Department of Consumer and Employment Protection

EnergySafety

Code of Practice
Safe Low Voltage Work Practices by Electricians

Working live is dangerous for electricians at your work place

Issued by:

Director of Energy Safety

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Edition 1

Code of Practice
Safe Low Voltage Work Practices by Electricians

Preamble

This Code of Practice sets out guidelines issued under the authority of Section 33AA of the *Electricity Act 1945 (WA).*

While the Code is written in obligatory terms, it is not legally mandatory.

I strongly recommend compliance with the practices and procedures prescribed in this Code. By doing so, electrical contractors and electricians can be confident they are using the safest practicable work methods.

Should you have suggestions and comments for improving the Code, please send them to me in writing and we will be happy to consider them.

A KOENIG
DIRECTOR OF ENERGY SAFETY
Energy*Safety*

Note: This Code does not apply to electrical work performed on network operator's transmission and distribution facilities, although network operators may wish to adopt those principles relevant to their operations.

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Safe Low Voltage Work Practices by Electricians

Summary

- **Live work is not allowed on domestic electrical installations**
- **Live work is justified only by a greater risk of danger to lives of persons using or affected by the electrical installation shutdown, compared with risks incurred by electricians performing the live work**
- **Loss of production, increased costs and operational inconvenience do not justify live work**
- **The live work case first must be made by the client to the licensed electrical contractor or in-house electrical installer**
- **Each such case must be backed by a formal risk assessment**
- **A detailed work plan and procedures are required**
- **The risk assessment, plan and procedures must comply with this Code**
- **The contractor or in-house installer and all electricians involved must agree the work can be performed safely**
- **Independent safety assessor must approve plans and procedure if prospective fault current exceeds 10kA (high risk)**
- **A safety observer must be present**

1 Code of Practice

1.1 Scope and Application

This Code of Practice is issued as a Guideline under Section 33AA of the *Electricity Act 1945*. It prescribes principles and methods for the organisation and performance of safe work on electrical installations. It sets out guidelines in the form of minimum requirements for a safe working environment for electricians (including self employed workers), authorised to perform work on electrical equipment and installations.

The Code also provides advice to clients to dissuade them from asking electrical contractors and their employees to undertake live work. Those in charge of worksites, owners and managers, are obliged under regulations administered by WorkSafe to maintain a safe work place.

This Code of Practice addresses general electrical safety obligations and especially those applicable to live work. Working on or near energised electrical equipment (live work) is the leading cause of serious accidents and fatalities for electricians. Other than certain unavoidable testing or commissioning functions, all electrical work should be carried out while de-energised. Clients may believe they have compelling operational reasons requiring the work to be carried out live. But requiring the dangerous act of working live when it could be avoided, places an onerous responsibility on the client. This Code provides a procedure to evaluate the risks and develop a safe work plan.

Statutory regulations take precedence over this Code of Practice. Also, this Code does not apply to electricity network operator activities, although many of the safe work practices may have relevance to all kinds of electrical work.

This document is designed for use by electrical contractors and their workers, but may also have application for others such as electrical linepersons and cable jointers. It will assist clients (users) to improve their safety and meet the various Western Australian statutory requirements including:

- Electricity Act 1945
- Electricity Regulations 1947
- Electricity (Licensing) Regulations 1991
- Occupational Safety and Health Act 1984
- Occupational Safety and Health Regulations 1996
- Mines Safety and Inspection Act 1994
- Mines Safety and Inspection Regulations 1995

1.2 Background

Too many electrical employers do not have safety management plans, procedures or systems under which a structured approach to performing electrical work safely is encouraged and implemented. Where these systems are in place, injury frequency and severity rates are significantly reduced. In other words, there is an implied obligation that safe work procedures and practices should be developed, implemented and reviewed regularly.

But the worrying issue identified with industry is the willingness of the electrical industry, especially commercially-focused electrical contractors, to perform live electrical work. Such work takes place even in high risk areas, without prior assessment, work plans and safety controls. Live work is frequently performed in switchboards next to substations, where the prospect of very high-level fault currents exist. These can be extremely destructive and dangerous.

Electrical contractors are subject to increasing commercial, time and competitive pressures. When clients engage an electrical contractor to perform electrical work, it is common for them to expect minimum disruption to their business or home. They are generally unaware that this may involve risky live work. Clients, while appreciating the dangers of electricity, expect that electricians can manage the hazard safely, despite the significant risks associated with live work.

Contractors may hesitate to tell clients that the work cannot be performed safely without shutting down all or part of the installation. They fear the client simply will seek the services of another contractor willing to take the risk of performing the work without a shutdown. In these circumstances, clients are taking a risk that they will cause an unsafe workplace, contrary to occupational safety legislation. Electrical employers are placed in a similar invidious position.

Other than some testing and fault-finding work, all electrical work can be done on de-energised equipment. The electrician has no reason to advocate live work.

However, there may be compelling reasons for the client to insist that there be no interruptions to his business. Processes need to be in place to allow the risks of such circumstances to be evaluated. If a safe work plan can be developed, the work may proceed live. The client needs to make the case for live work and, jointly with the electrical contractor, develop a safe work plan. Such circumstances may create higher costs for the work but unsafe work practices cannot be permitted. Such processes provide both enhanced electrical safety and competitive neutrality between electrical contractors. Live work can never be justified at a domestic home.

Any exceptional circumstances, justifying live work, must demonstrate that de-energising all or part of the client's plant would cause a greater safety risk to human life than the obvious risk of death incurred by the electricians involved.

If electrical accidents do occur, electricians, contractors and clients have an obligation to report them immediately to the relevant network operator or the Director.

1.3 Introduction

1.3.1 General Safety Obligations

Employers bear a general obligation to provide a safe workplace and workers must observe safe work processes. The electrical employer must provide for the safety of workers, sub-contractors and client personnel against electrical shock hazard, magnetic field hazards, damage to property and harm to domestic animals and livestock. The employer is to provide a safe system of work, including training the worker, providing the appropriate tools and equipment, including testing instruments, personal protective equipment and current procedures and practices to follow. The worker needs to be responsible for their own safety and the safety of others and to follow instructions, use personal protective equipment and advise the employer if they believe that they are being asked to do anything unsafe or beyond their competencies.

Electrical installation designers should give due consideration to the future need for maintenance and possible modifications. The design should facilitate such activities by ensuring they can be performed safely (see Appendix G).

1.3.2 Live work

From time to time, an electrician is called upon to undertake functions which involve working on or near live exposed electrical equipment. This type of work must only be carried out when the work cannot be done de-energised or when the client can demonstrate that their facility cannot tolerate a shutdown of the electrical supply and only when an adequate risk assessment process has been undertaken and appropriate safety measures are in place.

1.4 Definitions

For the purpose of this Code of Practice, the following definitions apply. Words or terms not specifically defined are to be interpreted as commonly understood.

Appropriate

Being suitable to, or proper for, the duty concerned.

Approved

Has the endorsement of the appropriate organisation for a specified function.

Authorised

Has the permission of the appropriate authority for the duty concerned.

Client (person having control of premises)

Means a person (other than the electrical employer) who has general responsibility for the site and if relevant, the building or other facilities, which incorporate or which are planned to incorporate an electrical installation or equipment on which electrical work is to be performed by the electrical employer.

Close Proximity (of electrical equipment)

Means, for low voltage, locations on installations, where deliberate, accidental or inadvertent contact with electrical equipment is possible, either by a part of the body touching a live part or indirectly through tools, long objects, drills, cutting blades or dropped conducting objects. The definition does not apply if the uninsulated and energised part of the installation has been safely

and securely shielded, and protected with barriers or shrouding to guard against unintended contact.

Competent

Means having acquired the knowledge and skills enabling that person to perform the task required, in a safe and effective manner.

De-energised

Means equipment has been disconnected from all sources of electricity supply but not necessarily isolated, earthed or out of commission.

Director

Means the Director of Energy Safety appointed under the *Energy Coordination Act 1994*

Discharged

Means an electric charge has been removed by the application of a suitably earthed conductor.

Electrical Employer

Means any person employing or engaging electricians or electrical apprentices for the purpose of carrying out electrical work.

Electrical Equipment

Any appliance, wire, fitting, component, conduit or apparatus that uses, conveys or controls electricity which is live or can be made live.

Electrician

Person engaged in the installation, maintenance, repair or testing of electrical equipment.

Extra-low Voltage

Voltage not exceeding 50 volts a.c or 120 volts d.c.

High Voltage

Voltage exceeding 1000 volts a.c. or 1500 volts d.c.

Isolated

Means disconnected from all sources of supply by the operation of isolators, isolating links or fuses and/or connections. The physical break must be of a length appropriate to the voltage and the insulating medium.

Isolator

A device, which for reasons of safety provides physical break in the circuit in the open position. The length of the break is dependent upon the voltage and the insulating medium.

Live (energised)

A term applied to part or all of an item of electrical equipment when a difference of potential exists between it and the mass of earth under normal conditions of operation.

Low Voltage

Voltage exceeding 50 volts a.c. or 120 volts d.c. but not exceeding 1000 volts a.c. or 1500 volts d.c.

Safety Observer

A person specifically assigned the duty of observing and warning against unsafe approach to equipment and other potential hazards. This is particularly important when working near live exposed high voltage equipment.

2 General Safety Obligations

2.1 General Obligations

An electrical employer must ensure that electrical work:

(a) provides for the safety of persons, including employees and contractors of the electrical employer;

(b) avoids or minimises the exposure of persons, including employees and contractors of the electrical employer, to electric and magnetic field effects;

(c) avoids or minimises any damage to property, or other detriment as a result of the activity;

(d) provides for the safety of domestic animals and livestock.

For these obligations, the reference to:

(a) doing anything includes a reference to omitting to do anything; and

(b) permitting anything to be done includes a reference to permitting an omission to do anything.

Without limiting the above, an electrical employer must:

(a) develop and implement safe work procedures and practices;

(b) instruct, train and supervise employees and contractors, taking into account the nature of the activity and the competency of the personnel doing the work; and

(c) review work procedures and practices regularly for safety and effectiveness.

2.2 Specific Hazards

Unless the work is solely for the purpose of operational switching, electrical commissioning or electrical fault-finding using relevant instrumentation and equipment, no person shall:

- perform work on electrical equipment or components of an electric installation energised at low voltage; or
- work in close proximity to uninsulated and exposed electrical equipment or components of an electric installation energised at low voltage;

unless the work is carried out to comply with this Code.

Operational switching, electrical commissioning or electrical testing, fault-finding and commissioning using relevant instrumentation and equipment shall not be performed by any person:

- on any part of an electrical installation energised at low voltage; or

- in close proximity to uninsulated and exposed electrical equipment or components of an electric installation energised at low voltage;

except as set out in Section 3.4

2.3 Electricians

A person must avoid doing anything, or permitting anything to be done, while carrying out an activity, that is likely to result in:

(a) a person sustaining any personal injury; or

(b) damage to any property or other detriment to any person.

In the above obligation (Section 2.3):

(a) the reference to doing anything includes a reference to omitting to do anything; and

(b) the reference to permitting anything to be done includes a reference to permitting an omission to do anything.

Without limiting the general obligation (Section 2.3) an employee shall:

(a) follow instructions given by his electrical employer for his own safety or health or for the safety or health of other persons;

(b) make proper use of protective clothing and equipment; and

(c) inform the electrical employer immediately if asked to perform work that exceeds his competence or that the employee believes cannot be carried out safely.

2.4 Clients

A client (a person in charge of a workplace) shall ensure that they:

(a) have a safe workplace;

(b) agree to reasonable requests from electrical employers for:

- safe access to electrical equipment
- safe egress from places where electrical work is conducted
- reasonable time to undertake electrical work
- adjust their processes or production or work flow to allow safe electrical work

(c) do not require electricians to undertake unsafe work;

(d) conduct a risk assessment on isolation requirements for electrical work.

3 Work on or Near Live Equipment

3.1 Domestic Premises

Work on energised low voltage electrical equipment, or low voltage components of an electric installation, is not permitted at any individual domestic installation or sub-installation.

3.2 High Energy (10,000A fault current or greater situations)

Work on energised low voltage electrical installations, components or equipment, where the prospective short circuit current is likely to exceed 10,000 A, is not permitted unless:

(a) the person having control of the premises has provided written evidence sufficient to convince the electrical employer, (to the standard set out in this Code of Practice), that a break in supply to isolate the relevant parts of the installation for the particular work proposed will endanger the safety or health of users of the installation or is not possible in practice; and

(b) the electrical employer is satisfied the work is able to be performed safely; and

(c) the electrical employer has carried out a risk assessment in accordance with Section 4 and has developed a detailed and documented safe work procedure and plan specifically for the work, with due consideration to ensure:

- the persons doing the work are appropriately qualified, trained and instructed in safe work practices for the particular task, including the proper use of test equipment, isolating barriers, tools, accessories and personal protective equipment; and
- appropriate test equipment and tools and accessories are provided to the persons doing the work, are properly used and are well maintained; and
- appropriate clothing and personal protective equipment for the work are provided to the persons doing the work and are properly worn and used; and
- the isolation point of the relevant electrical supply has been clearly identified and is able to be reached and operated quickly without any need to negotiate or remove obstacles; and
- the work area is clear of obstruction so as to enable entry and exit quickly and safely; and
- unauthorised persons are prevented from entering the work area by signage and barriers; and
- the work is undertaken in the presence of a safety observer who is competent to perform the particular task involved and is competent in electrical rescue and cardio-pulmonary resuscitation; and

(d) in developing the work procedure and plan, the electrical employer has consulted the employees who are to perform the work, has explained the risks and they have signed off on the procedure and plan to indicate their agreement; and

(e) the electrical employer has referred the procedure and plan to an independent competent assessor, as described in Appendix D, for checking and has received the assessor's certificate confirming that, in his or her opinion, the procedure and plan meet the requirements of this Code and the work can be safely performed in the manner proposed.

3.3 Medium to Low Energy (less than 10,000A fault current situations)

Work on energised low voltage electrical installations, components or equipment, where the prospective short circuit current is likely to be less than 10,000 A, is not permitted unless the person having control of the premises and the electrical employer have complied with requirements in Section 3.4 (a) to (d).

3.4 Testing, Fault Finding and Commissioning

Testing, fault finding and commissioning work on energised low voltage electrical installations, components or equipment is not permitted unless the electrical employer ensures:

(a) that a safe system of work is used that includes:

- a risk assessment for the testing, fault-finding or commissioning work; and
- measures to eliminate (preferable) or minimise the risk of the persons conducting the tests inadvertently contacting any part of the installation that is energised, and

(b) correct test equipment is provided and properly used by appropriately trained persons, and

(c) appropriate personal protective equipment is provided and used by the persons conducting the tests; and

(d) if the risks cannot be eliminated, the tests are conducted in the presence of a safety observer competent to assist the persons conducting the tests and to carry out electrical rescue and cardio-pulmonary resuscitation.

4 Risk Assessment

4.1 Introduction

Electricity is dangerous for everybody, including electricians. Unsafe electrical work can be catastrophic, with death or major disabling burns a likely consequence. No worker should be exposed to such hazards when it is not necessary. Working on or near energised electrical equipment (live work) is the leading cause of serious accidents and fatalities for electricians. Apart from some functional testing or commissioning, very nearly all electrical work can be carried out de-energised.

A client may voice operational reasons appearing to justify live work. Requiring the dangerous act of working live when it could be avoided places an onerous responsibility on the client to minimise the risks. Should an accident occur as a result of live work, a client is at risk of being found not to have provided a safe workplace. This could contravene obligations under the *Occupational Safety and Health Act*.

If exceptional circumstances exist:

a) A person in charge of a work place (client of electrical contractor) is obliged to prepare a written case for justifying live work; and

b) If the electrical contractor considers that the case is valid and satisfies the requirements set out in this Code of Practice, he can prepare an electrical safe work plan to perform the work safely. If no such plan is practicable, the work must be carried out with the electrical equipment de-energised, despite the apparent validity of the client's case; and

c) The persons assigned to do the work agree in writing that it can be done safely; and

d) For low voltage work, if flash burns are a risk (such as situations where the prospective fault current may exceed 10kA), the electrical safe work case is certified by an independent competent person that the electrical safe work plan complies with the regulations and, if followed, will allow the work to be done safely; or

e) For high voltage work, the work is done by a trained person in accordance with mandatory standards and codes and is supervised to ensure compliance with other relevant standards and codes; then

the live electrical work may proceed.

4.2 Case for Live Work

A case for live work must establish that:

- the safety risk to those persons directly affected by a supply interruption is higher than the risk to the electricians called upon to perform live work; or
- an industrial manufacturing process is so continuous that it cannot tolerate a short break in electricity supply (as verified, for example, by the presence of elaborate and very reliable uninterruptible power supplies, backed by local generation); or
- a vital health or other similar community service cannot be shut down (again requiring evidence of sophisticated local generation to support this argument).

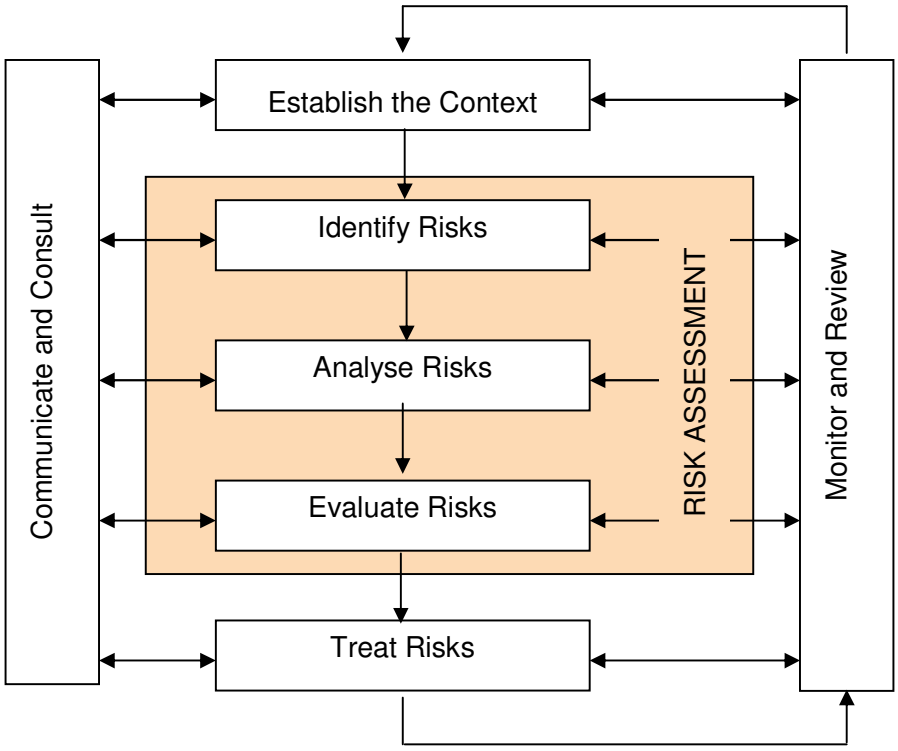
Such circumstances require a comprehensive risk assessment and supporting evidence to demonstrate that switching off the power cannot be tolerated, bearing in mind that in most cases

a short, planned and well-managed power interruption would allow the insertion of insulating barriers to allow the equipment to be worked on while adjacent equipment can remain energised.

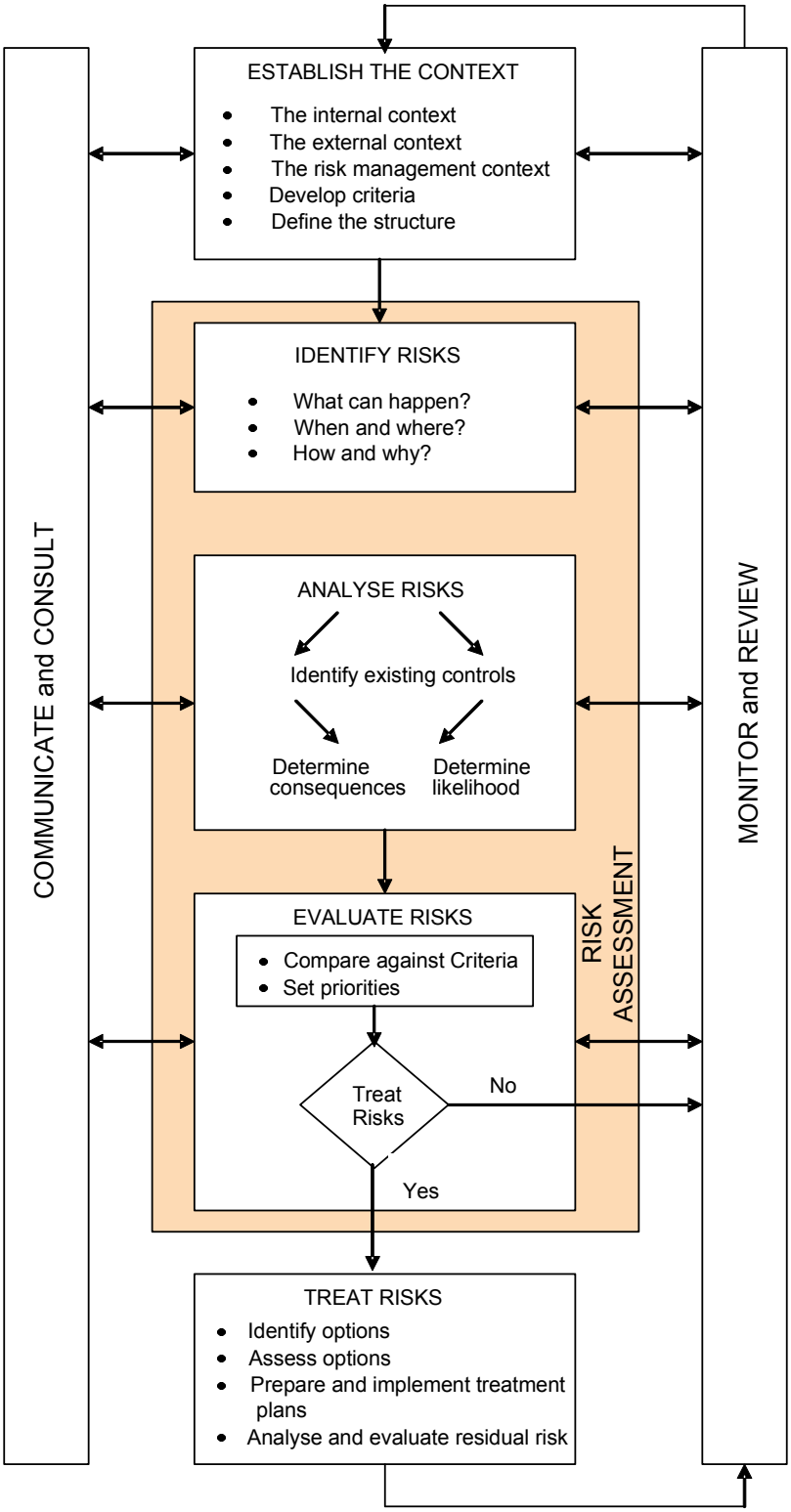
It is a very rare circumstance that the equipment itself must remain energised while electrical work is being performed on it.

4.3 Risk Assessment

A risk assessment should be conducted in accordance with "AS/NZS 4360:2004 – Risk Management" to compare the risks to electricians with the safety risks to users or risks to a continuous process. This standard gives the principles for risk assessment, the stages of which are shown in the attached diagram from AS/NZS 4360:



This process is set out in more detail in the following diagram (again from AS/NZS 4360):



In preparing the risk assessment, Standards Australia's handbook "HB 436:2004 - Risk Management Guidelines" may be of assistance.

Simple consequence and likelihood scales are given below but more complex scales can be used at an organisation's discretion.

4.3.1 Consequences

The consequences of the risk occurring are assessed using the ratings in the following table. The consequences of safety generally would be rated higher than maintaining process continuity.

		User Safety	Continuous process
1	Minor	Minor safety issues. Minimal impact on customers.	Some inconvenience to customers.
2	Moderate	Event is restricted in both area and time. Some remedial action is required.	Event is restricted in both area and time Some remedial action is required.
3	Major	Life-threatening injuries. Extensive remedial action required.	Significant system failure. Extensive remedial action required.

4.3.2 Likelihood

The likelihood of the risk occurring is assessed using the ratings in the following table:

	Level	Criteria
A	Likely	Event is expected to occur at least once or twice a year
B	Probable	Event is expected to occur once every three years
C	Unlikely	Event is expected to occur once every 30 years or longer

4.3.3 Inherent Risk

The inherent risk is then determined using the following table (a description of each risk rating is also shown below):

Likelihood	Consequence		
	1. Minor	2. Moderate	3. Major
A. Likely	**Medium**	**High**	**High**
B. Probable	**Low**	**Medium**	**High**
C. Unlikely	**Low**	**Medium**	**Medium**

Description of risk levels

Level	Description
High	Likely to cause major damage, disruption or major injuries / loss of life
Medium	Unlikely to cause major damage but may threaten the efficiency and effectiveness of process or cause minor injuries
Low	Unlikely to occur and consequences are relatively minor

4.3.4 Adequacy of Existing Controls

The adequacy of existing controls is assessed using the following ratings:

Level	Description
Strong	Strong controls sufficient for the identified risks
Moderate	Moderate controls cover significant risks; improvements could be made
Weak	Controls are weak or non-existent and have minimal effect on mitigating risks

4.3.5 Risk Evaluation - Tolerable Risk

A common approach is to divide risks into three bands:

(a) An upper band where adverse risks are intolerable whatever benefits the activity may bring, and risk reduction measures are essential whatever their cost;

(b) A middle band (or 'grey' area) where costs and benefits are taken into account and opportunities balanced against potential adverse consequences;

(c) A lower band where positive or negative risks are negligible, or so small that no risk treatment measures are needed.

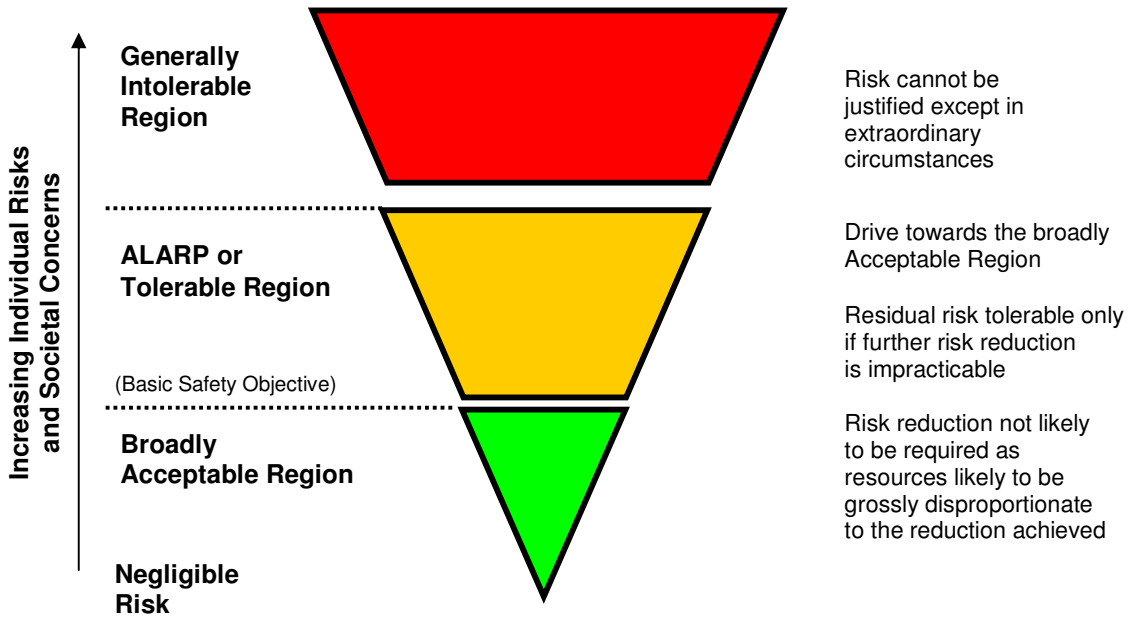
For risks with significant potential health, safety or environmental consequences, this is expressed as the 'As Low as Reasonably Practicable' or ALARP concept illustrated below. The width of the cone indicates the size of risk and the cone is divided into bands as discussed above. When risk is close to the intolerable level, the expectation is that risk will be reduced unless the cost of reducing the risk is grossly disproportionate to the benefits gained. Where risks are close to the negligible level, action may only be taken to reduce risk where benefits exceed the costs of reduction.

The concept of practicability in ALARP embraces ideas of practicality (can something be done?) as well as the costs and benefits of action or inaction (is it worth doing something in the circumstances?).

These two aspects need to be balanced carefully if the risks the organisation is treating relate to an expressed or implied duty of care.

Lord Justice Asquith in 1949 provided a definition of 'reasonably practicable':

""Reasonably practicable" is a narrower term than "physically possible" and it seems to me to imply that a computation must be made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other; and that if it be shown that there is a gross disproportion between them — the risk being insignificant in relation to the sacrifice — the defendants discharge the onus on them."



When conducting the risk assessment, after identifying a risk, the consequences and incidences have to be assessed. In the safety example, there are obligations to have a safe work place. Most safety issues will be in the generally intolerable region unless the inherent risk is low.

Where the risks to a continuous process are high, usually there are controls in place (which may be put to regular rehearsals) to manage the risk to at least ALARP. It is not credible to argue that it is impracticable to allow a short interruption to the electricity supply if strong controls to manage the risks to the process are custom and practice in the industry concerned. Identified risks include other cause of equipment failure, such as breakdown or loss of normal electricity supply. The risk assessment must show that controls are in place that will reduce the risk to an acceptable level for all identified risks.

4.4 Risk Assessment of Live Electrical Work

4.4.1 Consequences

Even the briefest contact with electricity above 50 volts can have severe consequences. Electrocution or flash burns can easily occur. The greatest risk is ventricular fibrillation, where the heart will usually not resume normal rhythm when the electricity is removed. During ventricular fibrillation, insufficient blood is pumped to sustain life. Under this condition defibrillation is required to restore normal rhythm and save the victim's life.

Flash burns can occur where the available energy under fault conditions is high. This can exist close to the very common 315 kVA (4% impedance) and larger transformers used in Western Australia's electricity distribution systems. Flash burns can be very damaging. Electricity flashovers produce very high temperature gases, causing disfigurement and severe internal burns when inhaled.

It only requires a very small failure of work practice, such a slip with a screwdriver or a dropped tool, for such accidents to occur.

High voltage shocks (more than 1000volts) may cause great damage to internal organs caused by high currents passing through the victim's body, in addition to contact burns. There are no minor injuries from high voltage electricity shocks.

4.4.2 Likelihood

Twelve fatalities, 185 accidents and 1,330 shocks occurred in Western Australia during the last 17 years. Many more near misses and actual shocks occur which are not reported. All shocks are potentially fatal. It is only a matter of luck and the peculiarities of local conditions which separate electrocution, accidents requiring medical treatment and shocks causing no lasting harm. Many unreported shocks could have resulted in death or injury had circumstances altered only slightly. All shocks must be avoided. Eleven accidents per year make the accident likelihood rating "likely" and two fatalities every three years is above the "probable" rating.

The inherent risk for live electrical work is given below:

Likelihood	Consequence		
	1. Minor	2. Moderate	3. Major
A. Likely			**High**
B. Probable			**High**
C. Unlikely			

Description of risk levels

Level	Description
High	Likely to cause major damage, disruption or major injuries / loss of life
Medium	Unlikely to cause major damage but may threaten the efficiency and effectiveness of process or minor injuries
Low	Unlikely to occur and consequences are relatively minor

The assessment of safety and risk to a client's continuous manufacturing process or service-delivery business has to be compared with the risks mentioned above.

The easiest and most effective risk-mitigation measure is to allow a short shut down to make sites for electrical work safe.

4.5 Supporting Evidence

The risk assessment set out above should be supported with evidence showing that strong controls are in place to manage the risks to workplace safety or to protect continuous processes.

It is possible that some power uses are so critical that their safety risks are higher than the risk to electricians performing live work. An example may be people on a ventilator for life support or those requiring home dialysis machines. But all such critical applications should make provision for loss of power by, for example, having battery/inverter backup.

There are some processes for which it is not practicable to have short break in supply. Some continuous processes may suffer severe consequences if interrupted. Normally the user has assessed such critical elements and made provisions through redundant equipment to allow for normal servicing and replacement of failed elements aimed at preventing interruptions to the process.

Critical computing equipment is almost always supplied through sophisticated battery/inverter power supplies to guarantee no voltage fluctuations or interruptions, or to allow an orderly shutdown. If no such uninterruptible power supplies are fitted, there is no case for live work. Similarly, if the carryover power only allows an orderly shutdown there is no case for live work. Only if the carryover power is for an indefinite period should the comparative risks be assessed.

In summary, a user that has made no provision for even short breaks in the network supply will not be able to make a credible case for live work.

A short break would allow the insertion (and removal) of insulating barriers, allowing the work to continue without live work precautions. It would be very unusual for critical equipment not to have some redundant components to allow for expected failures (including causes other than electrical). Without such redundancy provisions, it is reasonable to assume that the equipment is not considered critical and any request for live electrical work cannot be justified.

Most installations suffer no harm though unplanned interruptions of the network supply, including the usual break in supply while a standby generator starts up and is connected. They will suffer no more harm with a planned interruption to make the electrical work safe.

For every circumstance where a risk assessment attempts to make a case for live work, evidence must show how breakdowns of critical equipment or components do not jeopardise safety or operational continuity respectively.

5 Referenced Documents (Standards)

The following publications are referred to in this document:

Safe working on low voltage electrical installations (AS/NZS 4836)

Safety Rules Guidelines published by the Electricity Association of New South Wales (EA 6 – 1998)

Guide to Electricians' safety equipment published by the Electricity Association of New South Wales (EC 14 – 1993)

Guide to the training of personnel working on or near electricity works published by the Electricity Association of New South Wales (EA 18 – 1998)

Guide to Inspection Procedures for Plant and Equipment published by the Electricity Council of New South Wales (EC 11 – 1993)

Guide to Electricity Workers' Escape and Rescue Procedures published by the Electricity Association of New South Wales (ISSC 24 -1996)

Safe Working in a Confined Space (AS 2865 –1995)

Risk Management (AS/NZS 4360:2004)

Wiring Rules (AS/NZS 3000:2007)

Appendices

Appendix A Information For Electrical Employers (Electrical Contractors)

Live electrical work must not be attempted except in very rare and exceptional circumstances. The criteria justifying live work are strict. For all practical purposes, live work is banned, except for unavoidable testing, checking and fault-finding activities.

Electrical employers are obliged to provide for general electrician safety, including prohibiting live work in all but exceptional circumstances. Similar obligations apply to persons controlling premises (clients) who engage or employ electrical contractors. Electricians themselves also are obliged not to attempt live electrical work they consider unsafe.

Clients seeking live work on an electrical installation must provide written evidence to an electrical contractor demonstrating that it is not practicable, or would be detrimental to the safety or health of the users of the installation, to disconnect the electricity supply. Economic loss or operational inconvenience must not be used to justify live electrical work.

It would be difficult to claim that live work is required (i.e. an electrical shutdown is impractical) unless an electrical installation was equipped with a permanent standby electricity supply to safeguard against the occasional loss of supply that occurs in all electricity supply systems. Similarly, if the interruption of a continuous process were considered to be impractical, then it would be expected that all essential components and items of equipment that enable the process to function would be duplicated, with redundant/standby plant to safeguard against the unplanned failure of critical parts or sub-systems.

The following initial tests should be applied to the risk assessment that must be undertaken before any live work is contemplated:

- Will a planned shutdown cause a greater risk to safety than not having a shutdown?
- What provisions are in place to safeguard against any unplanned failure of the electricity supply?
- Are critical parts provided with redundant/standby plant to safeguard against unplanned failure of equipment?

If a client insists that the installation cannot sustain an electrical shutdown, an electrical contractor must:

(a) Be requested in writing by the person in control of the premises to consider doing the work live and be provided with a written explanation demonstrating that to isolate the installation from the electricity supply would not be practicable, or would be detrimental to the safety or health of the users of the installation. This Code of Practice sets out the issues that a case for live work should address. Appendix C.1 "Request for Electrical Contractor to Perform Live Work" may also be of assistance when used as a template.

(b) Be sure the written evidence satisfies the guidelines above for a live work case and live work can be done safely.

(c) Develop a safe work procedure and work plan to enable the work to be done safely. The procedure and plan should address issues such as:

- persons doing the work are qualified, trained and instructed in safe work practices;
- appropriate test equipment, tools and accessories are provided and used;
- personal protective equipment is provided and used
- access and exit; and
- safety observers.

Appendix F "Work Plan for Working On or Near Live Equipment" may be used for guidance.

(d) Determine if the prospective short circuit current of the installation exceeds 10kA. If so, the work plan must be certified by an independent competent person (see assessors information). For example, a prospective fault current of 10kA can be expected if a customer's main switchboard is close and contiguous with a substation with a 4% impedance 315kVA transformer or larger.

(e) Obtain agreement from the electricians doing the work that:

- it can be done safely;
- they are competent and sufficiently experienced to perform it;
- they will comply with the work procedure and plan and sign accordingly

A checklist should be used to ensure that all of the requirements have been met. A sample Checklist – "Checklist For Working On or Near Live Equipment " is provided in Appendix E.

A.1 Activities not Considered to be Live Work

Fault Finding and Commissioning

Some Electrical commissioning or electrical fault finding work is permitted if absolutely necessary and safe. See the related information on testing and commissioning on or near energised equipment.

Operational Switching

Although operational switching is necessarily performed on equipment that is energised, it is not considered to be live work for the purposes of this Code of Practice.

The use of insulating barriers to prevent contact with live parts

In many cases work can safely be carried out on de-energised electrical equipment in close proximity to energised electrical equipment if insulating barriers are installed to prevent direct or indirect contact.

Remember – it is very likely to be unsafe to perform live work unless the above requirements are met.

Appendix B Information for Electricians

Electricians have an obligation to work safely. This includes prohibiting live work in all but exceptional circumstances. Persons in control of the premises (clients) who engage or employ electrical contractors, the electrical contractors who employ electricians and the electricians themselves share a common responsibility to avoid live work unless it can be justified against strict criteria.

If the client and the electrical contractor believe that the installation cannot sustain a short electrical shutdown, then the electrical contractor must carry out the steps set out in Appendix A. An electrician asked to perform live electrical work, must:

(a) Be satisfied that the written evidence meets the guidelines above for a live work case and live work can be done safely.

(b) Review the electrical employer's safe work procedure and work plan and be satisfied that, if followed, it will enable the work to be done safely. The procedure and plan should address issues such as:

- persons doing the work are qualified, trained, sufficiently experienced and instructed in safe work practices;
- appropriate test equipment, tools and accessories are provided and used;
- Personal protective equipment is provided and used;
- access and exit; and
- safety observers.

Appendix F "Work Plan for Working On or Near Live Equipment" may be used for guidance.

(c) Confirm that he or she agrees that the work can be done safely, will comply with the work procedure and plan and sign accordingly**.**

A checklist should be used to ensure that all of the requirements have been met. A sample "Checklist For Working On or Near Live Equipment is provided in Appendix E.

B.1 General Safety Obligations

An electrician must avoid, so far as is reasonable and practicable, doing anything, or permitting anything to be done, in the course of carrying out electrical work, that results, or is likely to result in:

- a person sustaining any personal injury; or
- damage to any property or other detriment to any person.

In these requirements:

- the reference to doing anything includes a reference to omitting to do anything; and
- the reference to permitting anything to be done includes a reference to permitting an omission to do anything.

Without limiting the above an electrician (employee) shall ensure that:

(a) instructions given by his electrical employer for his own safety or health or for the safety or health of other persons are followed so far as he is reasonably able;

(b) protective clothing and equipment as is provided to protect him against hazards is used in the manner in which he has been instructed; and

(c) he immediately advises the electrical employer if he has been asked to perform work that exceeds his current competence or that the employee believes cannot be carried out safely.

B.2 Electrical Testing, Fault Finding and Commissioning

Electricians are obliged to work safely while testing, fault finding or commissioning new or modified installations. Testing, fault finding or commissioning is not permitted on or near energised equipment unless the electrical employer ensures that:

a) a safe system of work is used, including;

- a risk assessment in respect to the tests;
- measures to eliminate or control the risk of inadvertent contact of energised parts (including safe work practices to minimise the risk of inadvertent contact if that cannot be eliminated);

b) appropriate test equipment is provided and used by appropriately trained persons;

c) appropriate personal protective equipment is provided and used; and

d) if necessary to minimise a risk identified by the risk assessment, the tests are conducted in the presence of a safety observer. The safety observer must be competent in electrical rescue and cardio-pulmonary resuscitation. The safety observer may assist the tester but must be aware of the hazards present.

Appendix C Information for Clients

Persons in control of premises seeking performance of live electrical work must make a written request to a licensed electrical contractor and provide written evidence demonstrating that it is not practicable, or would be detrimental to the safety or health of the users of the installation, to isolate the installation from the electricity supply.

The meaning of "practicable" is taken from the *Occupational Safety and Health Act 1984:*

"Practicable means reasonably practicable having regard to:

(a) the severity of any potential injury or harm to health and the degree of risk of it occurring;

(b) the state of knowledge about:

(i) injury or harm to health from (a) above;

(ii) the risk of that injury or harm occurring; and

(iii) means of removing/mitigating risk of injury or harm;

(c) the cost, suitability and availability of the above (b) (iii) solution."

It would be difficult to claim that live work is required (i.e. a short electrical shutdown is impractical) unless an electrical installation was equipped with a permanent standby electricity supply to safeguard against accidental loss of supply that ultimately occurs in all electricity supply systems. Similarly, if the interruption of a continuous process were considered to be impractical, then it would be expected that all essential components and items of equipment enabling the process to function would be duplicated with redundant/standby plant to safeguard against the unplanned failure of critical equipment.

The following initial tests should be applied to the risk assessment that must be undertaken before any live work is contemplated:

- Will a shutdown cause a greater risk to safety than not having one?
- What provisions are in place to safeguard against any unplanned failure of the electricity supply?
- Are critical parts provided with redundant/standby plant to safeguard against unplanned failure of equipment?

If the person in control believes that an installation cannot sustain an electrical shutdown, the person must:

(a) Request in writing the electrical contractor considers doing the work live and provide him with a written explanation demonstrating that to isolate the installation from the electricity supply would not be practicable, or would be detrimental to the safety or health of the users of the installation. This Code of Practice includes the material that a case for live work should contain. The attached form in Appendix C.1 "Request for Electrical Contractor to Perform Live Work" will also assist.

(b) The electrical contractor completes the steps set out in Appendix A.

Although there may be additional costs and resources associated with the above requirements that a client may have to bear, electricians must not be exposed to unacceptable risks by working live.

Remember:

- If your electrical contractor recommends that a shutdown is necessary prior to starting electrical work, it is likely to be unsafe to perform the work live.
- The obligations placed on those controlling premises to provide a safe workplace.

Clients should prepare a formal written request to their electrical contractor using the sample format below.

C.1 Request for Electrical Contractor to Perform Live Work

Safety requires that live work is not performed in all but exceptional circumstances. If live work is necessary, then the person in control of the premises where an electrical contractor is required to perform work on or near live electrical equipment, must supply documented evidence which proves that isolating the equipment from the electricity supply would not be practicable or would endanger the safety of users of the electrical installation.

(Approved form to be typed, signed and retained by electrical employer, for inspection)

FROM:

(Name of person in control of premises)

TITLE/POSITION:

PROJECT/BUILDING:

I hereby request

(Name of electrical contractor)

to perform the following work with the electrical installation energised:

(*Description of installation, location, scope of work)*

The risk assessment, to the standard of the guidelines, setting out the risks to carry out the work live are greater than de-energised are attached. In summary the reasons why it would not be practicable to isolate the electrical installation to perform the work are:

Test for above:

- Is in accordance with the guidelines issued by the Director of Energy Safety
- Will a shutdown cause a greater risk to safety than not having one?
- What provisions are in place to safeguard against any unplanned failure of the electricity supply?
- Are critical parts provided with redundant/standby plant to safeguard against unplanned failure of equipment?

I understand that there is a very high level of danger by carrying out live work on, or in close proximity to, electrical equipment that is energised, unless a break in the electricity supply to isolate the equipment is not practicable, or would be detrimental to the safety or health of the users of the installation.

NAME:

(Signature of person in control of premises) *(Date)*

Appendix D Electrical Safe Work Plan Assessors

If a case has been developed that meets this Code of Practice and the electrical employer believes that the work can be done safely while the equipment is energised, the contractor must develop a safe work procedure and work plan.

If the prospective short circuit current of the installation exceeds 10kA, the work plan must be certified by an independent competent and experienced assessor. This Clause sets out the requirements for independence and competence.

D.1 Requirements for Assessors

An assessor must be a:

- licensed electrician with not less than ten year's trade experience in the type of work under assessment; or
- professionally qualified power electrical engineer with ten year's experience in supervising installation construction and maintenance work of the type under assessment.

The person assessing an electrical work plan must be independent of the person who developed it, and specifically:

(a) There must be no actual or perceived conflict of interest;

(b) If the assessor belongs to the same organisation, the assessor must not report to the person who prepared the plan.

The assessor must certify in a format approved by the Director that:

(a) The plan complies with this Code of Practice and, if followed, will provide for electrical safe work; and

(b) He or she is independent of the person who prepared the plan.

The person assessing the plan must be competent to carry out such assessments. They must have a thorough knowledge of the work and assessment processes, be suitably qualified and be experienced in supervising or carrying out the work involved.

D.2 Independence

The test for independence is the absence of perceived or actual bias concerning the work in question. The assessor must bear no responsibility for the timely execution of the work. No one can review their own plan. If the assessor is employed by or is a frequent sub-contractor to the contractor in question, he or she must not report to the person who prepared the plan.

The assessor must make a declaration of independence with their certification of the plan.

D.3 Competence

To be competent to assess the work plan, the assessor must have knowledge of safe work procedures, be suitably qualified and have experience in performing or supervising the work to be done.

Knowledge

It is expected that assessors will have the following knowledge:

- Electrical safety legislation
- Hazard management
- Principles of assessment
- Assessment and rating methods
- Injury data recording and calculation
- Fault level assessment
- CPR and defibrillation
- Safety observer responsibilities
- Testing and tagging procedures

Appendix E Checklist For Working On or Near Live Equipment

ITEM		YES	NO
1.	Has the client supplied documented evidence satisfying the guidelines issued by the Director and proving that isolating the equipment from the electricity supply is not practicable or would be detrimental to the safety or health of the users of the installation?	☐	☐
2.	Has a safe working procedure and plan been prepared?	☐	☐
3.	Have all electricians assessed the safe working procedure and plan, are satisfied that all safety issues have been addressed, and have signed accordingly?	☐	☐
4.	If the prospective fault current is greater than 10kA, has the plan been certified by an independent assessor?	☐	☐
5.	Is the work area clear of obstructions and is there a safe entry and exit?	☐	☐
6.	Is test equipment appropriate to task and is it functioning correctly?	☐	☐
7.	Are workers wearing appropriate clothing and associated personal protective equipment?	☐	☐
8.	Are appropriate insulating mats and sheeting in place?	☐	☐
9.	Are the necessary first aid facilities provided and accessible, including resuscitation/defibrillation equipment?	☐	☐
10.	Are workers competent to perform the required work scope?	☐	☐
11.	Are safety observer/s in place?	☐	☐
12.	Are all elements of the safe work plan in place?	☐	☐

Appendix F Work Plan for Working On or Near Live Equipment

Live electrical work is prohibited in all but exceptional circumstances. If live work is permitted, it must be done in accordance with a written work plan and safe work procedure.

The following is an approved format for a live work plan. It must be typed. The sample form shows the required content for a work plan, but the level of detail will depend upon the work to be performed and the number of electricians and other personnel involved.

PROJECT/BUILDING:

SCOPE OF WORK:

WORK PLAN: (show steps to be taken)

1.

2.

3.

4.

5.

6.

By adopting the above plan, the required work can be performed safely.

(continued)

ELECTRICAL CONTRACTOR:

(Name) _____ *(EC No)* _____ *(Signature)* _____ *(Date)* _____

CERTIFIED BY (required where prospective short circuit is likely to exceed 10kA):

(Name) _____ *(Title)* _____ *(Signature)* _____ *(Date)* _____

I/we have checked the plan, agree to comply with it, and agree that compliance with it will enable the work to be done safely: I/we agree that we are independent of the plan developer.

ELECTRICIAN:

(Name) _____ *(EW No)* _____ *(Signature)* _____ *(Date)* _____

ELECTRICIAN:

(Name) _____ *(EW No)* _____ *(Signature)* _____ *(Date)* _____

ELECTRICIAN:

(Name) _____ *(EW No)* _____ *(Signature)* _____ *(Date)* _____

Appendix G Electrical Design - Guidelines for Safe Electrical Work Practices

Electrical design engineers, technicians and electricians should give careful consideration to the design and construction of electrical equipment and installations so that if alterations, modifications and maintenance are required, the work can be performed without exposing electricians to live parts.

For example, in large switchboards insulating barriers should be installed between the incoming supply busbars and load terminals of switchgear. For smaller distribution switchboards, spare circuit breakers should be provided if additional future circuits are likely to be required.