Safe Electrical Work

Procedure

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Authority

	Title	Name	Date
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History

Revision	Date	Amended By (Name)	Details of Amendment
0.0	06/06/2025	Anthony Gollan	New Procedure

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1 Purpose

Electrical activities have the potential for serious incidents. As detailed within this document, all work carried out on electrical equipment shall only be performed by licensed or competent persons in compliance with the relevant standards.

The electrical activities of SCEE Electrical shall be compliant with the relevant safety and technical legislation.

2 Scope

This procedure applies to all SCEE workers on or visiting sites under the control of SCEE.

3 Definitions

Term	Explanation
Appropriate	Being suitable to or proper for the duty concerned.
Approved	Has the endorsement of SCEE for a specified function.
Authorised Person	The person in charge of the premises, or the licensed electrical contractor or electrician or other person appointed or selected by the person in charge of the premises to perform certain duties on the premises.
Capacitive Coupling	The connection of two or more circuits by means of a capacitor.
Close Proximity (to electrical equipment)	Locations on installations where deliberate, accidental or inadvertent contact with electrical equipment is possible, either by part of the body touching a live part or indirectly through tools, long objects, drills, cutting blades or dropped conducting objects.
Competent Person	A person who has acquired through training, qualification or experience, or a combination of these things, the knowledge and skills enabling that person to perform the required task correctly.
De-energised	Equipment has been disconnected from all sources of electricity supply but not necessarily isolated, earthed or out of commission.
Discharged	Electric charge has been removed by the application of a suitably earthed conductor.
DRSABCD	Danger, Response, Send, Airway, Breathing, Circulation, Defibrillation.
ECR	Earth Continuity Relay
Electrical Apparatus	Any item of electrical equipment, including overhead lines, insulated cables, transformers, electrical switchgear, machinery and plant, the conductors of which are live or can be made live.
Electrical Bridge	Shorting and/or removal of an electrical component from a circuit for the purpose of restoring equipment back into service or altering its designed operating function so that equipment can run in an abnormal state. This can be via the means of a physical hardwired bridge or software modifications, e.g. PLC.
Electrical Event	An accident: (a) that results from a sudden discharge of electricity or that otherwise has, or is likely to have, an electrical origin; and

	(b) that causes, or is likely to cause, danger to life, a shock or injury to a person or loss of or damage to property
Electrical Incident	Includes Notifiable Incidents as defined Acts and Regulations
Electrical Work	• connecting electricity supply wiring to electrical equipment or disconnecting electricity supply wiring from electrical equipment; or • manufacturing, constructing, installing, removing, adding, testing, replacing, repairing, altering or maintaining electrical equipment or an electrical installation.
Electrical Worker in Training	An electrical worker who is a electrical apprentice or who is undergoing a course of training.
ELV (Extra Low Voltage)	Extra-low voltage means a voltage not exceeding — a) 50 volts alternating current (as per AS3000); or b) 110 volts ripple-free direct current
Energised	Any part of an electrical installation or electrical apparatus which is energised at a potential different from that of earth.
Energised Work	Work required to be undertaken on, or near, energised electrical equipment which for whatever reason cannot be isolated and where contact with a tool or insulated glove is used to make a change to the equipment**.**
EPR (Earth Potential Rise)	Occurs when electrical current enters the ground.
EWP	Elevated Work Platform
Exposed	For the purpose of this work practice, 'exposed' shall refer to conductors that do not comply with an IP rating of IP2X or better.
Fault-finding & Testing	Fault-finding & Testing is the process of taking measurements or carrying out tests on LV electrical installations, and/or equipment, to locate faults or prove operability. It may also include the process of applying testing instruments or devices to various parts of the LV electrical installation This work must be carried out as per a detailed risk assessment including the PPE requirements e.g. FR clothing and voltage rated gloves. Where the installation **cannot be isolated** to take measurements, this shall be treated as **energised work**.
High Voltage	Voltage exceeding 1000 volts AC or 1500 volts DC.
IP2X	Ingress protection rating as finger safe.
Isolated	Equipment is isolated when disconnected from all sources of supply by the operation of isolators, isolating links or fuses and/or connections, using a lockout tag principal method. The physical break shall be of a length appropriate to the voltage and the insulating medium (e.g. air or SF6, etc.).
JHA	Job Hazard Analysis
Licensed Electrical Worker	An electrical worker who is authorised by state legislation and has an electrical license to carry out electrical installing work and electrical fitting work.
Low Voltage	Low voltage means a voltage within the following range; a) 50 - 1000 volts alternating current (VAC); or b) 110 - 1500 volts ripple-free direct current (VDC).

Notifiable Incident	A 'notifiable incident' is: • the death of a person • a 'serious injury or illness', or • a 'dangerous incident' that exposes someone to a serious risk (even if no one is injured) arising out of the conduct of the business or undertaking.
PLC	Programmable Logic Controller
Powerline Corridor	Area under a powerline and 10m either side of the powerline.
Proving Unit	A battery-powered portable device that serves as an electronic voltage source to safely verify the operation of an electrical test tool such as digital multimeters or other electrical testers.
RCD	Residual Current Device
Restricted Electrical Licence (RELs)	Restricted electrical licences are issued to persons other than electricians to legally carry out a "restricted" range of electrical tasks. The holder of a restricted electrical worker's licence is not permitted to carry out the installation or alterations to fixed wiring or to repair or replace items such as power points, lighting fittings etc.
Restricted Electrical Worker	A person with an REL (see Restricted Electrical License).
RTO	Registered Training Organisation
Safety Observer	A person specifically assigned the duty of observing and warning against unsafe approach to equipment and other potential hazards.
SF6	Sulphur hexafluoride
Shall	Mandatory
Should	Recommended but not mandatory
SLD	Single Line Diagram
SWL	Safe Working Load
SWMS	Safe Work Method Statement
SWP	Standard Work Procedure
Test for Dead	Testing for dead is the process of measuring the voltage on electrical installations and equipment; if the voltage is zero then the installation or piece of equipment is said to be dead.
Worker	A person is a worker if the person carries out work in any capacity including work as — a) an employee; or b) a contractor or subcontractor; or c) an employee of a contractor or subcontractor; or d) an employee of a labour hire company who has been assigned to work in the person's business or undertaking; or e) an outworker; or f) an apprentice or trainee; or g) a student gaining work experience; or h) a volunteer; or i) a person of a prescribed class.

4 Responsibilities

Role	Responsibility
HSE Advisor	Responsible for the notification to client and relevant SCEE personal of an electrical event. Audit and review procedure.
HSEQ Manager	Responsible for leading significant investigations (or assigning delegate), reporting events to senior management and external authorities as required by legislation.
Project Manager	Ensure this procedure is implemented across the scope of their operations. Ensure personnel are trained and aware of their responsibilities regarding Safe Electrical Work.
Construction Manager / Superintendent / Supervisor	Provide appropriate supervision and monitoring of activities to ensure correct implementation of safe electrical work processes. Investigate any breaches of the procedure.
Worker	Ensure full compliance to this procedure.

5 Flowchart:

N/A

6 Procedure

6.1 General Requirements

Where specific non-electrical activities (e.g. trenching, cleaning around light switches, etc.) involve increased risk due to their proximity to electrical apparatus, this risk shall be assessed prior to commencement and appropriate controls shall be put in place.

Persons conducting electrical work shall hold an appropriate electrical licence and be assessed as competent as per state legislative requirements.

Appropriate dry chemical or CO2 fire extinguishers shall be located near all main switchboards and substations.

Minimum safe approach distances to exposed high voltage equipment shall be maintained as per Section 15.

The area Electrical Supervisor shall be included in the investigation of electrical incidents, electrical fires and dangerous occurrences involving electricity.

A register of all electrical workers shall be maintained as per state legislation requirements.

Workers exposed to electrical hazards shall receive electrical hazard training at the commencement of their employment and thereafter on a two-yearly basis.

No electrical work shall be undertaken unless the worker is authorised to carry out that work by a Licence or permit issued under state legislation and is, as a minimum, certified as a Lock Holder.

All electrical workers and their assistants shall complete, as a minimum;

- Provide CPR refresher training on a 12-monthly basis or 2 years as per individual state legislation,
- Low Voltage Rescue refresher training on a 2 yearly basis and,
- If applicable Provide First Aid certificate every three years.

Competent non-electrical workers shall only perform appliance testing once they have:

- Completed a training course in the use of a Portable Appliance Tester (PAT) by an approved Energy Safety service provider and,
- Had their competency verified by an Electrical Supervisor.

In addition, all other requirements for Competent non-electrical workers shall be carried out as per the Guide to testing and tagging electrical equipment and residual current devices at workplaces.

All electrical installing work shall be performed and tested in accordance with applicable state legislation and AS 3000 Wiring Rules.

Note: Construction premises shall also comply with AS/NZS 3012 Electrical Installations – Construction and Demolition Sites.

Electrical apprentices shall be effectively supervised by licensed electrical worker in line with:

- Individual State requirements
- Safe working guidelines and assessment for electrical apprentices,
- Section 8 of this document (Supervision for Electrical Apprentices)

6.2 Notification of Electrical Work

All electrical work is to be carried out in accordance with:

- AS/NZS 3000,
- State Electrical requirements,
- applicable Australian Standards, and
- relevant Electrical Codes of Practice

Refer: SCEE-BS-EC-PRO-0001 Electrical Legislation Compliance WA
SCEE-BS-EC-PRO-0002 Electrical Legislation Compliance QLD

6.3 Access to Electrical Panels and Enclosures

Any room, enclosure or other place used principally for the installation of electrical equipment shall be designed such that access is restricted to authorised persons by the use of a keyed lock or use of a tool.

Therefore, all electrical control panels (including distribution boards) accessible to unauthorised personnel shall be kept locked at all times.

All personnel wishing to enter an electrical substation must have completed a substation induction. Where a person has not been authorised to enter a substation, they shall be escorted by an authorised person at all times.

6.4 Access to High Voltage Equipment

Cabinets, distribution boards or motor control centres with voltages in excess of 1000V shall be locked or otherwise closed in a manner that would require a key or tool to be used to access them.

Panels or covers enclosing high voltage equipment shall not be removed until the equipment enclosed within has been isolated and earthed in accordance with SCEE's Electrical Isolation and Tag Out Procedure.

Refer: SCEE-BS-HS-PRO-0005 Electrical Isolation and Tag Out

6.5 Portable Lighting

Adequate lighting is essential at all times. Portable lighting devices shall be of the fully insulated type and have no metallic or conductive exterior surfaces when used in close proximity to exposed energised electrical equipment.

Lamps should be protected against inadvertent breakage.

7 Safety Observer

A competent safety observer must be present when work is carried out on an energised electrical installation unless the risk assessment has determined that there is no serious risk associated with the proposed work.

The role of the safety observer must be clearly communicated to all workers and be understood by them.

The safety observer must understand the hazards and:

- where possible, locate themselves outside of any Arc Flash Boundary to safely observe the task
- be competent to implement control measures in an emergency;

- be competent to rescue the worker who is carrying out the work if necessary, and must have been assessed in the previous 2 years as competent to rescue and resuscitate a person;
- not carry out any other work or function that compromises their role — for example, they must not be required to observe more than one task at a time;
- not be situated in the work basket of the elevating work platform from which the electrical work is being carried out;
- be able to communicate quickly and effectively with the electrical worker(s) carrying out the work. Specialist equipment might be necessary if there is a barrier to communication such as a high level of noise; and
- not have any known temporary or permanent disabilities that would adversely affect their role and performance.

7.1 Protective Clothing

The safety observer shall be suitably attired with safety apparel appropriate to the situation. Refer to Section 12 - Personal Protective Equipment (PPE).

8 Supervision of Electrical Apprentices

For the purpose of preventing danger to life and property, all electrical work shall be effectively supervised, unless the person carrying out the electrical work is licensed to carry out the work without supervision.

Where an electrical worker in training is required to be supervised, the person employing the electrical worker in training shall:

- Ensure that supervision is carried out by a person who is authorised by a licence or permit to carry out the electrical work in question without supervision (the supervising electrical worker)
- Consider the kind of electrical work being undertaken, especially with regard to the proximity of live parts and live equipment
- Have regard for the level of knowledge, skills and competence of the person to be supervised

Before an apprentice commences any electrical work, the supervising electrical worker must:

- Be confident that the apprentice is fit for work.
- Ensure there are no exposed live parts, and the electrical equipment is de-energised and safe to be worked on or near.
- Clearly instruct the apprentice on which tasks are expected to be undertaken and which tasks must not be done until instructed on how to do the tasks.
- Confirm that the apprentice understands the work instructions.
- Advise the apprentice which level of supervision applies to the work and confirm the apprentice understands the limitations that applies to the work.

- Ensure that the apprentice is equipped with the necessary personal protective equipment (PPE) and tools and understands how to use them correctly.
- Where the equipment has been de-energised to allow work to be carried out on or near, ensure that the apprentice:
- has applied their personal lock and danger tag at the isolation point(s); and
- has verified by an electrical test that the equipment is de-energised – **TEST BEFORE YOU TOUCH**.

8.1 Western Australia Requirements

The following table provides guidance to site management and supervising electrical workers on appropriate minimum levels of supervision of apprentices at different stages of training and for different work types (de-energised only), subject to assessment by the supervising electrical worker.

Type of work (de-energised only)	Apprentice Training year	Recommended minimum supervision level
New electrical installations (not connected to electricity supply)	1st 2nd 3rd 4th or final	General General Broad Broad
Maintenance, alterations, and additions to existing electrical installations (isolated and proven de-energised by supervising electrical worker)	1st 2nd 3rd 4th or final	Direct General General Broad
Workshop assembly and maintenance of electrical equipment (not connected to electricity supply)	1st 2nd 3rd 4th or final	General General Broad Broad
Tag and lockout procedure on de- energised installations and equipment (isolated and proven de-energised by supervising electrical worker)	1st 2nd 3rd 4th or final	Direct General General Broad
Testing and fault-finding on de- energised installations and equipment (not connected to electricity supply or isolated and proven de-energised by supervising electrical worker)	1st 2nd 3rd 4th or final	Direct Direct General General

8.1.1 Direct Supervision

"Direct" supervision applies where an apprentice requires constant guidance and monitoring by the supervising electrical worker to ensure the work task is carried out safely

and correctly. A supervising electrical worker provides direct supervision of the electrical work of an apprentice if the supervising electrical worker:

- is as far as is practicable, present in the immediate work area at all times;
- can observe the work of the apprentice;
- both workers are able to communicate directly;
- is in close proximity to the apprentice at all times while electrical work is carried out on or near an energised part of an electrical installation (final year of training);
- provides instructions and demonstrates the correct procedures for carrying out the work;
- monitors the work and provide guidance and checks; and
- when the electrical work is complete, checks and tests the work to ensure that the work is safe, complies with the Regulations and is carried out to a trade finish.

8.1.2 General Supervision

"General" supervision applies where the apprentice or Provisional License holder requires periodic guidance and monitoring to ensure the work task is carried out safely and correctly. A supervising electrical worker provides general supervision of the electrical work of a supervised worker if the supervising electrical worker:

- Is present at the place where the electrical work is being carried out, at all times.
- While the electrical work is being carried out:
- provides instruction and direction, as required;
- is readily available to provide advice and guidance;
- periodically monitors the work; and
- checks, as required, that the work complies with the Regulations and is carried out to a trade finish.
- When the electrical work is complete, checks and tests the work to ensure that the work is safe, complies with the Regulations and is carried out to a trade finish.

The supervising electrical worker must remain on the same work site as the apprentice or Provisional License holder and be readily available to provide guidance and assistance.

8.1.3 Broad Supervision

"Broad" supervision applies where the worker does not require ongoing guidance and monitoring while performing familiar tasks. A supervising electrical worker provides broad supervision of the electrical work of a supervised worker if the supervising electrical worker:

- Visits the supervised worker at the place where the electrical work is being carried out, at least once per day.
- Before the electrical work commences, provides instruction and direction, as required, regarding the electrical work.
- While the electrical work is being carried out:

- is readily available or contactable to provide advice and guidance; and
- checks, as required, that the work complies with the Regulations and is carried out to a trade finish.
- When the electrical work is complete, checks and tests the work to ensure that the work is safe, complies with the Regulations and is carried out to a trade finish.

The supervising electrical worker does not need to remain on the same site as the supervised worker but must, as a minimum, attend the work daily to provide initial instruction and to verify the electrical work has been carried out safely and correctly.

8.1.4 Limit to the number of persons supervised

The number of workers that can be supervised at any time by a supervising electrical worker is limited dependent upon the level of supervision the worker is under.

A supervisor cannot supervise the work of more than two electrical workers who require supervision if at least one of the workers requires direct supervision.

If the supervisor is NOT providing direct supervision to a worker, then the maximum number of electrical workers they can supervise is four at any time.

Number of Apprentices	Levels of Supervision Permitted
No more than two apprentices	One Direct; One Broad or General
No more than four apprentices	Four Broad or General combination

8.1.5 Restrictions for apprentices working on or near energised equipment

Work on or near energised electrical circuits and equipment by any electrical worker is prohibited by the Electricity (Licensing) Regulations 1991 (ELR) except in certain prescribed circumstances and subject to performing a detailed risk assessment and formal documentation of a safe work method statement.

8.1.5.1 Testing and fault finding

The WA Electrical (Licensing) Regulations (ELR) permits an electrical apprentice to carry out isolation, testing and fault finding on energised equipment in the following strictly limited circumstances (in combination):

- only in the final year of training;
- only if assessed by the supervising electrical worker as being competent to perform the task safely; and
- only under direct supervision, with the supervising electrical worker in close proximity to the apprentice for the duration of the task.

In all cases, the supervising electrical worker is responsible for the risk assessment, safe work method statement, instruction and direct supervision of the apprentice and final verification and testing of the work.

8.2 Queensland Requirements

The following guide for supervision of electrical apprentices provides guidance to workers, supervising electrical workers and apprentices on appropriate minimum levels of supervision of apprentices at different stages of training and for different work types (de-energised only), subject to assessment by the supervising electrical worker.

Type of work	Typical time served (in months)				
	0 – 6	6 – 12	12 – 24	24 – 36	36 – 48
Installation of cable support and mechanical protection	Direct	Direct/ General	General	Broad	Broad
Installation of low voltage cabling	Direct	Direct/ General	General	General	Broad
Installation of low voltage electrical equipment	Direct	Direct	Direct	Direct/ General	Broad
Fault finding, repair and maintenance of de-energised low voltage electrical installation and equipment	Direct	Direct	Direct	Direct/ General	Broad
Proving de-energised of low voltage electrical installation and equipment (isolation and lock-out)	Direct supervision. The supervisor is ultimately responsible for proving the isolation before work commences.			Direct	Direct/ General[3]
De-energised verification (visual inspection and testing) of low voltage electrical installation and equipment	Direct	Direct	Direct	Direct/ General	General[4]/ Broad[5]
Energised verification (visual inspection and testing) of low voltage electrical installation and equipment	RTO Simulated only	RTO Simulated only	RTO Simulated only	RTO Simulated only	Direct
Commissioning (testing for correct operation/function) low voltage electrical installations and equipment (no access to exposed low voltage)	Direct	Direct	Direct	Direct/ General	General[6]

3 General supervision should be restricted to apprentices who have completed training in isolation and lock-out procedures, and the supervisor has performed a risk assessment and ensured the apprentice is competent to undertake the task.

4 General supervision is only appropriate after the apprentice has completed the relevant units of competency in installation verification.

5 Broad supervision should only be considered after the apprentice has successfully completed their Capstone assessment.

6 General supervision is only appropriate after the apprentice has successfully completed the relevant units of competency in installation verification.

8.2.1 Direct Supervision

"Direct" supervision is when a supervisor constantly monitors an apprentice. The supervisor should always remain readily available (within sight and/or earshot).

This level applies where the apprentice requires constant guidance and monitoring by the supervising electrical worker to ensure the work task is carried out safely and correctly.

Direct supervision is usually appropriate where:

- the apprentice is new to the task
- the apprentice has not demonstrated ability to perform the task to a minimum standard
- the assessed risks determine direct supervision is required for the task
- the apprentice has not completed off-the-job training that supports competent performance of the task
- unplanned events are beyond the apprentice's ability to manage
- the work includes "live" work or work near exposed energised parts (apprentices should not be undertaking any "live" work).

8.2.2 General Supervision

General supervision is when a supervisor is not constantly reviewing the apprentice but remains available in person for assistance or instruction as required. This does not include face time or video conferencing.

This level is used where the apprentice requires periodic guidance and monitoring to ensure the work task is carried out safely and correctly.

The supervising electrical worker must remain on the same work site as the apprentice and be readily available to provide guidance and assistance.

General supervision is usually appropriate where the:

- apprentice has demonstrated their ability to perform the task safely to the minimum standard without the need for constant intervention
- apprentice has demonstrated an understanding of any risks and can manage those risks appropriately
- assessed risks determine general supervision is required for the task
- apprentice has an appropriate level of knowledge and practical skills from completing off-the-job and on-the-job training
- apprentice has demonstrated an ability to manage or seek assistance with reasonably predictable unplanned events.

8.2.3 Broad Supervision

Broad supervision is when a supervisor only needs to make occasional face-to-face contact at intervals determined suitable by the supervisor.

Adequate apprentice supervision cannot solely be provided from an offsite location by electronic means such as phones, radios, and webcams.

This level applies where the apprentice does not require ongoing guidance and monitoring while performing familiar tasks.

Broad supervision is usually appropriate where:

- the apprentice has demonstrated their ability to perform the task safely to acceptable standards without the need for supervisor intervention
- the apprentice has demonstrated an understanding of any risks and has the ability and demonstrated how to manage those risks appropriately
- the assessed risks determine broad supervision is required for the task
- the apprentice has a significant level of knowledge and practical skills from completing off-the-job and on-the-job training
- the apprentice has demonstrated an ability to manage or seek assistance with unplanned events.

8.2.4 Limit to the number of persons supervised

Queensland does not require specific apprentice-to-electrician ratios, electricians must adapt supervision to the nature of the work, the apprentice's experience, and possible dangers. The supervising electrical workers ability to effectively and safely supervise the apprentice/s is the determining factor, especially regarding the level of supervision required for specific tasks.

8.2.5 Restrictions for apprentices working on or near energised equipment

SCEE must ensure that electrical work is not carried out on or near electrical equipment while the equipment is energised.

SCEE must ensure that:

- before electrical work is carried out on electrical equipment the equipment is tested by a competent person to decide whether it is energised.

There are only very limited circumstances where there is an exemption to this restriction. Testing is one of these exemptions. However, testing is “live” electrical work and a risk assessment must be undertaken to determine the control measures for managing the risks.

A risk assessment should be undertaken before electrical work is commenced. The Electrical Safety Regulation requires that a risk assessment be prepared in writing by a competent

person for work on energised electrical equipment. This includes electrical testing as testing is “live” electrical work.

For the workers safety, do not work “live”. Turn the power off. Isolate upstream at the point of power supply wherever possible.

9 Rescue Procedures

This section aims to provide guidelines for a person to perform a safe rescue of a victim who has received an electric shock or personal injuries while working on low voltage conductors or equipment.

The safety of the rescuer is paramount. Although speed of the rescue is essential, safety must never be compromised.

On arrival at the work location, all persons in the work group, especially the safety observer must be familiarised with:

- Arc Flash incident energises and the Arc Flash Boundary
- Layout of work area
- Avenues of approach for a rescue
- Risks that may be encountered, including the likelihood of fire or shock.

The appropriate point of isolation shall be identified before commencement of work and the method of operation explained to the safety observer.

Where possible, electrical equipment that is causing shock or injury shall be immediately disconnected from the source at the pre-designated supply point of isolation to allow rescue. As part of the initial set up, it may be possible to notify the Network Operator Controller of the task and ask whether remote isolation is possible in the event of an incident.

Prior to commencement of work, low voltage rescue kits shall be checked to ensure the contents are in good condition and applicable to the work situation. The low voltage rescue kit shall be placed in a suitable position which is accessible to the work area and clearly visible.

Contents of a LV rescue kit include:

- LV gloves: refer to Section 12.1 - Insulated Gloves
- Fibreglass hook
- Torch
- Label for isolation point
- Fire blanket
- Trauma dressing.

The safety observer shall be familiar with the means of sending a message for help i.e. operation of two-way radios, location and use of telephones (including knowledge of the phone numbers) to call the relevant emergency services. Refer to Section 7 - Safety Observer.

Note: Low voltage rescue kits shall be available when working on or in close proximity to energised equipment. Refer to Section 16 - Arc Flash Hazards.

9.1 Low Voltage Rescue

- Isolate supply if possible
- Always remember DRSABCD, there is one victim already, there must not be a second
- Avoid direct skin-to-skin contact with the victim
- Use the insulated gloves and fibreglass hook
- Assess the situation and rescue the victim as quickly as possible
- Assess the victim's condition
- Perform resuscitation/treatment of injuries
- Place the victim in the recovery position awaiting further medical help
- Rescuer to remain with the victim
- If access is restricted or hazards exist, the victim should be moved to a clear, safe area for treatment. The most effective way of moving an unconscious person is the one man drag method:
  - Crouch behind the victim
  - Position your arms around the victim's upper chest
  - Securely grip your wrist with the opposite hand
  - Adopt correct lifting procedure to avoid sustaining a back injury when lifting and dragging the victim
  - Drag the victim to a clear, safe area
- Use of fire blankets
  - Quickly remove the fire blanket from the container
  - Wrap blanket around the victim to extinguish flames
  - Direct flames away from the victim's face
- One method to achieve this is to lay the fire blanket from the victim's upper body towards their feet thus pushing the flames away from the head.
- All Electrical Workers shall undergo Low Voltage Rescue training on a 2 yearly basis

9.2 High Voltage

In the event of a person receiving an electric shock from high voltage equipment, it is likely that he/she would be thrown clear of the equipment, thus removing the need to free the victim from contact with live parts.

Should the victim remain in contact with the live high voltage equipment, no rescue procedures shall be performed unless complete isolation and testing of equipment is carried out. Do NOT attempt to assist the victim until the equipment is isolated.

Note: Always remember DRSABCD; there is one victim already, there must not be a second.

9.3 Low Voltage Kit Inspection and Testing

Item	Testing Frequency	Inspection Frequency	Register Required
Low Voltage Rescue Kit	Insulated Gloves 6 monthly	6-monthly and Before Use	Yes

Note: Brand new Low Voltage gloves shall be inspected prior to first use and tested every six months thereafter. However, if the gloves are opened within 12 months of the manufacturing date, then the testing period between the first inspection and the first test may be extended to 12 months.

10 Event Investigations

All workers have an obligation to ensure that, immediately after becoming aware of an Electrical Event such as Electrical Accidents, fires, injuries and shocks, that these are reported to site management immediately.

Where a dangerous situation exists that has caused or is likely to cause an accident or presents danger to a person or property, any person who is aware of the accident or danger shall if possible ensure the area is made safe and then report the fact to their Supervisor immediately.

10.1 Event Management

Workers are required to report all events, regardless of severity, to their supervisor immediately. Personnel involved in an event shall ensure that the immediate area is made safe without putting themselves or others at risk, and if required provide initial first aid to any injured personnel.

The Supervisor and HSE Advisor (if on site) shall assume responsibility for the site on behalf of SCEE and ensure the area is safe, that the appropriate medical treatment is provided for any injured personnel and commence the notification and investigation process.

For significant procedural breaches Project Management shall have the authority to temporarily stand down personnel pending the outcome of the investigation.

10.2 Event Notification

The SCEE event notification guide shall be followed for all events.

The Supervisor or HSE Advisor is responsible for notifying the Project Manager for all events. Escalation of notification will depend on the actual or potential consequence of the event.

The SCEE personnel to be notified and the notification timeframes for specific events are detailed within SCEE-BS-HS-GUI-0001 Event Notification Guide. The event notification guide should be displayed in all SCEE work locations where practicable.

Any necessary external notifications to regulatory bodies shall be made by the Corporate HSEQ Manager, in consultation with the Group Manager – Business Services.

Refer: SCEE-BS-HS-GUI-0001 Event Notification Guide.

10.2.1 Statutory Reporting Requirements

SCEE as the principal PCBU will take on the responsibility of reporting all notifiable events on site as per legislation and associated regulations on the Project.

If a Notifiable Incident is reported by SCEE it shall in writing provide the reference number and any other associated information to the applicable contractor as soon as practicable.

The SCEE Electrical Group Manager – Business Services, Corporate HSEQ Manager or the Learning and Development Manager (Electrical Events only) shall undertake the notification process to the regulator unless undertaken by the principal contractor.

All Notifiable electrical events shall only be reported once the Business Management Representative or Nominee of the applicable Electrical Contractors Licence is notified in writing of the report to be made.

Notice of an event must be given by the fastest possible means, by telephone or in writing (including electronic means, where available). If notice is given by telephone, the regulator may request follow-up written notice of the event. This must be provided within 48 hours of the request.

A record of each notifiable event must be kept by SCEE Electrical for at least five years.

The person with management or control of a workplace at which a notifiable event has occurred must ensure the site of the event is not disturbed until an inspector arrives at the site or directs otherwise. This does not prevent any action required to protect a person's health or safety, help someone who is injured or make the work front safe.

11 Tools and Equipment

Test instruments, including leads and probes, shall be appropriate and adequate for the tests being performed. The equipment shall be suitable for use on the highest voltage available and used in accordance with its operating instructions.

11.1 Low Voltage Test Instruments

11.1.1 Condition

Testing equipment shall be in good condition and working order, clean and without cracked or broken insulation components. Particular care shall be taken as to the condition of the insulation on leads, probes and clips of test equipment.

11.1.2 Testing

Functionality of test instruments (e.g. multimeters, insulation testers, impedance tester and RCD testers) shall be calibrated at all times.

As a risk reduction during testing, an independent 'proving unit' should be used as a known source rather than using the energised installation which may expose the user to working on or near energised electrical equipment.

Calibration, or at a minimum 'testing', of test instruments, shall be carried out at intervals not exceeding one year and records kept verifying this.

Refer: SCEE-OP-OP-PRO-0003 Measuring and Test Equipment

11.1.3 Accuracy

Calibration of test instruments may be required annually for specialised tasks where absolute accuracy is required by regulatory bodies. (i.e. hazardous area test equipment).

11.1.4 Suitability

Test instruments, where used in hazardous flammable areas, shall be designed and clearly marked as being suitable for use in such locations.

11.1.5 Appropriate Use

Multimeters shall not be used above their rated voltage and in no case shall they be used to test voltages above:

- 1000V AC; or
- 1500V DC.

11.2 Insulated Hand Tools

Only tools that comply with IEC 60900 are regarded as "Insulated hand tools". Low voltage insulated hand tools are intended for use on live low voltage equipment.

Other tools that are 'covered' or that appear to be insulated, but do not comply with IEC 60900 should not be used for live work, or in the vicinity of exposed electrical equipment without the use of insulated gloves.

Where work is deemed absolutely necessary to be carried out near energised electrical equipment, all insulated tools and equipment used for this work shall be tested every six (6) months as per IEC 60900

Note: Metallic measuring tapes, rulers or tools with exposed conductive parts shall not be used in the vicinity of live exposed electrical equipment.

11.3 High Voltage Test Probes

Test probes are used to gain access to circuit connections for the purposes of testing:

- High voltage equipment shall be isolated and tested prior to inserting test probes. The test probes shall be capable of both AC and DC.
- High voltage test probes shall be used in under a HV Access Permit,
- Ensure the correct test probe is selected for the specific equipment by checking the instrument manual
- Test probes shall be inspected for any damage prior to use:
- Insulated rods shall be clean and free from chips, cracks or other damage
- If any of the above damage is found, replace the test instrument immediately and place an 'out of service' tag on the damaged probes
- Test probes shall be cleaned prior to use:
- Use clean cotton cloth or silicon impregnated rag specifically made for this task.

11.4 High Voltage Proximity Testers for Use above 1000 VAC

Detectors must give a clear, definite and unambiguous indication of whether a conductor is alive or de- energised. Detectors must be suitable for their intended use e.g. overhead lines, open busbars or enclosed switchgear (not necessarily the same unit for all functions).

Detectors should preferably provide indication to two senses, sight and hearing, but the essential requirement is that the indication be unambiguous. Detectors shall be set to the correct voltage range for the equipment apparatus being tested.

Correct operation of the detectors must be proved before and after use. Preferably, this should be done at the same voltage level that was used to prove the apparatus or conductor de-energised. Should it be not possible to test in this manner, then the detector may be tested on another known voltage source or, as a last resort, by rubbing or tapping the head of the detector with your hand.

Operating sticks/handles shall be rated for the voltage level being tested and they themselves must be tested every six (6) months.

Note: Minimum safe approach distances shall be maintained at all times when testing high voltages.

11.5 Insulated Operating Sticks

Operating sticks or rods are used when operating or working on live high voltage conductors or equipment and to make actual direct contact with them.

With the exception of telescopic sticks, hand guards or warning markers should be fitted to all insulated sticks to distinguish the insulating section from the handle section.

All sticks or rods shall have a voltage rating corresponding to at least the system voltage on which they are to be used. The voltage rating determines the minimum length of the insulating section as shown in the table below.

Note: With telescopic poles, the insulating section of the stick is only the top section. The rest of the stick is hollow and therefore is not classed as insulating

Normal System Voltage (kV)	Voltage Rating Requirements Voltage Rating (kV)	Minimum Distance from Head of Stick to Hand Guard
11	12	700 mm
22	24	1000 mm
33	36	1000 mm
132	145	1500 mm
220	243	2500 mm
Minimum distances indicated are for dry conditions only.		

Before each use, sticks should be wiped clean with a clean cloth and examined. They shall be free of cracks, surface damage or mechanical defects.

The use of silicon impregnated cloth is recommended for cleaning as it puts a coating of silicon on the stick, improving insulating properties in damp conditions.

Insulated operating sticks shall be tested every six (6) months. Sticks shall be subjected to a power frequency withstand test consistent with the Manufacturer's recommendations. This test is completed over the entire length of the insulating material around the diameter of the stick.

Insulated operating sticks should be handled carefully and stored in protective bags to prevent damage to their surface coatings.

11.6 Portable Earths

All portable earthing equipment shall be capable of conducting the maximum short circuit current at the point of grounding for the duration of the fault.

Portable earthing equipment shall be marked with a fault current rating and rated fault duration.

The fault rating of the portable earths shall be greater than the available fault current at the point of installation and the protection clearing time must be less than the fault duration rating of the portable earths.

Portable earthing equipment shall be recorded on a maintained register and inspected every six (6) months. Results shall be included on the register.

Refer to Section 13.3 – Earthing HV and LV Equipment.

11.7 Low Voltage Insulating Mats

Insulating mats are intended to provide an electrically safe barrier on which the user can stand or kneel.

Insulated mats shall be supplied with a manufacturer's certificate that states that they were tested and certified as complying with AS/NZS IEC 61111: Live Working – Electrical insulated mats.

Insulating mats shall be thoroughly inspected for possible defects prior to each use. They shall be free from patches, blisters, cracks and embedded items.

Insulating mats shall be electrically tested and inspected every six (6) months. Fair wear and tear must be taken into account. If there are any cuts, punctures or signs of perishing, then the item shall be discarded.

As far as possible, mats must be kept away from direct sunlight and stored in a dry place free from sharp objects or other equipment that might damage them.

11.8 Low Voltage Insulating Covers

Insulating covers typically include blankets or pipes made from an insulating material intended to be wrapped around energised electrical apparatus, so as to prevent inadvertent contact and provide an electrically safe barrier for personnel or equipment working in the vicinity.

Insulating covers shall be supplied with a manufacturer's certificate that states that they were tested and certified as complying with AS 4202.

Insulating covers shall be thoroughly inspected for possible defects prior to each use. They shall be free from patches, blisters, cracks and embedded items.

Insulating covers shall be inspected every six (6) months. They do not require routine electrical tests.

As far as possible they must be kept away from direct sunlight and stored in a dry place free from sharp objects or other equipment that might damage them.

11.9 Pole and Tower Rescue Kits

Pole and tower rescue kit shall only be used by personnel trained in their use. They shall be thoroughly inspected before use, stored in suitable container and kept in a clean and dry condition. If any component shows any signs of deterioration, it shall be removed from service and discarded.

Pole and tower rescue kits shall be inspected visually for condition and correct assembly every six (6) months. The full length of rope shall be run out and checked.

11.10 Ladders

Portable ladders shall comply with the appropriate Australian Standard and be used in accordance with the Manufacturer's instructions.

Ladders should be of insulated type that is, constructed of fibreglass or wood. Ladders constructed from aluminium or other metals should not be used.

The primary type of ladders used at SCEE are, platform ladders. Prior to purchase of any other type of ladder the HSEQ Department are to be consulted and the necessary risk assessment for use conducted.

Refer: SCEE-BS-HS-WIN-0020 Portable Ladders

11.11 Elevating Work Platforms

All persons using elevating work platforms, including scissors hoists, boom lifts and cherry pickers, shall be trained in and qualified in their use, hold appropriate high-risk workers licence and be familiar with the appropriate machine. A Working at Heights Permit shall be completed whenever an EWP is used.

When operating an EWP with a non-insulated boom, no part of the EWP or personnel shall encroach the minimum safe approach distances as listed in Section 15 – Minimum Safe Approach Distances.

Refer: SCEE-BS-HS-WIN-0019 Mobile Elevated Work Platform (High Risk)
SCEE-BS-HS-PRO-0017 Working at Height (High Risk)

11.11.1 Regular Maintenance

Routine electrical insulation tests shall be carried out on all insulated boom EWPs. The interval between tests shall not exceed six (6) months. Results of the tests shall be located on the EWP.

11.12 Inspection and Testing Summary

Item	Testing Frequency	Inspection Frequency	Register Required
Low Voltage Test Equipment	Annual	Before use	✓
Low Voltage Insulated Hand Tools	6-monthly	Before use	✓
Portable Electrical Equipment	3-monthly	Before use	✓
High Voltage Test Probes	Before use	Before use	N/A
High Voltage Proximity Testers	N/A	Before use	N/A
Insulated Operating Sticks	6-monthly	Before use	✓
Insulated Covers	N/A	6-monthly and Before use	✓
Insulated Mats	6-monthly	Before use	✓
Controlled Descent Device	N/A	6-monthly and Before use	✓
Pole and Tower Rescue Kits	N/A	6-monthly and Before use	✓
Ladders and Step Ladders	N/A	3-monthly and Before use	✓
Insulated EWP Boom	6-monthly	Before use	N/A

12 Personal Protective Clothing

12.1 Insulated Gloves

Insulated gloves shall comply with AS/NZS IEC 60903. As a minimum, insulated gloves shall be used in the following situations:

- Testing for dead and fault finding on LV electrical equipment
- Working on or near energised LV electrical equipment

Refer to Section 14 - Working On, or Near, Energised Low Voltage Electrical Installations.

- Arc flash protection where required

- Operating HV isolators and earth switches when in direct contact with the switching mechanism
- Using insulated test sticks, operating rods or measuring sticks on HV equipment when in an earthed situation e.g. standing on the ground or in an uninsulated EWP.

12.1.1 Testing and Inspection of Insulated Gloves

Gloves shall be inspected and tested prior to use. This is carried out as follows:

- Hold the glove cuff and tightly roll towards the fingers to trap air inside the glove
- Hold the glove to your ear and feel and listen for escaping air
- Check for any nicks, cuts, perishing or any other damage to the glove.

Gloves that are damaged in any way shall not be used.

Gloves should be workshop tested as follows:

- Inflate each glove using a glove pump and immerse in water to check for leaks
- Strength test the glove as follows:
  - Firmly grasp the cuff and fingers and stretching the gloves as much as possible
  - Then stretch each finger and thumb as much as possible
  - If any damage or deterioration shows up, the glove shall be discarded.

Insulating gloves shall tested every six (6) months.

Note: When insulated gloves are used to make contact, or may make contact, with energised exposed equipment, they shall be electrically tested every six (6) months in place of the inflation test. Alternatively, the gloves can be replaced every six (6) months.

Insulating gloves should not be exposed to oil, corrosives or any other chemicals. All insulated gloves shall be used in conjunction with leather protectors. The cuff of the leather protectors shall be shorter than the insulated glove. The minimum clearance distances shall be as follows:

- LV gloves – 12mm
- HV Gloves – 50mm.

Gloves shall only be cleaned with soap and water or mild dishwashing detergent. After cleaning, the gloves shall be dried inside and out and dusted with talcum powder.

Gloves must never be left in the sun unnecessarily and must be stored in a suitable protective bag, e.g. canvas.

Note: Insulated gloves shall be rated and used as follows:

- Gloves used on Low Voltage equipment shall be rated to 500V or the voltage being worked on
- Gloves used on High Voltage Equipment shall be rated to at least 17kV.

12.2 Safety Harnesses and Lanyards

- Persons working at heights shall receive the relevant training prior to commencing the work
- A safety harness shall also be worn and suitably attached when using elevated platforms
- Safety harnesses shall comply with SCEE's) Working at Heights Procedure
- Prior to use, safety harnesses (including lanyards and ropes) shall be inspected for any visible failure, malfunction or deterioration
- Work at heights PPE must be inspected and tagged by a competent person quarterly as part of a periodic inspection programme. PPE must also be inspected prior to and after use by the wearer.

Refer: SCEE-BS-HS-PRO-0017 Working at Height (High Risk)

12.3 Safety Clothing

Licensed electrical workers and their assistants, including safety observers, shall wear appropriate protective apparel as per SCEE and client requirements.

As a minimum, category 2 Fire retardant rated pants and shirt shall be worn by all electrical workers at all times.

Protective clothing worn by personnel shall:

- Be of correct fit
- Be in good condition
- Cover the full body (including arms and legs)
- Safety glasses and gloves shall be worn in addition to any area specific PPE

12.4 Inspection and Testing Summary

Item	Testing Frequency	Inspection Frequency	Register Required
Safety Harnesses and Lanyards		3-monthly and Before use	✓
LV Insulated Gloves	6-monthly replacement	Before use	✓
HV Insulated Gloves	6-monthly	Before use	✓

13 Isolating and Test for Dead

13.1 Test Before You Touch

Electrical safety is primarily dependent upon appropriate job planning, isolations of circuits and equipment, and correct testing procedures and techniques. No electrical equipment should be assumed to be de- energised after isolation. Prior to starting work on de-energised electrical equipment, it shall be tested.

Note: In LV circuits, appropriately rated LV gloves and insulated hand tools shall be used when testing for dead or fault finding

A risk assessment shall be completed prior to all testing activities and identified controls implemented to protect against inadvertent contact or equipment malfunction. Refer to Sections 11.1 – Low Voltage Test Instruments and Section 12.3 – Safety Clothing.

13.1.1 Identity

Positively identify the electrical equipment to be worked on and the relevant point of supply.

Note: Some equipment may have more than one source of supply e.g. motor heaters.

13.1.2 Isolate

The electrical equipment to be worked on shall be isolated from all sources of supply, including auxiliary circuits.

Persons required to perform isolations shall be trained and assessed competent in isolations for their level of isolation to be conducted, together with area specific training if required.

13.1.3 Test

- All electrical equipment, unless verified to be de-energised, shall be treated as live. Voltage tests shall be conducted between all conductors and between all conductors (including the neutral conductor) and earth
- Voltage testers shall be set to the correct setting and range for the intended test
- Test leads shall be inserted to the correct sockets on the tester
- Energised equipment in the vicinity of the test shall be identified and protected from inadvertent contact
- Voltage testers shall be tested (on a known source) for correct operation immediately before use and again after use to confirm that the instrument is working correctly

- Consideration shall be given to the possibility of circuit wiring or electrical equipment becoming live due to any operation of automatic controls devices (e.g. thermostats, float switches, PLCs and other interface devices).

Note: Low voltage proximity testers shall not be used to confirm isolation unless approved by a risk assessment.

13.1.4 Neutral Connections

Particular care should be taken when removing neutral connections, as tests may have indicated a de- energised situation. However, when these connections are removed, a voltage may be present between conductors or between conductors and earth.

13.2 Out of Service Requirements

Out of Service tags shall be placed on:

- Faulty and dangerous equipment
- Equipment that is to be kept out of service for operational reasons
- Equipment that has been previously energised that work is not complete.

13.3 Earthing High Voltage and Low Voltage Equipment

- Inspect any portable isolation and/or working earths prior to use for any visible or obvious outward sign of damage, deterioration or faulty connections. Ensure that the Inspection tag and kA rating are current and appropriate for the intended task.
- Prior to placing earths, voltage tests shall be completed to confirm that the apparatus is de-energised
- When placing earths, the earth end connection shall be made first
- Earthing of the de-energised conductors is made, following the connection to earth of the other end
- Persons placing the earths shall keep clear of the earth leads until all connections are made
- When the earths are removed, the earth end of the conductor shall be removed last
- Earths must be placed on all sides of the work site, this may only be one earth in the case of end of line equipment such as motors
- Low voltage earths shall be used where the potential for transients or induced voltages may exist
- Wherever possible, the earth point should be connected to a fixed earth, e.g. overhead earth or installed ground earth. Where this is not available, then an approved earthing electrode shall be driven into the ground. Care must be taken to avoid driving the electrode into other underground services. Where this type of portable earth is used, it shall only be used as a working earth and shall be used in conjunction with an isolation earth

- Refer to Section 11.6 – Portable Earths.

Note: An Excavation Permit is required whenever electrodes are to be driven into the ground.

13.4 Testing Prior to Energisation

Prior to energisation of supply, ensure relevant personnel are notified and a visual inspection is conducted to ensure that all tools, surplus materials and wastes have been removed.

After any alterations or additions to electrical equipment are made, those parts that have been altered or added shall be inspected and tested to ensure they comply with relevant regulations and the inspections and test shall be fully documented.

Before supply is fully restored, these alterations or additions shall pass the appropriate tests, and the work verified that it is safe to connect to electricity supply. All testing and pre-energisation plans shall be completed by those undertaking the works and submitted to the SCEE Supervisor and client if required.

13.4.1 Tests – Electrical Installation Work

Electrical installation work shall be checked and tested as specified in AS/NZS 3000. More detailed testing information is contained in AS/NZS 3017.

13.4.2 Tests – Portable Equipment

Equipment connected to supplies via flexible cord and/or connecting devices shall be checked and tested in accordance with the requirements of:

- AS/NZS 3760, and
- Applicable States Guide to Testing & Tagging Electrical Equipment

14 Working On, or Near Energised Low Voltage Installations

Where that task is Low Voltage Electrical work and isolation is not possible, and it must be conducted on or near energised electrical equipment, the requirements of the Code of Practice for Persons working on or near energised electrical installations in Western Australia and in Queensland the Electrical Safety Code of Practice - Managing electrical risks in the workplace must be adhered to in their entirety.

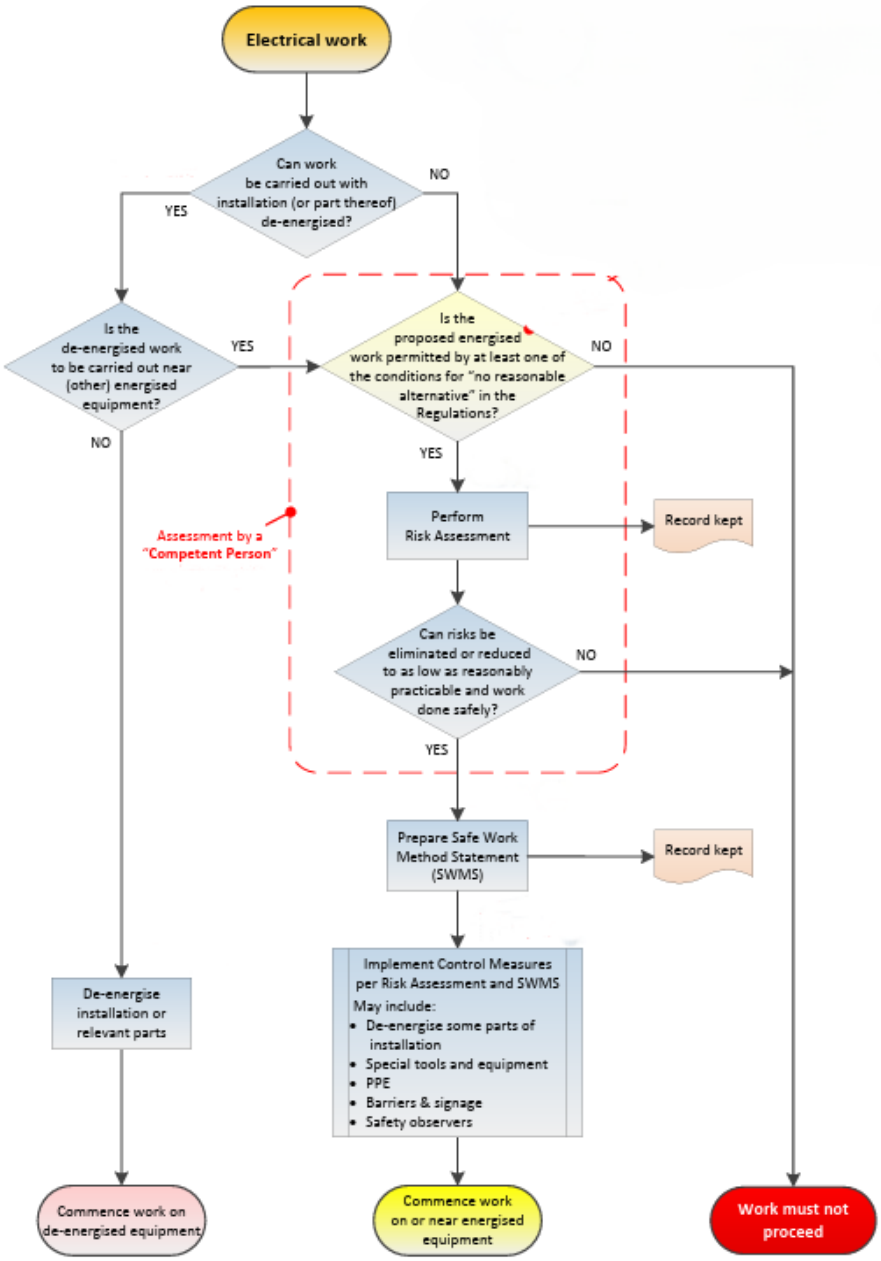
As a minimum the following shall be undertaken:

- A risk assessment is to be undertaken by a competent person familiar with the type of work to be carried out; and
- The competent person is satisfied that the requirements of Regulations and Code of Practice are met; and
- A safe work method statement (SWMS) or JHA for the work has been prepared in accordance with Regulations and Codes of Practices; and

- Suitable personal protective equipment and safety equipment is used by the worker carrying out the work.

Any risk assessment with an identified extreme residual risk are not to proceed and require referral to the Project Manager and HSEQ Manager for assessment. General Manager of Operations (or higher) approval is required for the activity to commence.

Decision Flowchart – Work on or near energised electrical installation



15 Working Near Energised, High Voltage Equipment

Any work performed within a powerline corridor, where any part of persons, equipment or machinery is capable of encroaching the minimum safe approach distances, shall be carried out under the conditions of a 'Vicinity Permit'.

Where workers work in the vicinity of exposed live high voltage mains and apparatus, personnel shall not allow any portion of their bodies or any object or tool (other than equipment issued for testing, operating or working on live voltage mains and apparatus) which they are handling to come within the minimum safe working distances from exposed live high voltage mains and apparatus.

Nominal System Voltage	Distance
Live insulated overhead power line or aerial bundled conductor line of a voltage of not more than 1,000 volts	0.5m
Live uninsulated overhead power line of a voltage of not more than 1,000 volts	1.0m
Live overhead power line whether insulated or not, of a voltage exceeding 1,000 volts but not more than 33,000 volts	3.0m
Live overhead power line whether insulated or not, of a voltage exceeding 33,000 volts	6.0m

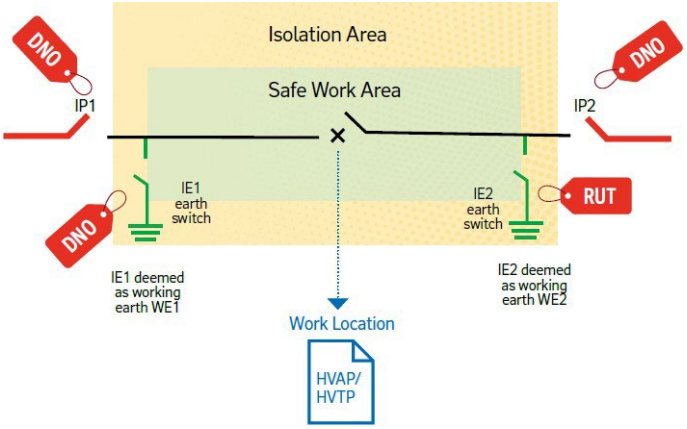
Minimum Safe Working Distances

In addition to the above minimum distances, workers should refer to each states industry's regulations, code of practice and guidelines.

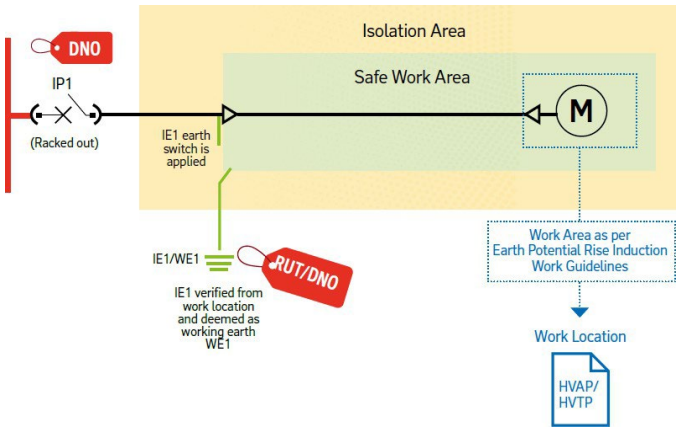
Note: A powerline corridor is defined as a 10 meter corridor applied to both sides of a power line from the base of the pole or tower.

15.1 High Voltage Testing – In-service Equipment

Tests on high voltage equipment should be performed where possible using a break on either side of the equipment to be tested (as indicated in figure below).



Test situation for two sources of supply, e.g. bus bar, powerline or circuit breaker maintenance



A typical test situation for radial equipment, e.g. motor

- This allows the tester to have an isolation earth between the test object and any source of supply at all times during testing.
- If this process is not followed personnel completing the tests could be exposed to an increased risk of electric shock or arc flash should the isolation gap flash over due to high test voltages reacting with the system voltages. This flash-over will result in full system voltage being supplied to the equipment being tested and the test equipment.
- If the system is set up as per the above figures, the isolation earths can remain in place throughout testing thus eliminating any risk of test voltage and system voltage interaction.

Note: Diagrams are indicative of single line diagram symbols, Isolation and/or Working Earths would be connected in an isolated state prior to undertaking any tasks.

16 Arc Flash Hazards

Anything that produces electrical current has the potential to produce an arc flash hazard. What the industry typically refers to as 'arc flash hazard' is the sudden release of large amounts of heat and light energy at the point of a fault. Exposure to an arc flash frequently results in a variety of serious injuries and in some cases death.

16.1 Potential Injuries

Severe injuries can result from an arc flash. Temperatures are often high enough to destroy skin and tissue. Temperature at working distances can approach 20,000 degrees Celsius.

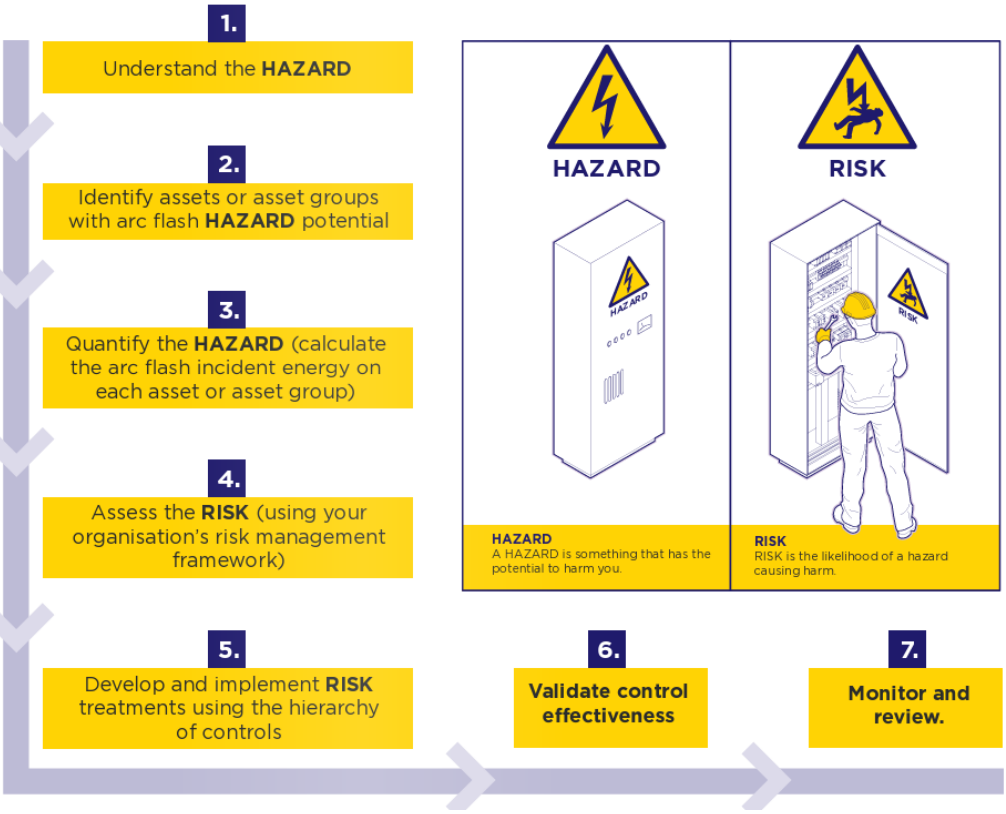
Heated air and molten materials from arc faults often cause ordinary clothing to burst into flames even if not directly in contact with the arc. Unless clothing is flame retardant, it may continue to burn increasing the area of injury. Synthetic fibres such as nylon and polyester may melt and adhere to the skin resulting in secondary burns.

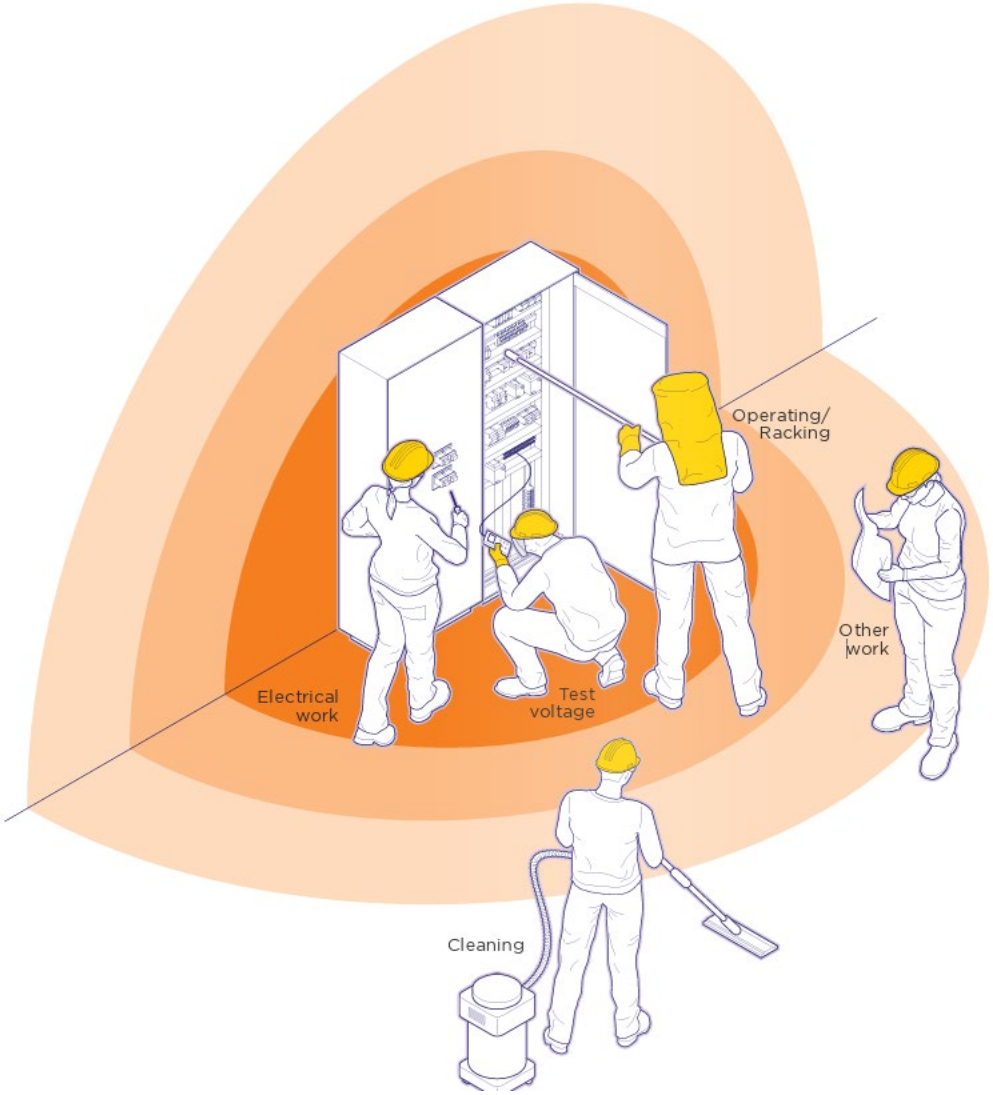
Hearing can also be affected by the loud noises and extreme pressure changes created by arc blasts. Tests have shown that noise generated by arc blasts can exceed 140 dB or equivalent to an aeroplane taking off. The sudden pressure changes can also rupture ear drums.

16.2 Management of Arc Flash Hazards

When workers are required to work on or near electrical equipment, all reasonably practicable measures should be taken to protect workers from the harmful effects of electric arc flash hazards through hazard elimination and risk reduction. To achieve this, the following steps should to be undertaken:

a) Understand the hazard
b) Identify assets or asset groups with arc flash hazard potential
c) Quantify the hazard (calculate the arc flash incident energy on each asset or asset group)
d) Assess the risk (using your organisation's risk management framework)
e) Develop and implement risk treatments using the hierarchy of controls
f) Validate control effectiveness g. Monitor and review.





Exposure to arc flash

17 Working on Earthing Systems

17.1 General

Correctly installed and connected earthing conductors pose minimal risk of electric shock. The risk of electric shock increases when the earth is disconnected or cut.

Work carried out on the earthing systems of energised equipment shall be limited to testing or minor repairs to those parts of the installation that provide redundancy through additional earth return paths, e.g. a system with two earth electrode connections at the main earth bar allows for one to be disconnected for testing, leaving the other in service. Only one earth connection shall be disconnected at any time.

If alternative paths do not exist or it is unclear, then under no circumstance should the earth connection be broken whilst related equipment is energised.

An earthing connection should be disconnected only for as short a time as possible to perform the required tests or repairs.

When disconnecting earthing connections associated with energised equipment, insulated gloves shall be used to protect from potential voltage difference across the connection. The insulation rating of gloves shall be as follows:

- For equipment up to 415 V, an insulation rating of 500 V
- For equipment above 415 V, an insulation rating of 1,000 V or above

17.2 Metallic Water Pipes

Metallic water service pipes to older installations were often used as the earth electrode. If any metallic water service pipe is to be cut or uncoupled, then the following precautions shall be taken:

- The main switch to the installation shall be turned off by an approved person and effectively isolated
- A bridging conductor fitted with suitable clamps and having a current rating of not less than 70 Amps shall be connected across the intended gap (refer AS3500.1)
- The electrical bridge shall not be removed or broken until all work on the water service is completed and continuity of the metallic water pipe is restored
- Where any existing metallic service pipe is to be replaced in part or in its entirety by plastic pipe or other non-metallic fittings or couplings, the work shall not commence until the earthing requirements have been checked by a Electrical Supervisor and modified if necessary.

18 Commissioning Electrical Equipment

Energisation of electrical equipment shall only commence once the necessary equipment inspection, testing, and commissioning has been completed, and relevant personnel have been notified.

All test results shall be documented in an approved format and where applicable display the actual test results obtained.

19 Decommissioning Electrical Equipment

An inspection shall be carried out on the equipment to be de-commissioned to determine access, voltage levels and isolation points. Drawings relevant to the particular job shall be studied to verify isolation points, process connections and possible interactions with the remaining plant.

Before conductors are exposed or cut, appropriate tests to prove the isolation shall be carried out. Only after all points of supply are proven to be isolated shall work commence on disconnection and removal of conductors. Refer to Section 20.1 - Cutting Cables.

Disconnections shall be made in such a way that inadvertent or accidental re-energisation of any part of the equipment is not possible. Refer to Section 20.8 - Redundant Electrical Equipment.

Single Line Diagrams shall be updated as applicable.

20 Special Risks

20.1 Cutting Cables

When carrying out work that involves cutting existing cables, the cable shall be treated as live until positive tests can be made at the point where the cable is to be cut, or one end of the cable can be positively identified and tested prior to cutting the cable.

'Positively identified' means the isolated, tested and earthed ends of the cable can be visually or clearly traced back to the point of the intended cut to ensure all sources of supply are isolated.

Refer: SCEE-BS-HS-WIN-0008 Identification and Removal of Redundant Cable and Equipment

20.1.1 Low Voltage

- One end of the cable shall be positively identified
- All energy sources shall be isolated
- The cable shall be treated as live until verification of isolation has been proven

Note: if the cable cannot be positively identified, stop work and contact your supervisor

- A continuity test shall then be completed to confirm that the cable has been correctly identified

Note: Cable cutting tools shall only be operated by competent personnel.

20.1.2 High Voltage

- All ends of the cable shall be positively identified
- All ends of the cable shall be isolated, earthed, and a HV Access Permit created
- The cable shall be treated as live until verification of isolation has been proven
- Cables that cannot be positively identified shall be spiked or cut by a remotely operated cable-cutter. Thereafter, the electrical system shall be checked to ensure no protective devices have operated.

Note: Cable spiking or cutting tools shall only be operated by competent personnel.

20.2 Chemically Treated Cables

Before handling any HV cable the user/s must identify if the cable is chemically treated i.e. Anti-Term or Termitex branding on the cable outer sheath, for the purpose of termite protection for the cable.

The chemical typically used for this application is called Cypermethrin which is commonly used in insect surface sprays.

Chemically treated cables are to be risked accessed within the business. If this type of cable is received on site it must be reported immediately to your supervisor and HSE Advisor and managed as per the cable safety data sheet.

20.3 Electrical Bridging

Bridging of equipment shall always be seen as a last resort and must not increase the risk of injury or damage to an item of plant to an unacceptable level. All bridges must be approved prior to installation.

Electrical Bridging refers to the shorting, removal or interference with an electrical component, or modification of software, resulting in equipment operating in an abnormal state or operating outside of its original design.

Bridging may involve:

- The lifting or shorting of wires (i.e. a hardwired bridge)
- Software modification (e.g. PLC)
- Simulation of inputs (e.g. PLC)
- Physical modification of plant such as isolating the detection element
- Changes to protection settings
- Changes to trip/interlock settings
- Isolating tripping or control supplies

Bridging of equipment must only be considered in the absence of a practicable alternative. All risks associated with the bridge must be assessed by using approved risk assessment tools and controlled to reduce the risk of personal injury and/or damage to equipment.

The potential risks associated with all electrical bridges must be considered and assessed, including any upstream or downstream effects.

20.4 PCB's (Polychlorinated Biphenyls)

PCBs belong to a group of toxic organochlorines and were used extensively as fluids in electrical equipment such as transformers and capacitors.

PCBs are a serious health problem because of their persistence in the environment, their accumulation in human and animal tissues, and their potential for chronic or delayed toxicity. The importation of PCBs for most purposes was banned in Australia in the 1970s. However, some equipment containing PCBs is still in use today.

20.4.1 Identification of PCB's

PCBs range in appearance from colourless, oily liquids to thicker or stickier and increasingly darker liquids, to yellow then black resins, depending on the chlorine content. The major use of PCBs in the electrical industry has been as an insulating fluid inside transformers and capacitors.

Capacitors containing PCBs were installed in various types of equipment including fluorescent light fittings during the 1950s, 1960s and 1970s and generally had a sealed metal casing. Capacitors manufactured after the 1970s do not contain PCBs.

Some transformers on older mine sites/buildings may contain amounts of PCB. These transformers should be appropriately labelled as containing PCBs. If in doubt stop work and contact your supervisor.

Should you have any concerns regarding the management and handling of PCBs, contact your supervisor or the HSEQ Department.

20.5 Capacitors

When working on equipment that includes capacitors such as VSDs, licensed electrical workers should be aware that substantial energy and subsequent arcs can be produced that may cause harm to workers or ignite material.

Capacitors and associated circuitry shall be proved to be fully discharged and de-energised by visual verification and/or the use of a voltage tester prior to performing work on them and their associated circuit wiring.

Always test immediately prior to commencing work to prove that these units are fully discharged. Capacitors that do not have discharge resistors attached may retain the full line voltage.

Discharge devices shall be used on all HV capacitors prior to earthing to eliminate any potential arcing or shock hazard.

20.6 Asbestos

Asbestos has been installed in some electrical switchboards (as a mounting panel for electric equipment or as fireproofing material), cable pits, and cable markers. Where there is a likelihood of the asbestos being disturbed by activities, e.g. removal, drilling or cutting, specific procedures shall be adhered to for the management of the asbestos hazards and disposal of any asbestos waste.

Refer: SCEE-BS-HS-TEM-0002 Dust and Fibrous Materials Management Plan

20.7 Sulphur Hexafluoride (SF6) Gas

SF6 gas is used as an electrical insulator within high-voltage circuit breakers and switchgear.

SF6 is considered a non-toxic gas, however it is classified as an asphyxiant (displaces oxygen in air). In addition, when exposed to sustained or intense electrical arcs, SF6 decomposes to form Disulphur decafluoride (S2F10), a highly toxic gas which can cause rapid suffocation with over exposure.

SF6 is an extremely potent greenhouse gas and therefore release to the environment should be kept to a minimum or ideally avoided. The quantity of SF6 contained in electrical equipment must be reported annually to the Commonwealth Clean Energy Regulator via the National Greenhouse and Energy Reporting Scheme.

20.8 Redundant Electrical Equipment

Redundant electrical equipment, where practicable, should be completely removed from the area and the relevant drawings, cable schedules, network power models and DB legends updated.

Any cables left in place or to be removed in the future shall be disconnected at both the load and supply ends and terminated (short out all conductors and earth).

Both ends of any cable to be left in place shall be suitably labelled to identify the location of the other end of the cable and its original purpose / cable number, as applicable. The label material shall be suitable for the intended purpose e.g. stamped metal.

Drawings and cable schedules shall be updated to identify any redundant equipment that has not been completely removed from service.

20.9 Hazardous and Flammable Areas

Any electrical work within hazardous areas, e.g. petrochemical installations (fuel farms, gas plants), shall be carried out using procedures applicable to the hazardous location by competent personnel in accordance with AS/NZS 60079.14 and AS/NZS 60079.17.

Hazardous area dossiers are required to be maintained for all hazardous areas documenting the equipment and its suitability for that location.

Appropriate intrinsically safe hand tools and equipment shall be used when working in hazardous areas.

20.10 Instrument Transformers

20.10.1 Current Transformers

Open circuit secondaries on current transformers can develop lethal voltages that may also damage equipment and start a fire. Do not disconnect or work on the secondary circuit of an energised current transformer (i.e. while the primary circuit is carrying current), unless the secondary winding has been short- circuited.

20.10.2 Voltage Transformers

The secondary star point should remain connected to earth while the primary is live due to capacitive coupling.

20.11 Alternative Power Supplies

Alternative systems may include inverter/UPS systems, standby generators, photovoltaic cells, separate auxiliary power supply for control, emergency lighting etc.

Particular care shall be taken when alternative power supplies are connected to the installation or equipment. Isolation procedures should include steps to ensure isolation of automatic connection of alternative supply.

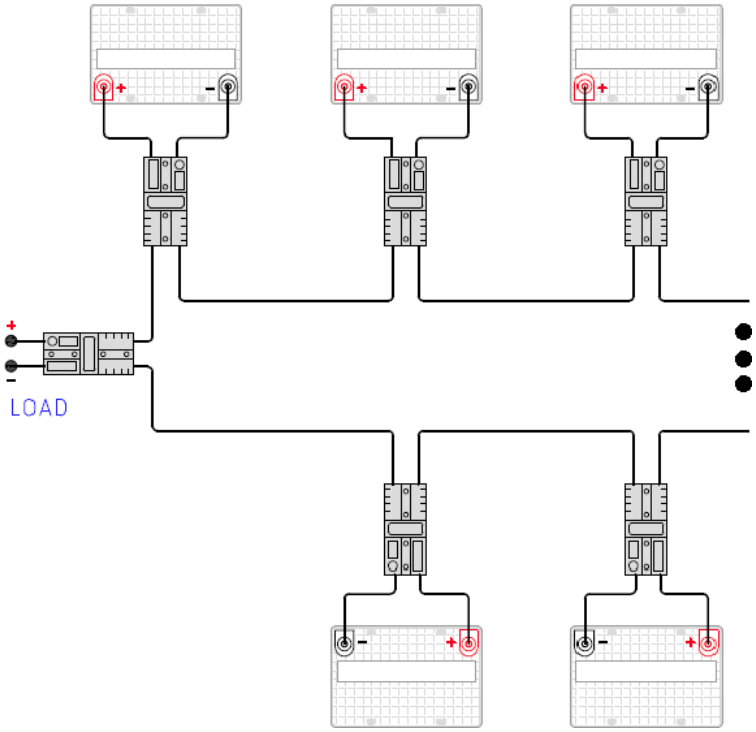
20.12 Batteries

When working on batteries or equipment that contains batteries, licensed electrical workers should be aware that accidental short-circuiting of battery terminals or connections may cause the battery to explode or create substantial arcs that can cause burns or ignite hazardous gases or materials. During charging, there is also the potential for gaseous explosion. Appropriate precautions shall be taken as determined by site based risk assessments.

Battery banks must:

- use one of the following battery types:
  - sealed lead acid
  - lithium ion
- have fully insulated terminals and connections
- use plug and socket connectors for battery connections (see Figure below)
- have the ability to monitor battery temperatures

- have a current-limiting fuse in each battery string
- have a lockable facility to allow for each battery string to be separated into sections of less than 110VDC.



Low Voltage electrical installations, Battery banks above 110VDC shall have their energy level defined, and an appropriate Arc Flash labelling applied.

Battery banks above 110VDC shall have their energy level defined, and an appropriate Arc Flash labelling applied.

For guidance on safe practices during battery installation and maintenance, refer to AS 2676.1.

20.13 Induced Voltages and Potential Rise

There are several potentially hazardous conditions routinely found on equipment connected to the electrical network including earthing conductors and interconnected structures. Hazardous conditions may also exist where equipment is in close proximity to, but not connected to the supply network.

These hazardous conditions include:

- Earth potential rise (EPR) and resulting step and touch voltages during system faults
- Induced voltages (including magnetic induction and capacitive charging)

- Transient voltages [from lightning and some high voltage (HV) switching surges].

While these conditions are more likely to be found during a fault somewhere on the electrical network (or during storm conditions), they can also occur during normal working conditions. Earth faults can result where the insulation of the electrical system breaks down.

20.13.1 Induced Voltages

Induced voltages can occur in overhead lines, underground cables, in switchyards, and on equipment installed or used near the power system. Wherever a line is adjacent to or connected to a line or cable which run near live parts of the system, induced voltages can develop (particularly if a fault occurs on the nearby line). Induced voltages most often occur between an energized line and a non-energized line but can occur wherever there are conductors parallel to a power line. Electrical induction transfers energy by either of the following mechanisms:

- Electromagnetic induction: Where current is flowing in a live line, other nearby lines, earth conductors, conveyors, pipelines, or railway tracks can rise in voltage even if they are earthed.
    - The level of induced voltage will depend on the magnitude of the current flowing in the energized line, proximity to the energized line, and the length of parallel exposure to the line.
    - Under fault conditions induced voltages by this mechanism can be very high (kilovolt).
    - A single earth applied at one end of the impacted line will not reduce the voltage induced on the line. An earth applied at both ends of the line will reduce the voltage and will create circulating currents in the conductor.
- Capacitive charging/Electric Field Induction: Occurs when an object is located within the electric field of an energised line. A voltage can be induced on equipment, out of service lines, structural metalwork, vehicles, fences, or even people.
    - The level of induction will depend on the operating voltage of the energised line and the proximity of the equipment to the energised line. Capacitive voltage is reduced by applying an effective earth connection to the object.

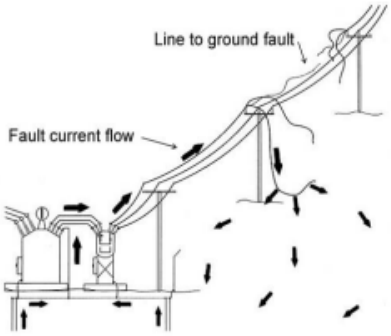
20.13.2 Earth Potential Rise

Earth potential rise (EPR) occurs when electrical current enters the ground (e.g. due to a flash over or fallen or damaged cables). The voltages produced by an earth potential rise can be hazardous to personnel and equipment. The earth potential is

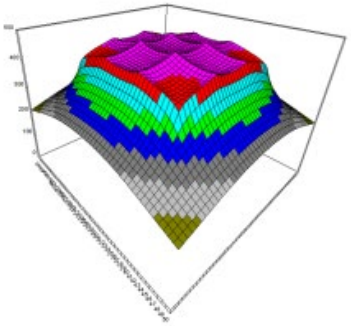
highest at the point where the current enters the ground and declines with distance from the source (i.e. potential gradient).

The earth potential rise also occurs at several other locations during a fault:

- The substation to which the earth fault current returns
- Where circuits supplying the fault transition from overhead to underground
- At earthed intermediate poles connected by an earth wire



Earth Fault Current Flow



Soil Voltage Response from an Earth potential rise at point of faut or supply station

20.13.3 High Voltage Substations

Electrical discharges can occur when working near high voltage equipment. This discharge is typically felt by workers working in an insulated situation and making contact with earth, e.g. standing on an insulated step ladder or mobile platform and then touching an earthed structure in a high voltage substation.

When working in a substation near live mains and apparatus, temporary structures and moveable plant must be continuously bonded to earth.

Other control measures may also include:

- Semi conducting boots
- Personal earth straps
- Earth bonds to equipment

The above measures will ensure that personnel are at the same potential as the structural steel work and prevent any electrical discharge.

Note: Often, the involuntary reflex action of a person on encountering electrostatic discharge causes greater physical injury than the discharge itself. Greater awareness is required when working in areas susceptible to electrostatic discharge.

20.13.4 Cables

Considerable voltage potentials can remain in long cable runs particularly high voltage for some time following certain testing tasks. This will typically be from high voltage testing, but other causes should not be discounted (e.g. adjacent energised cables).

Long cable runs should be discharged and earthed following isolation, and again after testing, to eliminate any risk of electric shock.

20.14 Cold Cathode Lighting Systems

Examples of cold cathode lighting systems include neon lights, and some fluorescent fixtures used to illuminate buildings, etc.

These lighting systems may have open circuit voltages up to 15,000 volts. No portion of the system should be touched whilst energised. Any work or replacement of component parts shall not be performed unless the system is isolated.

20.15 Portable Generators

All portable generators to be used shall be approved by a SCEE Supervisor before use on site. The installation shall be in accordance with AS3010 Electrical installations - Generating sets .

All 240V and 415V outlets fitted to generators and welders shall be RCD protected. All electrical panels associated with generators shall be lockable as per Section 6.3 - Access to Electrical Panels and Enclosures.

Earth electrodes shall not be used on portable generators. Trailer or vehicle mounted generators need to be earthed if they are connected to a building's electrical system or another earthed electrical installation.

Generators shall not be operated in locations where exhaust gases, smoke or fumes could reach dangerous concentrations or enter either directly or indirectly any enclosed areas occupied by persons.

In addition, generating sets shall not be installed —

- in damp situations or exposed to the weather unless suitably protected;
- in hazardous areas, unless the equipment and method of installation is in accordance with AS/NZS 3000 and AS/NZS 60079 (series) and the requirements of any relevant regulatory authority; or
- in locations that would provide a fire hazard for the fuel tank(s) and associated fittings provided for the generator set.

20.16 Vegetation Control Near Overhead Powerlines

For safety reasons, tree pruning near powerlines shall only be carried out by trained and competent persons.

All persons who are required to undertake vegetation management work near live overhead power lines must be trained and assessed as competent for work undertaken in the selected category prior to commencing the work.

Only those Vegetation Management Workers who have successfully completed training in the requirements for vegetation worker electrical safety can carry out work on vegetation management within the a danger zone.

Trainees may assist a suitably authorised vegetation management worker but only under the direct supervision of that vegetation management worker.

The danger zone of an overhead power line is anywhere that:

a) is at the same height as, higher than, or not more than the specified distance lower than, the power line conductors; and
b) is directly above or below, or not more than the specified distance to either side of, the power line conductors.

The specified distance is:

a) 3 metres for an overhead power line carrying electricity at a nominal voltage of not more than 33000 volts; and
b) 6 metres for an overhead power line carrying electricity at a nominal voltage more than 33000 volts.

20.17 Welding Equipment

All parts of welding circuits, including output leads and work return paths, should be considered electrically alive. Welding personnel should ensure that no part of their body is placed in such a position as would complete a conductive path for the passage of electric current.

General purpose outlets (GPOs) on welding machines shall be protected by an RCD.

VRD's (Voltage Reducing Device) shall be tested for correct operation in accordance with the requirements of AS 60974.1 section 13.1 this test will be completed using an internal test switch or by an external testing device.

Inspection and the use of welding equipment shall be performed by competent personnel every 3 months.

21 References

Documents, both internal and external, that are referenced within the content of this procedure, including Australian and International Standards and legislation.

New Document ID	Document Title
SCEE-BS-EC-PRO-0001	Electrical Legislation Compliance WA
SCEE-BS-EC-PRO-0002	Electrical Legislation Compliance QLD
SCEE-BS-HS-PRO-0005	Electrical Isolation and Tag Out
SCEE-BS-HS-GUI-0001	Event Notification Guide
SCEE-OP-OP-PRO-0003	Measuring and Test Equipment
SCEE-BS-HS-WIN-0020	Portable Ladders
SCEE-BS-HS-WIN-0019	Mobile Elevated Work Platform (High Risk)
SCEE-BS-HS-PRO-0017	Working at Height (High Risk)
SCEE-BS-HS-WIN-0008	Identification and Removal of Redundant Cable and Equipment
SCEE-BS-HS-TEM-0002	Dust and Fibrous Materials Management Plan

22 Related Documents

Related documents are those that have a relationship with this document.

Document ID	Document Title
	Code of Practice for Persons working on or near energised electrical installations (Energy Safety WA)
	Code of Practice for vegetation worker electrical safety (Energy Safety WA)
	National Guidelines for safe approach distances to electrical apparatus - ENA NENS 04-2006
	Qld Work Health and Safety Act 2011
	Qld Work Health and Safety Regulation 2011
	Queensland Electrical Safety Act
	Queensland Electrical Safety Regulations
	Queensland Managing electrical risks in the workplace Code of Practice 2021
	Queensland Safe working and supervision guide for electrical apprentices
	Queensland Work Health and Safety Act
	Queensland Work Health and Safety Regulation
	WA Electricity (Licensing) Regulations 1991
	WA Electricity Act 1945
	WA Safe working guidelines for electrical workers and apprentices
	WA Work Health and Safety (General) Regulations 2022
	WA Work Health and Safety (Mines) Regulations 2022
	WA Work Health and Safety Act 2020