



SWITCHING MANUAL



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Office of the Technical Regulator**

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Original	May 2001	
1	July 2001	Section 17 – to clarify that electrical equipment may be energised without written confirmation provided that appropriate systems are in place.
2	June 2004	Document completely revised to reflect the change from the SAIIR to ESCOSA. Reference to section 7.2 of the transmission code added for clarity re connection agreements. Some definitions amended. Contact list updated.
3	August 2012	Various editorial amendments; updated references to legislation, codes and standards. Committee contact list updated. Various amendments to update manual in line with current codes and practices.
4	November 2017	Amended Section 3 to reflect transfer the administration of the Switching Manual from the Essential Services Commission of South Australia to the Office of the Technical Regulator and associated legislative requirements. 19.3.3. Reports to external organisations – updated reference to WHS Act electric shock reporting.
5	June 2018	Changes to section 5.4 to include a risk-based application of international standards for PPE. Deletion of section 11 “Magnetic & Electric Fields” to avoid duplication or inconsistencies with the referenced ENA EMF Handbook. Other minor changes/clarification, and update of Switching Committee.
5.1	March 2019	Committee contacts updated. Various formatting changes.

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REFERENCE STANDARDS

The switching committee has identified the following standards (without limitation) that are either referred to in this Switching Manual or referred to in associated Acts and Regulations. It is essential that the applicable standards are understood and adhered to for all operational and OHS&W aspects of High Voltage switching.

AS/NZS 1336	Recommended Practices for Occupational Eye Protection
AS/NZS 1801	Occupational Protective Helmets
AS/NZS 2210	Occupational Protective Footwear
AS 2225	Insulating Gloves for Electrical Purposes
AS2550	Cranes, hoists and winches - Safe use - General requirements
AS/NZS 2978	Insulating Mats for Electrical Purposes
AS/NZ 3000	Australian/New Zealand Wiring Rules
AS 2865	Safe Working In Confined Spaces
AS 4202	Insulating Covers for Electrical Purposes
AS 5804.1	High-voltage live working – General
AS 5804.2	High-voltage live working – Glove & Barrier work
AS/NZ 60479	Effects of current on human beings and livestock
AS 61010.1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
ENA NENS 09	National Guidelines for Selection, Use & Maintenance of Personal Protective Equipment for Electrical Hazards
ENA EMF Management Handbook	ENA EMF Management Handbook

INTRODUCTION

1. Principle

The Switching Manual has been developed to define the High Voltage (HV) switching and associated safety policies for all electricity entities and HV customers in South Australia in accordance with the *Electricity Act 1996* (the Act).

2. Purpose

The policies in this Manual define the boundaries, interfaces, coordination requirements and safety principles to be observed by electricity entities when switching HV electrical equipment. In accordance with the electricity entity's licence, as required by *Electricity (General) Regulations 2012* Regulation 13A(10) and *Electricity Act 1996* Sections 22, 23 and 24A (1a), electricity entities must develop a detailed internal switching manual and safe work procedures for their staff and contractors and for specific equipment. Entities' internal manuals must be developed in accordance with policies and safety principles set out in this manual.

This Switching Manual covers the key aspects of HV switching and assists in providing a safe environment for the personnel of electricity entities, their contractors and the general public. This manual will also assist in providing for the secure, safe and reliable operation of electrical equipment at the various network interfaces as well as associated plant.

3. The Electricity Act 1996

The Switching Manual has been prepared, and is revised as required, by the Switching Committee comprising representatives of: electricity entities licensed to generate, transmit or distribute electricity in South Australia; a high voltage customer representative; and the Office of the Technical Regulator (OTR), in accordance with the requirements of the *Electricity Act 1996*. Appendix A provides details of the committee members and contact details.

One of the objectives of the *Electricity Act 1996* is to:

“establish and enforce proper standards of safety, reliability and quality in the electricity supply industry”

where, for the purpose of the Act, the electricity industry means the industry involved in the generation, transmission, distribution supply and sale of electricity.

The Electricity Act defines the functions and powers of the Commission, established under the *Essential Services Commission Act 2002*, who licenses electricity entities. The Electricity Act also establishes and defines the functions of the Office of the Technical Regulator.

3.1. Functions of the Technical Regulator

The Technical Regulator has the following functions under the *Electricity Act 1996*:

- the monitoring and regulation of safety and technical standards in the electricity supply industry; and
- the monitoring and regulation of safety and technical standards with respect to electrical installations; and
- the administration of the provisions of the Act relating to the clearance of vegetation from powerlines; and
- the monitoring and investigation of major interruptions to the electricity supply in the State and the provision of reports relating to such interruptions in accordance with any requirements prescribed by the regulations; and
- any other functions prescribed by regulation or assigned to the Technical Regulator by or under the Act or any other Act.

The *Electricity (General) Regulations 2012*, Regulation 13A adds:

- *the making of technical and safety standards relating to switching in connection with the safe operation of a transmission or distribution network, including in relation to electricity infrastructure or an electrical installation connected to, or used in connection with, a transmission or distribution network (the switching manual).*
- *In addition, the switching manual may provide for any other matter relating to switching that the Technical Regulator considers appropriate.*
- *The Technical Regulator may vary or revoke the switching manual.*
- *The Technical Regulator may, before making, varying or revoking the switching manual, consult with such representative bodies and participants in the electricity supply industry as the Technical Regulator considers appropriate.*
- *The Technical Regulator must—*
 - *give notice of the making, variation or revocation of the switching manual to each electricity entity to which the switching manual applies; and*
 - *ensure that a copy of the switching manual (as in force from time to time) is published on a website determined by the Technical Regulator.*

- The switching manual, or a variation or revocation of the switching manual, takes effect from a date fixed by the Technical Regulator and the Technical Regulator must—
 - give notice of the date fixed to each electricity entity given notice of the making, variation or revocation; and
 - publish notice of the date fixed on a website determined by the Technical Regulator.
- The switching manual published by the Technical Regulator may—
 - be of general or limited application; and
 - provide that a matter or thing in respect of which the switching manual applies is to be determined according to the discretion of the Technical Regulator, or any other person determined or approved by the Technical Regulator; and
 - provide for exemptions to be granted (with or without conditions) by the Technical Regulator, or any other person authorised by the Technical Regulator; and
 - apply, adopt or incorporate, with or without modification, any code, standard or other document prepared or approved by a body or authority referred to in the switching manual as in force from time to time or as in force at a specified time.
- If a code, standard or other document is applied, adopted or incorporated in the switching manual—
 - a copy of the code, standard or other document must be published on a website determined by the Technical Regulator; and
 - in any legal proceedings, evidence of the contents of the code, standard or other document may be given by production of a document apparently certified by or on behalf of the Technical Regulator as a true copy of the code, standard or other document.

Defined in Regulation 13A:

internal switching manual—an internal switching manual is a manual prepared by an electricity entity

relevant entity means the holder of a relevant licence or a person exempted from the requirement to hold such a licence;

relevant licence means any of the following licences under the Act:

- a licence authorising the generation of electricity;
- a licence authorising the operation of a transmission or distribution network;
- a licence authorising system control over a power system;

switching manual—the switching manual is the manual prepared by the Technical Regulator.

3.2. Responsibilities of Electricity Industry Participants

The Commission licenses all generators above 100 kVA that generate electricity for sale or reward and all transmitters and distributors of electricity in South Australia.

A relevant entity must, in accordance with the switching manual—

- *provide such information and assistance as is required by the Technical Regulator for the purposes of preparing and maintaining the switching manual; and*
- *prepare and maintain a manual (an internal switching manual) which—*
 - *specifies the technical requirements of the relevant entity in relation to switching; and*
 - *is consistent with the switching manual; and*
 - *addresses all matters set out in the switching manual relevant to the operations of the relevant entity; and*
- *ensure that any person with whom the relevant entity enters into—*
 - *a connection agreement relating to network services provided by the relevant entity; or*
 - *an agreement to perform work to which the switching manual relates for the relevant entity,*

is required under the agreement to comply with the relevant entity's internal switching manual.

The above defines the legal framework that requires the licensees to comply with the developed Switching Manual.

All customers connecting to either the distribution network or transmission network sign a connection and supply agreement or are covered by the network service provider's (NSP) standard connection and supply agreement. Compliance with the Switching Manual is one of the requirements of such agreements. Therefore, the requirements of the switching manual apply to all participants in the electricity industry whenever one party is required to perform a high voltage switching function at the interface with another participant in the SA electricity industry or within the electricity network.

3.3. Review

The Switching Committee will monitor switching incidents in the electricity industry in South Australia and amend this manual if, and when, required.

The Switching Manual will be kept under constant review and at a minimum, reviewed every five years.

DISCLAIMER

Live High Voltage (HV) electrical plant and apparatus is inherently very dangerous. Contact with, or being in close proximity to, HV apparatus can cause death or severe injury and could expose persons to other possible hazards if appropriate safe work practices are not observed. Any activity associated with, or in the vicinity of, HV plant and apparatus should only be undertaken responsibly and with extreme care.

This Manual sets out the general principles that must be included in the detailed internal Switching Manual that relevant electricity entities and customers, connected to a HV network, are required to develop.

This Manual is not a substitute for the development of a detailed internal Switching Manual. Internal Switching Manuals must be developed by persons who have appropriate experience and relevant qualifications for that task. Further, internal Switching Manuals should be adapted to the working environment and the nature of the plant and apparatus of the relevant electricity entity or HV customer.

The Board of Directors, (or persons with an equivalent level of responsibility) for each relevant electricity entity and for each HV customer, is ultimately responsible for ensuring that internal Switching Manuals are developed in accordance with this manual. They are also responsible to ensure that persons working with HV equipment are appropriately trained and authorised and that there is rigorous compliance with the Entity's internal Switching Manual.

Notwithstanding the above, the members of the Switching Committee that developed this Switching Manual, their employers and the Technical Regulator are not responsible, nor accept liability, for the content of the detailed internal Switching Manuals developed by the respective electricity entities, nor for any non-compliance by persons with those manuals. Nor are they responsible, nor do they accept any liability, for persons who fail to observe a sensible and cautious approach to any activity connected with, or in the vicinity of, HV plant and apparatus.

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PEOPLE

4. Training and Authorisation

4.1. Principle

It is the responsibility of the Entity or Authorised Person to ensure that appropriate training, qualification and authorisation is established for all persons performing switching on High Voltage electrical apparatus.

4.2. Purpose

At all times during switching activities, safety to personnel and the public shall be the primary objective. Personnel must be trained and must have the necessary skills to understand known existing hazards as well as to identify potential hazards and risks and understand how to deal with hazards if they arise. Processes to authorise personnel shall be developed and implemented by the Entity.

4.3. Training Requirements

Training courses will consist of identified learning outcomes and will be knowledge, skill (task), and attitude based. Where appropriate, the course shall reflect National Electricity Supply Industry Competency Standards (where they exist). The Entity or Authorised Person must ensure that systems of training are documented and that records are maintained in accordance with industry based competency standards.

4.4. Approved Training Courses and Processes

Entities must approve course descriptors and service providers as meeting their recognised needs in accordance with recognised industry standards. The descriptors of each course shall include learning outcomes, assessment criteria and assessment methods.

4.5. Rescue and resuscitation training

In accordance with Clause 68 of the Regulations, persons required to carry out, or assist in carrying out, HV switching must be suitably trained in rescue and resuscitation in accordance with recognised practices in the electricity industry.

Persons undertaking remote or supervisory switching are excluded from this requirement.

4.6. Records

Entities must develop and maintain an appropriate management system for the recording of all training and authorisations.

4.7. Frequency of training

Competency testing, refresher training, and first aid refresher training shall be conducted at appropriate intervals in accordance with recognised industry standards.

5. Personal Protective Equipment for Switching Purposes

5.1. Principle

It is the responsibility of the Entity or Authorised Person to ensure that appropriate, fit-for-purpose, Personal Protective Equipment (PPE) is made available to, and used by all, persons performing switching on HV electrical apparatus.

5.2. Purpose

At all times during HV switching activities, safety of personnel remains the primary objective. A person working on, or near, live apparatus must wear clothing and use equipment which gives appropriate full-body protection from exposure to electric shock, flash, noise, falling objects, arcs, burns or other possible hazards.

5.3. Equipment Requirements

The Entity or Authorised Person is required to undertake a risk assessment to establish and document the minimum level of PPE required for all HV switching activities. In the case of a specific or new switching activity, a further risk assessment must be undertaken to determine any additional PPE requirements or changes to the minimum level of PPE.

Personnel required to wear items of PPE are not to modify, damage or use PPE in a way contrary to manufacturer's instructions or the training provided for that particular item of PPE.

5.4. Use of Equipment

The Entity or Authorised Person must ensure that PPE is worn and used in accordance with manufacturers' recommendations, recognised electrical industry practice, company practice and/or Australian Standards.

An Entity may apply a standard of an internationally recognised organisation, provided it has undertaken a risk assessment to establish that compliance with such international standard will provide the same or higher level of protection as provided by Australian standards. The risk assessment may take into consideration the operational risks of that specific entity.

5.5. Records

The Entity or Authorised Person must ensure systems and records exist to maintain, test and inspect PPE for switching in accordance with manufacturers' recommendations, electrical industry practice, company practice and/or Australian Standards.

5.6. Frequency of testing

Equipment testing and inspection shall be conducted at intervals in accordance with the relevant standards or as defined by the Entity or Authorised Person and, where appropriate, additional testing or inspection carried out if necessary. Items of PPE that are defective or out

of test date are to be immediately withdrawn from service and must be sent for inspection, repair or, if necessary, disposal.

6. Personnel Health Aspects

6.1. Principle

It is the responsibility of the Entity or Authorised Person to ensure that all employees are provided with safe systems and a safe place of work in accordance with the relevant Occupational Health and Safety Acts, Regulations and Guidelines.

6.2. Purpose

To ensure that work in the vicinity of live electrical apparatus is carried out in accordance with documented safe work practices. Hazard identification and risk assessment shall be carried out prior to doing any work and precautions are to be taken that are consistent with the identified risks.

6.3. Work in the vicinity of Electric and Magnetic Fields

Persons working on, or in the vicinity of, electrical apparatus shall be appropriately protected from electric shocks. Protection from any known effects associated with strong electric and magnetic fields should also be taken into consideration.

For minimum safe personal limits and exposures reference must be made to relevant sources. Likely sources of information include, but are not limited to;

- South Australian Government – Technical Regulations,
- ESAA/ENA publications and guidelines,

ELECTRICAL PLANT

7. Electrical Plant Identification & records

7.1. Principle

Electrical plant, which includes switching devices and sources of electrical energy, must be adequately identified.

A record system must also be provided that identifies the connection of switching devices relative to the electrical plant and the source of electrical energy.

7.2. Purpose

Identification and record systems ensure that correct devices are operated during switching and that all sources of energy can be identified and isolated to ensure personnel and plant safety during switching.

7.3. Electrical Plant and switching device identification

7.3.1 Electrical Plant Identification

Electrical plant must be adequately identified to ensure that the operators and work groups can correctly identify electrical plant that is to be, or has been, isolated.

7.3.2. Switching device identification

All switching devices must be uniquely identified with a reference name and/or number to ensure that operators can correctly identify the switching device to be operated.

7.3.3. Switching device labelling

Prominent labels with the switching device identification name and/or number must be installed or painted adjacent to or on the device to ensure that the device can always be positively identified prior to operation

7.3.4. Switching activities

During all switching activities, the unique reference name or number must be used to identify the switching device to be operated.

7.4. Records System

A records system must be maintained which identifies the connections of electrical plant and switching devices and their capability.

7.4.1. *Purpose of records system*

The records system should provide for the safe planning and operation of switching to ensure that the correct switching methodology and processes are identified, particularly switching devices, points of isolation and earthing locations.

7.4.2. *Changes to Records*

Appropriate procedures must be provided to ensure that the records are updated when the electrical network is altered. This includes the provision of updates to those responsible for switching and advice to other entities that would be involved in the switching of that part of the network.

7.4.3. *Records system accuracy*

Responsibilities must be defined for ensuring the accuracy of the records system, the authorisation of changes to the records system and the allocation and installation of switching device identification.

8. Insulated Tools and Test equipment

8.1. Principle

Appropriate insulated tools and test equipment must be provided for the switching operations. Insulated tools and test equipment must be fit for purpose and maintained and operated appropriately.

8.2. Purpose

Insulated tools are required so as to ensure that people are not exposed to unsafe voltages and currents, as referred to in AS/NZ 60479 – “Effects of current on human beings and livestock”, when the tools are used.

Test equipment must be provided that is:

- a) suitable for the required testing and

- b) operated correctly and maintained in a safe operating condition to ensure correct operation of the equipment, to avoid injury to people and avoid damage to the test equipment or plant.

8.3. Tool and Equipment testing

All HV insulated tools and equipment that require regular testing to prove the effectiveness of the insulation must be tested at specific intervals by an approved body where required or in accordance with manufacturers' recommendations or accepted industry practice whichever is applicable. The tested item must be marked, eg via an identification plate, so that a user can determine whether the item is due for testing. Test equipment that requires calibration must be tested and calibrated in accordance with manufacturers' recommendations or accepted industry practice to ensure that it is in proper working order. Test and calibration records must be kept by the Entity.

Tools that are damaged, faulty or outside their limits of accuracy, must not be used and must be sent for inspection, repair, recalibration or if necessary, disposal.

8.4. Visual inspection

Insulated tools and test equipment should be visually inspected for defects prior to each use. The self-testing feature of test equipment, if available, should be used before the test equipment is operated for testing purposes.

PRACTICES AND METHODS

9. Work in Proximity to live Conductors and Live Electrical Equipment

9.1. Principle

The requirements necessary to enable safe work to proceed in proximity to, but beyond the required approach limits to, High Voltage (HV) electrical equipment must be clearly understood and observed.

Employees involved in HV switching or working near HV equipment, and their employers, must be aware of all Government Occupational Health, Safety and Welfare Acts, Regulations, Australian Standards and Guidelines relevant to this type of work.

If personnel are required to work in closer proximity to live HV electrical equipment than the approach limits permitted by the Electricity (General) Regulations 2012 (the Regulations), then the equipment must be proved dead and earthed or alternatively, live-line work techniques are to be implemented (refer to section 17).

9.2. Purpose

High Voltage equipment is potentially hazardous to personnel, especially where the equipment is not insulated. The primary hazard is electrical in nature. Electrical hazards may lead to severe burns, electrocution or death unless clearly-defined safety procedures are adhered to.

It is important to note that personnel are in danger of electrocution by bringing any part of their body, anything they wear, or any object they are carrying or in contact with (which is capable of conducting electricity), within the approach limit of any high voltage conductor. Within this distance an arc between the conductor and the object or person may occur, causing electrocution.

The following information and factors must be considered:

- The requirement for the provision of a clearance or access certificate;
- The location, nature and detailed description of work activities required to be carried out in proximity to normally live high voltage conductors or electrical equipment. Information on work activities shall be provided by the work party supervisor; and
- The present state of electrical equipment in the vicinity of the work area and its distance from the work location.

9.3. Approach Limits

To ensure that personnel are not injured when working near high voltage conductors, the approach limits between the worker or equipment used and the conductor or equipment are specified to ensure that safe working distances are maintained. Clause 64 of the Regulations specifies the approach limits for people with different skill levels.

9.4. Work Area Definition

A safe area in which work can be performed must be defined physically with the limits of isolation defined in writing.

Rope barriers, bunting or similar should be erected between the live high voltage electrical apparatus and the work area. At a minimum, this barrier must be set at the approach distance as defined under the Regulations from the live electrical apparatus for the respective voltage level. No personnel or equipment, or part thereof, shall violate the vertical plane indicated by the barrier.

When the area cannot be effectively defined by barriers, or the work party is not experienced in working near high voltage apparatus, a Safety Observer must be present.

9.5. Safety Observer

A safety observer shall be competent and experienced in working near high voltage apparatus, know and understand the minimum approach limits specified in the Regulations and be aware of the hazards involved.

When applying the minimum approach distance, caution should be exercised due to the uncertainty of estimating distances and for possible unexpected movements of the conductor, apparatus and nearby people or objects (especially from unstable positions).

The safety observer shall not perform any of the site work whilst observing and must not carry out any other work or function that compromises their role as a safety observer.

The safety observer's role is to be clearly communicated and understood. Their role is to be hazard and risk-aware and to continually observe that safety procedures are carried out by the electrical workers performing the work and to warn workers of danger, including the possibility of inadvertent contact with energised electrical circuits and apparatus. The safety observer must be able to warn and, if necessary, stop the work if, in the opinion of the safety observer, it is considered necessary to avert danger. The safety observer must be able to communicate quickly and effectively with the electrical workers performing the work.

The safety observer must also be capable of providing assistance in the case of an emergency and must be suitably attired with personal protective equipment appropriate to the situation.

10. Use of Cranes and Vehicles

The provisions set out in the Regulations, the Australian Standard AS2550 and relevant Codes must be observed during the operation of cranes, vehicles and machinery when in the vicinity of exposed electrical conductors. Cranes and vehicles must be earthed when used in the vicinity of live exposed conductors in accordance with AS2550. Where required, a Safety Observer must be present during operation of the vehicle or crane.

11. Isolation Practices

11.1. Principle

It is the responsibility of the Entity and Authorised Person to ensure that there are systems in place to identify the risks and required actions to safely isolate electrical plant and equipment prior to any work commencing.

11.2. Purpose

To ensure the safe isolation of all possible energy sources, the points of isolation and the risks involved in isolating the source should be identified. The point of isolation shall be uniquely marked to indicate potential danger to persons and equipment, and where possible, measures such as earthing systems must be employed to dissipate the energy from all possible sources should the isolation fail.

11.3. Operational Framework

Entities' systems shall include steps to:

- Complete an adequate hazard identification and risk assessment before work commences;
- Identify the required actions for isolating equipment;
- Ensure authorisation from an Authorised person is received before isolation and the commencement of work;
- De-energise equipment;
- Safely isolate equipment or sections of plant from the electrical and physical energy source to enable work to be carried out where necessary;
- Use systems to identify and highlight points of isolation;

- Ensure that the correct testing equipment is available and maintained in a fit state for use;
- Test and prove that equipment is dead;
- Establish a safe work area; and
- Provide the relevant training for personnel in all systems used.

Risk assessments shall include, but not be limited to:

- Review: check and verify all stages and key points of any applicable standard work procedures and permits required;
- Scope: all external and internal hazard sources including electrical circuits, hydraulic and pneumatic pressure systems and chemical residues;
- Neutralise: all hazards by isolating electrical and mechanical power systems and the dissipation of any residual energy by the venting, purging or draining of services from stored supplies. All stored energy in electrical and mechanical power systems must be restrained or dissipated by appropriate methods; and
- Identify: power, services and process connections by attaching locks and tags to switches, valves or controls.

12. Isolating, Proving Dead and Earthing

12.1. Principle

With the exception of work being performed using live High Voltage line procedures, work must not be carried out by direct contact with exposed high voltage conductors or exposed parts of high voltage equipment unless it has been isolated from all sources of electricity, proven dead and earthed by Authorised Persons. Earths must be applied where possible in accordance with approved procedures and good electricity industry practice.

12.2. Purpose

To ensure that apparatus is safely isolated from all possible sources of electrical or mechanical/pneumatic energy, that isolating points are created at each source of energy and that approved testing and earthing methods are implemented.

12.3. Isolating Apparatus for Work

12.3.1 *Electrical Isolation*

Where possible, electrical isolation is to be a visible break in the circuit(s), a distance commensurate to the voltage of the equipment and the insulating medium. Where the design of the isolating device does not provide for a visible break, the isolating device must be opened and the operating mechanism locked in an inoperative state, consistent with 13.3.2, 13.3.3 or 13.3.4 below, to ensure that any external control or action is not able to close the device.

12.3.2. *Mechanical Isolation*

Where required, the apparatus must be prevented from operating. This is done by the locked isolation of drives or removing and/or disconnecting shafts, couplings or linkages or by means of a mechanical device which is locked in place and engaged to prevent movement.

12.3.3. *Hydraulic (fluid)/pneumatic (gas) isolation.*

The apparatus must be isolated from all sources of pressure or fluid by placing a physical barrier in the circuit to prevent flow (e.g. by closing gates or valves, or by installing blanking plates).

12.3.4. *Gas Insulated Switchgear*

Gas-insulated switchgear (GIS), which generally comprises connect/disconnect and earthing capability, is fully enclosed. Visual confirmation of a break in the circuit may not be possible and therefore the GIS apparatus must be made safe and proved dead in accordance with the design elements specified by its manufacturer and with any supplementary actions determined by the entity and must be operated in accordance with good industry practice.

12.3.5. *Low Voltage series isolation*

Where there is the potential for HV apparatus to be energised from a low voltage source and it is not possible to install an earth near the isolation point, a second point of isolation may be established in series with the first isolation point. Low voltage series isolation points must be manually switched devices and at least one of the series isolation points

must be locked in the open position and an isolation tag installed on each of the series isolation points.

12.4. Testing (Proving Dead)

Live Line Test Indicators must be fit for purpose and of a fail-safe design for the particular application. They must be used to prove that both high and low voltage lines and equipment are dead after isolation and prior to the application of any earthing. If this is not possible (e.g. with metal-clad equipment or GIS), then the earthing device must be operator-independent and of fault-making capacity.

12.5. Earthing

Earths must be used to ensure the dissipation of electrical energy if the circuit becomes energised by:

- the isolation failing;
- induced voltages and currents;
- electrical energy due to lightning.

Only approved earthing devices shall be used and applied after the circuit or electrical apparatus is isolated and after confirmation (by tests, visual inspection or inquiry) that the conductors are de-energised.

Where possible, earths must be placed between the work location and all points of isolation. For line work and in substations, main earths should be connected at suitable poles or structures that are clear of the working position.

An earthing device shall be connected to earth before it is applied to the conductors and it shall be removed from the conductors before it is disconnected from earth.

Earths must be:

- Placed so that they are between each point of supply and the point of work;
- Placed so that they are visible to the work party where possible;
- Of low impedance so that the electrical energy will be conducted to earth rather than through other paths (e.g. a person);
- Able to carry the fault current without being damaged or destroyed;
- Applied and removed by trained persons using approved and maintained devices; and

- Securely connected in accordance with the relevant standard.

The earth path must not include apparatus such as fuses, reactors, power line carrier (PLC) line traps or transformers (except current transformers).

12.6. Low Voltage Earthing

Earths are applied to protect against:

- High voltage apparatus becoming live from the low voltage source; and
- Hazardous induced voltages.

All isolated low voltage circuits must be proven de-energised before they are worked on. A single main earth must be applied to the conductors being worked on. All phases must be earthed, with the neutral being the first conductor to be earthed and the last to be removed.

In **non**-Common Multiple Earth Neutral (CMEN) areas, a low voltage main earth must not be connected to the same earth point as any high voltage earth.

A portable earthing device shall be regarded as liable to become alive until the circuit earthing is complete.

12.7. Lock and Tag System

Locks and tags must be applied directly, or as near as possible, to a point of isolation.

The lock and tag system is a part of the switching program which must be approved by an Authorised Person.

There must be enough detail on the tag to clearly explain its presence. Information on the tag must clearly identify its purpose, the operator, the approved switching program number and when it was applied.

13. Operation of High Voltage Electrical Apparatus

13.1. Principle

Entities must ensure that there are systems in place to identify the risks, the required actions and the Authorised Persons to operate HV electrical plant and equipment prior to authorising the commencement of any work.

13.2. Purpose

To ensure safety during a high voltage switching operation, the available information regarding risk assessment and circuit conditions shall be taken into account. No electrical apparatus shall be operated if it is inappropriate for the duty to be performed. Written and authorised instructions shall be used to reduce the risk of incorrectly operating HV apparatus.

13.3. Switching Control

Entities must ensure that HV switching is controlled and co-ordinated. Entities must identify an Authorised Person (Control Authority) who is responsible for giving approval to proceed with any HV switching.

13.4. Switching Actions

For all HV switching, two persons must be present during switching operations except when the switching is done in accordance with documented procedures developed by the entities or under emergency conditions.

A switching program/schedule that clearly identifies the operators, equipment and required actions should be generated and authorised prior to any HV switching.

Isolation should be clearly identified in any switching schedule.

Switching in accordance with a switching program must not be undertaken unless each operator and checker:

- Has been briefed and fully understands the proposed switching and earthing;
- Has a complete copy of the relevant switching program;
- Has been authorised to conduct the switching; and
- Has the correct PPE & testing equipment.

A Switching Operator and a Switching Checker must be assigned and their names must be recorded on the switching program. In all cases, the Switching Checker must carefully and independently check each switching operation and its sequence for correctness. The Switching Checker must stop the switching operation should it become evident that the Switching Operator is about to perform an incorrect or unsafe switching operation. The Switching Checker must not unnecessarily talk with the Switching Operator. Unless a two-person operation is involved, the Switching Checker must stand well clear to check the correct identification of equipment by the Switching Operator.

Except in emergency circumstances, only authorised Switching Operators whose training, duties and instructions cover the particular electrical apparatus involved shall undertake switching and associated duties on HV electrical apparatus.

Note: When HV electrical apparatus is operated manually by grasping a metal handle the person undertaking the task shall be suitably protected in an approved manner from electric shock.

14. Emergency High Voltage Switching

14.1. Principle

Entities must ensure processes exist to perform HV switching for disconnecting supply when an emergency condition involving serious risk to persons or property exists.

14.2. Purpose

To reduce risk in the event of emergency circumstances, clearly defined processes should exist and Authorised Persons should be available to enable the delegation of authority to individuals to perform emergency HV switching operations.

14.3. Emergency Switching Actions

Switching must follow a Switching Program and normal switching procedure guidelines unless:

- In an emergency, when either a Switching Operator or a Switching Checker (or both) are absent, a specified Manager or Control Authority may authorise a suitable person to perform specified HV switching or checking if, in the opinion of the specified Manager or Control Authority, that person is capable of safely performing the required operations; or
- The switching operation is to open or close a circuit breaker or to open or close a recloser by an operator standing at ground level.

The Operator must inform the Authorised Person (Control Authority) that there is no Switching Checker present and must exercise extreme care in carrying out the switching operations and must work closely with the Authorised Person (Control Authority).

After switching, the electrical apparatus should be confirmed as operating correctly whenever possible.

15. Energising Conductors or electrical equipment

Conductors or electrical equipment must not be energised until it has been ascertained that:

- it has been handed over from the construction or maintenance operative in the form of written notification or by organisational procedures;
- all personnel are clear of the equipment and have been notified to treat the conductors or equipment as live; and
- The conductors or equipment is deemed safe to energise.

Before energising high voltage conductors or equipment forming a part of a distribution or transmission system, written confirmation, or alternatively verbal confirmation (receipt of which is recorded in writing), must be given to the Authorised Person advising that it is safe to restore the lines or equipment.

A protocol shall be developed to ensure that clear, unambiguous communication exists between parties involved in energising electrical equipment.

16. High Voltage live line work

High Voltage Live Line work and procedures must comply with AS5804 and the requirements of Regulation 67 including, without limitation to, the following:

- Written authorisation of the operator of the electricity infrastructure or electrical installation on which the work will be carried out;
- Appropriate training and competence to carry out the work; and,
- Clarification of the voltage of the infrastructure on which the work is being carried out.

In accordance with Regulation 68, an observer/assistant of the person performing high voltage live line work shall be suitably trained in the work being done and trained in resuscitation, releasing persons from live electrical apparatus and, if appropriate, rescuing persons from poles, structures, elevated work platforms or confined spaces.

The operator of the infrastructure or installation (or a contractor engaged by the operator) shall develop and maintain a Live Line Procedures Manual which must be made available to all persons involved in the live line work. This manual must contain as a minimum:

- a set of approved live line techniques or procedures
- a description of live line principles and requirements;

- a description of each live line tool, its functions, its uses and the determination of its safe working limits;
- instructions on caring for the tools and equipment; and
- information for use in the event of an emergency;

SWITCHING INTERFACE PROTOCOLS

17. Switching Interface Protocols

17.1. Principle

It is the responsibility of the Entity or Authorised Person to ensure that appropriate procedures and arrangements are prepared and used when switching at connections to, or between, a transmission system or distribution system.

17.2. Purpose

At all times during HV switching activities, safety of personnel and the general public is the primary objective. Switching that occurs at connection points to, or between, a transmission system or distribution system involves separate organisations and must be conducted in a manner that is agreed and coordinated between entities to ensure that there are no safety risks caused by communication or procedural difficulties or differences.

17.3. Agreed Procedures

Each Entity involved in connections to, or between, a transmission system or distribution system shall jointly develop and agree on procedures subject to the requirements for consistency which describe operations that include HV switching at the connection points.

17.4. General Content of Procedures

Procedures shall include specific details of the following items but not be limited to:

- Definition of Responsibilities;
- Identification of Authorised Officers;
- Communication arrangements;
- Planned switching arrangements;

- Emergency switching arrangements, including response to faults;
- Switching coordination arrangements;
- Documentation arrangements;
- Outage planning arrangements;
- Relevant asset information;
- Agreed operating boundaries;
- Relevant site security and entry arrangements; and
- Reporting arrangements for operations and incidents.

17.5. Consistency of Procedures

The procedures at the interface should be consistent where practicable to ensure that a Transmission or Distribution entity is not required to implement different switching procedures for different connection points.

17.6. Dispute resolution

Agreed procedures shall identify the arrangements for resolving disputes between the connecting parties. The procedure shall include an escalation regime so that a mechanism exists for handling all types of disputes (taking into consideration the significance and difficulty).

17.7. Review of Procedures

The procedures shall include the arrangements for review and shall be reviewed regularly and kept current.

17.8. Education and Training

Authorised Persons shall ensure that all persons involved in switching at connection points are trained in procedures applicable to that connection point.

INCIDENT INVESTIGATION AND REPORTING

18. Incident Investigation Reporting

18.1. Principle

Entities must ensure that processes exist to adequately and appropriately investigate and report switching incidents pertaining to their assets and employees.

18.2. Purpose

Switching incidents must be thoroughly investigated and reported to determine if existing work practices are adequate to cover the circumstances of a switching incident or need to be altered as a result of the findings of an investigation of a switching incident.

18.3. Procedure

18.3.1. Establishing guidelines for investigating incidents

An Entity must establish guidelines for determining how and when investigations are conducted into switching incidents pertaining to their assets. The guidelines must be developed to address at least the following possible incidents:

- injury or death to person(s);
- damage to plant or equipment;
- failure of high voltage switching equipment; and
- unauthorised deviations from the entity's existing processes.

The Entity must establish criteria for determining the level of investigation required. The severity of the incident should be used to determine the extent of the inquiry.

18.3.2. Reports of investigations of switching incidents

Reports into switching incident investigations should cover the following:

- the circumstances of the incident (what occurred, when and where it occurred, who was involved etc.), noting any injuries, burns or electric shock sustained by any persons;
- the factors contributing to the incident (how and why it went wrong);

- identification of variations from, or inadequacies in, existing safe work instructions, procedures or practices; and
- recommendations of required actions to prevent a recurrence.

Records must be kept of investigations into switching incidents. Appropriate feedback must be given to the Entity's personnel.

18.3.3. Reports to external organisations

If an accident happens that involves a fatality, electric shock, electrical burns or a prescribed fire caused by the operation or condition of electricity infrastructure or an electrical installation, a report must be made to the Technical Regulator of the details of the accident in accordance with Section 63 of the Act and Regulation 70 of the *Electricity (General) Regulations 2012*.

There is also a requirement to report these incidents to SafeWork SA under Part 3 of the *Work Health and Safety Act 2012*.

DEFINITIONS

Alive/Live	Means connected to any source of energy or subject to hazardous induced or capacitive voltages.
Apparatus	Means electrical apparatus and mechanical apparatus.
Approach limit	Means the minimum distance of approach to live electrical equipment for a person, including an article of clothing worn by a person, or a conductive object held or carried by the person as specified in the Regulations, applicable to the voltage, the skill level of the person and tools used by the person.
Approved	Means having appropriate organisational endorsement in writing for a specific function.
Authorised Person	Means a person with technical knowledge or sufficient experience who is trained, competent and provided with written approval to carry out a specific function.
Barrier	Means a rope, tape, barricade or alternative, erected in accordance with approved procedures that indicates limits of approach and defines an area of no access (eg operational barriers) to live electrical apparatus.
Cable	Means an insulated conductor, or two or more such conductors, laid together, whether with or without fillings, reinforcements or protective coverings.
Circuit Breaker	Means a switch suitable for opening a circuit automatically, as a result of predetermined conditions, such as overcurrent or under-voltage, or by some form of external control.
Commission	Means the Essential Services Commission of South Australia established under <i>Essential Services Commission Act 2002</i>
Confined Space	Means confined space as defined in Australian Standard AS 2865 "Safe Working In Confined Spaces".
Connection Point	Means the connection to or between a transmission system and a distribution system.
Control Authority	Means persons or persons authorised by the entity to control and co-ordinate switching.
Danger Tag	Means an approved tag, in accordance with Australian Standard 1319, affixed to a device as an instruction against the operation of the device.

Dead	Means electrical apparatus that has been isolated and proved de-energised.
De-energised	Means that the energy source (electrical, mechanical, hydraulic or pneumatic) to the apparatus has been removed, but not necessarily isolated.
Disconnected	Means the absence of electrical or mechanical connections to all sources of energy from which apparatus can be energised.
Distribution System	For the purpose of this manual the distribution system is high voltage equipment belonging to an electricity entity.
Earthed	Means electrical apparatus which has been connected by a conductor to the general mass of earth, so as to ensure and maintain the effective dissipation of electrical energy.
Electrical Equipment/ Apparatus/Plant	Means any electrical equipment, including overhead lines and underground cables, the conductors of which are live or can be made live.
Electricity Entity	Means the holder of a licence issued under the Electricity Act 1996 and includes a person exempt from the requirement to hold a licence who the Commission has determined, under section 80(2) of that Act, will be treated as an electricity entity for the purposes of that Act.
Entity	Means a licensed organisation under the Electricity Act or a customer of such a licensee.
Exposed Conductors	Means any electrical conductor, approach to which is not prevented by a barrier of rigid material or by insulation which is adequate under a relevant Australian Standard specification for the voltage concerned.
High Voltage (HV)	Means a voltage normally more than 1000 Volts alternating current (AC) or 1500 Volts direct current (DC).
High Voltage Enclosure	Means an area surrounded by fences, screens, walls or a cubicle to prevent access to exposed high voltage conductors. Any entrances must be kept locked unless in immediate use. A high voltage enclosure has "DANGER HIGH VOLTAGE" signs on all entrances and at intervals around the perimeter.
Insulated	Means separated from adjoining conducting materials by a non-conducting substance which provides resistance to the passage of current, to disruptive charges through or over the surface of the substance at operating voltage and to mitigate the danger of shock or injurious leakage current.

Insulated Tools	Means tools that provide protection for the user against direct contact with live electrical plant.
Isolated/Isolation	Means disconnection from all possible sources of energy by means that prevents unintentional energising of the apparatus and is a step in the process of making apparatus safe for access.
Isolation/Restoration Program	A documented procedure detailing the isolation and earthing/safeguarding needed to make apparatus safe and to allow safe access to it. Also, it is a set of steps to restore the apparatus to its normal operating state.
Isolator	Means electrical apparatus designed to disconnect a circuit already de-energised or a circuit so lightly loaded that, upon a contact opening, an arc would be self-extinguishing.
Low Voltage	Means a voltage not exceeding 1000 Volts alternating current (AC) or 1500 Volts direct current (DC), but greater than 50 Volts AC or 120 Volts ripple-free DC.
Low Voltage series isolation	Means the isolation of two series-connected low voltage devices where potentially, HV equipment could be energised from a low voltage source (e.g. back feed from a low voltage supply of a substation transformer tertiary winding), and earthing is not possible. At least one low voltage device must be locked open and isolation tags applied to both open devices.
Main Earths	Main earthing and short circuiting equipment that is applied for safety and operational purposes.
Mechanical Apparatus/Plant	Means any equipment used in the generation or supply of electricity that has the ability to rotate, or is pneumatic or hydraulic in nature or contains stored energy through mechanisms, liquid or gas, contained within the equipment.
Near	Means that a reasonable possibility exists that a person's body or an object being carried or touched could: come within the relevant approach limit; or approach or touch any apparatus in a way that risks their own or another person's safety.
Proving Dead	Means the procedure of using an approved voltage testing device to prove that electrical apparatus is de-energised.
Safe	Means not posing an unacceptable risk to life, health or property.

Safety Observer	Means a person competent for the task and specifically assigned the duty of observing and warning against unsafe approach to electrical apparatus or other unsafe conditions.
Screen	Means a fixture which physically prevents access to a hazard.
Shall/must	Is to be understood as mandatory.
Suitable Person	Means, in the context of switching during emergency circumstances, a person who, in the opinion of the specified Manager or Control Authority, is capable of safely performing the required switching operations.
Supply	Means all forms of energy including electrical, nuclear, thermal, mechanical, pneumatic, hydraulic, chemical or stored energy.
Switch	Means an item of electrical equipment designed to de-energise conductors when normal current is flowing in the circuit.
Switching	Means any operation or action involved in de-energising, energising or earthing a portion of electrical apparatus in accordance with a plan or switching program.
Switching Breach	<p>A failure to comply with the provisions of an Entity's Switching Manual or subordinate procedures such that personnel, assets or network security are compromised.</p> <p>A failure to comply with the provisions of this Switching Manual</p>
Switching Committee	A committee formed under the requirements of the Transmission Code, comprised of representatives of electricity utilities licensed to generate, transmit or distribute electricity in South Australia, high voltage customers and representatives from the Offices of the Technical Regulator and the Essential Services Commission of South Australia.
Switching Checker	Means a trained and authorised person who accompanies the switching operator during high voltage switching to independently check each switching operation.
Switching Devices	Means electrical plant that is designed to be used to disconnect or isolate electrical plant from sources of high voltage or to connect electrical plant to earth.
Switching Incident	Means an unintended occurrence during a switching operation, including any deviation from safe switching practices as documented in this manual, which may result in or have the potential to contribute to injury or death of personnel, asset failure or damage or inadvertent interruption of supply.

Switching Operator	Means a person performing the duties of their authorisation to operate a specific apparatus.
Technical Regulator	Means the South Australian Technical Regulator appointed under the <i>Electricity Act 1996</i> .
Test Equipment	Means equipment that permits tests to be undertaken on electrical plant.
Trained and Competent	Means a person who complies with legislative requirements to carry out their work safely.
Transmission System	Means High voltage equipment belonging to a licensed transmission entity.
Visible Break	Means the point at which conductors or isolating contacts are visibly separated by an appropriate distance. This distance is dependent on the insulating medium between the conductors.
Voltage	Means a potential difference between conductors or between conductors and the earth. Normally measured as Volts (V) or kilo-Volts (kV)
Warning Tag	Means an approved tag, in accordance with Australian Standard 1319, affixed to a device as a warning that this device shall not be operated or used except as indicated on the tag.
Working Earths	Means earthing and short-circuiting equipment that ensures equipotential conditions at the location where work is to be performed on electrical apparatus. NOTE: These earths, where required, are applied in addition to main earths.

APPENDIX A - SWITCHING COMMITTEE CONTACT DETAILS

NAME	ORGANISATION	POSITION	PHONE	E-MAIL
Reinhard Struve	Office of the Technical Regulator	Manager Infrastructure	8429 3306	reinhard.struve@sa.gov.au
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