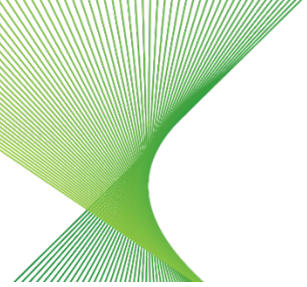


Safe Work Practices on Low Voltage and Mechanical Apparatus

CONTROLLED DOCUMENT



Summary

This work instruction supports the Power System Safety Rules and its requirements assembled under Work on Low Voltage and Mechanical Apparatus - Category 4 and describe safe work practices to be followed for the control of hazardous situations.

It applies to the installation, maintenance, repair, inspection and testing of Low Voltage and Mechanical Apparatus in the charge of a Controller.

Revision no:	3	TRIM No:	D2003/2373	Approval/ Review Date:	11/11/21
Business function:	Manage Health, Safety and Environment			Document type:	Work Instruction
Lumea circulation:	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Process owner:	Head of HSE				
Author:	Kitchener Morris, PSSR Manager				
EM approval:	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
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1. Overview

1.1. Purpose

This work instruction supports the Power System Safety Rules and its requirements assembled under Work on Low Voltage and Mechanical Apparatus - Category 4 and describe safe work practices to be followed for the control of hazardous situations.

1.2. Policy Base

Document
Power System Safety Rules

1.3. Reference Documents

Document No.	Document
AS4836:2011	Safe working on or near low-voltage electrical installations and equipment
-	Operating Process for Access to Low Voltage and Mechanical Apparatus
-	Access for Work on Low Voltage and Mechanical Apparatus.
-	Isolation and Restoration of Protection and Metering Equipment
D2005/18807	Low voltage - Joint Panel Outcomes

1.4. Scope

This work instruction applies to the installation, maintenance, repair, inspection and testing of all Low Voltage and Mechanical Apparatus in the charge of a Controller.

1.5. Accountability

Responsible person	Responsibility
Head of Health, Safety and Environment	Ownership of this procedure
PSSR Manager	Maintenance of this procedure
Training Manager	Implementation of training programs associated this procedure
Authorised persons	Comply with this procedure

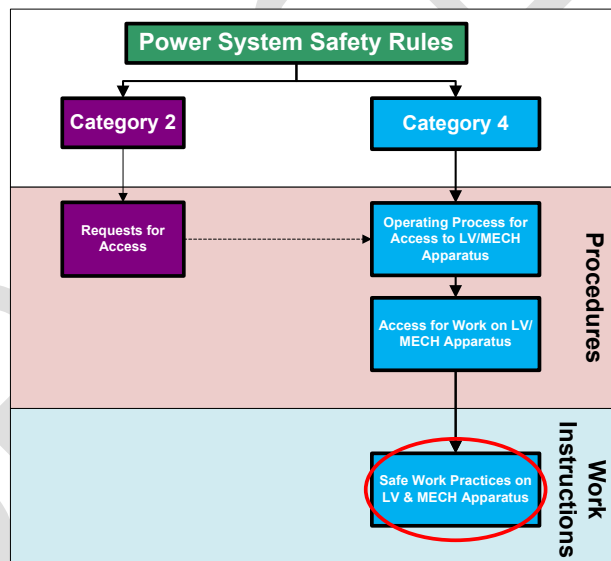
1.6. Definitions

Term	Definition
Extra-Low Voltage (ELV)	A nominal voltage not exceeding 50 volts AC or 120 volts ripple free DC
Low Voltage (LV)	A nominal voltage exceeding Extra Low Voltage but not exceeding 1,000 volts AC or 1,500 volts DC

Mechanical (MECH) apparatus	Any equipment that has the ability to rotate, or is pneumatic or hydraulic in nature or contains stored energy through mechanisms, liquid, thermal or gas contained within the equipment.
PMWI	An instruction which has been prepared and independently checked and which describes the equipment to be worked on, the work to be performed and the isolations to be performed prior to the commencement of work.
LVMPRI	A Low Voltage Mechanical Preparation Restoration Instruction which is used to ensure safe work conditions are in place for work under an Low Voltage and Mechanical Access Authority
Test/Testing	Work where the modification of some or all safety isolations or Access Authority earths is necessary and as a result, additional safety precautions are required to be implemented to ensure the safety of personnel. Testing may include operational checks, the application of test voltages or the application of Mechanical Energy. Testing does not include the application of extra Low Voltages or voltages produced by an insulation testing device operating at 1000V or below, provided it is not connected to a length of cable or a capacitor with a capacitance greater than 4000pF.

1.7. Document Location

Block diagram showing location of document in relation to others.



2. Introduction

This work instruction was developed as a guide to assist in selecting the correct safe work practices to be used when performing work on or near low voltage or mechanical (LV/MECH) apparatus in the charge of a Controller. Work may only commence on or near LV/MECH apparatus when it has been made safe for work and an LV/MECH Access Authority has been issued.

Work on or near electrical installations not in the charge of the Controller shall comply with Category 3 of the Power System Safety Rules.

The safe work practices contained within this work instruction protect workers from the hazardous occurrences or effects that can develop on or around LV/MECH apparatus.

This could be caused by operation of the apparatus, or through indirect interference from activities such as panel drilling, installation of new LV wiring, investigation of faulty supervisory alarms, etc., and result in injury to workers, inadvertent operation of HV equipment or preventing operation of HV equipment.

This work instruction sets out a range of hazardous situations, the controls (safeguards) to be implemented and describes the safe work practices which must be observed.

These safe work practices are to be used in conjunction with Transgrid's Risk Assessment Process. The process may identify that additional controls are required for particular tasks and situations.

3. Low Voltage and Mechanical Apparatus Hazards

Prior to undertaking work on LV/MECH apparatus, hazards shall be identified and controlled. The following hazards shall be considered:

3.1. Identification of equipment that is safe for work

Equipment on which work is to be carried out must be readily identifiable. Where necessary a means of identification shall be fixed to it which will remain effective throughout the course of the work.

3.2. Dangerous voltages

Dangerous voltages can occur from:

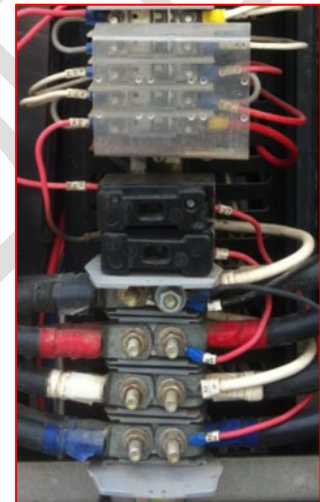
- Open circuit CT secondary circuits;
- Induction on cable sheaths, conductors; and
- Capacitors.

3.3. Exposed live conductors

3.3.1. Dangers can arise from:

Exposed or live adjacent equipment;

- Bare or damaged conductors;
- Inadvertent energisation;
- Short circuit conditions (battery); and
- Inadequate precautions or isolations for LV work.



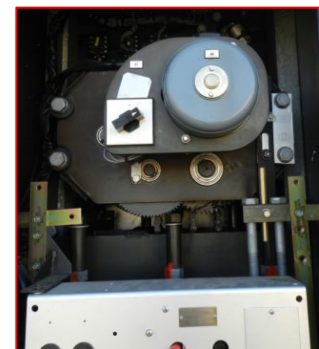
3.4. Pressure Systems & Stored Energy

Dangers can arise from the accidental release of stored energy from:

- Mechanical systems such as springs and other mechanisms;
- Gas systems such as accumulators;
- Batteries;
- Pressure storage vessels such as air systems and SF6 circuit breakers.

3.5. Rotating or moving parts

Some equipment can operate automatically without warning. Dangers can arise from rotating and moving parts such as HV apparatus control mechanisms, pumps and fans.



3.6. Other factors

Risks can be increased by:

- Cramped working conditions and Confined spaces;
- Multiple sources of supply;

- Damp situations;
- Environmental factors, e.g. heat, cold, vibration, noise and proximity of other work functions;
- Working at heights;
- Operational pressures to carry out work or to restore electricity supply;
- Unstable work area;
- Material containing asbestos;
- Hazardous substances;
- Inappropriate practices and procedures; and
- Working alone.

3.7. Low Voltage and Mechanical Hazardous Situations

The following table lists typical situations encountered when working on LV and MECH apparatus and the controls to be implemented.

Situations	Hazards	Controls	Reference
Installing, preparing, decommissioning, cutting and removal of cables	Live LV Cables	Safe work practices: Cables	This document Section 4.5
Discovery of abandoned cables in cable trenches and basements	Live LV Cables	Safe work practices: Cables	This document Section 4.5
Disturbing in service potentially damaged or deteriorated cables	Live LV Cables	Safe work practices: Cables	This document Section 4.5
Work on LV systems not in charge of the controller	Live LV Cables	Safe work practices: Work on Low Voltage systems not in charge of the controller	This document Section 4.18 PSSR cat 3.1.3
Work on 50v DC systems	Exposed live conductors	Safe work practices: Work on Extra Low Voltage	This document Section 4.17
Work on 110 - 130v DC systems	Exposed live conductors	Safe work practices: Work on Extra Low Voltage	This document Section 4.17
Work on control system RTU panels	Exposed live conductors	Safe work practices: Work on Extra Low Voltage	This document Section 4.17
Visual inspection work near live LV exposed conductors	Exposed live conductors	Safe work practices: Visual inspection work	This document Section 4.14 PSSR 4.0
Removing a barrier (e.g. a screwed cover) that exposes LV conductors	Exposed live conductors	Safe work practices: Removal of barriers requiring the use of a tool	This document Section 4.15
Work on Voltage Transformer secondary circuits	Exposed live conductors	Safe work practices: Voltage Transformer secondary circuits Operating Process for Access to High Voltage Apparatus	This document Section 4.7 GD SR G2 140

Situations	Hazards	Controls	Reference
Work on secondary circuits of CT's	Dangerous Voltages	PMWI LV/MECH Access Authority Safe work practices: CT Secondary Circuits	GM AS P2 001 PSSR 4.1 & TRIM No D2004/7798 This document Section 4.6
Electrical work e.g. relay maintenance; panel drilling; testing for the integrity and operability of energised circuits and apparatus or other work on or near live exposed conductors	Exposed live conductors	LVMPRI or PMWI LV/MECH Access Authority Safe work practices: Work on or near live exposed conductors	GD SR G2 140: GM AS P2 001 PSSR 4.1 & Trim No D2004/7798 This document Section 4.9
Fault finding	Exposed live conductors	Safe work practices: Authority for work Work on or near live exposed conductors	This document Section 4.2 This document Section 4.9
Electrical work on circuits containing capacitors	Dangerous Voltages	LVMPRI LV/MECH Access Authority Safe work practices: Capacitors	GD SR G2 140 PSSR 4.1 & TRIM No D2004/7798 This document Section 4.9
Work on batteries and power supplies	Short circuit conditions Hazardous areas	LVMPRI LV/MECH Access Authority Safe work practices: Batteries, Chargers and Power Supplies	GD SR G2 140 PSSR 4.1 & TRIM No 2004/7798 This document Section 4.11
Installation and commissioning of electrical circuits	Exposed live conductors	LVMPRI LV/MECH Access Authority Safe work practices: Cables ; Testing electrical work prior to energising ; and Unfinished electrical work	GD SR G2 140 PSSR 4.1 & TRIM No 2004/7798 This document Sections 4.5, 4.13 & 4.14
Work on mechanical systems such as springs and other mechanisms; Gas systems such as accumulators; pressure storage vessels such as air systems; and SF6 circuit breakers	Pressure Systems & Stored Energy	Isolating Mechanical Apparatus and LVMPRI LV/MECH Access Authority Safe work practices: Mechanical apparatus	GD SR G2 140 Section 7 PSSR 4.1 & TRIM No 2004/7798 This document Section 4.20
Work on mechanical moving parts such as CB mechanisms, pumps and fans	Rotating or moving parts	Isolating Mechanical Apparatus and LVMPRI LV/MECH Access Authority Safe work practices: Mechanical apparatus	GD SR G2 140 Section 7 PSSR 4.1 & TRIM No 2004/7798 This document Section 4.20

4. Safe Work Practices on Low Voltage, Extra Low Voltage, and Mechanical Apparatus

Safe work practices are applicable to all Low Voltage (LV), Extra Low Voltage (ELV) and Mechanical (MECH) Apparatus working situations.

Low Voltage examples ---- 240V DC batteries, 240V DC control supplies, 240/415V AC circuits

Extra Low Voltage examples ---- 50-120V DC batteries, 120V DC control supplies

Mechanical examples ---- any equipment that has the ability to rotate, or is pneumatic or hydraulic in nature or contains stored energy through mechanisms, liquid, thermal or gas contained within the equipment.

To work on LV/Mech Apparatus, it is necessary to determine whether it is safe to do so. This is done before starting work by applying the Transgrid Risk Assessment Process at each and every work site. The process shall identify all reasonably foreseeable hazards and environmental considerations (e.g. position of exposed energised conductors or live conductive parts, cramped conditions, moving equipment, hot or wet conditions and other factors).

4.1. Isolation Procedures

The switching, isolation or disconnection procedures and other necessary precautions appropriate to the work being carried out shall be carried out in accordance with Operating Process for Access to LV/Mech Apparatus.

4.2. Authority for work

For normal routine maintenance or construction work an Access Authority shall be issued before any work commences on apparatus in the charge of a Controller, in accordance with Access for Work on LV/Mech Apparatus.

Fault finding or other emergency work under the direction of the Controller would not normally require an Access Authority to be issued. Controls for work on or near live exposed conductors must be in accordance with section Work on or near live exposed conductors.

4.2.1. Testing of LV/Mech apparatus

Where the testing of apparatus is required a Testing LV/Mech Access Authority shall be issued in accordance with PSSR Rule 4.2.3.

4.3. Work Area Assessment

Safety shall not be compromised because of operational pressures to carry out the work. All work shall be planned and organised to minimise the risks associated with the work. An assessment shall be carried out at the work site before starting work to assess risks that have the potential to cause harm or damage.

If any person is required to work on or near LV/MECH apparatus, a person authorised PSSR Category 4.3 shall identify appropriate control measures to be adopted.

In some cases the identification and possibility of encroaching on or near energised ELV and LV conductors or apparatus will be obvious, e.g. terminal strips, cables and bus rails. In other cases it will not

be immediately obvious, e.g. power tools drilling into structures and work equipment that can extend onto conductors.

4.3.1. Awareness

All persons, including electrical workers, supervisors, safety observers and those assisting workers working on or near LV/MECH apparatus, shall understand the scope of the work and the potential hazards involved.

4.3.2. Trafficable areas

Persons working near traffic areas, including vehicular and pedestrian, should employ approved traffic management procedures, install suitable screens, barriers, signage and, if necessary, lighting for personnel safety and protection. Caution should be exercised and appropriate preventive action taken when working in a passageway or narrow access area, e.g. where a door could potentially be opened or closed and propel persons into energised ELV and LV conductors or apparatus, it should be restrained while work is being undertaken.

4.3.3. Illumination

Work areas shall be provided with lighting that is both adequate and suitable for the work and emergency evacuation.

4.3.4. Identify the safe area of work

The safe area of work should be identified by erecting barriers or warning signs or by other approved means if necessary. All personnel who are to work in the safe area shall be advised of its limits and the location of any adjacent exposed energised conductors, live conductive parts and mechanical hazards. Example methods include:



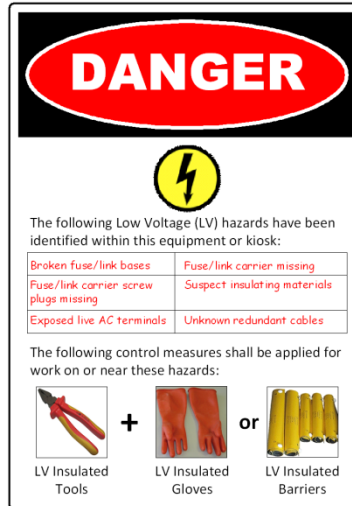
Barrier in



Barrier out

4.3.5. Danger Low Voltage Hazard

If the access door to a cabinet, kiosk or panel has a Danger Low Voltage Hazard notice affixed it indicates that an exposed LV hazard has been identified beyond. Work requiring access to this area shall be in accordance with section 4.9 work on or near live LV conductors.



4.4. Tools and equipment for work

4.4.1. Tools and PPE

Tools, PPE and barriers for work on or near live ELV or LV conductors shall have insulation rating appropriate for the work (minimum, 650V)and their condition inspected prior to commencing an activity. Typical examples include:



LV Insulated Tools



LV Insulated Gloves



LV Insulated Barriers

Tools, electrical equipment or plant with exposed conductive parts such as metallic tape measures, rules, reinforced tapes and ladders, shall not be used on or near live ELV or LV conductors.

4.4.2. Inspection of tools and equipment prior to use

All tools and testing equipment shall be inspected to ensure it is functioning correctly and in a serviceable condition prior to each use. Unserviceable tools or equipment shall not be used e.g. hand tools with damaged insulation.

4.4.3. Short circuiting and earthing equipment

There is no specific Australian Standard for this type of equipment for ELV and LV use, so the following should be used as a guide:

- Conductors should be stranded with a current carrying capacity suitable for the application;
- The current carrying capacity of the shorting and earthing conductors should relate to the size of the circuit conductors;
- Cables should be at least single insulated (with PVC or similar);
- Connections should be bolted or screwed via spade type terminals, not attached with alligator clips; and
- The short circuiting and earthing device should be electrically continuous from phase to phase and phase to earth.

4.5. Cables

4.5.1. Decommissioning of ELV and LV cables for removal

Any cable removal work in a substation shall use the [“Low Voltage Cable Removal check sheet”](#).

A Pre Work Risk Assessment must be completed and a SWMS/WASP must be completed for the cable removal works to be performed.

During decommissioning of cables a person authorised PSSR Category 4.3 is to ensure cables and their conductors are, by use of an LVMPRI:

- Positively identified; and
- Isolated from all energy sources and the isolation secured with Do Not Operate tags; and
- Proven de-energised (including all cable cores and screen/sheath).

Following this the person 4.3, or a person authorised 4.1 working under an LV/MECH Access Authority shall ensure that the cables are:

- Disconnected at both ends (where possible) ; and
- Where it is not intended to immediately remove the cable, LV rated insulation is applied to exposed conductors and cable ends and Warning Tags applied to both cable ends.

Where it is planned to remove the cable (within 7 days) the cable is to be marked to show it is ready for removal and the LV Cable removal check sheet is to be updated to record that the cable is ready for removal works.

4.5.1.1. Disconnecting LV cabling to an external party

When disconnecting LV cabling that runs between a Transgrid site and the site of an external party the [“LV Cable Isolation and Removal Checksheet – for use when disconnection of external party services is required”](#) must be completed to ensure that the status of cabling is known and acknowledged between the two parties. For further information refer to the Site Management Handbook section 2.9.

4.5.2. Removal and cutting of ELV and LV cables

4.5.2.1. Base Controls

- The Person in charge of the cable removal works shall be authorised 4.1 to supervise the works.

- All works to cut and segment cables that are connected within cabinets, panels and trenches must be performed by persons authorised 4.1.
- Workers providing manual handling assistance to handle and pull out cables shall be authorised 4.0.
- Cables must be treated as live unless clearly marked as isolated and proven de-energised.
- Before commencing cable removal works, the Person in charge of the cable removal is to confirm that the cable removal schedule states that the cable is isolated, proven de-energised and ready for removal.

All workers removing cables shall wear LV insulating gloves with protective outers when:

- Handling cables situated in trenches, panels and cabinets, or when working in the vicinity to other live cables or conductors
- Performing cable cutting works
- There is any risk of cutting or damaging a live cable/s

When segmenting cables for manual handling reasons, identification and marking is to be transferred to the new cable end.

4.5.2.2. Positive identification

When workers are segmenting cables, they must ensure cables are positively identified prior to cutting to prevent the wrong cable being cut. Only one cable is to be cut at a time.

Methods of identification are:

Visual:

- Tracing the cable hand over hand; and
- Pulling and pushing of the cables (with two persons working together)

Signal Injection:

- A transmitter is connected to the cable to be traced and sends a carrier signal which a non-contact receiver detects (verified by two persons).

Workers removing cables must identify the cable either side of any obstructions

4.5.2.3. Remote Cutting

Remote cutting of cables is acceptable where:

- You cannot view of the entire length of the cable, and
- You cannot use the push/pull or hand over hand methods for the entire length of cable, and
- You cannot trace the entire length of cable either side of an obstruction with an approved LV identifier, and
- At least one end of the cable has been proven de-energised and marked.
- An approved remote operated insulated shearing device is used by a person authorised PSSR category 4.3.
- An exclusion zone of 5m is established while the cable is being cut.
- The cable is proven de-energised immediately after being cut.

4.5.2.4. Completion of work:

- When workers have removed a cable, the LV Cable Removal check sheet is to be updated.

- While LV cable removal works are in progress the LV Cable Removal check sheet must be kept in readily accessible location.
- Any cables remaining in place after completion of the removal works shall be capped with LV rated insulation and identified with Warning Tags and any available information. Refer to section 4.17 for further requirements for unfinished work.
- In addition, short circuiting must be applied between all cores of 240v or three phase 415v cables which remain in place at the completion of the works, this is to prevent accidental re-energisation.

4.5.3. Installing new cables

Where work involves the installation of new cables into existing in-service panels, secondary boxes, distribution boards, marshalling kiosks, etc. workers shall be authorised PSSR category 4.1 or instructed persons.

Where possible, exposed LV conductors are to be isolated and proven de-energised by a person authorised PSSR category 4.3.

Where it is not possible to isolate exposed conductors, LV gloves with protective outers shall be worn when SAD cannot be maintained. Additional controls such as LV barriers can be installed.

4.5.4. LV cable stripping

When work involves stripping and preparing LV cables for termination, approved enclosed bladed strippers and cut proof gloves shall be worn. Exposed bladed tools such as Stanley knives are not to be used.

4.5.5. Abandoned Cables

When abandoned cables are discovered in cable trenches or basements, the cables shall be treated as live and any exposed conductors of the cable are to be treated as exposed LV. A SAD of 250mm is to be maintained or LV gloves shall be worn until a person authorised PSSR category 4.3 ensures the cable and any associated exposed conductors are positively identified, isolated, proven de-energised and made safe (as per 4.5.1.).

4.5.6. Potentially damaged or deteriorated cables

Where work will disturb in-service potentially damaged or deteriorated LV cables or which could come into contact with abandoned cables (e.g. any work involving handling cables in cable trenches and basements) persons shall be authorised PSSR Category 4.1 or instructed persons. Persons shall wear LV insulated gloves with protective outers for this type of work.

4.6. Current transformer secondary circuits

The secondary circuit of a current transformer (CT) must not be open circuited while the primary circuit of the CT is live, as a high voltage may be induced in the secondary winding of the CT and on associated secondary circuits and links. CT secondary links and circuits must be short circuited and earthed prior to opening any part of the circuit.

4.7. Voltage Transformer secondary circuits

Voltage Transformer (VT, CVT, MVT) secondary circuit voltages are nominal 110V AC phase to phase. VT secondary circuits require a low voltage SAD of 250mm or insulated contact only. Operation of slide links or the removal of fuse/link cartridges shall be performed with approved LV insulated tools or the use of LV insulated gloves. Persons shall be authorised PSSR Category 4.3 to operate VT secondary circuits as part

of a LVMPRI. Where VT links/fuses are to be operated as part of a HVPRI, persons shall also be authorised PSSR category 5.5 or 6.5.

4.8. Work on de-energised conductors

Work on de-energised low voltage apparatus shall only proceed if the apparatus is made safe by completing an LVMPRI and any other exposed conductors or conductive parts in the work area are either:

- De-energised and isolated via an LVMPRI; or
- Separated by LV barriers or an appropriate SAD based on a risk assessment.

All electrical apparatus shall be treated as energised until proven de-energised.

4.9. Work on or near live LV conductors

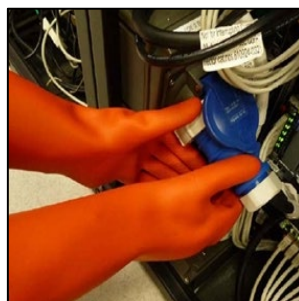
Fault finding, testing for the integrity and operability of energised circuits and apparatus or other work on or near live LV conductors shall only be performed when it is not practical to de-energise. Persons working on or near live LV conductors shall be authorised PSSR category 4.3 and apply a safe system of work that includes:

- a. A Risk Assessment and/or Work Method Statement is completed prior to the commencement of the work and appropriate control measures are documented and implemented for all identified hazards;
- b. Exposed live conductors must be clearly identified and their isolation points identified and accessible.
- c. All jewellery or conductive material must be removed prior to commencing work on or near LV conductors
- d. Where there is potential for inadvertent contact with live exposed conductors the use of; guards and barriers, LV insulating covers over the exposed conductors, or wearing of LV insulating gloves must be used.
- e. The work area is clear of any obstructions, adequate access and egress are available and a LV rescue kit is available at the work area;
- f. Where the Risk Assessment and/or Work Method statement identifies that it is necessary to have a safety observer, then work shall not be undertaken without the presence of a safety observer competent in LV rescue and CPR; and
- g. Appropriate tools, personal protective equipment (PPE) and/or LV barriers are used.



LV Insulated Tools

+



LV Insulated Gloves

or



LV Insulated Barriers

4.10. Capacitors

Capacitors and associated circuitry shall be proved de-energised and fully discharged before commencing work on them and their associated circuit wiring. This may be achieved by using and maintaining, for the duration of the work, approved safe discharging devices or by following the manufacturer's instructions. Immediately before performing work a voltage tester shall be used to prove that these units are discharged. The voltage tests shall be on an appropriate DC scale of the tester.

Care shall be taken against the harmful effects of arcing when applying discharging devices. Short-circuiting or earthing of capacitor terminals with metal objects such as spanners or screwdrivers can result in electrocution, arcs, flash burns or electric shock and shall not be attempted. Refer [short circuiting and earthing equipment](#).

4.11. Batteries, chargers and power supplies

Persons carrying out work that involves Batteries, Chargers and Power Supplies must ensure:

- The site Workplace Risk Assessment is reviewed;
- Controls noted on battery room doors are implemented;
- Battery rooms are adequately ventilated by means of the natural or forced ventilation provided;
- Eye wash facilities are available;
- Correct PPE for battery work is worn;
- Personal effects such as pens, keys, metal watches, jewellery, are removed prior to commencing work. If personal items such as wedding rings cannot be removed, they should be covered with gloves or other material to prevent accidental contact between them and live electrical parts
- Only insulated tools are used;
- Battery supplies are isolated;
- Chargers and power supplies are checked for residual charge or proven de-energised; and
- Workers are aware of and control stored energy retained by the battery.

Risk of injury from explosion, fire and associated equipment damage exist in battery rooms, especially during recharge. Actions that should not be undertaken in battery rooms include:

- Any form of hot work including welding or brazing;
- Use of a hacksaw, drilling or grinding of any type;
- Impact of a hammer or chisel onto concrete or metal; or
- Rubbing or movement of plastics, nylons and polyvinyl materials.

Refer also to: WASP working on batteries

4.12. Testing electrical work prior to energising

To assist with the tests required prior to energising, reference should be made to:

- AS 3017 - Electrical installation testing; and
- AS 4836 - Safe working on low-voltage electrical installations.

These publications give guidance on how to carry out the relevant tests and alternative methods may be adopted providing the alternate methods achieve the safety outcome intended.

4.13. Unfinished electrical work

When work is left unfinished, suitable measures shall be taken to ensure that persons are not exposed to hazards. These measures may include:

- Insulating exposed conductors;
- Physically securing cables;
- Tagging and taping off cables;
- Informing relevant parties that work is not complete;
- Taking reasonable precautions to ensure that cables cannot become live;
- Ensuring that points of isolation are clearly labelled in relation to circuits; or
- Short circuit conductors to earth to prevent energisation.
- Recording the location and controls applicable on the site hazard board.

4.14. Visual inspection work

Where visual inspection work is required near live exposed LV conductors, a SAD of 250mm shall be maintained. Persons shall be authorised PSSR category 4.0 for visual access to behind panels, tunnel boards, secondary boxes and marshalling kiosks.

4.15. Removal of barriers requiring the use of a tool

Where work involves the removal of a barrier requiring the use of a tool (e.g. screwed cover, screwed/bolted hinged panel) if possible, exposed LV conductors shall be isolated and proven de-energised by a person authorised PSSR category 4.3. Where not possible to isolate exposed LV conductors, LV gloves and/or barriers shall be used and installed until completion of work.

4.16. Missing Low Voltage barriers

When missing or ineffective LV 230/240vAC or 110vAC barriers have been discovered in a work area, workers shall maintain a SAD of 250mm or use LV gloves and/or install temporary barriers. Where a barrier can be easily replaced following a risk assessment, this shall be done using insulated work methods. Where a barrier cannot be easily replaced or is damaged then:

- Details are to be recorded on the site hazard board
- A defect needs to be raised
- A danger low voltage hazard label attached

4.17. Work on Extra Low Voltage

Extra low voltage is defined as a nominal voltage not exceeding 50vAC or 120vDC. Typical examples include 48vDC comms systems, 50vDC alarm systems, and 110/120vDC control systems. When working on ELV systems, persons shall ensure conductors have been made safe to work on via an LVMPRI. Where not possible to isolate supplies persons shall use insulated tools or gloves to work on ELV systems. The safe approach distance for ELV is insulated or non-contact.

4.18. Work on Low Voltage systems not in charge of the controller

When working on low voltage systems not in charge of the controller (230/400vAC light & power circuits, building air conditioning, hot water services, etc.) workers shall be authorised PSSR category 3.1 or

supervised by a person authorised PSSR category 5.2 and appropriately qualified to perform the work. All work shall be completed in accordance with PSSR category 3.1.3 Electrical work.

4.19. Bonding of conductors

Differences may develop in the voltages of local earths with respect to the general mass of earth due to the presence of earth fault currents, particularly when earth faults occur on high voltage conductors or equipment, driving high fault currents through the earthing grid at substations.

Such differences in earth voltages may cause harm from electric shock to any person exposed to them. Therefore, where such voltages may be transmitted along conductors from a remote position, the conductors and equipment to be worked on should be bonded to a local earth before work commences. This ensures that should any earth voltage difference between the remote point and the work site occur during the work, the person in contact with the conductors or equipment will not be exposed to that difference.

Where the work risk assessment identifies the need for bonding, the conductors shall be bonded together and connected to the general mass of earth at the work site. Bonding to earth may be affected by connecting conductors to the earthing system with conductors that are adequate to carry the potential short circuit currents to the electrical installation earthing system. The cross-section area of the conductor shall not be less than 4 mm².

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

Appropriate tools and personal protective equipment (PPE) shall be used when attaching or removing temporary bonding conductors.



LV Insulated Tools



LV Insulated Gloves

4.20. Mechanical apparatus

When work is to be performed on mechanical apparatus all materials, substances, agents or conditions that pose a risk to the health and safety of the persons required to work on the mechanical apparatus shall be isolated in accordance with Operating Process for Access to LV/Mech Apparatus Section 7 - Mechanical Operating Work.

Control measures taken to isolate mechanical apparatus shall:

- a. Prevent the activation or energising of apparatus or services including secondary sources of energy that are likely to adversely cause the activation or energising of the mechanical apparatus;
- b. Ensure, if required, the mechanical apparatus is unwound, un-tensioned or drained, vented and depressurised;
- c. Prevent the introduction of materials or substances through equipment such as piping, ducts, vents, drains, conveyors, service pipes;
- d. Prevent the uncontrolled movement or rotation of the mechanical apparatus; and
- e. Ensure, where practicable, that the devices isolating the mechanical apparatus are tagged and secured.

5. Accountability

Title	Responsibilities and Accountabilities
Head of HSE	Ownership of this procedure
Power System Safety Rules Manager	Maintenance of this procedure
Training Manager	Implementation of training programs associated with this procedure
Authorised Persons	Comply with this procedure

6. Implementation

This work instruction is to be implemented in conjunction with the implementation of Transgrid's Power System Safety Rules. It will be available as a resource, published on the Wire.

7. Monitoring and Review

The Head of Health, Safety & Environment is responsible for the ongoing monitoring and review of the documents associated with the Power System Safety Rules. This can include but is not limited to:

- Requesting regular feedback on the effectiveness of procedures and work instructions. Appropriate feedback tools include focus groups and online assessments;
- Where a change has occurred in our processes; and
- Recommendations arising from incidents.

8. Change history

Revision no	Approved by	Amendment
0	Lionel Smyth, EGM/Network Services & Operations	Replaces 'Work On Low and Extra Low Voltage Apparatus - GM SA G2 004'.
1	K McCall, Manager/Health, Safety and Environment	All significant new additions and alterations from Revision 0 have been highlighted in this version by a vertical sidebar. The following has also been altered:

		Revised accountability for this work instruction; Attachments deleted
2	Michael Gatt, EM, Works Delivery	Inclusion of information relating to the document Low Voltage – Joint Panel Outcomes prompting change in processes and recommendations arising from incidents.
3	Krista-Lee Fogarty, Head of HSE	<ul style="list-style-type: none"> Sections 4.5.1 and 4.5.2 updated and Appendix B removed with detail consolidated in these sections and the new LV Cable Removal check sheet. Section 4.5.1.1 added for disconnecting cables to external parties. Updated to new Transgrid branding template

9. Attachments

Appendix A – Gloves

SUPERSEDED

Appendix A – Gloves

Electrical safety insulating gloves are among the most important articles of personal protection for electrical workers. A glove system consists of:

Insulating gloves - Classified by the level of voltage and protection they provide.	Liner gloves - Reduce the discomfort of wearing rubber insulating gloves in all seasons, for year round use.	Outer protector gloves - Worn over rubber insulating gloves to provide mechanical protection against cuts, abrasions and punctures.
		

A.1 Inspection before use

Before use, insulating gloves are to be visually inspected for use by date, cuts, tears, perishing and distortion. Gloves are to be pressure tested for pinholes by sealing the entry to the glove and compressing the air trapped within by rolling the glove on itself. Listen for escaping air to detect holes, loss of air indicates that the glove is defective. **Insulating gloves found to be defective or out of date shall not be used.**

Step 1: Hold glove downward and grasp cuff.	Step 2: Twirl glove towards your body to trap air inside. Squeeze glove to look for damage	Step 3: Hold glove to face and feel & listen for escaping air
		

A.2 Precautions in use

Care should be taken to avoid mechanical damage caused by abrasion or sharp edges. Remove all jewellery and sharp objects from your hands or arms before wearing gloves. Insulating gloves are not to be exposed unnecessarily to heat or light or allowed to come into contact with solvents, oils or other chemical agents. If outer protective gloves are used at the same time as insulating gloves, they should be shorter than, and worn over, the insulating gloves. If the outer gloves become damp, oily or greasy, they should be removed. They should also be removed from the insulating gloves when the latter are not in use.

When insulating gloves become soiled, they are to be washed with mild soap and water and allowed to dry before storing.

A.3 Storage

Insulating gloves shall be stored in their natural shape, removed from outer protective gloves, inside a canvas bag and away from chemicals, direct heat, and out of direct sunlight. Tools and equipment must not be stored in the same bag as insulating gloves.



A.4 Procurement

[Safety Gloves - Stockcodes](#)

SUPERSEDED