LOW VOLTAGE ELECTRICAL WORK

CODE OF PRACTICE 2001

WorkCover NSW Health and Safety Code of Practice

WorkCover. **Watching out for you.**

Disclaimer

This is a Code of Practice which contains industry recommended action for managing workplace safety. It includes some of your obligations under the various Workers Compensation and Occupational Health and Safety Legislation that WorkCover administers. To ensure you comply with your legal obligations you must refer to the appropriate acts.

Contents

Contents *(continued)*

What is an industry code of practice?

An approved industry code of practice is a practical guide to achieving the standard of safety required by the *Occupational Health and Safety (OHS) Act 2000* and *OHS Regulation 2001* for a particular area of work.

An approved industry code of practice should be followed unless there is an alternative course of action, which achieves the same or better standard of health and safety in the workplace.

An industry code of practice is approved by the Minister for Industrial Relations. It comes into effect on the day the notice of this approval is published in the NSW Government Gazette or on the day specified in the Gazette notice.

An approved industry code of practice is designed to be used in conjunction with the Act and Regulation but does not have the same legal force. A person or company cannot be prosecuted for failing to comply with an approved industry code of practice.

However, in proceedings under the Act or Regulation, failure to observe a relevant approved industry code of practice can be used as evidence that a person or company has contravened or failed to comply with the provisions of the Act or Regulation.

A WorkCover inspector can cite an approved industry code of practice in a direction or in an improvement or prohibition notice, indicating the measures that should be taken to remedy an alleged contravention or non-compliance. Failure to comply with a requirement in an improvement or prohibition notice is an offence.

In summary an approved INDUSTRY CODE OF PRACTICE

- gives practical guidance on how the required standard of health, safety and welfare can be achieved in an area of work;
- should be followed, unless there is an alternative course of action which achieves the same or better standard of health and safety in the workplace;
- can be used in support of the preventive enforcement provisions of the *OHS Act*;
- can be used to support prosecutions for failing to comply with or contravening the Act or Regulation.

Preface

Aim

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 or systems.

It applies to work on electrical installations or systems. Some activities are excluded such as automotive work and the manufacture of appliances.

This code provides practical guidance on measures to control electrical risks. This will assist the implementation of the requirements of the *OHS Act 2000* and the *OHS Regulation 2001*, in a manner appropriate to the circumstances of each workplace.

In accordance with the statutory risk control requirements of the *OHS Regulation 2001*, the code recognises that in general the practice of working live on or near energised low voltage installations or systems 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 emergency situations where greater risks would occur if the installations or systems were to be de-energised.

This Code is based on the earlier WorkCover publication *Guide to electrical workers' safety practices (for up to 1000 volts)* (January 2001), which it now replaces.

What are 'low voltage installations or systems'?

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

Many electrical occupations and tasks expose employees to low voltage electricity, such as:

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

How can electricity at low voltage affect health and safety?

Contact with live 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 live parts at any voltage that causes sufficient current to pass through the heart is potentially injurious or even fatal.

Contact with live 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.

How to use the information in this code

- *What is this code of practice about?*
  This code of practice aims to assist you to take action to prevent electrical shock in your workplace. If you follow the advice set out here, you will be well on the way to complying with your legal obligation to control workplace risks arising from low voltage electricity, as required by the *OHS Regulation 2001*.
- Who is this code of practice for?
  This code of practice is for employers, managers, health and safety representatives, OHS committee members, employees and electrical workers, unions and employer organisations to assist them to manage electrical risks.
- When do I use this information?
  Use this code of practice to assess the effectiveness of your present arrangements for work on or near low voltage installations or systems, and to check that all sources of risk have been identified and dealt with. If you are setting up a new business, this code of practice should be your step by step guide to establishing a program to manage the risks.
- 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.

Assess the risks in your workplace

Legal obligations that you must follow

Consult and communicate with employees

Questions you (or others) might ask to clarify issues

Tools that can help you work out your plan

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

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 on or near low voltage installations or systems.

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 in places of work in NSW, including the work of electricity supply authorities, except in mines.

Electrical work is work on or near a low voltage electrical installation or system, for the purpose of installing, repairing, altering, adding to or removing an electrical installation or system, and the supervision of this work. This includes work on extra low voltage (ELV) systems.

This code does not apply to electrical work relating to:

(a) The manufacture or supply of electrical articles or plant, for sale or hire when unplugged from any electrical outlet socket.

(b) Automotive electrical work.

(c) Telephone systems (apart from the power supply above ELV).

(d) Repair of consumer appliances, plant, luminaries or equipment when unplugged from any electrical outlet socket.

If the requirements of this code are inconsistent with requirements of the *Electricity Safety (Electrical Installations) Regulation 1998*, or work carried out under a safety plan required by the *Electricity Supply (Safety Plans) Regulation 1997*, then those regulations prevail.

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, systems and appliances used during construction.

1.4 Authority

This is an industry code of practice approved by the Special Minister of State, under section 43 of the *OHS Act 2000*.

1.5 Commencement

This code commences on *1 January 2002*.

1.6 Interpretation

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".

Legal requirements
Words such as "must", "requires", and "mandatory" indicate legal requirements which must be complied with. Failure to comply is an offence which can attract a penalty.

1.7 Definitions

The following terms used in this code have these meanings:

approved — 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 — 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 (e.g. e-mail).

Note: Being authorised also carries with it responsibilities for employers and employees - see 7.1 and 7.4.

competent person — a person who has acquired through training, qualification, experience, or a combination of these, the knowledge and skill to perform the required task correctly.

control measures — measures taken to minimise or eliminate a risk.

controller of premises — 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, and

(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.

Notes: 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) — a term applied to an object when it is at or about earth potential and disconnected from any live system.

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

electrical installation — any appliance, wires, fittings, or other apparatus placed in, on, or under any land or premises and used for the purposes, or for purposes incidental to, the conveyance, control and use of electricity supplied or intended to be supplied by an electricity supply authority. This includes the supply authority's installation for the purposes of this code.

electrical wiring work or electrical work — the actual physical activity of installing, repairing, altering, removing or adding to an electrical installation or system and the supervising of that work.

Note: this is defined in the Electricity Safety Act 1945, but also includes the work on the system of the supply authority excluded under that Act.

ELV — extra-low voltage (not exceeding 50 V a.c. or 120V ripple free d.c., as defined in AS/NZS 3000:2000 *Australian/New Zealand Wiring Rules*.

emergency work — 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 remain live for the duration of the work.

employer — includes a self-employed person, to the extent of their duty to others at the workplace.

energised — a term applied to an object when a difference of potential exists or would exist between it and earth under normal conditions of operation. It may include the neutral conductor.

Note: the potential is not limited to low voltage as defined in AS/NZS 3000:2000, but includes ELV, as this can pose a burns hazard, if there is a high fault current capability.

exposed conductor — 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 — the contact of a person with a hazard.

fault-finding — the process of making measurements or carrying out tests on equipment in order to locate faults. It also may include the process of connecting testing instruments or devices to various parts of the equipment to determine how the equipment is operating.

hazard — anything with the potential to harm life, health or property.

Note: this is an intrinsic property of the hazard and should not be confused with risk.

hazardous area — an area with a risk of fire or explosion as defined in AS 3000 and AS 2430.

Note that hazardous areas are divided into zones of risk.

isolate (as a risk control measure) — to separate the hazard from the worker using barriers, distance, or time.

isolated (specific electrical usage) — disconnected from all possible sources of electrical energy by opening of switches, withdrawal of circuit-breakers, removal of fuses, links, connections and the like and rendered incapable of being energised unintentionally.

live (alive) — energised (see above), or subject to hazardous induced or capacitive voltages.

low voltage — exceeds extra-low voltage (ELV), but not exceeding 1000V a.c or 1500V d.c. as defined in AS/NZS 3000:2000 *Australian/New Zealand Wiring Rules*.

MEN — multiple earthed neutral.

near — see "on or near low voltage conductors", below.

on or near exposed low voltage conductors — an electrical worker is working on or near exposed conductors if there is a reasonable possibility that the worker's body, or any moveable object the worker may be carrying or touching during the course of the work, may come closer to the exposed low voltage conductors than 700mm.

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

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 equipment, appliance or machinery.

Note that the legal definition of plant is very broad and inclusive.

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

system — includes the electricity generation and supply system of a supply authority.

self-employed person — duties of self-employed persons are included in the term "employer" to the extent of their duty of care to others in the workplace.

Note: self-employed persons do not have a duty of care to themselves under the OHS Act 2000.

voltage — differences of potential normally existing between conductors and between conductors and earth. This is defined in AS/NZS 3000:2000 *Electrical installations (known as the Australian/New Zealand wiring rules)*.

worker — an employee, apprentice, self-employed or other person carrying out electrical work.

working live — the process of carrying out work on an electrical installation or electrical equipment that is or could be live (energised).

workplace — is the place of work, which can be anywhere and includes premises.

Chapter 2 Consultation at work

2.1 Obligation to consult

Employers are required by the *OHS Act 2000* to consult with employees (or their representatives) when taking steps to assess and control workplace risks.

The OHS Act requires employers to take into account the views of employees when making decisions that affect their health, safety and welfare. Involving your employees in identifying hazards and solving health and safety problems is an essential step in making your workplace safe and healthy.

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

2.2 What is meant by Consultation?

Consultation involves sharing information with employees, giving them the opportunity to express their views before decisions are made, valuing their views and taking them into account.

Using the experience and expertise of employees will help ensure safe outcomes. This is based on a recognition that employee input and participation improves decision-making about health and safety. Consultation will assist in developing safe systems of work based on the identification of hazards that may be present and the assessment of the risks these hazards might give rise to.

Although the responsibility for health and safety decisions rests with the employer, consultation provides the opportunity for employees to contribute to the decision-making process in resolving health and safety problems. This helps to ensure that employees cooperate and follow safe working practices.

2.3 When must consultation occur?

Consultation must occur when:

(a) changes that may affect health, safety or welfare are proposed to the:
- work premises;
- systems or methods of work; or
- plant or substances used for work;

(b) assessing the risks to health and safety arising from work;

(c) decisions are made about the measures to be taken to eliminate or control those risks;

(d) introducing or altering the procedures for monitoring risks;

(e) decisions are made about the adequacy of facilities for employee welfare;

(f) decisions are made about the procedures for consultation.

Employers must consult with employees about establishing an OHS consultation mechanism, such as a system of representatives or committees. Informal methods of consultation should also be used, such as toolbox meetings.

Further advice is provided in WorkCover's *Code of Practice: Occupational Health and Safety Consultation*.

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 re-modelling 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 risk.
- Monitor and review the control measures to ensure on-going safety.

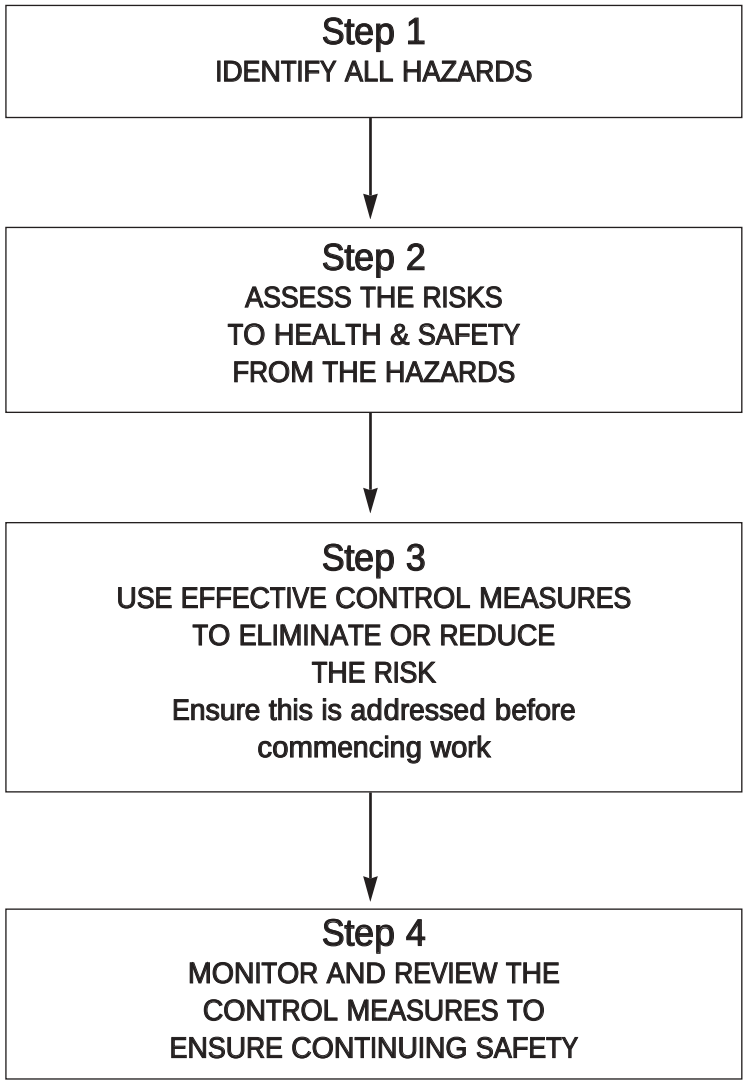
These are the key elements of a risk management process which should be undertaken in consultation with the people most likely to be affected, such as employees and contractors. When doing this, it may help to break the workplace or work activities into areas and deal with each separately.

To simplify the task, generic risk assessments may be used. Generic risk assessments are assessments covering more than one location or circumstance. These 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 workers also need to be identified.

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

Further advice on legal obligations is provided in chapter 7.

Diagram — Risk Management Process



3.2 Step 1 — Identifying the hazards

An employer must identify all the health or safety hazards, which could harm the workers or other persons in their workplace. The hazards may include 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 work is conducted.

(c) Consulting with workers.

(d) Looking at the workplace records on "near misses", 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 to develop a safety plan and can help in developing safe operating procedures. 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; and

(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 key risk is that of working live, which must be justified.

This risk assessment should also help you plan for emergencies.

The risk assessment should be recorded, along with the control measures selected. 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 (for example, discontinue the activity, use a different, less dangerous piece of equipment, or fix faulty machinery).

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 or the way work is done to something safer;

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 it 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 (e.g. 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.

Generally, working live cannot be justified as being as safe as working de-energised.

3.4.2 Safe working procedures (SWPs)

Safe working procedures are frequently used work practices that have been developed and documented, including control measures that ensure safety. They should be used by all organisations and self-employed workers. Safe working procedures used by organisations and self-employed persons in a particular industry should be identical or very similar.

SWPs should be developed and tried under simulated non-hazardous conditions and critically evaluated to be certain that they are safe and described clearly.

They should be reviewed periodically to ensure that they continue to be practical and safe, and there should be a process in place so that SWPs can be amended when necessary.

Employees should follow their employer's SWPs. Therefore, it is important that employee commitment and expertise is obtained during their preparation. SWPs should be developed after consulting with the employees who have to use them. They should be modified when experience shows how they can be improved. Workers' competency should be maintained in the use of SWPs relevant to their work.

SWPs should address the following requirements:

(a) training for various techniques, such as risk assessment;

(b) insulating exposed live conductors in the immediate area prior to working live;

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

(d) isolation and tagging procedures;

(e) insulating gloves and insulated tools;

(f) inspection of the condition of clothing;

(g) permit and approval processes; and

(h) safety rules to be followed before deciding to work live.

3.5 Step 4 — Keeping your workplace safe — monitor and review

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 safety plan 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 'stock take'.

4.1 Common hazards of working on or near low voltage installations or systems.

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

(a) Voltages between phases.

(b) Voltages between phases and earth.

(c) Voltages between live exposed conductors and surrounding metal framework.

(d) Voltages across undischarged capacitors.

(e) Voltages on disconnected conductors - particularly neutrals.

(f) Multiple supply sources (more than one source of supply or live circuit may be available on the premises).

(g) Voltages between live exposed conductors and the surrounding environment (including metalwork, damp situations, other conductive surfaces and persons nearby).

(h) Electrical testing or operating equipment with open enclosures in hazardous areas (as defined by AS/NZS 3000:2000).

(i) Lower voltages - for example ELV (extra low voltage) may be hazardous in a cramped situation with dampness, heat or water on the floor, especially when the worker is lying on the floor.

(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 live.

(m) Induced voltages.

Examples of work involving common hazards

Hazard	Work activity
Voltage between phases	• Working on polyphase installation or systems. • Wiring/testing/servicing of switchboards/motors/ heaters/ controllers. • Working on exposed busbars/catenary wires etc.
Voltage between phases and earth	• Working on single phase & polyphase systems. • Wiring/testing/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 installations or systems 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 in hazardous locations	Electrical testing in confined area with explosive gas mixture, fumes, vapour or dust which is inadequately ventilated.
Damp working conditions	Working in situations where condensation, spillage, drainage or seepage occurs and results in wet surroundings.

4.2 Common non-electrical hazards which may be encountered in electrical work.

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

(a) confined spaces (where there may be a hazardous atmosphere - see below);

(b) lack of sufficient light to work safely;

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

(d) excessive fatigue, due to pressure of deadlines or other factors;

(e) obstacles to getting the equipment switched off;

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

(g) temperature rise as a result of combustion;

(h) fall from heights;

(i) cramped working conditions;

(j) explosive atmospheres;

(k) static from clothing made from wool, wool blends, nylons and polyvinyl (unless treated with an anti static process);

(l) electric tools and equipment (e.g. hand lamps, drills, saws, torches and test instruments);

(m personal effects (e.g. rings, jewellery, cigarette lighters, matches, hearing aids, mobile phones and pagers, transistor radios and similar);

(n) general work activities (e.g. welding, cutting, brazing, using hand saws, drilling of all types, hammering and chiselling);

(o) static from the rubbing (friction effects) of plastics;

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

(q) use of metallic tape measures;

(r) excavation associated with electrical work; and

(s) molten metal from arcs.

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; and

(c) pipes, sewers, shafts, ducts, 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.

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 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) 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) Is the person physically fit for a task involving exposure to low voltage electricity (e.g. are they able to climb to heights to work on an overhead conductor)?

(b) Does the worker have a visual deficiency (e.g. do they have a visual colour deficiency)?

(c) Do they suffer from any heart, circulatory or other diseases (e.g. do they have a pacemaker)?

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

(e) Are the staff working excessively long hours?

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

(g) Do they suffer from claustrophobia?

5.2 Risk factors when modifying existing electrical installations or systems

Examples of common risk factors with existing installations or systems include:

(a) the supply may become live during the work;

(b) automatic starting of machinery after supply is restored;

(c) a conductor that was thought to be de-energised was found to be live;

(d) more than one source of supply or live circuit may be available on the premises;

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

(f) voltages on disconnected conductors - particularly neutrals;

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

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

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

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

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

(l) working alone on live equipment or installations; and

(m) contact with cables during excavation.

5.3 Risk factors in fault-finding and repair work

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

Some common risk factors in fault finding or repair include:

(a) exposed live terminals;

(b) terminals or conductors being live under different conditions of operation of the equipment;

(c) loose or disconnected leads becoming live;

(d) test equipment conducting the potential closer to the electrical worker;

(e) test equipment inappropriate for the task (particularly test probes);

(f) test points inadequate;

(g) inadvertent attempts to start machinery by other persons;

(h) incorrect or poorly-maintained testing instruments;

(i) inadequate knowledge of equipment or causes of faults;

(j) lack of information about circuits or equipment;

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

(l) working alone on live equipment or installations.

5.4 Risk factors of high fault current levels — working live

When working on live 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 times 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 — SWITCHBOARD CUBICAL BUSBARS IN PARTICULAR:

- **ARCS MAY CAUSE AN EXPLOSION AND OR MELT METAL AND RELEASE HOT GASES.**
- **SEVERE BURNS AND INJURY FROM FLYING DEBRIS MAY RESULT.**
- **OVERCURRENT DEVICES MAY NOT OFFER PROTECTION.**

5.5 Recording the risk assessment

The record should indicate the control measures chosen and why: 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 need to ensure adequate supervision of workers to make sure that control measures are applied.

Listed below are steps to consider. Every workplace is different, so select the controls that are the right ones for you.

6.1 Control measures for all electrical work

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

The first aim always should be to eliminate the hazard. Usually, the simplest way is to ensure the electricity supply is isolated. However, electrical equipment should not be assumed to be de-energised after isolation. Testing must be done prior to touching.

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

6.1.1 Elimination

Eliminate the risk of shock or burns by:

(a) switching off the supply;

(b) isolating the supply;

(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 testing instrument.

WARNING

EVEN IF IT IS BELIEVED THAT THE SUPPLY HAS BEEN ISOLATED, IT MUST BE ASSUMED THAT ALL CONDUCTORS AND COMPONENTS ARE LIVE 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; and

(c) investigate whether the section of the installation that needs to be de-energised can be 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 designs.

6.1.3 Isolation

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

(a) Time — do the work when supply can be de-energised (isolated) — in effect, this is the same as eliminating the hazard.

(b) Marking barriers — e.g. 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 live 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) approved insulated tools; and

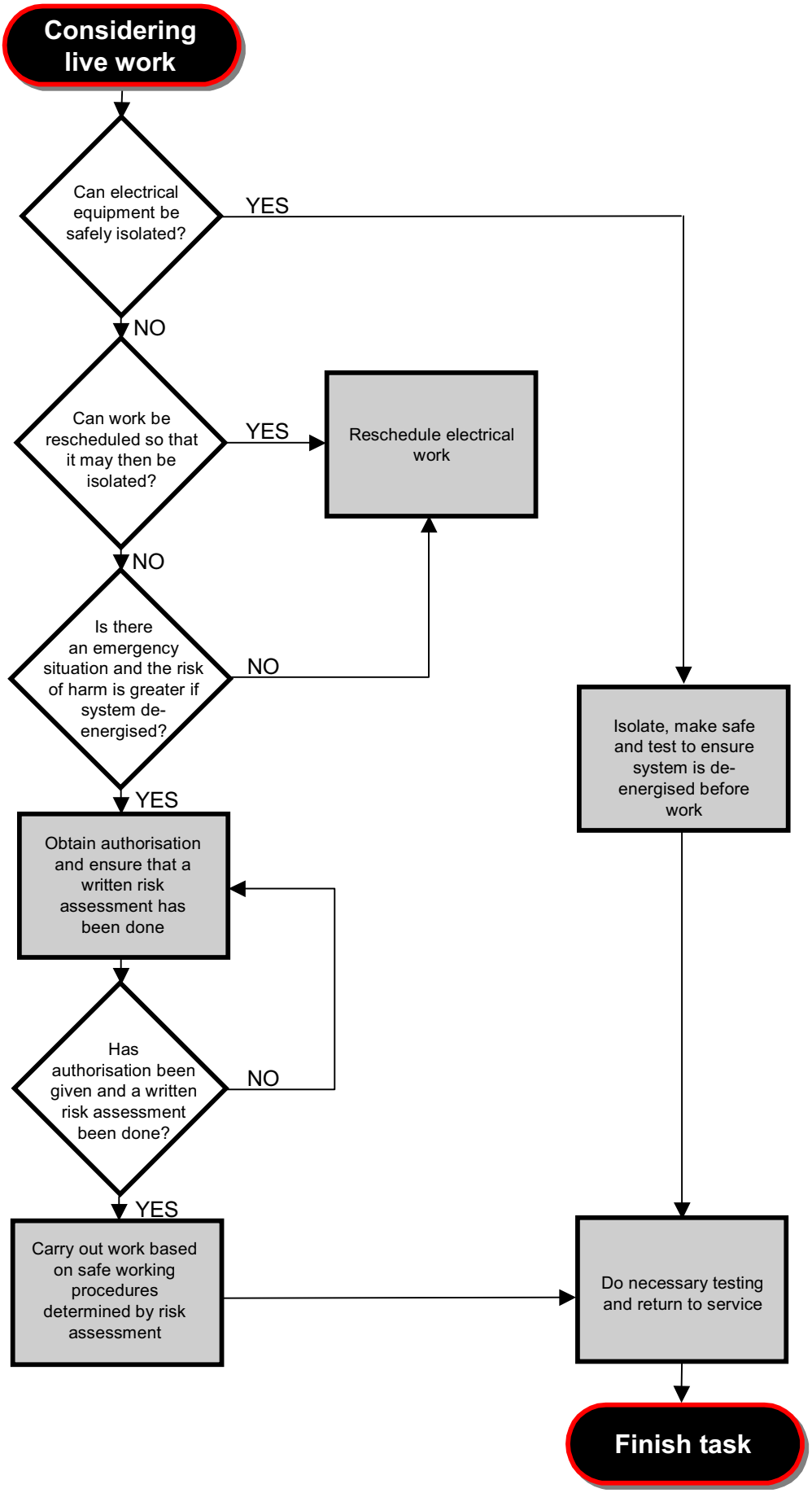
(g) approved insulating sheeting.

Workers must be trained to be competent in the use of PPE.

All the above practices should be described in the employer's or your own (if self-employed) safe working procedures, and rigorously carried out.

6.2 Flow chart of control measures for electrical work

Examine the flow chart and then work through sections 6.3 and 6.4.



Advice to workers

WORK SAFELY

ISOLATE THE SUPPLY

SECURE LOCKOUT DEVICE AND TAG

PROVE IT IS DE-ENERGISED

6.3 Control measures when fault-finding on or near live conductors

When fault finding, take the following precautions.

(a) Before starting and during work:

(i) Checks must be made to ensure that the test instruments to be used are functioning correctly, before starting and during the work.

(ii) Place safety barriers/notices to prevent other persons entering the vicinity of exposed live parts or exposed conductive parts that could become live during testing.

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

(iv) Use a safety observer where risk requires it.

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

(c) If a fault cannot be found with the supply isolated and live testing methods have to be used, put control measures in place that isolate all persons from the hazard. Then, prior to fault finding/testing, the following must be done:

(i) identify exposed conductive parts that could become live whilst using test instruments;

(ii) use only approved insulated tools, testing probes and isolation barriers should be used to isolate all workers from contact with exposed conductive parts that could become live during testing;

(iii) conduct periodic review of the situation to ensure that no new hazards are created during the process.

(d) When the fault finding work 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 that for work in hazardous areas, the special techniques required by AS/NZS 3000 are not covered in this code.

6.4 Control measures to be taken before working live in emergencies

The OHS Regulation specifies the following precautions (clause 207).

Working live procedures can be implemented in emergencies only:

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

(b) after a written risk assessment has been completed;

(d) after determining how it can be done safely; and

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

These do not apply to testing (see section 6.7), or to work under a safety plan required by the *Electricity Supply (Safety Plans) Regulation 1997*.

Before work is commenced the following factors 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 or near a live conductor.

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

(d) The following must be available and at hand:

- the appropriate test equipment, and
- insulated tools and accessories, which must be the correct ones for the task and must be well maintained.

(e) All testing of tools and equipment must be up-to-date and must have been inspected to ensure they are serviceable.

(f) The person who is to perform the work must be provided with and use the appropriate clothing and associated PPE for the task.

(g) There must be a safety observer available, who must be competent in electrical rescue and cardio-pulmonary resuscitation (CPR).

(h) 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.

(i) Evacuation lighting should be provided and should be operating correctly.

(j) Fire-fighting equipment that is suitable for electrical fires should be accessible.

(k) Key people must be informed that the electrical worker is about to work live, such as the owner or the person in control, and the supervisor.

(l) The isolation point of the relevant electricity supplies must be established and labelled.

(m) Live conductors should be insulated where necessary to prevent inadvertent contact or flashovers.

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

Advice for workers:

BEFORE *WORKING LIVE —* ***STOP!***

IS IT AN ***EMERGENCY*** *SITUATION?*

HAVE YOU DONE A ***RISK ASSESSMENT?***

HAVE YOU BEEN ***AUTHORISED*** *BY YOUR* ***EMPLOYER?***

6.5 Control measures to be taken while working live

While working live, the electrical worker should ensure that all precautions outlined above (section 6.4) have been taken and that:

(a) the work is done very carefully and in an un-hurried, considered manner (haste can be hazardous);

(b) the employer's safe working procedures are rigorously followed;

(c) all exposed conductors are assumed to be live;

(d) an awareness of the voltage to earth of all exposed conductors is maintained;

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

(f) a safety observer competent in electrical rescue and cardio-pulmonary resuscitation is present.

Using PPE to work live 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 WORKERS

TEST *BEFORE YOU TOUCH*

NEVER *ASSUME IT IS DEAD*

OTHERWISE ***YOU*** *MAY BE!*

6.6 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 cables;

(c) tagging, taping-off;

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

(e) taking any necessary precautions to ensure that cables cannot become live;

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

6.7 Electrical testing

It is often necessary for testing to be carried out live, such as testing meters, voltage, load, and phasing. The OHS Regulation requires employers to ensure that persons conducting tests for electrical system integrity and operability, conduct the tests in a safe manner using a safe system of work, appropriate PPE and appropriate test equipment.

6.8 Tagging-off procedures: preparation for work on de-energised equipment

6.8.1 General

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

6.8.2 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.

6.8.3 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, it must be racked out or removed to provide a visible break for isolation verification, then locked open and danger tagged.

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.

6.8.4 Tagging

Where practicable, appropriate tags should be placed at all points of switching.

Where appropriate, the tags should be signed and dated by all personnel involved in the work, or by the supervisor in charge of the work party. Tags should only be removed with the permission of all the signatories to the tags or, if this is not possible, by the signatories' immediate supervisor. Identification labels should also include warnings for any abnormal hazards, for example, multiple points of supply.

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 (caution or out-of-service) tag.

When work is resumed, the person in charge of the work removes the warning (caution or out-of-service) 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.

6.8.5 Locking off

All circuit breakers, switches and combined fuse switch units should be locked off where possible. Where locking facilities are not fitted, temporary securing devices must be used. Securing devices must be able to withstand any disrupting environment, for example, not becoming ineffective due to vibration.

6.8.6 Testing

All electrical equipment, unless proven to be de-energised, should be treated as live. Any voltage tests should be conducted between all conductors and between all conductors and earth.

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.

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

6.8.7 Bonding of conductors

Where isolation of electrical equipment is made at a remote location, all conductors supplying the equipment should be bonded together and to the general mass of earth at the work site, if practicable. Bonding to earth may be effected 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 safety apparel should be used when attaching or removing temporary bonding conductors.

6.9 Cutting cables

When carrying out work that involves cutting existing cables, the cable must be treated as live and the procedures for working on live 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.

6.10 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.

Warning: the use of a tester for detecting an electric field surrounding a live conductor may not be suitable for testing cables that are surrounded by a metallic screen.

Chapter 7 Legal obligations and responsibilities for implementing this code

This Chapter briefly outlines legal obligations and explains how these are related to the electrical work covered by this code. For full information, consult the *OHS Act 2000* and the *OHS Regulation 2001*.

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.

7.1 Duties of Employers

7.1.1 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:

- 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 live (apart from testing) is not undertaken unless justified and specific processes followed (see sections 6.4, 6.5 and 6.7);
- 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 employer must ensure:

(a) all installations and equipment are safe, regularly inspected and maintained;

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

(c) appropriate work systems prevent inadvertent energising of plant;

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

(e) work close to overhead power lines is done in accordance with a written risk assessment and a safe system of work;

(f) 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;

(g) adequate signs to warn of the hazards and to restrict access are provided where there is a risk of exposure.

However, where carrying out the duties (a) to (g) above are inconsistent with the *Electricity Safety (Electrical Installations) Regulation 1998*, that regulation prevails.

Records must be maintained of all inspections or tests that are made and maintenance that is performed on electrical articles or installations (not including supply), including:

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

7.1.2 Specific 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 working live.

(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, and
- CPR and Release and Rescue.

(e) The following information is provided to employees, 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 employee'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.

7.1.3 Supervision

Employers must provide appropriate supervision and should 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 live parts should 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 need to be described in policies and procedures.

7.1.4 Home Building Act — requirement for 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). 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 qualified supervisor. 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; and

(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 live 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.

7.1.5 Emergencies and first aid

Employers must provide for emergencies, including making arrangements for:

(a) safe and rapid evacuation;

(b) emergency communications; and

(c) appropriate medical treatment of injured persons.

7.2 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 7.1 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 live cables, parts or plant.

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

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

A person in control of a 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 a 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 (e.g. 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 live. 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 live 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 premises 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 7.1 above.

7.4 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.

7.5 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.

7.6 Enforcement

If a breach of legislation or safety standards is found, the WorkCover 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's Compliance & Prosecution Policy, which is available from WorkCover 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 OHS 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 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 for a formal review. This may result in the notice being confirmed, varied by the issue of a new notice, or revoked by WorkCover. A notice may be withdrawn at any time by the inspector who issued the notice or by WorkCover if the notice was issued in error or is incorrect in some respect

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

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.

Note: The sample in tool 1 deals only with work in a **low voltage distribution board.** In some situations, workers may be exposed to other conditions (eg workers may have to deal with multiple supply sources). Because the final assessment factor (Physical Condition/Capability) refers to an individual work team, it will in most cases be necessary to complete this Tool for each work team exposed to low voltage electricity.

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 live 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.	• Staff 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. • Staff to be encouraged to assume all conductors live 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.	• Work will be organised to ensure both workers present when all live 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 yrs 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 : Work On or near Low Voltage Electrical Installations or Systems

Preventive Actions Checklist

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 control measures in place.

Project:
Electrical worker:
Site address:
Type of work:

Notes:

See checklist on the next page

Employee/Worker preventive 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 it is an emergency 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 the section of the installation that needs to be de-energised can be isolated, while leaving the remainder connected? *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 output 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 live until you have proved them dead. **Test before you touch.** *Proceed to section 4.*		

Section 3 - Control Measures WORKING ON OR NEAR LIVE EQUIPMENT		YES	NO
8.	Have you completed a written risk assessment 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 live equipment?		
12.	Do you have a safe working procedure for the task at hand?		
13.	Is your work area clear of obstructions and is there a safe entry and exit?		
14.	Is your test equipment: appropriate to the task and functioning correctly?		
15.	Have you checked to ensure that your tools and accessories: are insulated, and have been inspected to ensure they are serviceable?		
16.	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).		
17.	Do you have the appropriate insulating mats and sheeting?		
18.	Are the necessary first-aid facilities provided and accessible?		
19.	Is a trained safety observer present?		
	REMEMBER: • Do the work very carefully. • Follow the safe working procedures. • Assume all exposed conductors are live. • 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 condition?		
21.	Have all tags and locking-off devices been removed?		

_____ _____ _____/_____/ _____

Electrical worker Signature (date)

Appendix 3 Some frequently asked questions

Are there any regulations that I must be aware of?

Yes. The OHS Regulation requires that employers take steps to protect employees from harmful effects of electricity. These requirements are summarised in this code of practice wherever you see this symbol:

Are there any other codes of practice that I should be aware of?

Yes. "Electrical Practices for Construction Work", which is a code of practice covering the acceptable temporary electrical wiring and testing arrangements for the construction industry in NSW. Also AS/NZS 3760:2000 has been gazetted as a code of practice.

Are there any other laws that I should be aware of?

Yes: Other legislation includes legislation such as:

Electricity Safety (Electrical Installations) Regulations 1998
Electricity Safety Act 1945
Electricity Supply Act 1995
Electricity Supply (General Regulation) 1996
Electricity Supply (Safety Plans) Regulation 1997
Home Building Act 1989
Home Building Regulation 1997

Are there any Australian or International Standards that I should be aware of?

Yes. A number of Australian Standards address issues associated with working on or near low voltage electrical installations or systems, as well as personal protective equipment and other relevant subjects. Some of these include:

AS 2225	*Insulating gloves for electrical purposes*
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 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 4202	*Insulating covers for electrical purposes*
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/NZS 2381	*Electrical equipment for explosive atmospheres-Selection, installation and maintenance*
AS/NZS 2381.1 — Part 1.	*General requirements*

AS/NZS 2978	*Insulating mats for electrical purposes*
AS/NZS 3000	*Electrical installations (Known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3017	*Electrical Installations — 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/NZS 3800	*Electrical equipment for explosive atmospheres--Overhaul and repair*
AS/NZS 3832	*Electrical Installations--Cold-cathode illumination systems*
AS/NZS 61009.1	*Residual current operated circuit-breakers with integral over-current protection for household and similar uses (RCBOs)-- General rules*
IEC 60900	*Hand tools for live working up to 1000 V a.c. and 1500 V d.c.*

The Standards you should be familiar with will depend upon your industry, your plant and your processes.

Standards Australia can be contacted on *1300 654 646*; their website address is *www.standards.com.au*.

How do I know whether the electrical installation at my work place exposes my workers to low voltage?

You need to assess the risks, using Chapters 3 and 5 in this code of practice. If in doubt about how serious a problem could arise, you should consider getting advice from someone competent to assess your exposure.

Do I have to arrange for a survey of all the works that my employees are doing?

This depends on your initial assessment of risk. If you believe you may have a problem with low voltage electricity, but you are not sure of its extent, you should arrange for a competent person to measure exposure, using a workers diary style system or similar to obtain a more complete picture.

You must provide them with the necessary equipment, and make sure they are able to monitor and record working conditions accurately.

Is it necessary to provide special tools and equipment for employees working on or near low voltage installations or systems?

Yes. You must provide all necessary PPE and special tools required for the work. Make sure employees know how to correctly use the equipment so that it provides the best possible protection.

Can I rely on employees to recognise the signs of electric shock, and to report any problem concerning exposure to electricity?

If you have provided information alerting employees to the physical effects of electric shock, and developed procedures for reporting problems, you should be able to rely upon them to inform you before an incident occurs. This does not substitute for your responsibilities to supervise the work and monitor conditions. And remember, you must manage the hazards to minimise the risk of employees being exposed in the first place.

Appendix 4 Case Studies of Electrical Incidents

A4.1 CASE 1

A4.1.1 Incident

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 live incoming terminals. He received very serious burns to his face and arm.

A4.1.2 Contributing factors and relevant sections

Failure to:

- isolate — Section 6.1, 6.2, 6.5
- use appropriate PPE — Section 6.1

A4.2 CASE 2

A4.2.1 Incident

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 supply authority with the mains changeover, and he carried out the connections at the factory while the 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 supply authority and the electrical worker.

A4.2.1 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

A4.3 CASE 3

A4.3.1 Incident

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 live parts of the switchboard, was also in the open position.

The investigation revealed that no means of insulating exposed live 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 live 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 live parts of the electrical switchboard comprising the bolted incoming supply connection points for each of the three phases of the centre-fed busway system.

The electrical worker was killed.

A4.3.2 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 6.4, 6.5

A4.4 CASE 4

A4.4.1 Incident

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 alive, 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 live 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.

A4.4.2 Contributing factors and relevant sections

Failure to isolate — Section 6.1, 6.2

A4.5 CASE 5

A4.5.1 Incident

Two electrical workers were installing cables in a section of a switchboard isolated and proven de-energized. 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.

A4.5.2 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 6.4, 6.5

Notes

Notes

Notes

WorkCover Offices

HEAD OFFICE
Office Hours 8:30am-5:00pm
Monday to Friday
400 Kent Street
SYDNEY NSW 2000
Phone: (02) 9370 5000
Fax: (02) 9370 5999
Postal Address
WorkCover NSW
GPO Box 5364
SYDNEY NSW 2001

WorkCover Assistance Service
Office Hours 8:30am-4:30pm
Monday to Friday
Ground Floor, 400 Kent Street
SYDNEY NSW 2000
Phone: 13 10 50
Fax: 9370 6150

REGIONAL and LOCAL OFFICES
Office Hours: 8:30am-4:30pm
Monday to Friday

REGIONAL OFFICES

Newcastle
956 Hunter Street
NEWCASTLE WEST 2302
Phone: (02) 4921 2900
Fax: (02) 4921 2929

Parramatta
Level 8, 128 Marsden Street
PARRAMATTA 2150
Phone: (02) 9841 8550
Fax: (02) 9841 8490

Wollongong
106 Market Street
WOLLONGONG 2500
Phone: (02) 4222 7333
Fax: (02) 4226 9087

LOCAL OFFICES

Albury
463 Kiewa Street
ALBURY 2640
Phone: (02) 6021 5911
Fax: (02) 6041 2580

Batemans Bay
Shop 6, Fenning Place
12 Orient Street
BATEMANS BAY 2536
Phone: (02) 4472 5544
Fax: (02) 4472 5060

Blacktown
125 Main Street
BLACKTOWN 2148
Phone: (02) 9671 8701
Fax: (02) 9831 8246

Dubbo
Suite 3, 157 Brisbane Street
DUBBO 2830
Phone: (02) 6884 2799
Fax: (02) 6884 2808

Central Coast
3/13 Anzac Road
TUGGERAH 2259
Phone: (02) 4350 6370
Fax: (02) 4353 2373

Goulburn
21-23 Clifford Street
GOULBURN 2580
Phone: (02) 4822 1243
Fax: (02) 4822 1242

Grafton
NSW Government Offices
49 - 51 Victoria Street
GRAFTON 2460
Phone: (02) 6641 5111
Fax: (02) 6641 5100

Griffith
NSW Government Offices
104 - 110 Banna Avenue
GRIFFITH 2680
Phone: (02) 6964 2027
Fax: (02) 6964 1738

Hurstville
Level 4, 4-8 Woodville Street
HURSTVILLE 2220
Phone: (02) 9598 3366
Fax: (02) 9585 0261

Lindfield
345 Pacific Hwy
LINDFIELD 2070
Phone: (02) 9936 3000
Fax: (02) 9936 3030

Lismore
Suite 4, Level 4
Manchester Unity Building
29 Molesworth Street
LISMORE 2480
Phone: (02) 6622 0088
Fax: (02) 6622 0090

Liverpool
Suite 4, Ground Floor
157 - 161 George Street
LIVERPOOL 2170
Phone: (02) 9827 8600
Fax: (02) 9827 8690

Narrabri
Level 1, 55 Maitland Street
NARRABRI 2390
Phone: (02) 6792 4643
Fax: (02) 6792 3532

Newcastle
956 Hunter Street
NEWCASTLE WEST 2302
Phone: (02) 4921 2900
Fax: (02) 4921 2929

Orange
74 McNamara Street
ORANGE 2800
Phone: (02) 6361 7070
Fax: (02) 6362 8820

Parramatta
Level 8, 128 Marsden Street
PARRAMATTA 2150
Phone: (02) 9841 8550
Fax: (02) 9841 8490

Port Macquarie
Shops 1 & 2,
Raine & Horne House
145 Horton Street
PORT MACQUARIE 2444
Phone: (02) 6584 1188
Fax: (02) 6584 1788

Shellharbour
134 - 134A Lamerton House
Shellharbour Square
BLACKBUTT 2529
Phone: (02) 4297 3796
Fax: (02) 4296 8914

Tamworth
Shop 20, 341 Peel Street
TAMWORTH 2340
Phone: (02) 6766 2490
Fax: (02) 6766 4972

Lake Macquarie
Shop 2, 33 The Boulevarde
TORONTO 2283
Phone: (02) 4959 6366
Fax: (02) 4950 5587

Tweed Heads
Suite 5, 1 Sands Street
TWEED HEADS 2485
Phone: (07) 5536 3262
Fax: (07) 5536 4389

Wagga Wagga
Level 2, 76 Morgan Street
WAGGA WAGGA 2650
Phone: (02) 6937 3600
Fax: (02) 6937 3616

Wollongong
106 Market Street
WOLLONGONG 2500
Phone: (02) 4222 7333
Fax: (02) 4226 9087

WorkCover NSW 400 Kent Street Sydney NSW 2000
GPO Box 5364 Sydney NSW 2001 WorkCover Assistance Service 13 10 50
Email contact@workcover.nsw.gov.au Website www.workcover.nsw.gov.au
Catalogue NO. 964 ISBN:1 876995 43 2 ©Copyright WorkCover NSW 2001
Production & printing by NSW Government Printing Service – Tel: 9743 8777