 of WHS regulations
AS/NZS 4761 Competencies for working with electrical equipment for hazardous areas Part 2: Guide to assessing competency	Hazardous areas and zones	As amended from time to time	Chapter 4 EECP Contents, 4.3 – Schedule 2 clause 3(1)(d)
AS/NZS 4836 Safe working on or near low-voltage electrical installations and equipment	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(n)(ii)
AS/NZS 4871 series Electrical equipment for mines and quarries	Hazardous zones in underground coal mines	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause
AS/NZS 60079.10.1 Explosive atmospheres - Equipment protection by flameproof enclosures	Hazardous areas and zones	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(r)
AS/NZS 60825.1 Safety of laser products Part 1: Equipment classification and requirements	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(q)
AS 60974.1 Arc welding equipment Part 1: Welding power sources (IEC 60974-1:2000, MOD)	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(n)(i)
AS 60974.6 Arc welding equipment Part 6: Limited duty portable arc welding and allied process power sources (IEC 60974-	All	As amended from time to time	Chapter 4 EECP Contents, 4.5 – Schedule 2 clause 3(3)(n)(i)

6:2003, MOD)			

Documents that do not form part of this code

Below is a list of some published documents that may be useful to refer to in the management of risks associated with electricity. These documents, whether or not referred to in the text of this code, do **not** form part of this code.

Please note the list below is not an exhaustive list of references that may be relevant to the management of electrical risks, and compliance with any one or more of the following documents does not guarantee compliance with WHS laws.

This guide provides details of useful information that persons may refer to so as to possibly support their compliance for WHS laws involving the management of electrical risks in mines.

Appendix C also contains amended extracts of published documents that do not form part of this code and the same cautionary notes above apply to its application.

Standards

Australian Standards

- AS 2660 *Hose and hose assemblies - Air/water - For underground coal mines*
- AS/NZS 4240 series *Safety of Machinery*
- AS 60529 *Degrees of protection provided by enclosures* (IP code)
- AS 61508 *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*
- AS 61511 *Functional safety - Safety instrumented systems for the process industry sector*

International Standards

- ISO 13849 *Safety of machinery – Safety related parts of control systems*

Other Standards

- SABS (South African Bureau of Standards) 0347 *Avoidance of hazards underground in collieries due to lightning*

Other Technical Publications

- QLD Recognised Standard 01 – *Underground electrical equipment and electrical installations*, Qld Department of Natural Resources and Mines

  https://mines.industry.qld.gov.au/assets/mines-safety-health/recognised_standard01.pdf
- NSW EES – 001 *Electrical Engineering Management Plan*
- NSW EES – 003 *Practices for the Life-Cycle Management of Explosion Protected Equipment*
- NSW EES – 004 *Practices for Portable Electrical Apparatus*
- NSW EES – 005 *Electrical Protection and Earthing Guideline*
- NSW EES- 006 *Removal and restoration of power*
- NSW EES- 013 *Electrical engineering safety technical reference to MHS Regulation and OHS Regulation*
- NSW MDG 25 - *Guidelines for Safe Cutting and Welding Operations at Mines*

  NSW Trade & Investment

  http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health/publications

- Handbook 187 *Guide to Selecting a Safe Multimeter,* Standards Australia*http://infostore.saiglobal.com/store/details.aspx?ProductID=568785*
- Safe Work Australia, *Working in the vicinity of overhead and underground electric lines* guidance material, July 2014:

  http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/guidance-overhead-underground-electric-lines
- Welding Technology Institute Australia, TN 22 *Welding electrical safety,* 2003.

  http://www.wtia.com.au/publications/publications

Websites

- NSW Trade & Investment, Division of Resources & Energy – http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health
- WA Department of Mines and Petroleum – www.dmp.wa.gov.au
- Queensland Department of Natural Resources and Mines - www.dnrm.qld.gov.au
- Safe Work Australia – www.safeworkaustralia.gov.au
- Health and Safety Executive, UK (http://www.hse.gov.uk/humanfactors/)

Appendix A: Registration

Information on plant registration can be found on the Trade & Investment web site http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health

General plant that must be design or item registered if used at a mine

Plant designs that require design registration (refer Schedule 5 WHS Regulations) and are often powered by or controlled by electricity, and which are often used at mine sites include:

- lifts
- hoists with a platform movement exceeding 2.4 metres, designed to lift people
- boom-type elevating work platform
- gantry cranes with a safe working load greater than 5 tonnes or bridge cranes with a safe working load of greater than 10 tonnes
- vehicle hoists
- mobile cranes with a rated capacity greater than 10 tonnes.

Items of plant that require item registration and which are often used at mine sites include:

- lifts
- mobile cranes with a rated capacity greater than 10 tonnes.

Mine specific plant that must be design or item registered if used at a mine

The WHS (Mines) Regulations also requires that the design and/or item of certain other plant (as set out below) be registered in accordance with the WHS Act if it will be used in a mine.

Clause 177 of the WHS (Mines) Regulations requires that plant that is required to be registered is not used unless it is registered. As commissioning of plant requires the use of the plant, a PCBU must not commission an unregistered item of plant for use in a mine if it is required to be registered.

The EECP should make provision to ensure that plant is not used unless it is appropriately registered.

All mines

The use of a winding system at a mine requires both the registration of the design and the registration of each item of plant.

Underground coal mines

The following types of plant require plant designs:

- diesel engine systems
- booster fans
- plant or items used to determine or monitor the presence of gases
- shotfiring apparatus (including exploders and circuit testers)

The following types of plant require plant designs:

- diesel engine systems
- booster fans

Appendix B: Life cycle

Lifecycle phases

This appendix is referred to in section 4.3.1 of this code to explain lifecycle and associated engineering practices in greater detail for people to understand and apply it in the EECP

The life cycle of plant and installations consists of a number of phases including:

- design – provides fit for purpose plant and installation that includes risk controls that enable the plant or installation to go through the phases of lifecycle without exposing people to unacceptable levels of risk. All risk controls are required to be identified and incorporated into the design in accordance with the hierarchy of risk controls.
- manufacture – provides plant and installations that meet the design requirements
- installation - which includes transportation and possible assembly at the workplace
- commissioning – verifies conformance to the specified requirements, including risk controls
- operation – requires that plant and installations are operated in a safe manner within the design parameters
- maintenance – ensures that plant and installations continue to operate in the designed manner, which may involve repair and overhaul
- decommissioning – can be conducted in a manner that controls identifiable risks, in accordance with the hierarchy of controls. This phase may involve dismantling, disposal and/or recycling.

Engineering practices

Specific engineering practices for each phase of the lifecycle may include:

Design

- engineering analysis
- research to gather information on requirements (such as standards, regulatory guides, user requirements) and options for development of plant
- may require consultation with people involved in other phases of the life cycle, particularly operation and maintenance

Manufacture, supply or import

- meeting the identified standard to achieve fit for purpose plant
- supply of fit for purpose items to the required standard

Procurement

- purchase of plant and equipment that conforms to required site standard

Installation, assembly or construction

- safe assembly and installation
- inspections to ensure risks are controlled
- communicating and consulting with workers and other PCBUs involved

Commissioning the plant or installation for use

- training workers to be competent in operation of plant
- testing to ensure specified requirements are satisfied

Operation/use

- pre start checks
- emergency drills
- preventing unauthorised use or alterations to plant

Maintenance

- scheduling for pre-determined types and frequency
- safety critical items are identified and maintained as a priority

Decommissioning or dismantling

- research and implement information so decommissioning or dismantling can be carried out safely
- determining work areas to be restricted for access and prevent harm to others

Disposal

- good environment practices such as recycling
- safe disposal of liquids and hazardous materials such as asbestos
- safe use of lifting devices, mobile plant and vehicles.

Practices used in more than one phase

The practices that are carried out in more than one phase of the lifecycle include:

- risk management to identify, assess, and control hazards to be implemented, monitored and reviewed
- identifying competency requirements for workers, delivering training and assessing their competence
- inspection and testing of plant and installations to ensure that they remain fit for purpose
- management to plan, implement and monitor/review mine safety activities, including assigning work, reviewing for fit for purpose.

Note: If people alter or modify plant and installations (see meanings in glossary), then they must satisfy designer duties under the WHS Act.

Appendix C: Useful Information

Below are amended extracts from published documents that may be useful to refer to in the management of electrical hazards in mines. In some extracts, additional guidance has been added to be consistent between NSW, Qld and WA and to be appropriate to the NSW WHS laws. These extracts, whether or not referred to in the text of this code, do **not** form part of this code.

Please note the extracts contained within appendix C do not represent a comprehensive statement of law to be applied to electricity hazard management at a mine, and compliance with any one or more of the following documents does not guarantee compliance with WHS laws.

C1 Reliable circuit interruption

All mines

Reliable circuit interruption should be fitted to all circuits to interrupt the supply when a fault occurs. Special protection has to be provided on certain types of circuit. The current in all systems should be controlled so that when, in any circuit, the current exceeds a specified value, it is automatically cut off. Adequate electrical protection should also be provided against earth faults.

Circuit interruption includes:

- Short circuit protection on all circuits and sub-circuits.
- Earth fault protection is provided on all distribution and control circuits.
- Earth-leakage protection on all sub-circuits.
- For mobile equipment in particular, earth continuity and earth-fault lockout protection on reeling and trailing cable circuits.
- The first level of earth-leakage protection should have no intentional delay in operation.
- High voltage distribution tripping circuits should have redundancy with no common modes of failure.
- For underground installations protection arrangements should conform to the arrangements specified in the AS/NZS 4871 series.
- For surface installations, protection arrangements should conform to the arrangements specified in AS/NZS 3007.

Short circuit protection should detect and clear arcing faults. Arcing faults have resistance and therefore the short circuit trip setting of the protection device should be set as low as possible but not exceed 60% of the prospective fault current calculated for the furthest point on the system being protected.

The EECP should provide for each electrical circuit to have a fault level and protection setting study so that every electrical circuit can be provided with short circuit protection that will identify and automatically disconnect the supply of electricity in the event of a fault. The depth of the study will vary depending on the complexity of the system, from high voltage reticulation to final sub-circuits. Extra low voltage circuits should also be included. These are sometimes supplied over a long distance and the cable impedance may cause the current to be limited to a value less than the trip setting.

Motor contributions during short circuit fault conditions should be taken into account when determining current interrupting rating and tripping capability of switchgear. Motor contributions should be ignored in the determination of the setting of the fault current protection. Information detailing protection studies, fault level studies and a single line diagrams are essential.

For earth fault current limited (IT) systems the protection devices as detailed below should comply with AS/NZS 2081. These protection devices include:

- Neutral earthing resistors or reactors (NERs),

- Earth continuity protection,
- Earth fault protection,
- Earth-fault lockout protection,
- Frozen contact protection, and
- NER integrity protection.

Other electrical protection devices should conform to the IEC 60255 series of standards.

The use of IT supply networks, along with correctly designed and rated electrical equipment and cables greatly enhances the probability of the first fault being a low energy (due to the NER) earth fault. Protection systems should be provided to detect and interrupt these low energy faults before they propagate into high energy short circuit faults. Unlike high energy arc faults, low energy earth faults do not contain enough energy to create arc faults with associated arc flash or arc blast risks.

Earth leakage protection should be fitted to every final sub-circuit. This protection should not have any intentional delay imposed on the tripping. Backup earth leakage protection should be fitted.

Circuits supplying plant and equipment operating in a production area should not have any intentional time delay imposed on earth leakage settings.

Back up earth leakage protection is recommended on all supply systems. Back up earth leakage systems may be time graded to provide discrimination.

Testing of earth leakage protection systems should be undertaken more often if there is only one level of earth leakage protection. Multiple levels of earth leakage protection allow for extended testing frequencies of the earth leakage protection systems.

Where it is not possible to provide earth leakage protection on an incoming supply circuit, earth fault protection should be provided through the correct selection of protection devices, such as fuses.

On low voltage three phase systems, one earth leakage test circuit should involve a direct connection of a line (phase) to earth through an appropriately rated current limiting test resistor and adequately rated switchgear. On single phase systems, a regime of testing should include regular testing using the RCD inbuilt test button and by periodic testing by a qualified electrical tradesperson or qualified electrical engineer using an instrument designed to test both the tripping time and tripping current.

With high voltage supply systems it is not always practicable to connect a phase to earth as part of an earth leakage test. A device to continuously monitor the integrity of the star point connection to earth should be fitted, especially where there is no phase to earth test of the earth leakage systems, regardless of system voltage. For IT networks, the monitoring device should also monitor the integrity of the current limiting device for both a reduction of impedance and an increase of impedance.

Earth fault lock out is required to prevent the connection of electrical power to mobile plant in the event of an earth fault on a flexible reeling or trailing cable supplying the plant. Typically this is applied to poly-phase equipment. This control is required in all mines, and is a known, proven and effective risk control for electric shock and for hazardous zone applications.

The integrity of the earth connection will be compromised by open circuit or excessive resistance in the earth conductors. This may result in electric shock incidents and arcing and sparking when another fault condition exists or where inverter technologies are used for speed control.

Where mobile plant and equipment is fed via flexible reeling or trailing cables earth continuity protection is required to interrupt the supply of electricity to the mobile plant when the continuity of the connection to earth is compromised. This is applicable to ALL types of mobile plant fed via flexible reeling or trailing cables, both on the surface and in the underground of mines.

For underground coal mines:

'For installations in underground coal mines switchgear should be provided with no-volt or under-volt protection to automatically initiate tripping of the switchgear in event of a power failure and to avoid inadvertent or uncontrolled restoration of electrical power into areas that may have suffered ventilation problems during the power outage.'

Note: The above paragraph is an extract from MESHCM/2006/9, *Code of practice on safety and health in underground coalmines* and it relates to ILO 176. It is applicable to underground coal mines only.

Source for 9.1: MESHCM/2006/9, *Code of practice on safety and health in underground coalmines* and *NSW Industry & Investment Technical Reference EES-001. Electrical Engineering Management Plan – July 2009*

C2 Commissioning and routine testing of electrical installations

Commissioning

Clause 32(2)(b) requires newly installed or recommissioned electrical installations to be tested prior to energising in accordance with the Wiring Rules (AS/NZS 3000).

The results of tests and inspections should be kept as verification that the testing has been conducted.

The following is a guideline of the minimum requirements for each circuit or complete installation test requirements. This should not be considered an exhaustive list and for some installations additional testing may also be required. These tests apply to all new, additional, altered or removed services:

- Visual inspections:
  - lockout devices are fitted,
  - labels fitted,
  - access restrictions,
  - egress,
  - protection against damage,
  - connections checked and tight,
  - source of supply identified and labelled,
  - support and fixings adequate,
  - protection against inadvertent contact,
  - Multiple Earth Neutral (MEN) connection as required
  - segregation from other services as required.
- Earthing system – inspections include:
  - continuity of the earthing system conductors including equipotential bonding,
  - earth fault-loop impedance,
  - conductor sizing,
  - protection against damage
  - support and fixings adequate.
- Insulation resistance – inspections include :
  - all new circuits and sub-circuits of the installation
  - the load connected to each circuit.
- Protection – should include items such as:

  - circuit breaker or fuse rating,
  - overload rating and time delay if applicable,
  - earth fault settings,
  - earth leakage settings and time delay if applicable
  - RCD trip current and time results.
- Polarity tests including:
  - switching of active conductors, not neutral unless in conjunction with active conductors
- Phase sequence (rotation) testing may be required.
- Documentation – should include items such as:
  - cable size,
  - cable type,
  - route length of cables,
  - voltage drop and fault levels calculations
  - protection relay settings
  - as-built schematics, including changes to existing schematics,
  - single line diagrams
  - cable location diagrams.
  - documentation may also include spare parts listings, preventative maintenance and maintenance guidelines
- A signed declaration by the person completing the tests to include:
  - name and signature,
  - electrical licence number
  - completion date of test.

In addition to the above recommended tests and inspections for installations, commissioning for plant should include functionality checks to verify that all control systems are operating as per the design intent.

Also during commissioning and completion of an installation or project a dossier should be maintained and be readily available when required. ASNZS4871.1 and/or AS/NZS 3007 should be used as a guide for the contents of this dossier.

Routine testing of electrical installations

Electrical installations and equipment should be maintained in a safe condition, by people who are competent to do the work and recognise when electrical engineering safety risk controls have been compromised. Consideration of the impact of hostile environments should be taken into account when determining maintenance activities and frequency of inspection.

The EECP should specifically address:

- Electrical installations are to be maintained by a competent person to ensure they remain safe for use.
- Inspections and maintenance are performed having regard to procedures developed by a competent person based on recommendations of the designer or manufacturer.
- All electrical safety features and warning devices of plant are maintained and tested. This will be an integral part of maintaining the functional safety ratings and will require the identification of safety related functions and systems.
- If an electrical installation is found to be unsafe or has been damaged to the extent that its operation or condition is impaired it should be disconnected, inspected, repaired and tested prior to re-energising.

- Any repairs or alterations to the installation are carried out so as to maintain the installation's integrity.
- All portable equipment that is supplied with electricity through an electrical socket outlet is regularly inspected, tested and maintained by a competent person to ensure it is safe for use.
- Any portable equipment that is found to be unsafe is to be removed from the electricity supply, repaired, replaced or permanently removed from use.
- Appropriate work systems are provided to prevent inadvertent energising of plant connected to the electricity supply.
- A record is to be maintained of all electrical installation inspections, tests and maintenance carried out. The following information is to be recorded:
  - The name of the person who performed the inspection, test or maintenance.
  - The date on which or dates over which the inspection, test or maintenance was carried out.
  - The result or outcome of the inspection, test or maintenance.

After testing and notification, the EECP should then address the ongoing inspection and testing of the circuit through activities such as:

- maintenance procedures so the electrical installations remain safe for use
- the necessary facilities and systems of work are provided to minimise risks to health and safety of persons maintaining, inspecting, altering, repairing or cleaning the plant
- safety features and warning devices are identified, maintained and tested.

For additional information refer to AS/NZS 3000.

C3 Electric shock protocol

Background

A person suspected of receiving an electric shock may sustain delayed effects to their health and welfare from irregular heart beat (delayed ventricular arrhythmias). Potential delayed effects from electric shock could be hours or days after receiving an electric shock.[2]

Note: People should also refer to WHS legislation and guidance on first aid and emergency procedures.

Sample electric shock protocol

Purpose

The purpose of this protocol is to provide guidance for people to follow in the event that a person(s) is suspected of receiving an electric shock from a source voltage above extra low source voltage.

This protocol applies to any person receiving an electric shock, regardless of how minor the contact may appear.

Scope

The scope of this protocol is to provide guidance material for mine operators in the development of mine site electrical shock response procedures.

This protocol applies to all persons (employee, contractor or visitor) at the mine.

[2] British Heart Journal: "Electric Injury Causing Ventricular Arrhythmias" Vol 57, No3, pp 279-283.

Note: The source voltage is to be treated as greater than extra low volts until the actual source voltage has been positively identified. Priority is to be given to the treatment of the injured person which should not be with-held while the level of source voltage is being determined.

Definitions

ECG*:* means electrocardiogram

Notifications

The operator of the mine is to notify the relevant authority of electric shock incidents, in accordance with the legislative requirements.

Depending on severity and nature of injuries, other notifications may include:

- injured person's family
- employer, if a contractor
- as requested by the injured person

Steps

The following steps may be taken as a protocol determined by the mine, however any advice given by a medical practitioner treating the injured person should be followed.

Step 1: Establish a safe area.

If the victim is in contact with live apparatus, the electric power source must be isolated before attempting to attend the victim.

The site is to be secured to prevent injury to other people.

Step 2: Assess condition and stabilise victim.

The victim is to be assessed and rendered the necessary first aid treatment. Where required, apply basic life support:

D – **Dangers**

R – **Responsive**

S – **Send** for help

A – Open **Airway**

B – Normal **Breathing**

C – Start **CPR**

D – Attach **Defibrillator** (AED)

Note: Directions should be made available in the form of CPR signs posted at electrical distribution boards.

Refer to the Australian Resuscitation Council for further information

Step 3: Arrange transport to the nearest medical facility.

The supervisor is to arrange for transportation to a medical facility. If it is possible and appropriate, an ambulance should be used, particularly in cases where the person has lost consciousness for a period of time or the electric shock involved high voltage. An ambulance is better resourced to perform CPR if suddenly required during the transportation of the victim.

Step 4: Record relevant details of the incident.

The supervisor is to obtain the relevant information relating to the electrical shock incident and record it on the "Electric Shock Protocol Form".

Step 5: "Electric Shock Protocol Form" to be sent with the victim.

The “Electric Shock Protocol Form” is to be sent with the victim and given to the medical facility.

Step 6: Notify the medical facility

The supervisor is to contact the medical facility and advise the facility of the incident and transport arrangements.

Step 7: Provide incident information to the medical facility reception.

Upon arriving at the medical facility the following information is to be provided:

‘The injured person was attending (*name of the operation*) where (name *of the injured person*) received an electric shock and that the details are documented on the “Electric Shock Protocol Form”.

The completed “Electric Shock Protocol Form” should be presented to the medical facility.

Note: the person should receive a 12 lead ECG at this time.

The person escorting the injured person is to advise the mine’s operator of the situation.

Step 8: Return to work.

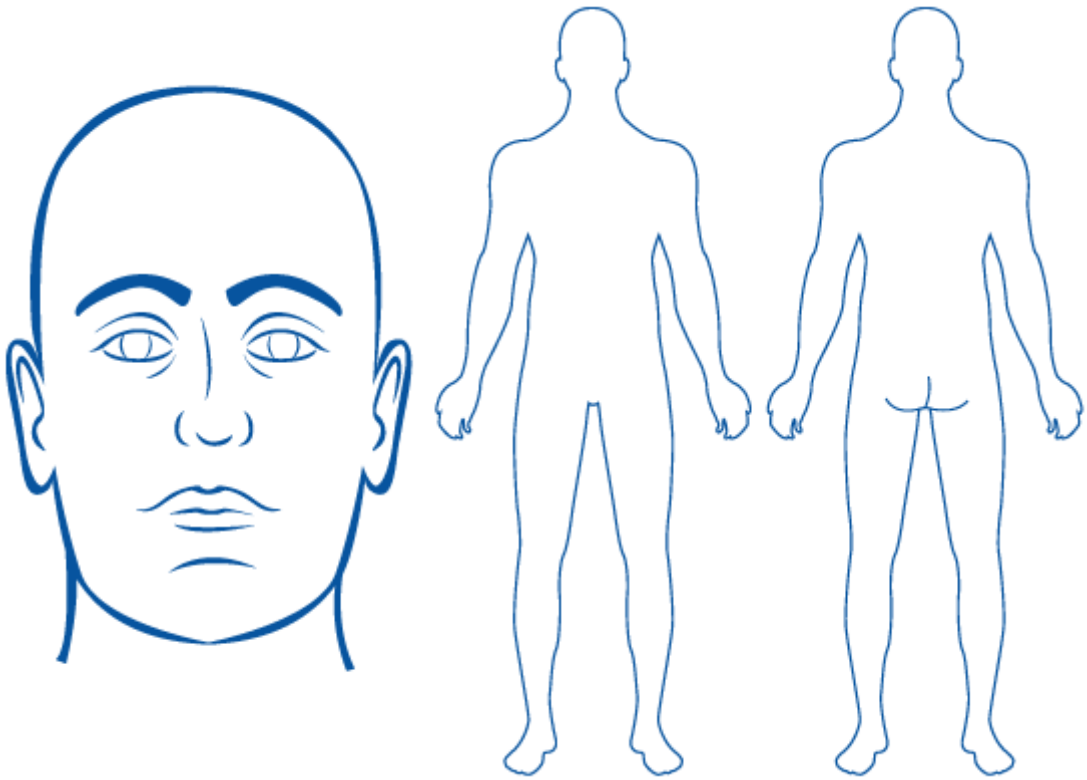
Where the injured person is released from the medical facility for return to work, the mine should arrange transportation.

Upon arrival back at the mine the person shall report to the supervisor and advise of the results of the tests.

The supervisor is to notify the mine operator.

Sample electric shock protocol form

<table>
<tr><td colspan="4">Instructions:
Form to be completed when a casualty presents to the Mine First Aid Room after receiving a suspected Electric Shock.
Attach completed form to the Mine Incident Investigation Report when complete</td></tr>
<tr><td colspan="2">Name:</td><td colspan="2">Employer:</td></tr>
<tr><td colspan="2">Date:</td><td colspan="2">Location:</td></tr>
<tr><td colspan="4">Approximate Time Shock Received:</td></tr>
<tr><td colspan="2">Level of electrical voltage exposed to (source voltage):</td><td colspan="2">Tripping current of earth leakage unit and whether it tripped</td></tr>
<tr><td colspan="2">Temperature:</td><td>Pulse bpm:</td><td>BP (if taken):</td></tr>
<tr><td colspan="4">Nature of symptom (one or more may be present): (Circle those applicable)
Burns Swelling Irregular heartbeat Difficulty breathing Muscular soreness
Loss of Consciousness Disorientated Loss of cohesion Cold/Hot sensations</td></tr>
<tr><td colspan="4">Area of Body affected / displaying symptoms (mark on diagram)
“Where are you injured and where did you feel the electric shock?”</td></tr>
</table>



Casualty's description of Sensation: (Circle those applicable)

HEAT	COOL	TINGLE	MUSCLE SPASM	PIN PRICK	SHARP
JOLT	SHAKING	DIZZY	CAN'T LET GO ELECTRIC FENCE		

Specific Comments on Sensation:

_____

_____

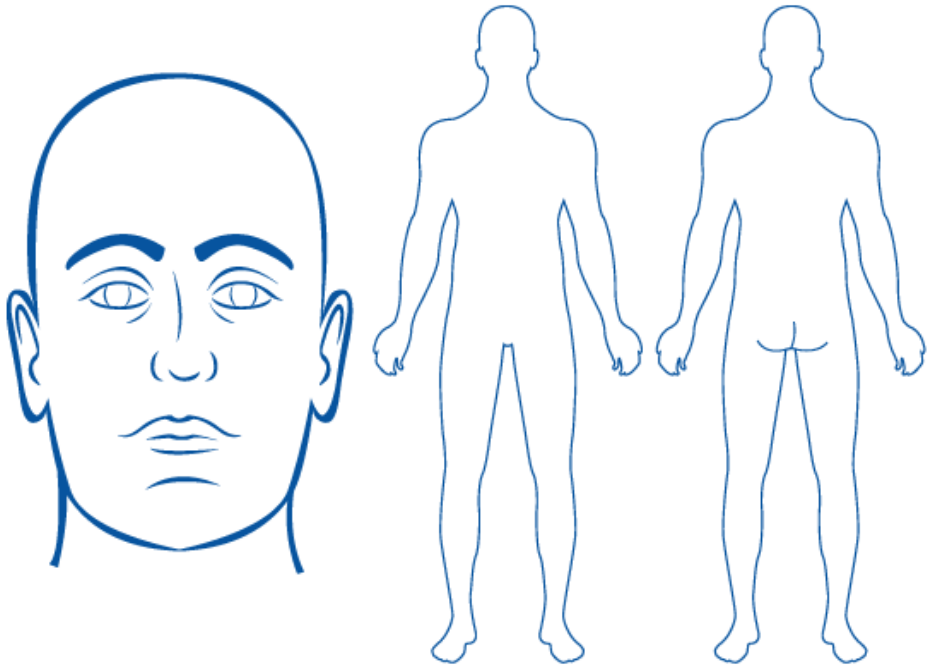
_____

_____

_____

Inspect casualty for Entry/Exit marks (mark on diagram)

Note: Footwear may need to be removed to find marks. There may be two or more marks on the casualty. Check underneath Jewellery and Watch bands. If metal framed spectacles are worn, check behind ears.



General condition of clothing / PPE: (circle those applicable)

DRY WET CLEAN DIRTY INTACT DAMAGED

Specific comments on clothing / PPE

_____
_____
_____

Person Completing Form

Name:_____ Position: _____

Our company medical policy is that any employee who reports receiving an electric shock is provided with a medical assessment and a request for the medical practitioner to perform a 12-lead ECG.

Glossary

This glossary includes terms used in this code of practice. Definitions, where indicated, have been sourced from WHS laws and NSW or Safe Work Australia codes of practice. Elsewhere, the meanings are, as far as possible, commonly understood in electrical engineering applications or in mining operations.

Alteration - changed from the original design that may affect health and safety. Wear and tear due to normal service, whether or not specified by the designer or manufacturer, does not constitute alteration.

Competent person –a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task (other than in respect of work for which a particular competency is prescribed, for example clause 5 definition of 'competent person' paragraphs (a)-(f) of the WHS Regulations, or in clause 3(1) of the WHS (Mines) Regulations.

Control measure – in relation to a risk to health and safety, means a measure to eliminate or minimise the risk (source: clause 5 of the WHS Regulations).

Earth fault current – means a current that will flow between an energized conductor and earth as the result of insulation failure (source: AS/NZS 2081).

Earth leakage current – means a current that flows between an energized conductor and earth as the result of a reduction in the value of insulation resistance (source: AS/NZS 2081).

Electrical plant - means plant, all or part of which is powered by electricity

(source: clause 3 of the WHS (Mines) Regulations)

Electrical engineering practices - activities undertaken during the lifecycle of electrical plant and installations, including the implementation of controls to manage risk.

Electrical installation - means a group of items of electrical equipment that:

(a) are permanently electrically connected together, and
(b) can be supplied with electricity from the works of an electricity supply authority or from a generating source.

(source: clause 145 WHS Regulations)

Electrical safeguards - controls that use electrical technology to control workplace hazards and that are of a reliable nature to reduce risk.

Fit for purpose – something that is sufficient to do the job for which it was designed.

Functional safety - part of the overall safety (of plant or installations) that depends on a system or equipment operating correctly in response to its inputs (source: 61508.0-2006).

Hazardous area – means a hazardous area under:

(a) AS/NZS 60079.10 *Electrical apparatus for explosive gas atmospheres—Classification of hazardous areas*; or
(b) AS/NZS 61241.10 *Electrical apparatus for use in the presence of combustible dusts—Classification of areas where combustible dusts may be present'*.

(source: clause 5 of the WHS Regulations)

Hazardous zone – in an underground coal mine means each of the following:

(a) any part at the mine in which the concentration of methane in the general body of the air is 1.25% by volume or greater,

(b) a return airway,

(c) any part of an intake airway that is on the return side of such points that are within 100 metres outbye of:

(i) the most inbye completed line of cut-throughs, or

(ii) (ii) any longwall or shortwall face, but only to the extent that the intake airway is on the intake side of that face (but not if the longwall face is an installation face at which the development of the face, and mining for development coal, have been completed and at which longwall mining has yet to commence).

(source: clause 3 WHS (Mines) Regulations

Ignition source – means a source of energy capable of igniting flammable or combustible substances (source: clause 5 WHS Regulations).

Isolated - disconnected from all possible sources of electricity supply and rendered incapable of being made energised without premeditated and deliberate action. (source: NSW *Code of Practice: Managing Electrical Risks in the Workplace*)

Live testing - The use of test instruments or test equipment on an electrical installation that is energised (source: AS/NZS 4836).

Live electrical work – The actual physical work of installing, maintaining, repairing, altering, removing or adding to electrical equipment and electrical installations, whilst the installation or equipment is energised, or the supervising of that work (source: AS/NZS 4836 but adapted for use in this code).

Modification - alteration (see meaning above).

Plant - includes:

(a) any machinery, equipment, appliance, container, implement and tool, and

(b) any component of any of those things, and

(c) anything fitted or connected to any of those things.

(source: section 4 WHS Act)

Portable electrical equipment - electrical equipment intended to be held in the hand during use or which is capable of being carried by one (1) or more persons while energised.

Voltage -

- ***Extra low voltage*** means voltage that does not exceed 50 volts alternating current (50 V a.c.) or 120 volts ripple-free direct current (120 V ripple-free d.c.).
- ***Low voltage*** means voltage that exceeds extra-low voltage and does not exceed 1000 volts alternating current (1000 V a.c.) or 1500 volts direct current (1500 V d.c.).
- ***High voltage*** means voltage that exceeds low voltage.

(Source: NSW *Code of Practice: Managing Electrical Risks in the Workplace and AS/NZS 3000*)

Acronyms

A – Amps

AC – Alternating current

AS – Australian Standard

AS/NZS – Australian and New Zealand Standard

DC – Direct current

EECP – Electrical Engineering Control Plan

ELV – Extra Low Voltage

Ex – Explosion protected

HV – High voltage

ILO – International Labour Office

IP – Ingress protection

IT – Information technology

LV – Low voltage

mA - milliamperes

NZS – New Zealand Standard

PCBU – Person conducting a business or undertaking

PCP – Principal Control Plan

PMHMP – Principal Mining Hazard Management Plan

PPE – Personal Protective Equipment

RCD – Residual Current Device

SMS – Safety Management System

SWA – Safe Work Australia

TARP – Trigger Action Response Plan

WHS – Work Health and Safety