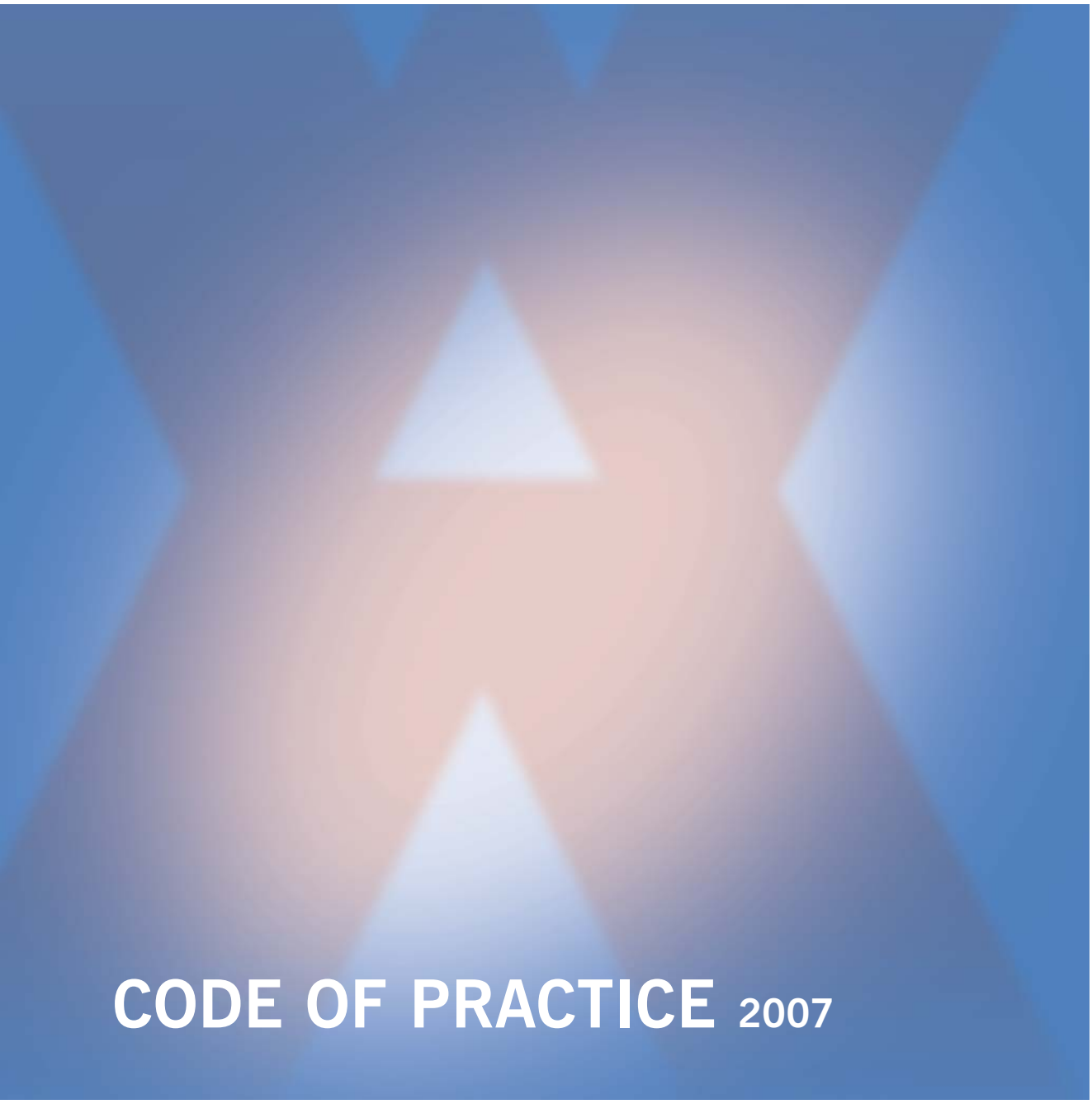
WorkCover
NEW SOUTH WALES

LOW VOLTAGE ELECTRICAL WORK



CODE OF PRACTICE 2007

WorkCover. **Watching out for you.**

New South Wales Government

Revised 2nd Edition 2007

Disclaimer

This publication contains information regarding occupational health, safety, injury management or workers compensation. It includes some of your obligations under the various workers compensation and occupational health and safety legislation that WorkCover NSW administers. To ensure you comply with your legal obligations you must refer to the appropriate Acts.

This publication may refer to WorkCover NSW administered legislation that has been amended or repealed. When reading this publication you should always refer to the latest laws. Information on the latest laws can be checked at www.legislation.nsw.gov.au or contact 1300 656 986.

CONTENTS

WHAT IS AN INDUSTRY CODE OF PRACTICE?

An approved industry code of practice is a practical guide to employers and others who have duties under the *Occupational Health and Safety Act 2000* (OHS Act) and the *Occupational Health and Safety Regulation 2001* (OHS Regulation) with respect to occupational health, safety and welfare.

An industry code of practice is approved by the Minister administering the OHS Act. It comes into force on the day specified in the code or, if no day is specified, on the day it is published in the NSW Government Gazette. An approved industry code of practice may be amended from time to time (or it may be revoked) by publication in the Gazette.

An approved industry code of practice should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare at work is being followed.

An approved industry code of practice is intended to be used in conjunction with the requirements of the OHS Act and the OHS Regulation but does not have the same legal force. An approved industry code of practice is advisory rather than mandatory. However, in legal proceedings under the OHS Act or OHS Regulation, failure to observe a relevant approved industry code of practice is admissible in evidence to establish an offence under the OHS Act or OHS Regulation.

A WorkCover Authority inspector can draw attention to an approved industry code of practice in an improvement or prohibition notice as a way of indicating the measures that could be taken to remedy an alleged contravention or non compliance with the OHS Act or OHS regulation. Failure to comply with an improvement or prohibition notice without reasonable excuse is an offence.

In summary, an approved Industry Code of Practice:

- ✓ gives practical guidance on how health, safety and welfare at work can be achieved;
- ✓ should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare in the workplace is being followed;
- ✓ can be used in support of the preventive enforcement provisions of the *Occupational Health and Safety Act*;
- ✓ can be used to support prosecutions for failing to comply with or contravening the OHS Act or OHS Regulation.

PREFACE

The aim of this code of practice is to protect the health and safety of electrical workers. It will help employers and self-employed persons decide on appropriate measures to eliminate or control the risks to employees and other workers who perform electrical work on or near low voltage installations. It provides practical guidance on implementing the requirements of the *Occupational Health and Safety Act 2000* and *Occupational Health and Safety Regulation 2001* (OHS Regulation) as amended by the *Occupational Health and Safety Amendment (Electrical Work) Regulation 2004,* which amended clauses 207 and 208 of the OHS Regulation.

Some activities are excluded, such as electrical work on extra low voltage installations, work on high voltage installations, automotive work and the manufacture of electrical appliances and apparatus.

WARNING

In accordance with the statutory risk control requirements of the OHS Regulation, the practice of working on an energised (live) low voltage installation cannot usually be justified. It is the responsibility of the employer, and the controller of the premises, to ensure that this is not done other than in situations where 'it is necessary in the interests of safety and the risk of harm would be greater' if that part of the installation's circuits or apparatus were to be de-energised.

Note: The Australian Standard AS/NZS 4836: *Safe working on low voltage electrical installations* also provides guidance for safe work practices on or near low voltage electrical installations. The guidance relating to energised (live) work is inconsistent with the statutory provisions of the OHS Regulation and the requirements of this code. Observance only of the requirements of AS/NZS 4836 does not meet the provisions of the OHS Act and OHS Regulation and therefore this code prevails.

This code was developed in consultation with members of the electrical industry including relevant unions, employer bodies and government agencies and replaces the first edition of the *Code of practice for low voltage electrical work*, which commenced on 1 January 2002.

WHAT ARE LOW VOLTAGE INSTALLATIONS?

In this code of practice, low voltage installations include any and all electrically operated circuits, apparatus, components in which the electrical voltage exceeds extra low voltage (ELV) and is at or below 1000 Volts a.c. or 1500 Volts d.c.

Many electrical occupations and tasks may place electrical workers at risk to low voltage electricity, such as:

- new electrical installations and their connection to supply
- existing installations and their maintenance and modification
- temporary wiring arrangements
- testing and fault finding on circuits or equipment
- switching operations
- inspections.

HOW CAN ELECTRICITY AT LOW VOLTAGE AFFECT HEALTH AND SAFETY?

Contact with energised electrical conductors is a serious risk because a proportion of the current passing through the human body may also pass through the heart. The current through the heart can disrupt the heart's operation by forcing it into fibrillation, which then stops blood being pumped around the body. When the body or the brain no longer receives oxygen from the blood, it begins to die. This means that contact with energised parts at any voltage that causes sufficient current to pass through the heart is potentially injurious or even fatal.

Contact with energised electrical components can also cause serious burns arising from the discharge of electrical energy. Health effects can include muscle spasm, shock, burns, palpitations, nausea and vomiting, collapse, fibrillation, unconsciousness, or death. Other risks include fires and explosions.

WHAT DO THE SYMBOLS IN THE CODE OF PRACTICE MEAN?

To help you work out what you require, a number of symbols are used to highlight things you need to take into account and tools to help you do the job.

Consult and communicate with employers

Legal obligations that must be followed

The process of finding things that cause harm, working out how big a problem they are and fixing them

Assess the risks in your workplace

Tools that can help you work out your plan

CHAPTER 1 – ESTABLISHMENT

1.1 Title

This is the *Code of practice for low voltage electrical work*.

1.2 Purpose

This code of practice provides practical guidance in order to protect the health and safety of persons working, testing or fault finding on or near low voltage electrical installations.

This code explains the requirements for managing risks associated with electricity, to ensure the health, safety and welfare of electrical workers, appropriate for the particular circumstances of each workplace.

1.3 Scope

This code of practice applies to all electrical work, testing or fault finding in places of work in NSW, except as listed below.

Electrical work is work on or near a low voltage electrical installation, for the purpose of installing, repairing, altering, removing or adding to an electrical installation or the supervision of that work.

Note: For the purposes of this code this includes electrical work, testing or fault finding on a low voltage electrical installation under the control of an electricity network operator, which does not form part of the electricity distribution network.

This code does not apply to electrical work, testing or fault finding relating to:

(a) extra low voltage electrical installations – refer to Appendix 5

(b) high voltage electrical installations – refer to Appendix 6

(c) work by or for an electricity network operator, which is carried out in accordance with a safety plan required by the *Electricity Supply (Safety and Network Management) Regulation 2002*

(d) the manufacture or supply of electrical appliances, apparatus, articles or plant, for sale or hire when unplugged from any electrical outlet socket

(e) automotive electrical work

(f) telephone, communication and data systems

(g) repair of consumer appliances, plant, luminaries or equipment when unplugged from any electrical outlet socket

(h) work on a mine site.

If the requirements of this code are inconsistent with requirements of the *Electricity (Consumer Safety) Regulation 2006* then that regulation prevails.

On construction sites, this code applies in addition to the requirements of the *Code of practice: Electrical practices for construction work,* which applies to temporary installations and electrical appliances used during construction work.

1.4 Authority

This is an industry code of practice approved by the Minister for Commerce under section 43 of the *Occupational Health and Safety Act 2000,* on the recommendation of the WorkCover Authority of New South Wales ('WorkCover NSW').

1.5 Commencement

This code of practice takes effect on and from January 19, 2007.

1.6 Revocation

This code of practice replaces the first edition of the *Code of practice for low voltage electrical work*, published in the *Government Gazette* on 14 December 2001, which is hereby revoked as provided by section 45 of the *Occupational Health and Safety Act 2000*.

1.7 Interpretation

1.7.1 Recommended practices

Words such as 'should' indicate recommended courses of action. 'May' or 'consider' indicate a possible course of action the duty holder should consider. However, you may choose an alternative method of achieving a safe system of work. For a further explanation, see 'What is an industry code of practice?'.

1.7.2 Legal obligations

Words such as 'must', 'requires' and 'mandatory' indicate obligations that, pursuant to the OHS Regulation, must be complied with. These obligations are included in this code as appropriate background material against which the guidance afforded by the code should be assessed. In addition to the obligations imposed by the OHS Regulation, failure to comply with the code can be used as evidence in proceedings for an offence against the OHS Act or OHS Regulation where the code is relevant to an element of particular prosecution.

1.8 Definitions

The following definitions are used for the purposes of this code of practice:

approved means any, or a combination, of the following:

- agreed to for a purpose in writing by the employer or the controller of the premises, subject to the consultation process
- certified for a function by a recognised testing authority
- meeting an Australian Standard (or other standard recognised by regulatory authorities).

authorised means to give authority in writing or by other means to perform a particular task. This can be achieved by any, or a combination, of the following:

- providing a paper document
- sending a facsimile
- discussing the matter over the telephone, with details recorded on paper at each end, or
- other equivalent means (eg email).

Note: Being authorised also carries with it responsibilities for employers and employees – see Sections 8.1 and 8.4.

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

Note: See definition of 'safety observer'.

control measures measures taken to minimise a risk to the lowest level reasonably practicable.

controller of premises means a person who has control of the premises used by people (who are not their employees) as a place of work, including:

(a) a person who has only limited control of the premises

(b) a person who has, under any contract or lease, an obligation to maintain or repair the premises, but

(c) does not include an occupier of a private dwelling.

Note: In some cases the controller is the owner who can also be the occupier. The obligations of employers to their employees in relation to premises are covered under specific employer obligations, and not under controller obligations.

de-energised (dead) means separated from all sources of supply but not necessarily isolated, earthed, discharged or out of commission.

electrical article means any appliance, wire, fitting, cable, conduit, meter, insulator, apparatus, material or other electrical equipment intended or designed for use in, or for the purposes of, or for connection to, any electrical installation.

Note: Electrical article has the same meaning as it has in the *Electricity (Consumer Safety) Act 2004.*

electrical installation means any fixed appliance, wires, fittings, apparatus or other electrical equipment used for (or for the purposes incidental to) the conveyance, control and use of electricity in a particular place, but does not include any of the following:

(a) any electrical equipment used, or intended for use, in the generation, transmission or distribution of electricity that is:

(i) owned or used by an electricity supply authority, or

(ii) located in a place that is owned or occupied by such an authority

(b) any electrical article connected to, and extending or situated beyond any electrical outlet socket

(c) any electrical equipment in or about a mine

(d) any electricity installation operating at not more than 50 volts alternating current or 120 volts ripple free direct current

(e) any other electrical equipment, or class of electrical equipment, prescribed by the Electricity (Consumer Safety) Regulations 2006.

Note: Electrical installation has the same meaning as it has in the *Electricity (Consumer Safety) Act 2004.*

electrical supply authority (electricity network operator) has the same meaning as it has in the *Electricity (Consumer Safety) Act 2004.*

electrical wiring work (electrical work) means the actual physical work of installing, repairing, altering, removing or adding to an electrical installation or the supervising of that work.

Note: Electrical wiring work has the same meaning as it has in the *Electricity (Consumer Safety) Act 2004.* For the purposes of this code this includes electrical wiring work carried out on a low voltage electrical installation under the control of an electricity network operator, which does not form part of the electricity distribution network.

electrical worker means an employee, apprentice, self employed or other person carrying out electrical work, including the supervision of such work.

ELV – extra low voltage means an operating voltage not exceeding 50 V a.c. or 120 V ripple free d.c., as defined in AS/NZS 3000 *Australian/New Zealand Wiring Rules.*

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

employer means a person who employs persons under contracts of employment, or apprenticeship.

Note: In some chapters of the Regulation, the term 'employer' includes a self employed person in relation to duties to other persons.

energised (live) means connected to a source of electrical supply or subject to hazardous induced or capacitive voltages.

exposed conductor	means an electrical conductor that is hazardous because it has not been protected by a barrier of rigid material or by insulation that is adequate for the voltage concerned, under a relevant Australian Standard specification.
exposure	means the contact of a person with a hazard.
fault finding	means the process of making measurements or carrying out tests on the electrical installation in order to prove operability or locate faults.
hazard	means anything (including work practices or procedures) that has the potential to harm the health and safety of a person.
high voltage	means an operating voltage of more than 1000 V a.c. or 1500 V d.c. between phase conductors or between a phase conductor and an earth as defined in AS/NZS 3000 *Australian/New Zealand Wiring Rules.*
in the interests of safety	means a situation where a properly performed and documented risk assessment shows that the risk of harm would be greater if the circuits and apparatus were de-energised than could be the case with the circuits and apparatus remaining energised for the duration of the work. **Note:** This definition applies to situations where there is a significant potential for the loss of life or serious injury to persons, destruction of or significant damage to property, destruction of or significant damage to the environment or the loss of the provision of essential community services that would, if the circuits and apparatus were de-energised, result in greater harm.
inspection	means a visual observation of a low voltage electrical installation, electrical circuits, apparatus, associated equipment and other workplace hazards.
inspector	means an inspector appointed under the *Occupational Health and Safety Act 2000.*
isolated	(specific electrical usage) means disconnected from all possible sources of electrical energy by opening of switches, opening or withdrawal of circuit-breakers, removal of fuses, links, connections and the like and rendered incapable of being energised unintentionally.
low voltage	means an operating voltage that exceeds extra-low voltage (ELV), but not exceeding 1000V a.c. or 1500V d.c. as defined in AS/NZS 3000 *Australian/ New Zealand Wiring Rules.*
MEN	means multiple earthed neutral.
near	see 'on or near exposed low voltage conductors', below.
neutral	means a conductor of a three wire or multi wire system, which is maintained at an intermediate and approximately uniform potential in respect of the active conductors or the conductor of a two wire system that is earthed at its source. A neutral should be considered (and treated) as an energised conductor until isolated and proven de-energised.
OHS Act	means the *Occupational Health and Safety Act 2000.*

OHS Regulation means the Occupational Health and Safety Regulation 2001.

on or near exposed low voltage conductors means a situation where an electrical worker is working on or near exposed low voltage energised conductors and there is a reasonable possibility that the worker's body, or any conducting medium the worker may be carrying or touching during the course of the work, may come closer to the exposed energised low voltage conductors than 500mm.

Note 1: The term 'on or near exposed low voltage conductors' does not apply if the uninsulated and energised part of the installation is safely and securely shielded by design or segregated and protected with insulated barricades or insulated shrouding or insulating material to prevent against inadvertent or direct contact.

Note 2: An exposed conductor is a conductive part of low voltage electrical equipment which:

(a) can be touched with the standard test finger as specified in AS/NZS 3100: *Approval and test specification – General requirements for electrical equipment.*

(b) is not an energised part but can become energised if basic insulation fails.

personal protective equipment (PPE) means items that electrical workers can use to protect themselves against hazards. PPE includes insulating gloves, insulating mats or sheeting, safety helmet, safety glasses, face protection and appropriate clothing.

Note: A number of items of PPE are made and tested to Australian Standards. PPE that is not designated as meeting a recognised standard may be unreliable in service, as its performance is unknown.

plant includes any equipment, appliance or machinery.

Note: The legal definition of plant is very broad and inclusive.

risk means a combination of the probability that a hazard may cause an injury and the severity of an injury.

safety observer means a person who has been specifically assigned the responsibility of observing and warning against unsafe approach to electrical equipment, exposed low voltage energised conductors and other potential hazards.

- For work on an energised electrical installation, the safety observer must be competent to perform the particular task that is to be carried out and must also be competent in electrical rescue and cardiopulmonary resuscitation (CPR).

Note: This means the safety observer must be competent and qualified under the *Home Building Act 1989* to carry out the electrical work that is being performed by the electrical worker who is carrying out the work.

- For testing, the safety observer must be competent to assist the persons who are conducting the tests and must also be competent in electrical rescue and cardiopulmonary resuscitation (CPR).

safe work method statement	means a statement that: • describes how work is to be carried out • identifies the work activities assessed as having safety risks • identifies the safety risks; and • describes the control measures that will be applied to the work activities, and includes a description of the equipment used in the work, the standards or codes to be complied with, the qualifications of the personnel doing the work and the training required to do the work.
self-employed person	means a person who works for gain or reward otherwise than under a contract of employment or apprenticeship, whether or not employing others. **Note:** In some chapters of the OHS Regulation, the term employer includes a self-employed person.
separate	(as a risk control measure) means to separate the hazard from the worker using barriers, distance, or time.
testing	means the use of logical methodology or test instruments or test equipment by an electrical worker to test for the integrity and operability of energised circuits and apparatus of an electrical installation or electrical equipment.
voltage	differences of potential normally existing between conductors and between conductors and earth. This is defined in AS/NZS 3000 *Electrical installations (known as the Australian/New Zealand Wiring Rules).*
working energised (live)	means the process of carrying out electrical work on an energised low voltage electrical installation or electrical equipment that is not isolated. **Note:** This excludes testing and fault finding carried out in accordance with the requirements of Clause 208 of the OHS Regulation.
workplace	is the place of work, which can be anywhere and includes premises.
WorkCover NSW	means the WorkCover Authority of New South Wales established by Section 14 of the *Workplace Injury Management and Workers Compensation Act 1998.*

CHAPTER 2 – CONSULTATION AT WORK

The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

To effectively implement this code, employers need to be aware of these requirements and have procedures in place to apply them.

The advice in this code of practice should be used when consulting with employees about the hazards of working on or near low voltage electrical installations and involving them in the risk assessment and control process.

Employers are advised to consult the OHS Act and the OHS Regulation as well as the *Code of practice: Occupational health and safety consultation* and the *Code of practice: Risk assessment* for details of these requirements and how they can be met. The following information is designed to provide an overview of legislative requirements.

2.1 Consultation at the workplace

Employers must consult with employees when taking steps to assess and control workplace risks.

In order to consult with employees, employers are required to set up consultation arrangements and develop consultation procedures.

2.1.1 Consultation arrangements

The OHS Act provides three options for consultation arrangements under sections 16 and 17:

Arrangement	Number of employees	Requirement
OHS committee	20 or more employees	• requested by a majority of employees, or • direction by WorkCover.
OHS representative	any size	• at least one employee requests an election, or • direction by WorkCover.
Other agreed arrangements	any size	agreed to by both the employer and employees (in a small workplace it may be a regular safety meeting with employees)

Before using this code, an employer must ensure that consultation arrangements are in place. An employer may initiate the establishment of an OHS committee or the election of an OHS representative if the employees have not made such a request. When the consultation arrangements have been decided, clause 27 of the OHS Regulation requires employers to record them and advise all existing and new employees.

2.1.2 Consultation procedures

After setting up the consultation arrangements, employers need to consider when and how these consultation arrangements need to be applied.

2.1.3 When should consultation be undertaken?

Under section 13 of the OHS Act, employers have a general duty to consult employees when decisions are being considered that may affect their health, safety and welfare at work. Therefore, employers are required to consult with their OHS committee, OHS representative or other agreed arrangement when such decisions are being considered.

Note: Section 17(3) of the OHS Act provides that a Federal or State industrial organisation of employees may, on request, represent employees for the purposes of consultation on occupational health, safety and welfare under other agreed arrangements.

Decisions that could affect health, safety and welfare include:

- planning for new premises or modifying existing premises
- purchasing new plant, equipment or substances
- planning, designing or changing work tasks or jobs
- using contractors in the workplace
- investigating incidents or accidents
- developing emergency procedures
- determining or reviewing workplace amenities
- determining or reviewing consultation arrangements
- assessing, reviewing and monitoring risks to health and safety from work
- eliminating or controlling risks to health and safety from work.

Note: Any procedures that are developed to encompass these activities must incorporate consultation.

It may not be practical or reasonable to involve the OHS committee or the OHS representative in every purchase decision or task change. However, the employers or committee or representatives should agree on what process is needed to ensure that affected employees are consulted.

2.1.4 How should consultation be undertaken?

When engaged in consultation, section 14 of the OHS Act requires employers to:

- share all relevant information with employees – for example, if an employer is going to change a work task, employees need to be told of any risk to health and safety that may arise and what will be done to eliminate or control these risks
- give employees reasonable time to express their views – employees need adequate time to assess the information given to them, obtain relevant safety information and consult with fellow employees to enable them to form their views
- value the views of employees and take into account when the decision is made to resolve the matter – in many cases, agreement will be reached on how the safety issues are to be addressed. When agreement cannot be reached, the employer should explain how the employee's concerns have been addressed.

CHAPTER 3 – RISK MANAGEMENT

3.1 Managing risks in the workplace

Under the OHS Regulation all employers and self employed persons must use a risk management approach to address workplace health and safety.

Risk management should be initiated when considering new work, purchasing equipment, developing or changing work systems, or designing or remodelling the workplace. This will help you identify the special needs of each workplace.

The OHS Regulation requires employers to:

- identify hazards
- assess the risks to the health and safety of persons arising from the hazards
- use appropriate control measures to eliminate or reduce the risks
- monitor and review the control measures to ensure on-going safety.

These are the key elements of a risk management process, which should be undertaken in consultation with the people most likely to be affected, such as employees and electrical contractors. When doing this, it may help to break the workplace or work activities into areas and deal with each separately.

To simplify the task, generic risk assessments may be used. Generic risk assessments are assessments covering more than one location or circumstance. Clause 35(3) of the OHS Regulation requires that risk assessments may be used for similar work in several locations or circumstances, where the hazards and risks are comparable, so long as the applicability has been checked for each place or circumstance. See, for example, tool 1 in Appendix 1. The needs of individual electrical workers also need to be identified.

WARNING

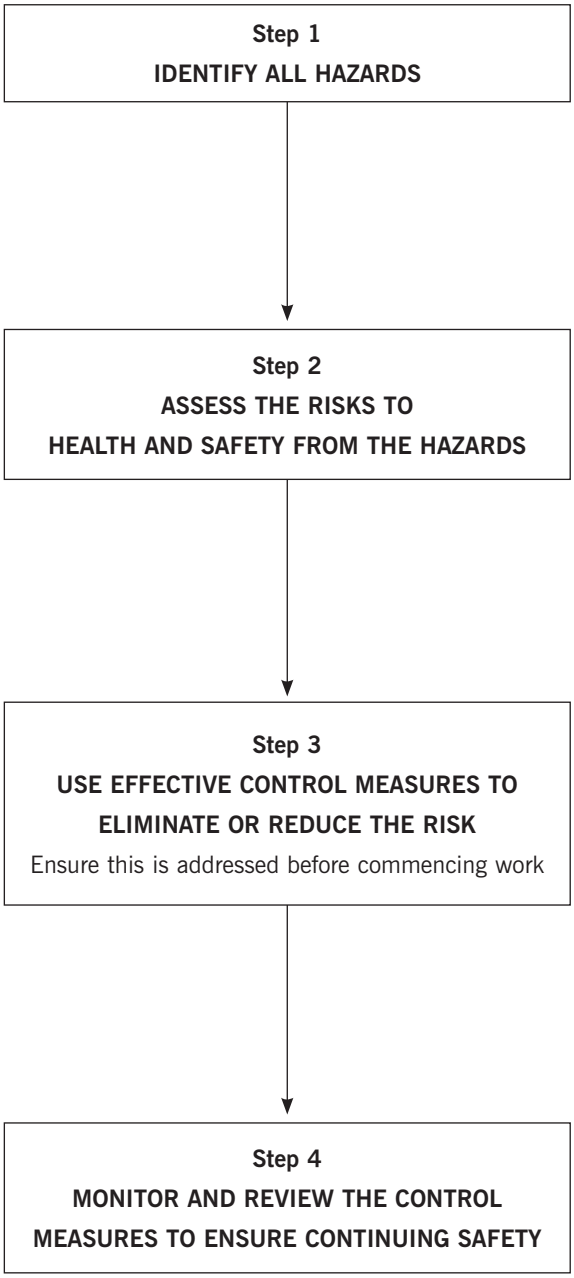
In accordance with the statutory risk control requirements of the OHS Regulation, the practice of working on an energised (live) low voltage installation cannot usually be justified. It is the responsibility of the employer, and the controller of the premises, to ensure that this is not done other than in situations where *it is necessary in the interests of safety and the risk of harm would be greater* if that part of the installation's circuits or apparatus were to be de-energised.

The OHS Regulation places specific risk control obligations on controllers of premises concerning the practice of working on or near energised electrical installations.

Importantly, this means that where such a person engages the services of an electrical worker, and the electrical worker informs that person that the work cannot be done safely with the electricity supply switched on, then the person in control (or in charge) of the premises cannot ask or expect the electrical worker to do the work while the circuits and apparatus are energised. The person in control must then ensure that the work can be done when that part of the electrical installation to be worked on is de-energised.

Further advice on legal obligations is provided in Chapter 8.

Diagram: Risk management process



3.2 Step 1 – Identifying the hazards

An employer must take reasonable care to identify all the health or safety hazards, which could harm the workers or other persons in their workplace. The hazards may include work practices, shift arrangements, people, equipment, materials and the environment.

The following are ways of identifying hazards in your workplace:

(a) a walk through of the workplace. This is a simple visual check, which may be assisted with the use of a floor plan, site plan or map

(b) looking at the way electrical work, testing and fault finding is carried out

(c) consulting with workers

(d) looking at the workplace records on 'near misses', electric shock incidents, accidents and injuries

(e) using information provided by manufacturers and suppliers about the proper use of electrical plant (for example manufacturer's operating instructions and labels)

(f) using an outside expert or independent adviser.

It is a good idea to list the hazards, identifying the form in which the hazard occurs, where it occurs, things that contribute to the hazard, and the persons likely to be exposed to the hazard. This can be used in developing safe work method statements. Chapter 4 deals with identifying hazards.

Suppliers of plant (including all electrical equipment) have an obligation to provide you with safety information.

3.3 Step 2 – Assessing the risks

Risk assessment involves looking at the:

- **likelihood (which is a combination of length of time and frequency of exposure) and the**
- **likely severity, of any injury or illness that may occur.**

This will indicate how serious the exposure each source of hazard is. When doing this, review any available health and safety information related to the hazard, and identify the factors contributing to the risk.

Consider:

(a) the sources of low voltage exposure

(b) the number of people involved and their individual needs

(c) the nature of work undertaken

(d) the work practices in use

(e) the type of plant, machinery and equipment to be used

(f) the premises and working environment including their layout or condition

(g) the capability, skill, experience and age of people doing the work

(h) foreseeable abnormal conditions.

To prioritise the work on reducing risks, you should make a list of the potential injuries and diseases that can occur, and list them from the most to the least serious (for example, from death by electrocution through to minor shock and minor burns). The most serious risks are the ones that should be dealt with first.

A significant risk is that of working energised (live), which must be justified.

This risk assessment should also help you plan for electrical work that may be necessary in the interests of safety. The risk assessment should be recorded, along with the control measures selected.

WARNING

The risk assessment for working on energised (live) circuits or apparatus MUST be written down in consultation with the electrical workers that have been requested to do the work and recorded. Detailed checklists for risk assessment are provided in Chapter 5.

3.4 Step 3 – Eliminate or control the risk

The third step involves working out how to eliminate or control the risks, using what is termed the 'hierarchy of control'.

3.4.1 Hierarchy of control

If it is not reasonably practicable to eliminate the risk, the employer must control the risk, using the order specified below.

Level 1

Firstly, eliminate the risk, which is always the first priority (for example, de-energise the power supply to the circuit or part to be worked on, reschedule the electrical work to a time when the work can be done de-energised).

Level 2

Secondly, if you can't eliminate the risk, consider redesigning the equipment or processes so that less hazardous equipment, materials or situation may be used. Minimise the risk by:

(a) modifying the plant

(b) modifying the way work is done to make it safer

(c) isolating the hazard (for example, introduce a restricted work area or isolate the supply)

(d) using engineering controls (for example, insulation, guarding, safety screens, safe working distances).

Level 3

Thirdly, consider other controls such as:

(a) administrative controls and safe work practices (as examples, specific training and work instructions, preventing unauthorised access to areas where hazards are present, preventing unauthorised electrical work)

(b) personal protective equipment (as examples, insulated gloves, insulated tools, insulated mats).

The control measures at Level 1 give the best result and should be adopted where practicable. The measures at the other levels are less effective and they require more frequent reviews of the hazards and the systems of work. In many situations, a combination of control measures may be needed.

Personal protective equipment (PPE) is the least preferred way of dealing with risks. However, it is often necessary and should be used when other methods are simply not practical or feasible, or in combination with other methods to ensure sufficient control. Make sure the PPE is appropriate, fitted correctly, maintained in good condition and always used correctly.

Workers must be trained how to use PPE correctly and how to look after it, to ensure ongoing correct use.

The employer is responsible for ensuring that the method of control is working. Identify any records necessary (eg record maintenance of controls).

Any new control measures should be evaluated to ensure that they are effective and do not create new hazards. Also, develop clear work procedures and make sure they are written down and available to employees. For specific advice refer to Chapter 6 – Controlling risks.

WARNING

Generally, working on energised circuits and apparatus cannot be justified as being as safe as working de-energised.

3.5 Safe work method statement (SWMS)

The OHS Regulation requires safe work method statements for 'live electrical work' that is carried out in the interests of safety and high risk construction work, which includes work on or near that part of an energised electrical installation.

A safe work method statement is required for electrical wiring work on an electrical installation at a construction site.

In developing safe work method statements, work activities that have safety risks must be identified, the risks must be assessed, and means to eliminate or control the risks must be adopted.

Many contractors submit technical procedures for carrying out work processes as SWMSs. These documents are often not a SWMS as required for the purpose of assessing risks.

A SWMS requires the work method to be presented in a logical sequence. The hazards associated with each process are to be identified, and the measures for controlling these hazards specified.

Break down each job into a series of basic job steps, to identify the hazards and potential accidents in each part of the job. The description of the process should not be so broad that it leaves out activities with the potential to cause accidents and prevents proper identification of the hazards. It is not necessary to provide fine detail of the tasks.

A hazard may be either intrinsic or inherent, existing or potential, an unsafe condition and/or an unsafe act, eg a dangerous location, an unsafe (hazardous) work process, or a potentially hazardous task as a stage of the electrical work.

Where risks cannot be eliminated, the 'hierarchy of control measures' must be applied. Personal Protective Equipment is the least preferred approach. In some situations a combination of control measures may need to be used. References to legislation, codes of practice or Australian Standards are not an acceptable alternative for the elimination or control of risks. When referencing legislation, codes of practice or Australian Standards in the SWMS, make sure the specific part of the reference is described in the SWMS for the actual procedure or control.

The SWMS should nominate the occupations and number of employees required to safely perform the task(s). Safety and/or skills training provided, or required, prior to commencing work is to be identified, together with any special qualifications, permits, licenses, certificates of competency the employees require under the OHS Regulation. Copies of such documents and training records should be available.

SWMSs must be developed after consulting with the electrical workers who have to use them and they should be tried under simulated non hazardous conditions and critically evaluated to be certain that they are safe and described clearly. The SWMS is to be available at the worksite for review by the electrical workers undertaking the task.

SWMSs should address the following requirements:

(a) the qualifications and training to do the work

(b) insulating exposed energised conductors in the immediate area prior to working on energised circuits and apparatus

(c) access requirements for various electrical situations, such as access permits or safety clearances from exposed energised conductors

(d) isolation and tagging/locking out procedures

(e) the selection and use of safe testing equipment/instruments

(f) insulating gloves and insulated tools

(g) inspection of the condition of clothing

(h) permit and approval processes

(i) safety rules to be followed before deciding to work on an energised installation

(j) an emergency plan (eg fire, explosion, electric shock)

(k) instructions for the safety observer.

An example of a SWMS is provided in Appendix 3.

3.6 Instruction, training, information and supervision

The OHS Regulation requires employers to provide such instruction, training, information and supervision as may be necessary to ensure the health, safety and welfare of their employees while at work. An employer must also ensure that any person who may be exposed to a risk to health or safety is consulted and informed of the risk and is provided with the instruction, training, information and supervision necessary to ensure the person's health and safety.

3.6.1 Instruction and training

Electrical work must not be performed unless those performing the work have received appropriate and adequate instruction and training.

Electrical workers undertaking electrical work should only be engaged for duties consistent with their qualifications and training, and appropriate supervision must be provided to ensure that they carry out their duties in a lawful and competent manner.

Records of training that is provided to electrical workers should be kept by the employer.

3.6.2 Provision of information

Information may include:

- the results of any applicable risk assessment
- safe work method statements
- a review of such a risk assessment and/or safe work method statement or safe working procedure
- any other relevant OHS information.

Electrical workers and other relevant employees must always have, on request, access to risk assessments, safe work method statements and safe working procedures at the workplace or electrical worker's base.

Employers must brief each electrical worker as to the contents of risk assessments, safe work method statements and safe working procedures when each electrical worker and/or other person begins to perform electrical work, at regular intervals thereafter, and whenever there are changes to risk assessments or new information about health and safety risks becomes available.

The employer must consult with their employees to ensure that such information and training is in a form that is accessible and easily understood. This is important where employees are from a non English speaking background and/or have special needs or disabilities, and may have specific language or literacy requirements.

3.6.3 Supervision

The OHS Regulation requires employers to ensure that employees are provided with reasonable supervision as may be necessary to ensure the health, safety and welfare of the employees and other persons at the employer's workplace.

Supervision must be undertaken by a competent person and should take into account the competence, experience and age of each employee.

Supervision for electrical work must entail the following:

(a) **ensuring** (if required) that electrical workers performing electrical work hold appropriate electrical licenses issued under the *Home Building Act 1989* or are directly supervised by a licence holder

(b) **ensuring** that the electrical workers have acquired the knowledge and skills needed to perform the electrical work through approved competency training, and/or experience

(c) **ensuring** that adequate occupational health and safety management systems are in place and operating so that the systems of work and safe work practices that have been adopted are followed.

3.6.4 Incident reporting

Hazards and OHS problems should be reported as soon as they are noticed so that the risks can be assessed and addressed as quickly as possible. Records of reported hazards should be kept and should include details of the action taken to remove the hazard or control the risk arising from the hazard.

Employers have responsibilities to have systems in place to enable electrical workers and others to report workplace hazards and incidents (for example, faulty equipment) and for those hazards and incidents to be recorded. These should be developed and implemented in consultation with employees and/or other persons undertaking the electrical work. Details to be recorded about an incident include where it happened, why it occurred, who was involved and the course of action to be taken to prevent a recurrence of the incident.

3.6.5 Notification of incidents

Whether you are an employer, self employed person and/or occupier, you are required by law to notify certain types of incidents to WorkCover NSW and/or your workers compensation insurer.

Incidents that must be notified include:

- a fatality (electrocution)
- an incident where there has been a serious injury (electric shock, fractures, burns, etc)
- an incident where there is an immediate threat to life but result in no injury or illness (electric shock).

In addition to the above OHS Regulation requirements, the *Electricity (Consumer Safety) Regulation 2006* requires that a '*serious electrical accident*' be notified.

A '*serious electrical accident*' has the same meaning as it has in the *Electricity (Consumer Safety) Act 2004* and means an accident:

(a) in which an electrical article or electrical installation is involved that is or was used for the conveyance, control and use of electricity and electricity was, at the time of the accident, being so conveyed, controlled and used, and,

(b) as a consequence of which a person dies or suffers permanent disability, is hospitalised, receives treatment from a health care professional or is unable to attend work for any period of time.

Employees also have a duty to report incidents and 'near misses' to their employer so that appropriate remedial action can be taken, ie medical assessment if a worker has received an electric shock.

In addition to the above, the OHS Act and the OHS Regulation requires that certain occurrences that occur at the work place are not to be disturbed for 36 hours (unless the work area has to be made safe to perform a rescue or permission has been given by WorkCover).

Serious incidents can be notified to WorkCover on 13 10 50, as an urgent investigation may be needed.

3.7 Step 4 – Monitor and review

The OHS Regulation requires employers to review risk assessments and measures adopted to control risks.

Risk management is an ongoing process. It is a pivotal part of overall business management and, just like other business activities, must be checked and reviewed. To ensure that work stays safe, an employer must review the risk assessments undertaken.

This will occur whenever:

- there is evidence that the risk assessment is no longer valid
- an injury or illness occurs
- a change is planned to the place of work, work practices, or work procedures, or
- an accident or incident occurs.

The process of identification, assessment and control must be repeated whenever circumstances change. Where a system of work is updated, workers affected by the change must be consulted and informed of new requirements. This is part of a continuous improvement process, which is fundamental in ensuring health and safety is maintained.

CHAPTER 4 – IDENTIFYING HAZARDS

The first step is to identify the sources of exposure to electricity and other related hazards.

To do this, you could break the workplace or tasks down into areas and then identify the hazards in each area.

'Stocktake' your workplace hazards to be sure you identify all the sources of electricity or stored electrical energy, to which people may be exposed. The following examples of hazards will assist this 'stocktake'.

4.1 Common hazards of testing, fault finding or working on or near low voltage installations

Below are examples of typical sources of hazard that, individually or in combination, could lead to electric shock, severe injury, fire or explosion. The list is not in order of priority.

(a) voltages between phases and between phases and neutral

(b) voltages between phases and earth

(c) voltages between energised exposed conductors and surrounding metal framework

(d) voltages across open switch contacts

(e) voltages across undischarged capacitors

(f) voltages on disconnected conductors (particularly neutrals)

(g) multiple supply sources (more than one source of supply or energised circuit may be available on the premises), eg 'essential services' on a switchboard, emergency backup generators or UPS

(h) voltages between energised exposed conductors and the surrounding environment (including metalwork, damp situations, other conductive surfaces and persons nearby)

(i) electrical testing or operating equipment with open enclosures in hazardous areas (as defined by AS/NZS 3000)

(j) in installations or systems where the MEN (multiple earthed neutral) system is used, the rise in the earth potential in an installation due to a high impedance return path to the distribution neutral

(k) damp conditions

(l) switched off circuits becoming energised

(m) induced voltages or currents

(n) faulty equipment

(o) hygroscopic materials that become conductive, eg fertiliser dust.

4.2 Common non-electrical hazards that may be encountered in electrical work

Other hazards which may contribute to risks while carrying out electrical work include:

(a) fall from heights, slippery surfaces

(b) removal of cover plates near energised equipment eg escutcheon plates

(c) confined spaces (where there may be a hazardous atmosphere – see below)

(d) lack of sufficient light to work safely

(e) lack of ventilation leading to uncomfortable, hot and humid working conditions

(f) excessive fatigue of the workers, due to pressure of deadlines or other factors

(g) obstacles to getting the equipment switched off

(h) using a gas flame near exposed electrical conductors (a flame is a conductor)

(i) using conductive or flammable cleaning solvents

(j) temperature rise as a result of combustion

(k) cramped working conditions, including cable trenches and cable pits

(l) explosive atmospheres

(m) use of conductive tools and equipment, eg metallic tape measures and rulers

(n) electric tools and equipment (eg hand lamps, drills, saws, torches and test instruments)

(o) personal effects (eg rings, jewellery, watches, pens, cigarette lighters, matches, hearing aids, mobile phones and pagers, transistor radios and similar)

(p) general work activities (eg welding, cutting, brazing, using hand saws, drilling of all types, hammering and chiselling)

(q) static electricity from materials and clothing

(r) hot metal surfaces due to drilling, grinding welding, etc

(s) excavation associated with electrical work

(t) molten metal from arcs

(u) asbestos material/switchboards.

Examples of confined spaces are:

(a) storage tanks, process vessels, boilers, pressure vessels, silos, and other tank like compartments

(b) open topped spaces such as pits and degreasers

(c) pipes, sewers, shafts, ducts, cable trenches/tunnels and similar structures.

Note: There are specific regulatory provisions for entry into confined spaces, not covered in this code.

Having identified hazards, the next step is your risk assessment, which will then consider the likelihood and how serious a problem each hazard could create.

Examples of work involving common hazards

Hazard	Work activity
Voltage between phases and between phases and neutral	• working on single or polyphase installations • wiring/testing/fault finding/servicing of switchboards/motors/heaters/controllers • working on exposed busbars/catenary wires etc • general electrical work.
Voltage between phases and earth	• working on single phase or polyphase installations • wiring/testing/fault finding/servicing of switchboards/motors/heaters/controllers • working on exposed busbars/catenary wires etc • general electrical work.
Voltage across undischarged capacitors	Work with apparently isolated plant with reactive storage components.
Multiple supply sources	Working in large electrical installations with standby power systems, multiple distribution boards, where source of power in a single location or zone is uncertain, such as solar energy sources.
Electrical testing and fault finding in hazardous locations	Electrical testing and fault finding in confined area with explosive gas mixture, fumes, vapour or dust, which is inadequately ventilated.
Environmental working conditions	Working in hazardous situations where there is substantial contact with earthed metal or condensation, spillage, drainage or seepage occurs and results in wet surroundings.

CHAPTER 5 – ASSESSING THE RISKS

The next step is to estimate the risk arising from each hazard.

You could do this area by area, or task by task, in order to make this task more manageable (if you have not done so already at the hazard identification stage).

Risk is a combination of likelihood that something will occur and how serious (severe) the consequences are. Start with severity, by making a list of the identified hazards in the order of severity of potential injury, from fatal through to minor injury. Then, next to each item on this list, write down the number of times and/or the length of time workers are exposed to each hazard. This will tell you how likely it is that each hazard will occur.

The combination of severity and likelihood determines the level of risk. Consider both of these factors to provide a new order of priority. This will be approximate – an exact quantification is not required. A rough estimate will help you to prioritise the risks.

For example, a combination of long or frequent exposure and the possibility of severe injury would mean the hazard should be placed high on the priority list. A combination of short or infrequent exposure and the possibility of slight injury would mean the hazard should be placed low on the priority list.

The purpose of prioritising the risks is to give you an order in which they should be addressed, and the extent of control required. However, all risks must be controlled, irrespective of the level of risk. The priority order is not as important as ensuring that all hazards are addressed.

The needs of individual workers also need to be identified – see 5.1 below.

Following that are checklists of factors contributing to common risks (risk factors) in Sections 5.2 to 5.4.

5.1 Identifying individual needs

When assessing the risk, any one of the following factors trigger special consideration of individual worker's needs:

(a) are they experienced in, and have they been properly trained for the working conditions?

(b) is the person physically fit for a task involving exposure to low voltage electricity (eg are they able to climb to heights to work on an overhead conductor or are they mentally alert and not fatigued)?

(c) does the worker have a visual or hearing impairment (eg do they have a visual colour deficiency or hearing loss)?

(d) do they suffer from any heart, circulatory or other diseases (eg do they have a pacemaker)?

(e) are they taking any medication which may increase their vulnerability to work in electrical environments (eg are they being treated for epilepsy)?

(f) are the staff working excessively long hours?

(g) do they suffer from claustrophobia?

5.2 Risk factors when modifying or repairing existing electrical installations

Examples of common risk factors with existing installations include:

(a) electrical drawings/tables not reflecting 'as installed' installations

(b) more than one source of supply or energised circuit may be available on the premises or at the equipment

(c) the supply may become energised during the work

(d) automatic starting of machinery after supply is restored

(e) a conductor that was thought to be de-energised was found to be energised

(f) old installations (where several modifications may have been made, circuits have not been identified, or the insulation has deteriorated)

(g) voltages on disconnected conductors – particularly neutrals

(h) installations where the MEN system is used, the rise in the earth potential due to a high impedance return path to the distribution neutral

(i) lack of information about isolation, sources of supply, or the location of electrical conductors

(j) lack of clear safe access to locate electric cables (other hazards may be present such as exposed conductors)

(k) damage to conductors in metallic conduits where earthing continuity of the conduit has not been maintained

(l) equipment located in hazardous areas, which often includes bolt on or screw on covers, can be dangerous if opened without obtaining specialist advice

(m) working alone on energised equipment or installations

(n) drilling into switchboards/electrical enclosures

(o) contact with cables in walls, floors or roof spaces

(p) contact with cables during excavation work or when cutting or drilling concrete

(q) exposure to asbestos material/switchboards

(r) variable frequency devices.

5.3 Risk factors when testing and fault finding

Risks arise because it is often difficult to find faults or malfunctions in electrical equipment when the circuits are not energised or when the equipment is not operating. This is particularly so if feedback circuits or sensors are involved.

Some common risk factors when testing and fault finding include:

(a) electrical drawings/tables not reflecting 'as installed' installations

(b) exposed energised terminals or conductors

(c) terminals or conductors being energised under different conditions of operation of the equipment

(d) loose or disconnected test leads or wiring becoming energised

(e) test equipment and leads bringing electrical hazards closer to the electrical worker

(f) test equipment inappropriate for the task (particularly test probes)

(g) test points inadequate

(h) inadvertent attempts to start machinery by other persons

(i) incorrect or poorly maintained testing instruments

(j) inadequate knowledge of equipment or causes of faults

(k) lack of information about circuits or equipment

(l) equipment located in hazardous areas, which often includes bolt on or screw on covers, can be dangerous if opened without obtaining specialist advice

(m) testing or fault finding alone on energised equipment or installations

(n) testing or fault finding in cramped or restricted work situations

(o) rotating or moving machinery (crush hazards)

(p) overriding of interlocks or forcing of control equipment

(q) resetting of protective devices in energised switchboards

5.4 Risk factors of high fault currents – Working, testing or fault finding energised

When working, testing or fault finding on energised electrical equipment, workers should be aware that a fault current of up to 20 times the rated current of the supply transformer can flow for short duration during fault conditions.

Arcs that are produced under these conditions have the energy to cause an explosion and/or melt metallic switchboard cubicles. Arcs may cause severe burns to the skin and/or flash burns to the face and eyes. Inhaled hot gases and molten particles can cause serious internal burns to the throat and lungs. Injury can also occur through the impact from flying debris and dislodged components. Overcurrent circuit protection may not operate in such circumstances.

WARNING

- Arcs may cause an explosion and/or melt metal and release hot gases.
- Severe burns and injury from flying debris may result.
- Over current devices may not offer protection.

5.5 Recording the risk assessment

The record must indicate the control measures chosen: see the next chapter, Chapter 6 – Controlling risks.

CHAPTER 6 – CONTROLLING RISKS

Employers and self employed persons have legal responsibilities for implementing risk control measures to safeguard employees and other workers against harm arising from low voltage while at work.

Having assessed the risks, action must now be taken to ensure that the risks are eliminated or controlled. Employers must ensure adequate supervision of workers to make sure that control measures are applied.

6.1 Control measures for all electrical work – General principles

Electrical safety is primarily dependent upon appropriate training, job planning and correct testing procedures and techniques.

The first aim must be to eliminate the risk. If this is not reasonably practicable then the risk must be controlled. Usually, the simplest way to eliminate the risk is to ensure the electricity supply is isolated. However, electrical equipment should not be assumed to have been de-energised after isolation.

Workers must be appropriately trained and competent in test procedures and in the use of testing equipment.

Note: The *Home Building Act 1989* requires that persons must not do electrical wiring work unless they hold a Qualified Supervisor Certificate (Electrician) or (Electrical) or a Personal Electrical Contractor's Licence. A person who is not a qualified supervisor may do electrical wiring work only if a qualified supervisor is present at all times when the work is being done and is available to be consulted by, and give directions to, that person.

Employers should reinforce with employees the safe work procedure:

TEST BEFORE YOU TOUCH

Before commencing the work, the electrical worker must ensure that isolation carried out on the electrical installation is verified by testing and is suitable for the work being performed.

6.1.1 Elimination

Eliminate the risk of electrocution, electric shock or burns by:

(a) switching off the supply (de-energising)

(b) isolating the supply (isolating)

(c) taking precautions to ensure that the supply remains isolated by locking off and/or tagging, or by disconnecting the load side of the isolator and tying back disconnected conductors

(d) proving the supply is de-energised by using an approved test instrument (verifying).

WARNING

Even if it is believed that the supply has been isolated, it must be assumed that all conductors and electrical components are energised until they have been proven de-energised.

The electrical worker or supervisor should:

(a) discuss options for de-energising the supply with the person in charge of the premises

(b) consider working at another time when the supply can be isolated

(c) investigate whether the part of the electrical installation that needs to be de-energised can be safely isolated, while leaving the remainder connected.

6.1.2 Substitution

If the risk cannot be eliminated, then substitute a lesser hazard – for example, use a lower voltage. That is, if low voltage is intended to be used in an earthed situation where there is a significant risk of continual exposure, it may be feasible to use extra low voltage as an alternative. This is usually not an option on an existing installation. However, it should be considered in new electrical installation designs or when the installation or electrical equipment is modified or upgraded, for example replacing low voltage control equipment with extra low voltage control equipment, eg changing control circuits from 240 V a.c. down to 24 V d.c.

6.1.3 Separation

If the risk cannot be eliminated or substituted, then separate the hazard from the worker by:

(a) time – do the work when supply can be de-energised. In effect, this is the same as eliminating the hazard.

(b) marking barriers – eg using rigid or tape barriers to mark off the adjacent hazards (this is practised in the electricity supply industry in switch yards)

(c) insulation – insulate identified exposed energised conductors by using approved insulating sheeting or sleeves.

6.1.4 Use of personal protective equipment (PPE)

Frequently personal protective equipment (PPE) is necessary, such as:

(a) a safety helmet with face shield (as appropriate)

(b) safety glasses/face shields (anti flash)

(c) safety boots

(d) protective clothing

(e) approved insulating gloves

(f) safety harness

(g) approved insulated tools

(h) approved insulating sheeting.

Workers must be trained to be competent in the use of PPE, tools and equipment.

Elimination is the best control measure and should be adopted where practicable. The measures at the other levels are less effective and they require more frequent reviews of the hazards and the systems of work.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

All the above practices should be described in the employer's or your own (if self-employed) safe work method statements or safe working procedures, and complied with.

6.2 Working de-energised or near energised parts

Clause 207 of the OHS Regulation specifies that electrical work must not be carried out while that part of the electrical installation's circuits and apparatus to be worked on are energised.

6.2.1 General

Work on de-energised equipment, which may involve work near adjacent energised conductors can only proceed if that part of the installation to be worked on is isolated and any exposed conductors in the immediate work area are either:

(a) de-energised and isolated

(b) separated by design or segregated and protected with insulated barricades or insulated shrouding or insulated material to prevent against inadvertent or direct contact.

Do not assume that electrical equipment is de-energised after isolation. Testing must be done prior to work commencing. Workers must be appropriately trained and competent in the test procedures and in the use of testing instruments/equipment.

6.2.2 Identification

It is necessary to clearly identify the electrical equipment to be worked on and the appropriate point of supply. Identification should include labelling that is both consistent and clear at the equipment to be worked on and at all points of possible isolation, for example at the control isolator and main point of supply.

6.2.3 Isolation

The electrical equipment to be worked on must be isolated from all sources of supply. Where isolation is effected at a removable or rack out circuit breaker or combined fuse switch, if practicable it must be racked out or removed, then locked open and danger tagged.

Note: Verification of the isolation is the responsibility of the electrical worker carrying out the work.

When returning after being absent from the immediate work area, it is imperative that checks and tests are carried out to ensure that the electrical equipment being worked on is still isolated when you return, to safeguard against inadvertent reconnection by another person.

Isolation procedures for electrical equipment must be developed in consultation with relevant electrical workers.

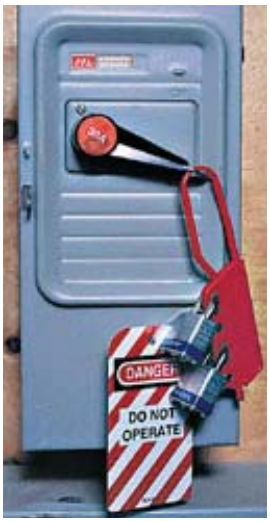
The effectiveness of isolation procedures that incorporate the use of locks and tags relies on:

- having isolation procedures documented and accessible to electrical workers in the workplace
- the provision of information, instruction and training of electrical workers involved with the electrical equipment
- having in place appropriate supervision to ensure that isolation procedures are rigorously applied.

6.2.4 Securing the isolation – Locking off

A wide range of devices are available for locking off electrical equipment. These include switches with a built in lock, and lockouts for switches, circuit breakers, fuses and other types of electrical equipment. Also available are safety lockout jaws (sometimes called hasps) accommodating a number of padlocks. Only devices that incorporate a lock or can accommodate one or more padlocks are suitable lockout devices.

All circuit breakers, switches and combined fuse switch units should be locked off where possible. Refer to Figure 1 for examples of locking off methods, incorporating danger tags.



Danger tagged locking off hasp

Danger tagged circuit breaker locking off devices

Figure 1: Locking off methods incorporating danger tags

Where locking off facilities are not fitted, other control measures that prevent energisation of the electrical installation or equipment must be used. The control measures must be able to withstand any disrupting environment, for example, not becoming ineffective due to vibration.

Alternative controls may include:

(a) an additional component, such as a clip, screw, bolt or pin that will prevent the switch from being operated and used in conjunction with additional control measures such as danger tags, or permit system

(b) other means approved by the employer.

Isolation may be secured by removing and tying back connections.

6.2.5 Tagging

A tag does not perform the isolation function but acts as a means of providing information to others at the workplace that the isolating device to which it is attached has been operated for a purpose.

Tags normally used are:

- **danger tags:** Danger tags are applied by electrical workers who will be working on electrical equipment. A danger tag on an isolating device is a warning that operation of that device may endanger the electrical worker who attached the tag.
- **out of service tags:** An out of service tag is a notice that distinguishes electrical equipment out of operation for repairs or alteration, or electrical plant that is still being installed or commissioned. While an out of service tag is attached to electrical plant or equipment, it must not be operated.

Refer to Figure 2 for examples of a danger tag and out of service tag.

Where practicable, appropriate tags should be placed at all points of isolation used to de-energise the equipment from all sources of supply, and the information provided thereon should be clearly understandable as to the purpose of the tag and include warnings for any abnormal hazards, for example, multiple points of supply.

Tags should be dated and signed by all personnel involved in the work or, where appropriate, by the supervisor in charge of the work party.

Figure 2: Example of a danger tag and out of service tag

Tags should only be removed by the signatories or with the permission of all the signatories to the tags or, if this is not possible, by the signatories' immediate supervisor.

Note: In this circumstance, a thorough investigation of the worksite must be carried to verify all workers are safe before any tags are removed.

When the work is incomplete, at a change of shift or similar circumstances, the last person removes their danger tag and replaces it with a warning (out of service or caution) tag.

When work is resumed, the person in charge of the work removes the warning (out of service or caution) tag and each person then applies his/her danger tag.

When work is finally completed, each person removes his/her danger tag.

Where a formal permit system is used, the designated sign on and tagging procedure must be adhered to.

6.2.6 Testing

After the electrical circuits and equipment have been isolated, locked off and tagged, the circuits or equipment must be tested to verify all supply has been removed. Verification is carried out using approved test instruments before any electrical worker attempts to start work on the electrical circuit or equipment.

All electrical circuits and equipment should be treated as energised (including the neutral conductor) unless proven to be de-energised. Any voltage tests should be conducted between all conductors and between all conductors and earth.

WARNING

When voltage testers are used, they must be tested for correct operation immediately before use, and again after use, to confirm that the instrument is still working. This testing verification is part of the **'Test Before You Touch'** procedure. Refer to Sections 7.8 and 7.9 of the code for further details about the safe use of test instruments.

Consideration must be given to the possibility of circuit wiring or electrical equipment becoming energised because of the operation of automatic control devices, for example, thermostats, float switches, programmable logic controllers (PLCs) and other interface devices.

6.2.7 Bonding of conductors

Where isolation of electrical equipment is made at a remote location, all conductors supplying the equipment should be bonded together and connected to the general mass of earth at the work site, if practicable. Bonding to earth may be affected by connecting conductors, which should be adequate to carry the potential short circuit currents to the electrical installation earthing system.

Temporary bonding conductors must always be bonded together and attached to the general earth before any attempt is made to attach them to any de-energised component portion of the electrical installation.

Removal of the bonding conductors must be carried out in reverse order. Suitable PPE and safety apparel should be used when attaching or removing temporary bonding conductors.

6.3 Cutting of cables

When carrying out work that involves cutting existing cables, the cable must be treated as energised and the procedures for working on energised electrical equipment adhered to, until positive tests can be made at the point where the cable is to be cut that prove the cable is de-energised.

6.4 Removing out of service electrical equipment

When removal of out of service or decommissioned electrical equipment is required, the equipment must be isolated from supply and appropriate tests made to ensure the equipment is de-energised. Further tests must be made at any point that a cable is to be cut.

ADVICE TO ELECTRICAL WORKERS:

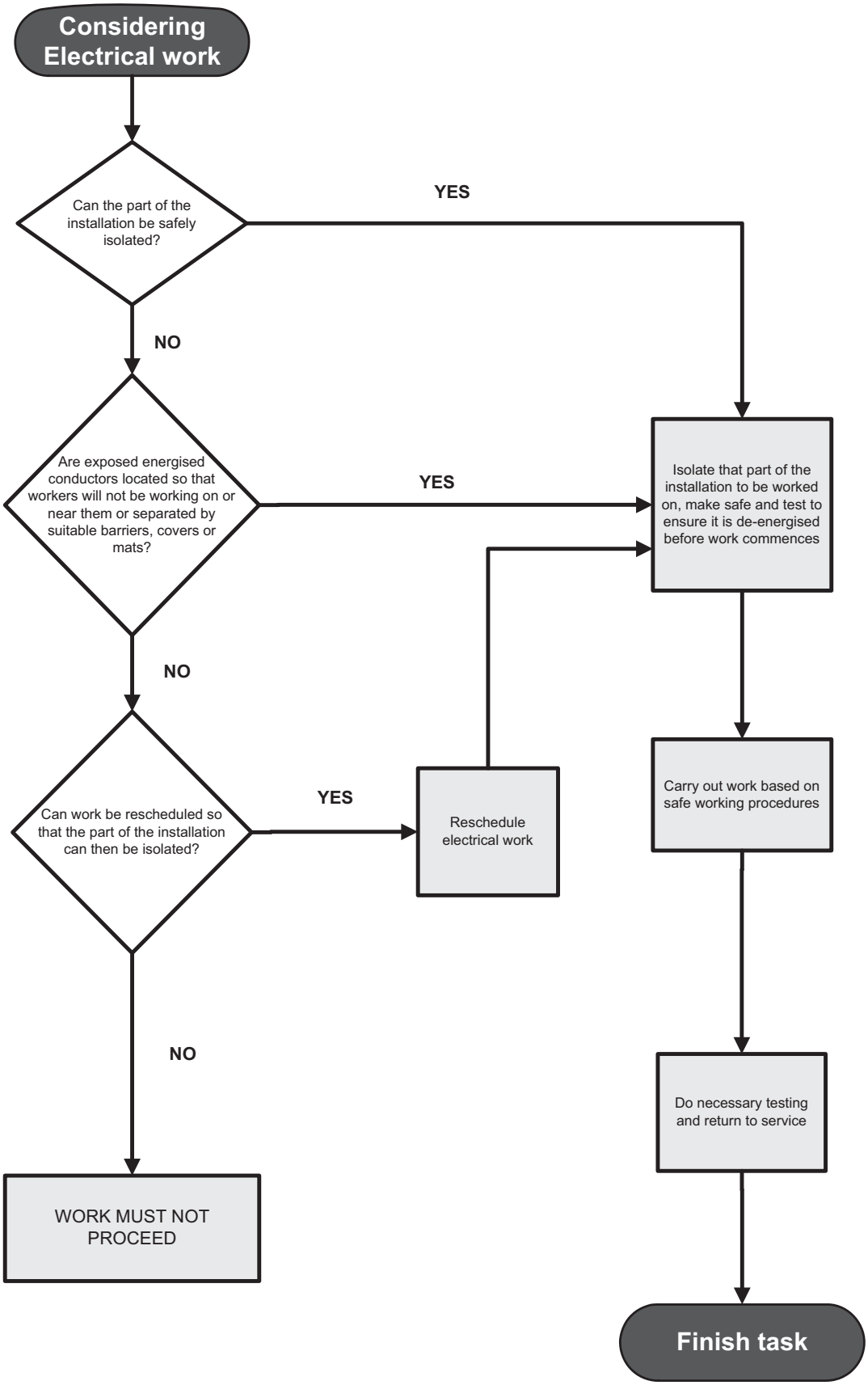
- **WORK SAFELY**
- **IDENTIFY** THE CIRCUIT YOU ARE WORKING ON
- **ISOLATE** TO DE-ENERGISE THE SUPPLY
- **SECURE** YOUR LOCKING OFF DEVICE AND DANGER TAG
- **TEST** THAT THE CIRCUIT/EQUIPMENT IS DE-ENERGISED

Figure 3 illustrates the requirements for risk control measures for work on or near de-energised equipment.

Please refer to the next page for Figure 3.

FIGURE 3: WORKING DE-ENERGISED OR NEAR ENERGISED PARTS

Examine the flow chart and then work through sections 6.1 and 6.2



6.5 Working on energised (live) circuits

Clause 207 of the OHS Regulation specifies the following precautions when work on energised circuits and apparatus is to be carried out.

WARNING

In accordance with the statutory risk control requirements of the OHS Regulation, the practice of working on an energised (live) low voltage installation cannot usually be justified. It is the responsibility of the employer, and the controller of the premises, to ensure that this is not done other than in situations where *it is necessary in the interests of safety and the risk of harm would be greater* if that part of the installation's circuits or apparatus were to be de-energised.

Working on energised circuits and apparatus can be implemented in situations where **it is necessary in the interests of safety and the risk of harm is greater** only:

(a) when the risks of de-energising are greater

(b) after a written risk assessment has been completed in consultation with the persons proposing to do the work

(c) after determining how it can be done safely

(d) when authorisation has been obtained from the person in control of the premises.

These requirements do not apply to testing (see Section 6.6), or to work under a safety plan required by the *Electricity Supply (Safety and Network Management Plans) Regulation 2002.*

6.5.1 Planning and preparation before working on energised circuits

Before work is commenced the following control measures must be applied:

(a) the electrical worker must be competent and confident of applying the particular safe working procedures and techniques required for the task at hand, and must be appropriately qualified

(b) the worker must be authorised by the employer (as well as the person in control of the premises) to work on the energised circuits and apparatus

(c) the work must be carried out in accordance with a safe work method statement. An example of a safe work method statement is shown at Appendix 3 to assist with this

(d) the work area must be cleared of obstructions so that the worker can enter and leave it quickly and safely

(e) the following must be available and at hand:

- appropriate test equipment
- insulated tools and accessories, which must be suitable for the task and must be well maintained ie clean, dry and no damage to the protective insulation

(f) all testing of tools and equipment must be up to date and must have been inspected to ensure they are fit for purpose, serviceable and safe to use

(g) the person who is to perform the work must be provided with and use the appropriate PPE for the task

(h) there must be a safety observer present, who **must be competent and qualified to perform the particular task** that is to be carried out and also competent in electrical rescue and cardio-pulmonary resuscitation (CPR)

Note: This means the safety observer must be competent and qualified under the *Home Building Act 1989* to carry out the electrical work that is being performed by the electrical worker who is carrying out the work.

(i) the first aid facilities must be provided at the site and they must be readily accessible. Emergency Services contact numbers should be made available at the site.

(j) emergency lighting should be provided and should be operating correctly

(k) fire fighting equipment that is suitable for electrical fires should be accessible

(l) key people, such as the owner or the person in control and the supervisor, must be informed that the electrical worker is about to work on energised circuits and equipment

(m) the isolation point of the relevant electricity supplies must be identified and labelled

(n) energised conductors should be insulated where necessary to prevent inadvertent contact or flashovers

(o) unauthorised persons must be prevented from entering the work area by signage and/or a barrier.

ADVICE FOR ELECTRICAL WORKERS:

BEFORE WORKING LIVE – **STOP!**

- IS THE WORK **NECESSARY IN THE INTERESTS OF SAFETY?**
- HAVE YOU DONE A **WRITTEN RISK ASSESSMENT?**
- HAVE YOU BEEN **AUTHORISED** BY YOUR **EMPLOYER?**

6.5.2 Control measures to be taken while working on energised circuits

While working on energised circuits, the electrical worker must ensure that all of the necessary planning and preparation precautions outlined above (Sections 6.5 and 6.5.1) have been taken and that:

(a) the work is done very carefully and in an unhurried, considered manner (haste can be hazardous)

(b) the employer's safe work method statement and safe working procedures are rigorously followed

(c) all exposed conductors are assumed to be energised. Energised conductors should be fitted with **temporary or fixed isolation barriers** or insulation where necessary to prevent inadvertent contact or flashovers.

(d) an awareness of the voltage to earth of all exposed conductors is maintained; this may also include the neutral conductor

(e) fire fighting equipment that is suitable for electrical fires is at the site and is readily accessible

(f) there must be a safety observer present, who **must be competent and qualified to perform the particular task** that is to be carried out and also competent in electrical rescue and cardio-pulmonary resuscitation (CPR).

Note: This means the safety observer must be qualified under the *Home Building Act 1989* to carry out the electrical work that is being performed by the electrical worker who is carrying out the work.

Using PPE to work on an energised installation does not guarantee safety. The use of PPE must be supported by training in how to select the correct type of equipment, and by necessary care and understanding to ensure that the PPE meets its performance standard when used.

ADVICE FOR ELECTRICAL WORKERS

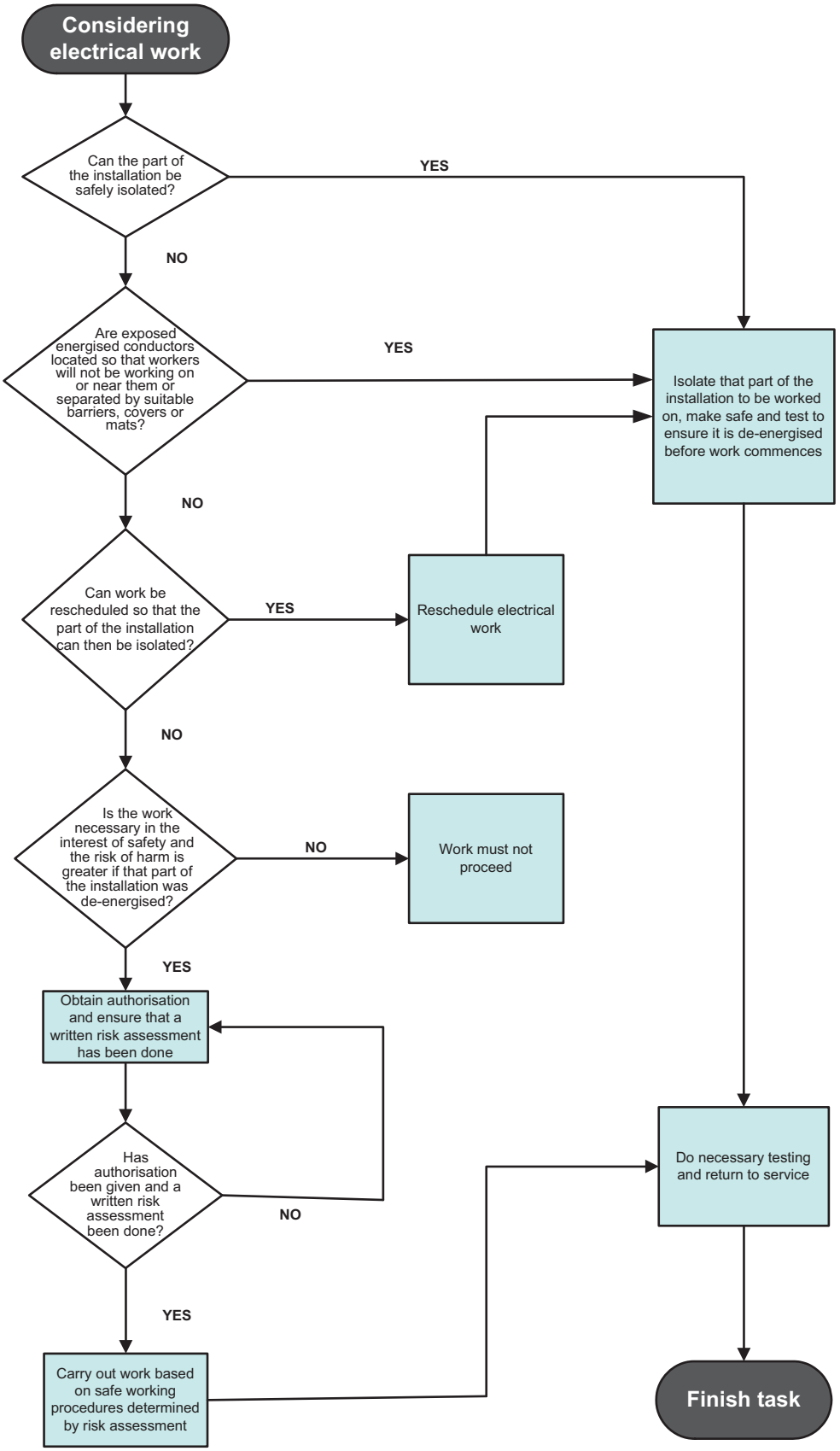
- **TEST** BEFORE YOU TOUCH
- **NEVER** ASSUME IT IS DEAD
- OTHERWISE **YOU** MAY BE!

Figure 4 illustrates the requirements for risk control measures for electrical work including work on energised circuits and apparatus.

Please refer to the next page for Figure 4.

FIGURE 4: CONTROL MEASURES FOR ELECTRICAL WORK INCLUDING WORK ON ENERGISED CIRCUITS AND APPARATUS

Examine the flow chart and then work through sections 6.1, 6.2 and 6.5



6.6 Testing and fault finding

Clause 208 of the OHS Regulation specifies a number of safety precautions when testing and fault finding is carried out on an electrical installation.

When testing or fault finding, undertake a risk assessment of the proposed task and then take the following precautions:

(a) before starting and during the testing or fault finding:

   i. checks must be made to ensure that the test instruments to be used are appropriate and are functioning correctly, before starting and during the testing or fault finding

   ii. place safety barriers/notices to prevent other persons entering the work area, which may have exposed energised parts or exposed conductive parts that could become energised during the testing or fault finding process

   iii. safe working procedures relevant to each activity must be maintained and coordinated with co workers who may have to assist in the work task, such as procedures related to switching circuits or equipment on and off during the fault finding or testing process.

(b) the location of faults should first be attempted with the supply safely de-energised, and by utilising de-energised testing methods

(c) if a fault cannot be found with the supply de-energised and energised testing methods have to be used, put control measures in place that eliminate or control the risk of inadvertent contact with energised parts by protecting all persons from the hazard. Then, prior to the testing or fault finding, the following must be done:

   i. identify exposed conductive parts that could become energised whilst using test instruments

   ii. temporary or fixed isolation barriers should be used to isolate all electrical workers from inadvertent contact with exposed conductive parts that could become energised during testing

   iii. use only approved insulated tools, test instruments and test probes and ensure workers are wearing appropriate clothing and using correct PPE

   iv. use a safety observer who is competent to **assist the persons** conducting the tests where an identified risk requires it. Refer to Appendix 4 for the duties and responsibilities of the safety observer when testing is carried out on energised circuits

   v. conduct a periodic review of the work situation to ensure that no new hazards are created during the process.

(d) when the testing or fault finding is completed, circuits and equipment must be restored to a safe condition. For example, disconnected conductors should be reconnected and left in a safe state, covers replaced and accessories and equipment properly secured in compliance with AS/NZS 3000 requirements.

Note: For testing or fault finding in hazardous areas, the special techniques required by AS/NZS 3000 are not covered in this code.

6.7 Control measures to be taken when leaving unfinished work

Risk control measures do not end when you finish the immediate task. Ensure that the work does not present a hazard to others at the workplace.

This means leaving the work site in a safe state for access by others, including:

(a) terminating exposed conductors

(b) physically securing any exposed conductors or surrounding metal work

(c) tagging, taping off the equipment and/or the worksite

(d) informing relevant parties that the work is not complete

(e) taking any necessary precautions to ensure that exposed conductors cannot become energised

(f) ensuring that switchboards are clearly labelled in relation to circuits

(g) providing sufficient information for other electrical workers to safely complete the work if required.

CHAPTER 7 – TOOLS, INSTRUMENTS, PPE AND EQUIPMENT USED FOR ELECTRICAL WORK

7.1 General

In general industry, tools, instruments and equipment that are poorly maintained, inappropriately used or not fit for purpose can cause injuries. With electrical work, there is the added risk of electric shock and/or large release of energy from arcing and explosion.

The tools, instruments, PPE and equipment used by electrical workers often have special design characteristics. For example, many are insulated as a risk control measure. However, regular maintenance and inspection are required. Otherwise, certain dangers can arise, eg the insulating medium might conceal a mechanical defect that could cause an open circuit in the testing device.

7.2 Insulated tools and equipment

Insulated tools and equipment must be fit for purpose and be in good order, regularly maintained and tested. Where any doubt exists that the insulation of tools and equipment might not be adequate, they should not be used. In accordance with the requirements of the OHS Regulation, workers must be trained and competent in the safe and effective use of the tools and equipment.

7.3 Portable electric tools

Personnel protection should be provided by supplying all portable electrical tools and appliances through a (30mA) fixed or portable residual current device (RCD). If portable RCDs are used in an existing electrical installation they should be utilised as close as practicable to the point of supply, eg at the supply end of an extension cord and not at the appliance end. Caution must be exercised when using portable electrical tools or equipment having exposed conductive parts where there is risk of exposed conductive parts contacting energised parts, eg by drilling or cutting into conductors concealed in the building structure.

All plant including portable electrical equipment and flexible electrical cords must be visually inspected, tested and maintained in accordance with the requirements of clauses 64 and 65 of the OHS Regulation and the Australian Standard AS/NZS 3760.

Note: Electrical plant used for construction work must be inspected, tested and tagged in accordance with the requirements of the *Code of practice: Electrical practices for construction work.*

7.4 Ladders and step ladders

Metallic, wire reinforced or otherwise conductive ladders must not be used in close proximity to equipment where an electrical hazard may result from their use. These types of ladders should be avoided for any kind of electrical work.

Portable ladders and step ladders should comply with the appropriate Australian Standard and be used in accordance with the manufacturers instructions. Ladders should have a load rating of at least 120kg, be of the correct size and length for the work and be provided with anti slip feet where practicable. Only one person should work from a ladder at any one time unless a rescue is being performed.

Ladders must be located and positioned to provide a safe and secure working medium and persons working from ladders should not over reach when working from them.

Extension ladders should be secured at the top by securing the ladder head, or held secure by other means, eg held at the base by an assistant.

7.5 Safety harnesses

Persons working at heights, such as using ladders on poles or similar structures should, wherever practicable, be constrained by an appropriate fall arrest device, eg safety harness. A safety harness must be worn and suitably attached when working from an elevated work platform (EWP).

7.6 PPE

Personal protective equipment (PPE) worn by electrical workers must be appropriate for the purpose, fit correctly and be maintained in good condition. PPE can include eye protection, footwear, insulating gloves, noise protection, clothing and safety helmets.

Note: A number of items of PPE are made and tested to Australian Standards. PPE that is not designated as meeting a recognised Standard may be unreliable in service, as its performance is unknown.

7.7 Insulating barriers and insulating mats

Insulating covers and mats for electrical purposes must comply with AS/NZS 2978.

Insulated barriers must be of suitable material to effectively isolate electrical workers from adjacent energised equipment.

Insulated covers and mats must be visually inspected for possible defects before and after each use.

7.8 Instruments and test devices

Instruments and test devices that are to be used or connected to a low voltage electrical installation should meet the following conditions:

(a) suitable for the testing or measurement application in terms of the functions that they perform, operating range and accuracy

(b) suitably insulated leads and connection probes that enable connection or contact with live parts to be made with minimal risk to the electrical worker

(c) suitable protection against hazards arising from overvoltages that may arise from or during the testing or measurement process.

Note: The Australian Standard, AS 61010.1, *Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General requirements* provides a classification for instruments on the basis of their immunity to overvoltages liable to be experienced in different parts of an electrical installation. Devices should be rated as Category III or IV to enable their use on all parts of the installation.

WARNING

1. The use of a tester for detecting an electric field surrounding an energised conductor may not be suitable for testing cables that are surrounded by a metallic screen, enclosed in a metallic pipe or duct or cables carrying direct current and in some other circumstances.
2. When proximity voltage testers are used to prove de-energisation, they must be tested for correct operations immediately before use, and again immediately after use, particularly if the test result indicates zero voltage, to confirm that the instrument is still working correctly.
3. These types of tester must not be relied upon to prove isolation in all circumstances.
4. To confirm a positive indication and to establish the circuit voltage the use of an alternative test instrument that incorporates a visual display should be used before commencing electrical work on the installation.

7.9 Use of instruments and test devices

When using instruments and test devices, the work practice should include inspecting and testing the device before and after use to confirm the device is operating correctly, as appropriate, and that the work practices during use are in line with the manufacturers operating instructions.

Electrical workers must be appropriately trained and competent in test procedures and in the use of testing equipment.

Employers should reinforce with electrical workers the safe work procedure:

TEST BEFORE YOU TOUCH

CHAPTER 8 – LEGAL OBLIGATIONS

This chapter briefly outlines legal obligations and explains how these are related to the electrical work covered by this code. For further information, consult the OHS Act, OHS Regulation and the OHS Amendment (Electrical Work) Regulation 2004.

Note that an obligation may fall on more than one person or organisation, and that one person or organisation may have several of the obligations outlined below. Where several parties have an obligation, it must be carried out in a coordinated manner.

8.1 Duties of Employers

8.1.1 Overview

A prime responsibility for ensuring that a safe working environment is established, and that safe work practices are implemented and maintained, resides with the employer.

Employers must ensure that:

- workers are consulted about the work tasks that are performed
- hazard identification and risk assessment have been done
- risks are eliminated, or if that is not practicable, control measures are applied and safe work practices put in place before starting work
- a review of the hazard identification and risk assessment occurs on an ongoing basis
- working on energised circuits and equipment is not undertaken unless justified and specific procedures followed (see Section 6.5)
- testing and fault finding is carried out using a safe system of work
- supervision is adequate and competent to ensure health and safety
- training and induction training are provided, including the specific procedures for the place of work and how to access safety information.

Specifically, the OHS Regulation describes a number of legislative obligations that an employer must follow. Listed below is a summary of the key points from specific clauses of the OHS Regulation that relate to electrical safety requirements.

Note: Consult the OHS Regulation for full particulars about these legal requirements.

Clause 64, Electricity – Particular risk control measures

The employer must ensure that:

(a) all electrical installations at a place of work are inspected and tested prior to being energised, and are maintained to ensure they remain safe for use

(b) electrical equipment that is used in construction work or used in a hostile operating environment is regularly inspected, tested and maintained

(c) plant is not used in conditions likely to give rise to an electrical hazard

(d) appropriate work systems prevent inadvertent energising of plant

(e) if excavating, all available information on the position of underground cables is obtained and provided to workers

(f) work near overhead power lines is done in accordance with a written risk assessment and a safe system of work: refer to the *Code of practice: Work near overhead power lines.*

(g) any extension cords, cables or fittings are not located where they are likely to be damaged, or protected against damage, and are not laid across passageways or access ways unless suitably protected

(h) adequate signs to warn of the hazards and to restrict access are provided where there is a risk of exposure of persons to hazards arising from electricity.

However, where carrying out the duties (a) to (g) above is inconsistent with the *Electricity (Consumer Safety) Regulation 2006*, then that regulation prevails.

Clause 65, Maintenance of records

Records must be maintained of all inspections or tests that are made and maintenance that is performed on electrical articles or electrical installations, including:

- the name of the person who carried out the inspection, test or maintenance
- the date or dates
- the result or outcome
- the date by which further inspection, test or maintenance must occur.

Clause 207, Electrical work on electrical installations – safety measures

Electrical work on an electrical installation must be carried out using a safe system of work.

Specifically, the employer must ensure that:

- electrical work is not carried while that part of the electrical installation being worked on is energised
- the safe system of work includes checks to ensure the circuits and apparatus are de-energised before commencing the work and remains that way until the work is completed
- electrical work on an **energised** electrical installation can only be performed if the work is necessary 'in the interests of safety and the risk of harm would be greater'. In this limited circumstance the work can only proceed if the mandatory risk control measures described in clause 207(4) of the OHS Regulation are followed. Refer to Section 6.5 for further guidance.

Clause 208, Electrical testing on electrical installations – safety measures

Electrical testing of energised circuits and apparatus of an electrical installation must be carried out in a safe manner.

Specifically, the employer must ensure that a safe system of work is used that includes:

- a risk assessment in respect of the tests
- measures to eliminate or control the risk of inadvertent contact with energised parts while the testing work is carried out
- persons are appropriately trained for the testing work and use appropriate testing equipment
- personal protective equipment is provided and used by the persons conducting the tests
- if identified by the risk assessment, the testing is carried out in the presence of a safety observer. Refer to Section 6.6 for further guidance.

8.1.2 Other electrical safety recommendations

To meet their obligations, employers should ensure that the following are carried out:

(a) an electrical hazard control policy and program of action are developed, and justification for work on energised circuits and apparatus is outlined

(b) it is explained to all employees that they are required to cooperate in using safe work practices, agreed through consultation

(c) a comprehensive personal electric shock protection program, including the selection of appropriate tools and personal protective equipment (including instruction of employees in their correct use and maintenance) is implemented

(d) the training employees receive includes:

- competence to do the work they are assigned to do
- competence in undertaking the hazard identification and risk assessment process
- CPR and Release and Rescue.

(e) the following information is provided to electrical workers, taking language and literacy into account:

- what electric shock is
- the range of injury due to electric shock
- the exposure to electricity in their particular workplace
- the reasons for, and nature of the general electric shock control (or prevention) measures which are used to protect them and other persons who might be affected by their work
- the specific control measures which are necessary in relation to each worker's own job (these measures may include instruction in the correct use of and maintenance of electrical tools and equipment and correct methods of operation for minimising risks of electrical shock)
- the electrical safety policy and program of action, and the timetable for future improvements
- the arrangements for reporting defects likely to cause electrical shock
- when and how to use personal protection equipment and insulated tools provided for the prevention of electrical shock and their proper care and maintenance
- statutory responsibilities of employers and employees.

8.1.3 Supervision

Employers must provide appropriate supervision and recognise their supervisor's role in the management of the risks and the protection of employees. Close liaison between supervisors and employees is vital.

Supervision of electrical workers working on or near energised parts must ensure that the control measures are fully implemented and followed at all times by employees. If you are supervising, it is your responsibility to ensure that the situation is safe for everyone.

The level and extent of supervision required will vary according to the safety aspects of each task and the skills of the worker.

In determining the necessary level of supervision, an employer should consider:

- the complexity of the job environment in which the job is being done
- the hazards at each work site
- the worker's level of competence and experience.

The levels of supervision required for various tasks and for apprentices in particular need to be described in policies and procedures.

8.1.4 Home Building Act – Licensing and supervision

The supervision requirements of the *Home Building Act 1989* must be satisfied. This Act requires that persons must not do electrical wiring work unless they hold a Qualified Supervisor Certificate (Electrician) or (Electrical) or a Personal Electrical Contractors Licence. A person who is not a qualified supervisor may do electrical wiring work only if a qualified supervisor is present at all times when the work is being done and is available to be consulted by, and give directions to, that person.

The Home Building Act and Regulations also require the supervising of apprentice electrical workers. Such apprentices must be under the supervision of a person who holds a Qualified Supervisor's Certificate – Electrician/Electrical.

However, the level of supervision may be less stringent where:

(a) the qualified supervisor is of the opinion that the apprentice's knowledge and experience in doing such electrical work is such that the apprentice does not need that level of supervision

(b) the apprentice does that work under the supervision, and in accordance with the directions, if any, of the qualified supervisor.

Where the person supervising the work has satisfied him/herself that the site has been made safe, so that there is no possibility of the work becoming energised from an electricity supply, or by induction, then the supervision need be no more stringent than for other non electrical work. However, the licensing and supervision requirements of the NSW *Home Building Act 1989* are still relevant.

8.1.5 Emergencies and first aid

Employers must provide for emergencies, including making arrangements for:

(a) safe and rapid evacuation

(b) emergency communications

(c) appropriate medical treatment of injured persons.

8.1.6 Notification of electrical incidents

Whether you are an employer, self-employed person and/or occupier you are required by law to notify certain types of incidents to WorkCover NSW and/or the Office of Fair Trading and/or your workers compensation insurer.

An occupier (of premises/workplaces) is someone who manages or has responsibility for a workplace or a particular operation at a workplace, even though they may not be the employer.

Incidents that must be notified include:

- a fatality (electrocution)
- an incident where there has been a serious injury (electric shock, fractures, burns, etc)
- an incident where there is an immediate threat to life but result in no injury or illness (electric shock).

In addition to the above OHS Regulation requirements, the *Electricity (Consumer Safety) Regulation, 2006* requires that a '*serious electrical accident*' be notified.

A *'serious electrical accident'* has the same meaning as it has in the *Electricity (Consumer Safety) Act 2004* and means an accident:

(a) in which an electrical article or electrical installation is involved that is or was used for the conveyance, control and use of electricity and electricity was, at the time of the accident, being so conveyed, controlled and used, and,

(b) as a consequence of which a person dies or suffers permanent disability, is hospitalised, receives treatment from a health care professional or is unable to attend work for any period of time.

Employees also have a duty to report incidents and 'near misses' to their employer so that appropriate remedial action can be taken, ie medical assessment if a worker has received an electric shock.

In addition to the above, the OHS Act and the OHS Regulation require that certain occurrences that occur at the work place are not to be disturbed for 36 hours (unless the work area has to be made safe to perform a rescue or permission has been given by WorkCover NSW).

Serious incidents can be notified to WorkCover on 13 10 50, as an urgent investigation may be needed.

8.2 Duties of self-employed persons

A self-employed person must ensure that other people are not exposed to the risk of electrical shock arising from the conduct of the self-employed person's undertaking, while they are at the self-employed person's place of work. In other words, self-employed persons have the same duties as employers have to other persons at the workplace, outlined in Section 8.1 above.

This covers all types of persons at the workplace, including passers-by, persons working for other employers and contractors. It includes likely visitors to each site, such as children in shopping centres. It also covers all risks, from trip hazards over cables on the ground to electric shock hazards arising from accessible exposed energised cables, parts or plant.

8.3 Duties of persons in control of work premises, plant or substances

The OHS Act and OHS Regulation place obligations on controllers of premises, plant and substances.

A person in control of premises used by people (who are not their employees) as a place of work must ensure that the premises are safe and without risk to health, and that plant and substances are safe and without risks to health when properly used. This includes all electrical hazards. A controller of premises includes a person who has limited control and a person who has an obligation to maintain or repair the premises under any contract or lease. The controller is sometimes the occupier (eg an owner who occupies their own premises).

This also means that where such a person engages the services of an electrical worker, and the electrical worker informs that person that the work cannot be done safely with the supply switched on, then the person in charge (or control) of the workplace cannot ask or expect the electrical worker to do the work energised. The person in control must then ensure that the work can be done when the system is de-energised.

Specifically, a controller of premises must ensure that any electrical installation or article:

(a) is safe for use by an employer at the premises, or if not it is disconnected and the employer is informed that it is not safe

(b) containing energised components are suitably secured and persons entering such areas are properly trained

(c) is maintained in a safe condition

(d) documentation is obtained and kept of modifications to circuits at the premises, and made accessible to any person doing further electrical work.

The above controller obligations do not apply to the occupier of a private dwelling, even though an electrical worker performs work there.

The OHS Regulation provides that an electrical installation does not include the transmission and distribution infrastructure of a supply authority, appliances (etc) beyond any outlet socket, or ELV. Controller duties do not apply to employers in relation to their employees – these are covered under employer duties in 8.1 above.

8.4 Duties of employees

Employees must:

(a) take reasonable care for the health and safety of people who are at the employee's place of work and who may be affected by the employee's acts or omissions

(b) cooperate with their employer, or other person, in complying with any procedures provided by the employer or other person to eliminate or control risks. This includes the correct use and maintenance of the required PPE and any special tools, instruments and equipment provided for the work.

(c) notify the employer or supervisor of any matter that (to the knowledge of the employee) may affect the capacity of the employer to comply with the requirements of the OHS Regulation.

8.5 Duties of designers, manufacturers and suppliers of plant for use at work

Manufacturers, importers and suppliers of plant (which includes equipment) must ensure that it is designed and constructed so that it is safe and without risks when properly installed, maintained and used. Specifically, designers must have regard to such safety requirements as insulation, earthing and appropriate access to controls for plant designed to work near electrical conductors.

Where necessary, research and development work should be carried out to eliminate or reduce the risk of electrical shock at the design stage.

Risk elimination or reduction should take into account:

(a) the range of uses for which plant is supplied, available information on the conditions under which it is likely to be used, the foreseeable methods of using it, and misuse

(b) if operation and use of the plant might create an electrical hazard, the manufacturer, importer or supplier should ensure that adequate information is made available to the employer, if possible prior to the supply of the plant, about:

- its electrical risks
- the means of installation, maintenance and use of the plant that will enable it to present the lowest practicable electrical shock risk.

A person who hires or leases plant to you must ensure that all safety features, including all insulation, earthing, controls and all warning devices are maintained and tested.

Users of plant and equipment can expect that the supplier will provide them with adequate information on how to use it safely and without risk to health.

8.6 Enforcement

If a breach of legislation or safety standards is found, the WorkCover NSW inspector will decide what action to take. The action will depend on the nature and seriousness of the breach. Inspectors follow procedures set out in WorkCover NSW's *Compliance and Prosecution Policy*, which is available from WorkCover NSW if you require more information.

Inspectors can implement the following range of enforcement options:

- **Improvement Notices** require a particular hazard or potential risk to health and safety to be rectified within a specified time frame. The Improvement Notice states the reasons for the notice and will specify the nature of the hazard or risk to health and safety.
- **Prohibition Notices** are issued when an inspector is of the opinion that a situation is of immediate risk to the health and safety of people in the vicinity. The notice requires the cessation of work until the situation is made safe.
- **Penalty Notices (on the spot fines)** can be issued for a range of matters, and the level of fines attached to penalty notices are detailed in the Occupational Health and Safety Regulation. Once a fine is paid, no further legal proceedings for that particular offence will take place.
- **Investigation Notices** are issued by an inspector to stop plant or prevent disturbance of premises, to allow the investigation of workplace health and safety matters.
- **Prosecution** is pursued when the offence is regarded as serious. This is not only to penalise, but also to prevent similar risks to health and safety. WorkCover NSW will also initiate prosecutions to draw attention to a particular problem that is common and of considerable community interest and concern.

A person who has been issued with a Prohibition, Improvement or Investigation Notice can apply to WorkCover NSW for a formal review. This may result in the notice being confirmed, varied by the issue of a new notice, or revoked by WorkCover NSW. A notice may be withdrawn at any time by the inspector who issued the notice or by WorkCover NSW if the notice was issued in error or is incorrect in some respect.

However, an applicant who is not satisfied with WorkCover NSW's review may appeal to an Industrial Magistrate at a Local Court.

8.7 Other significant legislation

Other legislation relating to electrical safety includes:

- *Electricity (Consumer Safety) Act 2004*
- *Electricity (Consumer Safety) Regulation 2006*
- *Electricity Supply Act 1995*
- *Electricity Supply (Safety and Network Management) Regulation 2002*
- *Home Building Act 1989*
- *Home Building Regulation 1997*

APPENDIX 1

Tool 1 (sample risk control plan) provides an example of the way in which risk controls can be developed from your assessment of risk factors.

When decisions are made about what actions are to be taken, these should be documented to make subsequent review of agreed risk controls easier. The form this Tool uses gives a simple example of the hazards identified and the actions, which have resulted following a risk assessment.

Please see next page for Tool 1.

TOOL 1: SAMPLE RISK CONTROL PLAN – DISTRIBUTION BOARD

Hazard – exposure to low voltage	Control plan
Source of low voltage Exposed energised conductors in distribution board	• main switch controlling sub main switched and locked off • main switch to be tagged • testing to be done to determine all exposed conductors de-energised.
Nature of work undertaken • electrical fitting of new final 3 phase subcircuit • 3 phase cable is run to outlets and switchboard end is located in distribution board • outlets are connected to cable • circuit breaker to be fitted to distribution board • cable to be terminated on circuit breaker at distribution board.	• workers to run cable to socket outlets from location near to distribution board allowing sufficient length for termination • work to be organised so that all terminations of socket outlets done prior to termination at distribution board • earth continuity tested prior to termination of actives and neutral at distribution board. • cable terminated at distribution board after isolation, locking and tagging as above • workers to be encouraged to assume all conductors are energised and work accordingly.
Duration of exposure to low voltage electricity • electrical testing of conductors to ensure switchboard is de-energised • electrical testing to prove all actives are broken by switching of socket outlets • electrical testing to prove isolation by circuit breaker.	• testing will be organised to ensure workers are present when all energised electrical testing is done • one worker to be positioned to operate main switch and provide assistance if necessary.
Physical condition and capability of the worker • Two workers, 28 and 22 years of age, both fit and experienced in the tasks undertaken. No medical history or current medications that may affect capacity to work with low voltage electricity.	• any incidence of electric shock to be reported at once • any change in medical status (eg employee taking prescribed medication) to be notified and medical advice regarding their fitness for work sought if any doubt exists.

APPENDIX 2

TOOL 2: PREVENTATIVE ACTIONS CHECKLIST –
WORK ON OR NEAR LOW VOLTAGE ELECTRICAL INSTALLATIONS

Electrical safety checklist

Please photocopy for use on your work site.

This checklist will help you to identify hazards at the workplace and develop work procedures that will ensure your safety and the safety of other workers and visitors. It will assist you in identifying some of the common hazards and risks.

If the answer to any question is 'NO', you must take the necessary action to put **appropriate risk control measures** in place.

Project:

Electrical worker:

Site address:

Type of work:

Notes:

See checklist on the next page.

EMPLOYEE/WORKER PREVENTATIVE ACTIONS CHECKLIST

Section 1: Initial assessment		**Yes**	**No**
1.	Can the electrical equipment be safely isolated? If Yes, *proceed to section 2.* If No, go to Q 2.		
2.	Can the work be rescheduled to another time so that the electrical equipment can be isolated? If Yes, *proceed to section 2.* If No, have you obtained genuine reasons from the client and/or controller of the premises that the proposed work is necessary in the interests of safety and de-energising the equipment presents a higher risk than leaving it energised? Have you discussed the matter with your employer/supervisor? Have you investigated whether that part of the installation that needs to be de-energised can be isolated, while leaving the remainder connected?		
	List any other assessment factors that may be applicable to the proposed electrical work: *Proceed to section 3.*		
Section 2: Eliminate the hazard – Work de-energised		**Yes**	**No**
3.	Do you have approved test instruments suitable for the task?		
4.	Have you checked that the test instruments are functioning correctly?		
5.	Have you switched off the supply?		
6.	Have you isolated the supply, for example by removing fuses or disconnecting the load side of the isolating device?		
7.	Have you taken precautions to ensure that the supply remains switched 'off' by: • locking off and/or tagging, or • disconnecting the load side of the isolator and tying back disconnected conductors? Always assume that all conductors or components are energised until you have proved them de-energised. **Remember to 'TEST BEFORE YOU TOUCH'.**		

	List any other factors that may be applicable to eliminating the hazard prior to commencing the electrical work: *Proceed to section 4.*		
Section 3: Control measures **WORKING ON OR NEAR ENERGISED EQUIPMENT**		**YES**	**NO**
8.	Have you completed a written risk assessment in consultation with the workers and identified all electrical hazards and non electrical hazards, both actual and potential? All materials including liquids and gases should be regarded as conductive unless you have definite knowledge to the contrary.		
9.	Have you determined the control measures required to remove, manage or minimise the risks?		
10.	Are you trained, competent and confident in applying the particular procedures or techniques that are required for the task at hand?		
11.	Have you been authorised by your employer and person in control of the premises to work on or near energised equipment?		
12.	For work on energised circuits and apparatus – do you have a safe work method statement for the task at hand?		
13.	For work near energised circuits and apparatus – do you have a safe working procedure for the task at hand?		
14.	Is the isolation point identified and is your work area clear of obstructions and is there a safe entry and exit?		
15.	Is your test equipment appropriate to the task and functioning correctly?		
16.	Have you checked to ensure that your tools and accessories are insulated, and have been inspected and maintained to ensure they are serviceable?		
17.	Are you wearing the appropriate clothing and associated PPE for the task? For example, safety helmet and boots, anti flash safety glasses, insulating gloves (gloves to be air tested daily prior to use).		
18.	Do you have the appropriate insulating mats and sheeting?		
19.	Are the necessary first aid facilities provided and accessible and are unauthorised persons prevented from entering the work area?		
20.	Is a trained, competent and qualified safety observer present?		

	List any other risk control measures relevant to the electrical work:		
	REMEMBER: • Do the work very carefully. • Follow the safe working procedures. • Assume all exposed conductors are energised. • Make sure you are aware of the voltage to earth of all exposed conductors.		
Section 4: After completing the work		**YES**	**NO**
20.	Have the installations/circuits/equipment been restored to a safe and operable condition?		
21.	Have all tags and locking-off devices been removed?		

_____ _____ ___/__/___

Electrical worker **Signature** **(date)**

APPENDIX 3 – EXAMPLE SAFE WORK METHOD STATEMENT

Write all your work method statements after consulting the workers who are going to use them. You may then need to redraft them to include their suggestions. They may see a better and safer way of doing the job.

Safe Work Method Statement (Part 1)			**Accepted:** Yes / No
Employer / Contractor: *Enter the name of the employer or contractor*			**Signed off:** *Enter the name of the person approving the SWMS*
Project: *Enter the name of project*			**Date:**
Job Description: *Enter the task to be undertaken*			
Procedure (in steps):	**Possible hazards:**	**Safety risks:**	**Control measures:**
1. *Write out the job step by step (include all major phases of the work to be done)*	*Include all possible hazards. Some examples of hazards are:* • *working near energised electrical apparatus* • *falls from heights* • *working near moving plant*	*High, Medium or Low*	*List all safety controls such as:* • *access authority* • *safety harness* • *mechanical controls / PPE* • *safety observer required*
2.			
3.			
4.			
5.			

Points to remember when writing out your work method statements:

- write out the job procedure step by step
- put the main idea first
- start each step with an action word. For example isolate, erect
- use active, not passive voice. For example 'test instruments', 'fit lock and tag'
- keep sentences short and clear
- choose words carefully
- keep it simple
- get somebody who does not know the job to read the work method statement to check if they understand the job.

Note: The possible hazards, safety risks and control measures are placed side by side. This will make it easier for you to consider the possible hazards for each step and decide on the appropriate controls to overcome each hazard.

Safe Work Method Statement (Part 2)

Project: *Enter name of project here*

Personal qualifications and experience	Personnel, duties and responsibilities	Training required to complete proposed work
Enter all the qualifications for everybody to undertake the tasks: *Electrician's Licence, experience in doing the tasks that may not require certificates.*		
Engineering details/certificates/approvals	**Legislation/codes of practice/standards**	
Enter details of certification that may be required to undertake tasks. Plant usage eg EWPs.		
Plant/equipment	**Maintenance checks**	
List all major items of plant and equipment that will be used during the duration of the task eg EWP etc.		
Read and signed by all employees on site:		

Enter details of duties and responsibilities of Supervisors, Plant Operators and other employees. Enter such things as daily safety checks, weekly site inspections.

Detail here the training required by all personnel before the activity is commenced.

Enter here all legislation, codes of practice and standards that are relevant to the work to be undertaken. Refer to the requirements when completing the Safe Work Method Statements.

Detail here the system in place to ensure plant and equipment is serviced and maintained. Enter details of tagging for electrical equipment.

Safe Work Method Statement (Part 3)

Read and signed by all employees undertaking the work:

Project: *Enter name of project here*

Job Description: *Enter the task to be undertaken* | **Revision no.:**

Name	Company	Date inducted	Signature

APPENDIX 4 – SAFETY OBSERVERS

Clause 207 and 208 of the OHS Regulation outline specific requirements for the use of a safety observer for electrical work on an energised circuit or when high risk electrical testing is carried out.

Use of Safety Observers – Legislative requirements

Safety Observer – Energised circuits

The OHS Regulation requires that a safety observer must be present when performing electrical work on energised circuits and apparatus in situations where it is necessary to perform the work in the interests of safety and if the risk of harm is greater if the circuits and apparatus were de-energised. In this situation, the safety observer must be **competent to perform the particular task that is to be carried out** and also be competent in electrical rescue and cardiopulmonary resuscitation.

Note: *The Home Building Act 1989* requires that persons must not do electrical wiring work unless they hold a Qualified Supervisor Certificate (Electrician) or (Electrical) or a Personal Electrical Contractor's Licence.

Safety Observer – Testing

Where a risk assessment determines it necessary, a safety observer must be used as a control measure when testing is to be carried out on an energised circuit or apparatus. In these situations the OHS Regulation requires the safety observer to be **competent to assist the persons conducting the tests** and also be competent in electrical rescue and cardiopulmonary resuscitation.

General principles

If a safety observer is used as part of a safe system of work as required by the OHS Regulation the following should apply:

(a) the safety observer's role is to be clearly communicated and understood. Their role is to be hazard and risk aware and to continually observe that safety procedures are carried out by the electrical worker/s performing the work and warn the worker/s of danger, including inadvertent contact with energised electrical circuits and apparatus.

(b) the safety observer must be able to warn and if necessary stop the work before the risks become too high

(c) the safety observer must not carry out any other work or function that compromises their role as a safety observer, ie the safety observer must not observe more that one task at a time

(d) the safety observer must be able to communicate quickly and effectively with the electrical worker/s performing the work

(e) the safety observer must be capable of providing assistance in the case of emergency as well as being competent to perform electrical rescue and cardio-pulmonary resuscitation, as required

(f) the safety observer must be suitably attired with personal protective equipment appropriate to the situation

(g) the safety observer must not have any known temporary or permanent disabilities that would adversely affect their role and performance

(h) the presence of a safety observer is one of the risk control measures to ensure electrical safety when electrical work on energised circuits and apparatus is being carried out. Refer to Sections 6.5 and 6.6 for details of risk control measures that are required for the performance of electrical work.

APPENDIX 5 – GUIDE FOR SAFE WORK PRACTICES ON EXTRA LOW VOLTAGE ELECTRICAL INSTALLATIONS

GENERAL

This appendix applies to electrical installations operating at extra low voltage (ELV). The appendix is intended as a source of practical guidance in order to protect the health and safety of persons working on or near an ELV electrical installation or battery installation.

ELV means extra low voltage (not exceeding 50 V a.c. or 120V ripple free d.c.), as defined in AS/NZS 3000: *Australian/New Zealand Wiring Rules.*

WARNING

If the extra low voltage electrical work is carried out on or near a low voltage electrical installation, the guidance outlined in this code MUST be followed, as the electrical work would be considered to be work on or a near a low voltage electrical installation.

TYPICAL ELV HAZARDS AND RISK CONTROL MEASURES

Part 1: General work on Extra Low Voltage (ELV)

1.1 Hazard: ELV battery systems and capacitors are stored energy devices and should always be regarded as energised equipment**.** ELV circuits may have high fault levels and be capable of causing harmful arcing if worked on energised and may result in electric shock, electrical or chemical burns, fire or explosion in adverse circumstances.

To manage these risks:

Work on an energised ELV installation should only be performed where it has been identified by a risk assessment that there is no risk of harm to personnel or equipment.

ELV installations should, wherever practicable, be isolated before any work is carried out on them. Work on an energised circuits and apparatus should be done in accordance with a safe system of work that incorporates the following control measures:

- Identify the hazards and assess the risk to personnel and equipment, taking into account the task being undertaken. Document and issue a safe work procedure that identifies each step in the process, the potential hazards and the relevant control measures to carry out the task safely, eg security/alarm work, control and protection systems, routine maintenance, testing or fault finding procedures.
- Electrically conductive objects such as jewellery, watches and bracelets should be removed before working on or near energised conductors. Other electrically conductive items, such as metal tape measures, etc should not be used on or near an energised ELV installation or battery installation.
- Assess the practicability of power isolation and de-energise wherever possible. Always isolate battery chargers before connecting or disconnecting leads. Where one leg is earthed, always disconnect the earthed lead first, then the non earthed lead. When connecting, connect the non earthed first and then the earthed lead.

- To ensure that the voltage is within the appropriate ELV range, testing should be performed for both d.c. and a.c. voltages with a device capable of separately identifying both d.c. and a.c. voltages – eg a multimeter. This requirement is necessary to be able to identify if a potentially dangerous low voltage a.c. component is not masked by the d.c. component or vice versa. Tests should be made to earth as well as between sources of differing potential. The testing device must be rated for voltages in excess of ELV.
- Working energised with high current circuits or potential high fault currents presents a risk of fire, explosion and arcing, which may result in burns to the worker and/or damage to equipment. When working on bolted type connections, ensure adjacent connections are suitably insulated to prevent short circuiting. Use two spanners, suitably insulated, one on the terminal connection bolt head and one on the nut to prevent twisting the battery terminals and damaging the internal connection. Other tools used on or near ELV should also be suitably insulated to reduce the risk of arcing.
- When working on energised equipment, the risk of electrical shock is increased in situations where there is a possibility of large body contact and confined/restricted space and wet conditions exist. (Refer AS/NZS 60479:2002 (Parts 1-3) *Effects of current on human beings and livestock.*)

Part 2: Other hazards associated with Extra Low Voltage installations

2.1 Hazard: Battery electrolyte is highly corrosive. The risks involved when handling this substance are severe chemical burns and chemical reactions.

To manage these risks:

- For information on the specific product, it is important to read the label and the Material Safety Data Sheet (MSDS). When handling or working on storage batteries it is recommended as a minimum that the following personal protective equipment (PPE) be used:
    - safety glasses
    - face shield
    - chemical resistant gloves
    - chemical resistant apron
    - suitable footwear.
- In the event of an electrolyte splash on the skin or in the eyes, it is essential to wash the affected parts immediately with large amounts of water and seek further medical treatment immediately.
- Any spillage of acid or alkaline electrolyte should be neutralised by appropriate means, and cleaned up in accordance with the requirements of the MSDS. Waste should be disposed of into a suitable clearly labelled disposal facility.
- Do not use battery hydrometers that have been used for testing alkaline cells on acid cells or vice versa. Ensure battery hydrometers are regularly cleaned after use.
- When acid or alkaline electrolyte is supplied as a concentrate, it shall be diluted by slowly adding the concentrate to water while stirring, never by adding water to the concentrate.
- Alkaline electrolytes shall only be stored in correctly labelled containers that are inert to the alkali, for example alkali resistant plastics.
- Acid electrolytes shall only be stored in correctly labelled containers that are inert to the acid, for example acid resistant plastics.

2.2 Hazard: During charging, both lead acid and alkaline batteries can generate a highly explosive mixture of hydrogen and oxygen.

To manage this risk:

- Battery compartments or charging areas should be adequately ventilated to prevent the build up of explosive gases.
- Never bring a naked flame near, or cause a spark (eg use of power tools, and mobile phones etc) in close proximity to the batteries. Do not smoke in the vicinity of batteries or in battery rooms.
- Always isolate battery loads and chargers before connecting or disconnecting leads to prevent arcing at battery terminals.
- All metallic tools used on batteries should be insulated to avoid accidental short circuiting.
- Ensure containers are not left near or around battery systems that could accumulate hydrogen gas forming a potentially explosive mixture of gases.

Note: Hydrogen is lighter than air and can accumulate in inverted containers or ceiling spaces.

FURTHER INFORMATION

A number of Australian/New Zealand Standards address health and safety issues associated with extra low voltage electrical installations. Some of these include:

AS/NZS 2210.1	*Occupational protective footwear – Guide to selection, care and use*
AS 2562	*Hydrometers – Portable syringe-type for lead-acid batteries*
AS 2676	*Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings*
AS 2676.1	*Part 1: Vented cells*
AS 2676.2	*Part 2: Sealed cells*
AS/NZS 3000	*Australian/New Zealand Wiring Rules*
AS 3011	*Electrical installations – Secondary batteries installed in buildings*
AS 3011.1	*Vented cells*
AS 3011.2	*Sealed cells*
AS 3015	*Electrical installations – Extra-low voltage d.c. power supplies within public telecommunications networks*
AS/NZS 60479.1	*Effects of current on human beings and livestock – General aspects*
AS/NZS 60479.2	*Effects of current on human beings and livestock – Special aspects*

APPENDIX 6 – HIGH VOLTAGE ELECTRICAL INSTALLATIONS

GENERAL REQUIREMENTS

Persons who intend to or are required to work on high voltage equipment after switching, isolation, short circuiting and earthing must be appropriately instructed and provided with an access permit issued by an appropriately trained and authorised person (High Voltage Switching Operator). These are specialised requirements beyond the scope of this code.

Employers should refer to their local electricity network operator for advice regarding work on or near their high voltage electrical installations.

HIGH VOLTAGE – INSTALLATION SAFETY MANAGEMENT PLAN

Employers who have a high voltage (HV) electrical installation should prepare an Installation Safety Management Plan for their workplace. The plan should address the full range of risks likely to be associated with the operation and maintenance of the high voltage installation.

Topics that may be included in the plan are:

(a) a single line diagram for the installation showing all switches and circuit breakers and their identifying labels or numbers

(b) a set of site specific operating rules and instructions covering all aspects of operating the high voltage installation. This should include a procedure for arranging isolation of the installation from the local electricity network

(c) documentation of the qualifications and training of persons who are allowed to operate and or work on the HV installation. This should include retraining/re-testing/re-accreditation procedures

(d) induction procedures for acquainting non employees and contractors with the requirements of the HV installation plan

(e) inspection and maintenance programs including a periodic testing regime that will ensure high voltage equipment remains serviceable and safe and that protection schemes will operate correctly when required

(f) procedure to ensure no extension or alteration of the high voltage installation without the agreement of the local electricity network operator

(g) procedures for the safe handling of insulating oils and other substances that may be encountered by workers maintaining or repairing HV electrical equipment including environmental considerations

(h) identification of hazardous areas including confined spaces associated with the HV installation

(i) procedures for ensuring that all parts of the HV installation (eg underground cables and high voltage overhead power lines) are not damaged by heavy vehicles, such as cranes, mobile plant, earth moving equipment and tipper trucks etc. Warning signs may be required in some locations.

FURTHER INFORMATION

The following is a list of reference material employers may find useful when preparing a High Voltage Installation Safety Management Plan:

- AS/NZS 3000 *Australian and New Zealand Wiring Rules*
- AS 2467 *Maintenance of electrical switchgear*
- New South Wales Service and Installation Rules, 2006
- Electricity (Consumer Safety) Regulation, 2006
- NENS 03-2006 *National Guidelines for Safe Access to Electrical and Mechanical Apparatus*

Further information about your high voltage electrical installation can be obtained from your local electricity network operator:

- Energy Australia: 13 15 25
- Integral Energy: 13 10 81
- Country Energy: 13 23 56

APPENDIX 7 – USEFUL PUBLICATIONS

WORKCOVER NSW APPROVED INDUSTRY CODES OF PRACTICE

- *Code of practice: Electrical practices for construction work*
- *Code of practice: Risk assessment*
- *Code of practice: Occupational Health and Safety consultation*
- *Code of practice: Technical guidance*
- *Code of practice: Work near overhead power lines*

Note: Some of the Australian Standards listed below are also approved industry codes of practice

WORKCOVER GUIDES

- *Identification Tool for Electrical Hazards on-site*
- Subby Pack – OHS contractor Management Tool
- Hazpak! Making your workplace safer
- Your Guide to Working with Asbestos

Standards and Codes offer practical guidance on health and safety for construction work. However, these are subject to change from time to time. For further information contact the WorkCover Assistance Service on: **13 10 50** or go to the WorkCover website at **www.workcover.nsw.gov.au**

For information about the wide range of other codes of practice, certification guides and publications on OHS, rehabilitation and workers compensation, contact the Publications Order line: 1300 797 003.

Information on the latest laws can be checked at **www.legislation.nsw.gov.au** or contact 1300 656 986.

AUSTRALIAN STANDARDS

Australian Standards can be purchased from SAI Global by contacting the Customer Service Centre on **13 12 42** or over the net at **http://www.saiglobal.com/shop**

AS/NZS 1892	*Portable ladders*
AS/NZS 1892.1 – Part 1:	*Metal*
AS/NZS 1892.2 – Part 2:	*Timber*
AS/NZS 1892.3 – Part 3:	*Reinforced plastic*
AS/NZS 2161	*Occupational protective gloves*
AS/NZS 2161.4 – Part 4:	*Protection against thermal risks (heat and fire)*
AS 2225	*Insulating gloves for electrical purposes*
AS/NZS 2381	*Electrical equipment for explosive atmospheres – Selection, installation and maintenance*
AS/NZS 2381.1 – Part 1:	*General requirements*
AS 2676	*Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings*
AS 2676.1 – Part 1:	*Vented cells*

AS 2676.2 – Part 2:	*Sealed cells*
AS/NZS 2978	*Insulating mats for electrical purposes*
AS/NZS 3000	*Electrical installations* (Known as the Australian/New Zealand Wiring Rules)
AS/NZS 3012	*Electrical Installations – Construction and demolition sites*
AS/NZS 3017	*Electrical Installations – Inspection and testing guidelines*
AS/NZS 3108	*Approval and test specification – Particular requirements for isolating transformers and safety isolating transformers*
AS/NZS 3175	*Approval and test specification – Residual current-operated circuit-breakers without integral over-current protection for household and similar uses (RCCBs)*
AS/NZS 3175.1 – Part 1:	*General rules*
AS 3190	*Approval and test specification – Residual current devices (current-operated earth-leakage devices)*
AS 3527	*Hand-operated screwdrivers and screwdriver bits*
AS 3527.2 – Part 2:	*Insulated screwdrivers*
AS/NZS 3760	*In-service safety inspection and testing of electrical equipment*
AS/NZS 3800	*Electrical equipment for explosive atmospheres – Overhaul and repair*
AS/NZS 3832	*Electrical Installations – Cold-cathode illumination systems*
AS 4202	*Insulating covers for electrical purposes*
AS/NZS 61009.1	*Residual current operated circuit-breakers with integral over-current protection for household and similar uses (RCBOs) – General rules*
AS 61010	*Safety requirements for electrical equipment for measurement, control and laboratory use – General requirements*
IEC 60900	*Hand tools for live working up to 1000 V a.c. and 1500 V d.c.*

APPENDIX 8 – CASE STUDIES OF ELECTRICAL INCIDENTS

CASE 1

Incident – Work on or near energised apparatus

An electrical worker had replaced the fuses in a switch fuse unit and had difficulty in turning the switch on. He opened the cover of the switch and found that the fuse carriage had jammed. As he was trying to free the switch carriage with a pair of pliers, the pliers slipped off, shorting the energised incoming terminals. He received very serious burns to his face and arm.

Contributing factors and relevant sections

Failure to:

- isolate – Section 6.1, 6.2, 6.5
- use appropriate PPE – Section 6.1.

CASE 2

Incident – Work on or near energised apparatus

The main switchboard at a factory had been upgraded and a new mains supply cable was being installed during the weekend shutdown. The electrical worker was assisting the electricity supply authority with the mains changeover, and he carried out the connections at the factory while the electricity supply authority made the connections at the transformer end.

The following day the electrical worker was removing the old mains cable that had been disconnected from the main switchboard, and as a final check to ensure that the cable was dead he shorted out the conductors with his pliers. This caused a short circuit resulting in flash burns to his eyes.

An investigation revealed that the old main supply cable had been mistakenly left connected to the transformer because of lack of communication between the electricity supply authority and the electrical worker.

Contributing factors and relevant sections

Failure to:

- use appropriate job planning – Chapter 3
- follow appropriate isolation procedure – Section 6.1, 6.2
- use proper means to prove de-energisation – Section 6.1
- wear face and eye protection – Section 6.1.

CASE 3

Incident – Work near energised apparatus

An electrical worker was carrying out electrical wiring work at an installation's main electrical switchboard at the time of the incident. It appears that he was working in the vicinity of the upper right hand compartment of the combined switchboard and metering assembly. This compartment contained a number of double pole circuit breakers providing control and protection for the fuel dispensing pump motor's final sub circuits.

Since electricity supply was required in order to operate all the dispensing pumps at all times, it seems that the electrical worker decided to carry out the work with the supply still energised to the switchboard compartment where he was working.

The outer hinged door of this compartment was open and the associated inner hinged metal escutcheon plate, which would normally cover all exposed energised parts of the switchboard, was also in the open position.

The investigation revealed that no means of insulating exposed energised parts was evident in this switchboard compartment or at the pump control board immediately above this compartment.

All exposed metal of the switchboard was effectively earthed and connected to the main earthing systems.

The exposed energised parts of the switchboard compartment was of three bolted incoming supply connection points in the upper section; one for each of the three phases of the centre fed busway system.

The work involved the placement of circular orange Tough Plastic Sheathed (TPS) cables extending from cable enclosures at floor level through a compartment below the switchboard and through a cable entry aperture in the bottom left hand corner of the upper right hand switchboard compartment.

The electrical worker inadvertently contacted the exposed energised parts of the electrical switchboard comprising the bolted incoming supply connection points for each of the three phases of the centre fed busbar system.

The electrical worker was killed.

Contributing factors and relevant sections

Failure to:

- isolate – Section 6.1, 6.2
- insulate exposed energised parts with an effective barrier, cover or mat – Section 6.2
- take care in an area of reduced mobility – Section 4.2
- use a safety observer when working on energised equipment – Section 6.5.

CASE 4

Incident – Work on energised apparatus

An electrical worker was called to a hotel to repair a walk in freezer that was tripping out on overload.

He climbed on to the roof where the refrigeration compressor was mounted. He took with him basic hand tools and electrical test equipment. Despite knowing where to isolate supply to the compressor, he did not do so.

When he viewed the unit, it was obvious that the motor run capacitor (with a metal case) was leaking, so he removed the capacitor from its mounting to read the details with the power still on. Because the case of the capacitor was energised, and he was in contact with metal that was earthed, the electrical shock he received was sufficient to kill him.

A later inspection of the capacitor revealed that insulation had broken down around the capacitor terminals and a conductive mixture of oil, dust and salt spray caused the case to be livened up.

Testing would not have helped in this situation. While the capacitor was mounted on the unit, it was earthed by way of its fixing and at earth potential; any voltage test would have shown zero volts with respect to earth.

The circuit breaker did not trip because the run capacitor is in series with the run winding which has sufficient impedance (resistance) to reduce the current to less than that required to operate the 15 amp circuit breaker.

In fault conditions, even the metallic refrigerant pipes are potentially energised but held at earth potential by connections to earthed equipment. By disconnecting a coupling or cutting this pipe anywhere between the fault and the earth connection you would have a potential of 240 volts across the open point of the pipe, which would then be across you if you were to hold the separate pipe ends in each hand.

Contributing factors and relevant sections

Failure to isolate – Section 6.1, 6.2.

CASE 5

Incident – Work on or near energised apparatus

Two electrical workers were installing cables in a section of a switchboard isolated and proven de-energised. Whilst one electrical worker was working on busbars in one cubicle, the other was working in an adjacent cubicle, using a two piece metal hole punch to make a 37mm penetration through to a cable access zone. During this task, the rear section of the hole punch was caught around a neutral conductor that was obscured from the vision of the electrical worker and consequently the conductor was severed in the hole cutting process. This neutral was supplying a control panel neutral link. The actives for the control circuits associated with the link were supplied from a separate energised portion of the switchboard. The severing of this neutral created a backfeed on the red phase that one electrical worker was touching at the time, resulting in a shock, which was measured as approximately 180 volts, shortly afterwards. The electrical worker receiving the shock was unable to break contact and was dragged clear from the switchboard (without the use of any insulated aids). He was taken to hospital with burns to hands.

Contributing factors

Failure to:

- follow appropriate isolation procedure – Section 6.1
- wear insulating gloves – Section 6.1
- have suitable rescue techniques and equipment in place – Section 6.5.

Catalogue No. **964** WorkCover Publications Hotline **1300 799 003**

WorkCover NSW 92-100 Donnison Street Gosford NSW 2250
Locked Bag 2906 Lisarow NSW 2252 WorkCover Assistance Service **13 10 50**
Website **www.workcover.nsw.gov.au**

ISBN 1 876995 43 2 V1.00 Production and printing by Salmat – 02 9743 8777