



# Electrical Safety Rules

**Metro Trains Sydney**

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## 1.1 Purpose

As a part of the MTS Electrical (Electricity) Network Safety Management System, the MTS Electrical Safety Rules (ESR) sets out the rules and procedures to be applied for the safe operation and access to the MTS electrical network.

The ESRs include the following components:

- Hazards and Warnings
- General information
- Safe Approach to Electrical Equipment
- Access for Work on or near Electrical Equipment
- Switching Programs
- Low Voltage System
- Permits
- Reference Documents

If a conflict is identified between the ESR and the contents of any Electrical Operation manual or procedure, the ESR will apply.

## 1.2 Scope

The MTS electrical safety rules are applicable to the MTS electrical network, comprising of the low voltage distribution network, high voltage distribution network, and the traction power system.

These rules do not apply to MTS electrical installation equipment.

## 1.3 Conventions

Where instructions contain alphabetical identifiers, the order in which the list is carried out is not critical.

Where instructions contain a list using roman numerals, the points must be carried out in sequential order.

## 1.4 Electricity Network Safety Management System

This document forms part of the MTS Electricity Network Safety Management System (ENSMS) Element 32: Management of the Electrical Distribution Network. Rules developed for this document support and comply with the requirements of Element 32.

## 1.5 Document Review

This ESR will be reviewed and updated as required at intervals not exceeding three years in accordance with the requirements of the MTS SMS Element 6: Document Control and Information Management.

## 2 Terms & acronyms

### 2.1 Acronyms

Acronym	Technical Term
EPTW	Electrical Permit to Work
ESR	Electrical Safety Rules
ROM	Rail Operations Manual

Table 2 Acronyms

### 2.2 Substation names & abbreviations

Acronym	Substation name
BLV	Bella Vista station
BSP0	Bulk Supply Point Substation
BSS0	Bella Vista Traction Substation
CHE	Cherrybrook station
CHT	Cherrybrook Traction Substation
CHW	Chatswood station
CSF	Cheltenham Service Facility
CSH	Castle Hill station
CTN	Chatswood North Traction Substation
CUD	Tallawong station (formerly named Cudgegong Road)
DLS0	Delhi Rd Traction Substation
EPP	Epping station
ESF	Epping Service Facility
EST0	Epping Traction Substation

Acronym	Substation name
KVE	Kellyville station
LGDO	Lady Game Drive Traction Substation
MCV0	Macquarie University Traction Substation
MQP	Macquarie Park station
MQU	Macquarie University station
NRW	Norwest Station
BLV	Bella Vista Station
BSP0	Bulk Supply Point Substation
BSS0	Bella Vista Traction Substation
NTR	North Ryde Station
RSH	Rouse Hill Station
RSS0	Rouse Hill Traction Substation
SHT0	Hills Showground Traction Substation
SHW	Hills Showground Station
SMTF	Sydney Metro Trains Facility (formerly RTRF)

*Table 3 Substation names & abbreviations*

## 2.3 Definitions of common terms

Term	Definition
Approved	Unless otherwise stated, means approved in writing by the Electrical Manager or a person nominated for that purpose by the Electrical Manager.
Approved Prospective Permit Holders	Permit Holders that have previously been briefed in the permit including safe working area, isolation points and nearest live equipment by a Switching Operator.
Authorised / Authorisation	Has the permission of the appropriate organisation in writing for the duty concerned.
Authorised for substation access	Means a person authorised to enter a substation and in accordance with these rules undertake specific functions.
Authorised Person	'Authorised Person' means a person with technical knowledge or sufficient experience who has been approved, or has the delegated authority to act on behalf of the network operator, to perform the duty concerned (ENA NENS 04)
Authorised Switching Operator	See Switching Operator
Authority for Removal of Supply from 1500 Volt Sections, (Authority)	The MTS form, completed and signed, used whenever it is necessary to remove supply from a section or subsection of the 1500-volt overhead wiring system.
Barrier in	A method of establishing a barrier to define a safe work area which is within the confines of the barrier
Broad supervision	Means the worker does not require constant supervision but requires personal contact with an authorised person on at least a regular/occasional basis when working on electrical equipment. Regular/occasional basis means being under instruction and direction with checks being carried out on completion of multi-tasks and before energising of circuits and/or apparatus/equipment.
'Danger – Do Not Operate' Tag	A warning notice attached to a controlling switch or other equipment as a warning not to operate such equipment where this could cause injury to staff or damage to equipment. This tag must be a label, tape or other device with the word "DANGER – DO NOT OPERATE" displayed on it along with other relevant details.
Dead	Refer to de-energised
De-energised	Below a voltage at which it is safe to apply earths or rail connections, by disconnecting from all sources of supply, but not necessarily isolated, earthed / rail connected or out of commission.
De-energised section	A section of 1500 volt overhead wiring from which supply has been removed. <b>Warning:</b> Although a section of OHW is de-energised, this does not mean that the equipment or the section of the OHW is safe to work on.
Direct supervision	Means the personal supervision of a worker on a direct and constant basis, within visual contact and/or earshot (audible range). Constant basis refers to the continuous supervision of tasks being performed (for a trainee, direct supervision is provided until skill is demonstrated for the complexity of the task and work environment).



Term	Definition
discharged to earth, discharged	Connected to earth (earthed) or short circuited for sufficient time to ensure that any energy stored in capacitors, or in the electrical equipment or the cable capacitance, is discharged.
Disconnected	<p>Electrical equipment to which there are no electrical connections, and which cannot be made live by switching or the making of bridges.</p> <p>Withdrawable type circuit breakers, switches and switch fuses become disconnected equipment when fully withdrawn.</p>
Earthed	Earthed means directly electrically connected to the general mass of earth to ensure and maintain the effective dissipation of electrical energy.
Electrical Distribution System	<p>The independent electricity distribution network operated by MTS as an integral part of its rail operations. The network interfaces with the high voltage networks of the external adjacent Distributor via bulk supply points and includes associated control wiring.</p> <p>The network may consist of insulated cables and operates as a HVAC and LVAC power distribution network.</p> <p><b>NOTE</b> The 1500VDC Overhead Wire is not considered part of the electricity distribution network.</p>
Electrical equipment	<p>Electrical equipment which includes any generator, transformer, switchgear, reactor, capacitor, control gear, conductor, cable, rectifier or other electrical equipment, parts of which may normally be energised at a high voltage, low voltage or 1500 volts dc.</p> <p><b>NOTE</b> Electric rolling stock and electrical equipment within rolling stock are not regarded as electrical equipment</p>
Electrical Manager	See; Electrical Network Manager
Electrical Network	<p>The:</p> <ul style="list-style-type: none"> <li>• low voltage, high voltage electrical distribution system, and,</li> <li>• 1500-volt dc traction power system, and</li> <li>• the associated protection and monitoring systems.</li> </ul>
Electrical Network Manager	The person, specifically authorised under these rules with the appropriate delegated authority, engineering competence and experience to make judgements concerning electrical safety. The electrical network manager is delegated as the electrical authorising officer.
Electrical Permit	<p>An Electrical Permit to Work, a Test Permit, an Operating Agreement or variant as appropriate.</p> <p><b>NOTE</b> In some cases, this is abbreviated to Permit where it is clear from the context that it is referring to an Electrical Permit.</p>
Electrical Permit to Work	The pre-printed form completed and signed, which is issued by an Authorised Electrical Switching Operator to an Authorised Electrical Permit Holder, to define the electrical distribution or 1500-volt traction power equipment on or near which work may be carried out. The work and the extent of the electrically safe work area are described on the form.
Electrical Switching Operator	See Switching Operator

Term	Definition
Electrical work	<p>The actual physical work of:</p> <ul style="list-style-type: none"> <li>• constructing, installing, maintaining, repairing, altering, removing, testing, replacing, adding to commissioning or decommissioning, or</li> <li>• removing or restoring supply to, electrical equipment on the electrical system or the supervising of that work.</li> </ul> <p><b>NOTE</b> The erection, modification and dismantling of 1500-volt OHW support structures is not considered to be electrical work.</p> <p>Exemptions to 'electrical work' are listed in the Work Health and Safety Regulation section 146.</p>
Energised (live)	Connected to a source of electrical supply or subject to hazardous induced or capacitive voltages.
Engineering Controller	The MTS employee or delegate that is trained, competent and authorised to control the MTS electricity network. This role is a subset of Authorised Person.
Exposed electrical equipment	<p>Electrical equipment where approach to the normally live portion of the equipment is not prevented by a barrier, insulating material or an earthed metal shield.</p> <p>Exposed energised part means a part is:</p> <ul style="list-style-type: none"> <li>• exposed where it is bare or not effectively insulated or guarded by a fixed barrier or an earthed metal shield; or</li> <li>• energised until it is isolated and proven to be de-energised and not likely to become re-energised; if the part is a high-voltage conductor, it is considered energised until it is earthed.</li> </ul>
Extra low voltage	A nominal voltage not exceeding 50V ac or 120V dc.
Floating	Insulated from earth, rail and all sources of supply but where failure of such insulation may result in it becoming live.
General supervision	Means the worker does not require constant attendance of the supervisor but requires personal contact with an authorised person on a recurrent/periodic basis when working on electrical equipment. Recurrent/periodic basis means being under instruction and direction for tasks being performed with checks and tests being made prior to commissioning and/or energising of circuits and/or apparatus/equipment.
Height measuring stick	An insulated stick designed for measuring the height of live aerial conductors or other electrical equipment. They are usually telescopic with the lower sections being hollow and must have the integrity of insulation verified by testing at intervals not exceeding 12 months.
High voltage	<p>A nominal voltage that exceeds low voltage.</p> <p><b>NOTE</b> 1500-volt dc is treated as a high voltage special case in the MTS Electrical Safety Rules.</p>
Induction	Production of a magnetic or electrical state in a body by proximity (without contact) of an electrified or magnetised body.
Inspection	Non-invasive activities that do not meet the definition of work.

Term	Definition
Instructed Person	Instructed Person means a person adequately advised or supervised by an Authorised Person to enable them to avoid the dangers which electricity may create. (ENA NENS 04)
Insulator	An item or assembly consisting of non-conductive material and any associated intermediate couplings, used for the purpose of mechanically connecting electrical equipment at different potentials.
Isolated (electrically)	Disconnected from all possible sources of supply by opening of switches, withdrawal of circuit breakers, removal of fuses, links, bridges and / or connections, and rendered incapable of being made live without premeditated and deliberate operation, normally by the application of a lock and tag.
Line Manager	Is a MTS employee or delegate who has management responsibility, or in the case of a non MTS employee, "a person conducting a business or undertaking" (PCBU).
Live (alive, livened up)	Refer to energised
Live line work	All work performed on components of an aerial line or overhead wiring which is live, or capable of being energised, without implementing the full protective practice of isolating, proving de-energised and earthing / rail connecting at the worksite.
Local instruction	An operating instruction written for a specific item of electrical equipment. Local instructions are in place for electrical equipment for which the generic operating procedures are insufficient.
Low voltage	A nominal voltage exceeding extra low voltage but not normally exceeding 1000 volts alternating or 1500 volts direct current.  1500-volt dc is treated as high voltage a special case in the MTS Electrical Safety System
Low Voltage Access Permit, (LV Access Permit)	Refer to: Electrical Permit to Work
Low voltage distribution system	A system comprising all the low voltage electric wiring, cables, aerial lines, accessories, fittings, consuming devices, control and protective gear and other equipment used by an Electrical Network Operator for the purpose of the conveyance to, measurement and control of, electricity to one or more electrical installations. A low voltage distribution system may also include isolating transformers, the distribution main earthing system e.g., bond to water pipe, bond to earth electrode, attached earthed LV equipment, and earth bonding to an overbridge or footbridge supporting 1500-volt Equipment, changeover contactors, metering equipment, and other equipment.
Low voltage installation	All the low voltage electric wiring, accessories, fittings, consuming devices, control and protective gear and other equipment associated with the wiring situated in, on, or beyond any building, structure or premises to which electricity is supplied or is to be supplied through any one or more low voltage mains or submains from a substation or distribution aerial line. This includes substation general lighting and power but excludes equipment used for the transmission or distribution of electricity.
May	'May' indicates an optional course of action.
Metro Trains Sydney	The company engaged by Transport for NSW to operate the Sydney Metro Northwest, and City and Southwest networks.
Must	Indicates that a statement is mandatory

Term	Definition
Network Operating Protocol	An agreement between Electrical Distributors for the isolation and restoration of assets interfaced between the two organisations.
OHW rail connection stick	A specific type of operating stick used for rail connecting, testing and bridging both live and isolated 1500-volt dc overhead wiring conductors or equipment. Rail connection sticks are made of insulating material and must have the integrity of insulation verified by testing at intervals not exceeding 12 months.
Operating Agreement	<p>A form, completed and signed which is issued by one Electrical Network Operator to another, as an undertaking that the listed electrical equipment will remain isolated, proved dead and if required earthed or rail connected as appropriate until the form is returned.</p> <p>The work on the listed electrical equipment is carried out in accordance with the conditions specified on the Operating Agreement and the receiving Electrical Network Operator's Safety Instructions and Permit System.</p>
Operating Diagrams	The set of electrical diagrams comprising 1500-volt Sectioning diagrams, and HV System Diagrams.
Operating stick (rod)	An insulated stick used for operating or working on live high voltage or 1500V conductors or electrical equipment. Operating sticks are made of insulating material and must have the integrity of insulation verified by testing at intervals not exceeding 12 months.
Operating work	<p>Work involving any of the following:</p> <ul style="list-style-type: none"> <li>• the operation of switches, link switches and circuit breakers, or</li> <li>• use of specially insulated apparatus, or</li> <li>• the opening or closing of links or other connections intended for ready removal, or</li> <li>• the removal or replacement of fuses, or</li> <li>• proving that electrical equipment is de-energised, or</li> <li>• application and removal of earths and short-circuiting links, or</li> <li>• application and removal of rail connections.</li> </ul>
Out of Service tag / Caution tag	<p>Out-of-service or caution tags are used to identify electrical equipment that is not safe to use or fit for purpose. The out-of-service or caution tag should:</p> <ul style="list-style-type: none"> <li>• be an MTS approved out-of-service or caution tag</li> <li>• be durable and securely attached</li> <li>• clearly state the nature of the defect or reason why the electrical equipment is unsafe</li> <li>• be attached on a prominent position on each isolation point, and</li> <li>• only be removed by a competent person after fixing or rectifying the defect and making the electrical equipment safe or replacing with a danger tag in preparation to work on the equipment.</li> </ul>
Overhead Wiring or 1500 Volt Equipment or 1500 Volt Overhead Wiring or OHW	All 1500-volt direct current overhead wires and associated equipment that normally conducts, isolates or may be energised with a voltage of 1500 volts dc including the secondary circuit of rectifier transformers. For the purpose of Safe Approach Distances, negative equipment which is normally at rail potential (connected to rail) is not considered to be 1500-volt equipment.

Term	Definition
Overhead wiring structure	Any structure that supports or registers a catenary and/or contact wire, rigid conductor or supports ancillary equipment such as a field switch or surge arrester. These structures can include masts, portals, wood poles, overline bridges, embankments, and tunnels.
Permit Holder	A person trained and authorised by MTS to hold an MTS electrical permit at all voltages
Permit Holder (restricted)	A person trained and authorised by MTS to hold an MTS electrical permit on 1500v direct current overhead wire
Person / worker	Has the same meaning as 'worker' as defined in the Work Health and Safety Act 2011.
Person conducting a business or undertaking (PCBU)	Has the same meaning as 'PCBU' as defined in the Work Health and Safety Act 2011.
Person in Charge of the Switching Program	The Switching Operator who is authorised to, and holds the Switching Program for an isolation
Personnel Register	A pre-printed form bound to an electrical permit and used to record the names and signatures of all persons working under the Permit.
Plant	Equipment that when in an operating mode can modify its own operating envelope and could inadvertently encroach on clearances to electrical equipment.
Portable rail connecting equipment	A portable rail connecting equipment set consists of assemblies of insulated flexible cables and clamps and suitable insulated handles or sticks, which are used for connecting de-energised 1500 volt Overhead Wiring to rail. The equipment is designed to be applied from ground level.
Prove dead	See prove de-energised.
Prove de-energised	The process of proving that electrical equipment de-energised
Rail connected or rail connections	<p>The connection of the 1500-volt equipment to the negative return rail or busbar (traction rail) in the approved manner to ensure the immediate effective discharge of electrical energy from the 1500 volt equipment to rail in the event of the equipment concerned being, or becoming, live.</p> <p>Rail connection may be completed using a suitable connection including a switch or portable rail connection. While equipment may use terms including "short circuiting device", "maintenance" and "to rail" the term "rail connect / rail connection" is preferred.</p>
Railway Signalling Electric System	<p>All the low voltage electric wiring, cables, aerial lines, accessories, fittings, consuming devices, control and protective gear and other equipment associated with the wiring, installed for the operation of railway signals, points and associated control equipment to which electricity is supplied, or is to be supplied, through any one or more low voltage service mains from a low voltage distribution system.</p> <p>A Railway Signalling Electric System does not include:</p> <ul style="list-style-type: none"> <li>any part of any low voltage distribution system, or</li> <li>any part of any low voltage installation.</li> </ul> <p>A Railway Signalling Electric System generally commences at the secondary terminals of the isolating transformer(s), between the source of supply and the Railway Signalling Electric System.</p>

Term	Definition
Reasonably practicable	<p>Has the same meaning as 'reasonably practicable' as defined in the Work Health and Safety Act 2011.</p> <p><b>NOTE</b> Safe Work Australia provides an interpretive guideline on the meaning of 'reasonably practicable'.</p>
Safe Approach Distance (SAD)	<p>The minimum separation, in air, from an exposed conductor or exposed electrical equipment that must be maintained by a person, or any object held by or in contact with that person (other than insulated objects designed for contact with live conductors), or any mobile plant operated or controlled by that person.</p> <p><b>NOTE</b> Safe Approach Distances are defined in section 5</p>
Safe Work Method Statement (SWMS)	<p>Means a statement that:</p> <ul style="list-style-type: none"> <li>• Describes how the work is to be carried out</li> <li>• Identifies the work activities as having safety risks</li> <li>• Identifies the safety risks, and</li> <li>• Describes the control measures that will be applied to the work activities and includes a description of the equipment used in the work, the standards or codes to be complied with, the qualifications of the personnel doing the work and the training required to do the work.</li> </ul>
Safety earths	<p>Those earths that are applied to the electrical equipment as close as practicable to the points of isolation. It is not necessary that the conductors be continuous between the point at which the safety earths are applied and the worksite.</p>
Safety Observer	<p>A worker with sufficient knowledge and experience of the task being performed and assessed as competent for the duty of observing and warning against unsafe approach to electrical apparatus or other unsafe conditions</p>
Shall	<p>See "must"</p>
Short circuit and earth	<p>The procedure for connecting conductors together and connecting them to earth by approved means so that the conductors are at earth potential.</p>
Short circuiting	<p>The bonding of conductors by approved means to minimise potential difference between the conductors.</p>
Should	<p>'Should' indicates a recommended course of action.</p>
Spiking, spiked	<p>The procedure for proving that a high voltage cable is dead prior to cutting the cable.</p>
Substation	<p>A substation, traction substation, transformer room, Switch room, Sectioning Hut, 1500V link area, 1500V switch area containing switches that connect DCCB's to OHW sections, pole or pad mounted transformer location, containing either high voltage or 1500V electrical equipment.</p>
Switching Operator	<p>An Authorised Person who is specifically trained and authorised to undertake the role of electrical switching operator in accordance with these rules. This role is a subset of Authorised Person.</p>
Totally enclosed equipment	<p>Electrical equipment in which the conductors can only be exposed by unbolting or unlocking covers or shutters which prevent normal access. Cables which have an earthed metallic sheath or screen are regarded as totally enclosed equipment.</p>

Term	Definition
Traction rail (negative return rail)	The rail(s) by which a return path is provided for the 1500 volt dc traction current from the train to the traction substation.
Traffic Controller	The Train Control Officer having jurisdiction over the relevant portion of the rail system.
Vehicle	Equipment (including motor vehicles) that have a fixed envelope when crossing or traversing the network.
Work	Physical work of installing, repairing, altering, removing, or adding to equipment or infrastructure. This includes activities that may impact on the operation of equipment or infrastructure.
Work in the vicinity of (exposed electrical equipment)	<p>Work at a distance greater than the Safe Approach Distance but still close enough that the presence of the electrical hazard is to be considered in the planning of the work.</p> <p><b>NOTE</b> There is no single specified outer boundary of the area that is "in the vicinity of" as the boundary varies according to each situation and the work method, materials, and tools to be used.</p>
Work near (exposed electrical equipment)	<p>Work within or potentially within the Safe Approach Distance.</p> <p><b>NOTE</b> The work near distance varies with the equipment voltage and competence of the people performing the work.</p>
Work on (exposed electrical equipment)	Work that requires contact with the normally live parts of the electrical equipment, either directly or indirectly.
Work party	A group of workers, undertaking a combined activity within a discrete location or portion of the network.
Working earths	Earths that are applied to all AC conductors on which the work is being carried out, on each side of the worksite, to ensure equipotential conditions at the worksite are maintained.
Working rail connection	Rail connection, applied to equipment where work is being carried out, to ensure equipotential conditions of the traction power equipment at the worksite are maintained.

*Table 4 Definitions*

## 3 Hazards & Warnings

### 3.1 Electric arcs, electric shocks & explosion

#### 3.1.1 Electric arcs

Serious injury can result from burns caused by electric arcs. Arcs can be caused by attempting to apply, though inadvertently in most cases, an earth or rail connection to live equipment, or by opening non-load breaking isolating switches carrying current.

Electric arcs may be the source of an explosion which will scatter molten material, radiate intense light and heat, and emit dangerous quantities of hot gas or plasma. Severe burns to the body due to radiated heat and contact with molten materials, and flash injuries to the eyes may result. Airway burns from plasma is a serious risk.



**WARNING:** Burns may initially appear minor despite significant deep tissue injury. If burnt it is essential that appropriate medical treatment is obtained

Burns from high voltage may appear minor at the surface whilst causing significant damage to underlying deeper tissue. Skin with high resistance will transmit energy to deeper tissues with lower resistance.

#### 3.1.2 Electric Shocks and the Human Body

The human body is a conductor of electricity, and severe injury or death may result if a conducting path that allows electric current to pass through the body is formed.

Burns are most often severe at the source (usually hands or head) and ground contact point (usually feet). The severity and extent of tissue damage are influenced by the strength and duration of contact with the source.



**WARNING:** If a person receives an electric shock, it is essential that appropriate first aid is provided without delay and checked by a medical professional

#### 3.1.3 Mitigation Measures against Electric Arcs, Electric Shocks and Explosions

Mitigation measures against the occurrence of electric arcs and explosions include, but not limited to, the following:

- Never operate off-load isolating switches on load.
- Follow the correct procedure when undertaking operating work, (eg prove dead at every location immediately prior to the application of earths or rail connections).
- Wear the appropriate PPE when undertaking switching operations, live work, or other work within substations.
- Work under Electrical Permit conditions.



- Where live work is to be carried out, appropriately Authorised Persons undertaking such work must strictly adhere to the appropriate Safe Work Method Statements, including the correct use of insulated tools.
- Work is assessed, planned, managed, and supervised

## 3.2 Earthing system

### 3.2.1 Disconnected or broken earth connections

Earth connections between equipment and the earthing system must not be removed while the equipment is in service unless a suitable alternative earth connection is provided first.




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**WARNING:** If an earth or neutral connection is broken or removed from equipment that is in service, a dangerous voltage may appear on the neutral or earth cable connected to that equipment.

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Equipment that can produce dangerous voltages under these conditions includes voltage transformers and surge arresters.

### 3.2.2 Substation earth grid voltages and transferred earth potentials

Under fault conditions, substation earth grids can rise to hazardous voltages.

Care must be taken when working on power cables, metallic telecommunications cables and signalling cable entering a substation. Dangerous voltages could arise between the earth grid and the cable if a substation fault or a remote earth fault occurs during the work.

Appropriate bridging connections must be made between the equipment being worked on and the substation earth grid.

### 3.2.3 Earth grid and earth electrodes

If part of an earthing system is separated, a voltage may appear at the break. When it is necessary to break a part of any earthing system and there is no parallel connection, bridges of equivalent current carrying capacity must be connected across the part of the earthing system before it is broken, unless all associated equipment has been isolated.




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**WARNING:** Additional care should be taken when repairing or reconnecting broken earth leads.

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### 3.2.4 Check to ensure No missing earthing connections Before Touching

Incidents of copper theft and other vandalism acts create safety hazards.

To avoid possible electric shock, it is essential that all people gaining access to or working inside substations must check to ensure that there are no missing earthing connections at substation access gates, fencing and switch operating handles etc. prior to touching such items or undertaking switching operations. Use the voltage tester if there is any uncertainty regarding the earthing system.

### 3.2.5 Neutral, negative and earth circuits

Prior to working on neutral, negative or earth circuits, confirmation of isolation using a voltage tester is not considered sufficient to establish safe conditions. It is necessary to make sure that no current is flowing as breaking a neutral, negative, or earth connection that is carrying current will result in line voltage appearing across the break.

A clamp-on ammeter (tong tester) should be used to prove that no current is flowing. On dc equipment a dc tong meter must be used.

Current through a harmonic filter is audio frequency ac, not dc or mains frequency ac, and care must be taken to make sure an appropriate instrument is used.

When working on neutral or negative circuits, other precautions include:

- Confirming that the number of connections is as expected - additional unexpected connections could indicate additional hazards and must be investigated before work proceeds.
- Checking any labels on all conductors connected to a bar or link, not just labels on the conductors being worked on.

## 3.3 Rectifier negative

While the rectifier negative circuit is normally at or near rail potential, in the event of a fault causing a DCCB opening, high voltages can appear across the reactor and therefore between the rectifier negative and rail.



**WARNING:** Voltage Limiting Device (VLD) does not reduce the risk of shock from the rectifier negative.

## 3.4 Capacitors

Capacitors store electrical energy and care must be taken when working on equipment with capacitors. Large capacitors or banks of capacitors must be:

- isolated, and then
- discharged through an appropriately rated load or allowed to naturally discharge over an appropriate time frame, and
- then proved dead prior to commencement of work.



**WARNING:** Ensure that capacitors are isolated, completely discharged (for at least 5 minutes) and "Test before Touch" prior to working on the equipment.

Capacitors are found in rectifiers, harmonic filters, lighting control and other equipment. Lengths of screened or metallic sheathed cable also have significant capacitance and must be treated in the same manner.

### 3.5 Battery rooms

On routine inspection and maintenance work, eye protection safety glasses must be worn.

Unprotected hands and clothing must always be kept away from battery cells.

Work performed on a battery in service must use methods which prevent circuit interruption or arcing in the vicinity of the battery including;

- ensuring using insulated tools
- using insulated ladders
- ensuring test equipment leads are firmly connected with enough length of cable to prevent accidental arcing in the vicinity of the battery
- ensuring connections to load test equipment include short-circuit protection

Smoking, the operation of electric hand tools, the use of open flame and the operation of equipment that produces electric arcs are prohibited in the immediate vicinity of the battery.

Any spilled electrolyte must be diluted or neutralised immediately and removed.

If electrolyte splashes in the eye or on the skin, immediately flood the eye or skin with water. Portable eye wash stations are provided in MTS substations for this purpose. Following irrigation of the eye or skin, immediate medical attention must be sought.

### 3.6 Current transformers

The secondary circuit of a current transformer (CT) must not be open-circuited or left open circuit while the primary circuit is live. Care must be taken when working on substation wiring, especially protection relays and CT links in circuit breakers.

### 3.7 Work on Maintenance Roads fitted with eFKS

Work on a Maintenance Road fitted with a functional eFKS (e-Fortress Key System) does not require the issuing of a Switching Program and electrical permit.

Persons accessing the SAD within an eFKS zone are to:

- comply with the applicable eFKS procedure
- avoid contact with the overhead wire

**NOTE:** Infrastructure work on overhead wiring within an eFKS zone is not exempt from the requirement to issue a switching program and electrical permit.



**WARNING:** Additional control measures are required for a non-functional eFKS unit, these include the use of a switching program and the issue of an electrical permit.

### 3.8 Operation of field switches fitted with eFKS

Operation of 1500v field switches fitted with a functional eFKS are exempt from the requirement to be operated under a switching program under these rules. Persons operating the eFKS must;

- be specifically trained and authorised in the operation of the eFKS; or
- hold authorisation as a Switching Operator

**NOTE:** Manual operation of a field switch fitted with an eFKS may only be undertaken by an authorised switching operator under the direction of the duty engineering controller.

### 3.9 Securing of damaged pantographs

Care must be taken when it is necessary to secure or make safe a damaged pantograph of an electric vehicle. Test dead before commencing any work to secure or make safe the damaged pantograph.

If a damaged pantograph is tied down and it is within **50mm** of the roof, the pantograph isolating switch must be opened.

### 3.10 Metallic tapes and Metal Ladders

Steel tapes, metal reinforced linen tapes and long steel rules conduct electricity and are **NOT** to be used when:

- (a) taking measurements near live exposed electrical equipment, or
- (b) there is any likelihood that the metal tape/rule might bridge between metal objects that might be at different potentials, for example:
  - between overhead wiring structures and rail (or vehicles on rail)
  - between structures and fencing or metallic troughing.

Conductive (metal) Ladders must not be used in the electrified rail corridor, electrical substations or near high voltage equipment

### 3.11 Rail voltage

DC traction systems are designed to operate without a fixed earth connection. This results in rail voltage fluctuating near, but not at, earth potential. Contact with rail track should be avoided where possible.

### 3.12 Interfering with negative connections to rail

If the negative cables connecting a substation to the track or to the track bonding equipment are broken or disconnected, equipment in the substation could cause the cable voltage to rise to a hazardous level. Similarly, separating a section of rail to which these negative cables are connected from the rest of the track could cause the separated rail to become live at a hazardous voltage.

Broken or disconnected cables are to be reported to Engineering Control and the responsible Asset Manager.

Asset Managers are to coordinate any work requiring disconnection of negative cables (traction bonds), such as re-railing, with the work crew. Appropriate bridging connections are to be made when negative cables or conductors are connected or disconnected, or the 1500V supply is to be removed and the persons involved signed on to the appropriate Electrical Permit.

### 3.13 Disconnecting or removing sections of rail

When removing or disconnecting sections of rail, work crews must apply control measures for traction return current. Return current may be the result of electric traffic on an adjacent track or may be current returning to a nearby substation from more distant electric traffic on the same track.




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**WARNING:** Extra care must be taken when a traction rail or traction bonds are disconnected in a section of electrified track beyond which there is no substation, there is a danger that overhead wiring equipment or equipment on a stationary train might cause the rail ends to become live at a dangerous voltage.

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All work crews must ensure that a continuous path for traction return current is maintained. This may include the use of temporary bonds between rail or verification that sufficient cross rail traction bonds are in place.

If it is necessary to de-energise the 1500V supply to make the work safe, an Electrical Permit is to be issued to ensure that supply is not restored until the rails or traction bonds are reconnected.

### 3.14 Application of portable earths or rail connections

A person applying portable earths or rail connections must;

- i. Identify the correct equipment by identification of switchgear number, structure numbers, tracing of the overhead line or other effective means.
- ii. Prove de-energised using;
  - a. Hivotec (or equivalent) contact tester – 1500v equipment only
  - b. Modiewark (or equivalent) non-contact voltage tester – High Voltage AC only
  - c. Approved contact tester – High Voltage AC only
- iii. test device → prove de-energised → test device

- iv. apply the portable earth or rail connection using an approved and tested insulated operating stick
- v. apply a completed DANGER tag
- vi. record the location of installation on the permit or switching program (as appropriate) and notify engineering control

### 3.15 Removal of portable rail connections

A person breaking the connection of portable rail connection equipment to rail could inadvertently become part of the 1500V circuit, potentially exposing themselves to an electrical hazard and could also render the rail connection ineffective in protecting other workers.



**WARNING:** Do not interfere with or remove portable rail connecting equipment without the proper authority.

All persons are to make sure that connections to rail of portable rail connecting equipment are not damaged or disconnected. Contact the duty Engineering Controller immediately if accidental damage or disconnection occurs. Engineering Control will arrange with electrical staff if it is necessary for a portable rail connection to be relocated for work to proceed.

### 3.16 1500 Volt DC Overhead Wiring structures or Equipment

There is a possibility that overhead wiring structures may rise to an electrical potential above earth. The risk of persons receiving an electric shock when standing beside an overhead wiring structure and touching the structure, or when standing on the rail, is low but not impossible.



**WARNING:** When working on or near 1500 Volt DC OHW structures or equipment, only use electric power tools that are:

- (a) battery operated, or
- (b) supplied from an isolating transformer, generator, or inverter.

This applies to all electric power tools and equipment to be used in the rail corridor and substations, including work on:

- overhead wiring structures
- rail, and
- rail connected equipment, (including trains standing on the rails).

### 3.17 Testing HV equipment at Line Voltage to Carry out Phase Checking

When restoring equipment to service following work that has disturbed the primary electrical connections confirmation of phasing and sequence is required. Testing can be completed across a HV open point by;

- (c) Testing across capacitive test points using a multi-meter (where the output from the capacitive test point is in sequence with the primary phase angle).
- (d) Testing across LV equipment where the phasing and sequence has previously been proven.
- (e) Where neither option a) or b) is available, direct testing of the HV primary equipment across a HV open point is permitted using HV phasing equipment.

Phase checking is considered a switching operation and may only be carried out by authorised switching operators as a step in a switching program.

If phase checking is found to be incorrect, the switching operator is to contact Engineering Control to arrange isolation of the equipment to allow rectification under an Electrical Permit to Work.

## 4 General

This section provides general information about the application of the MTS electrical safety rules including authorisation, communication, tags and warnings, and substation access.

### 4.1 Instruction & authorisation

MTS provides specific certification to persons with a demonstrated business need, instructing or authorising that person to undertake the nominated tasks on the MTS electrical network.

Instructed and Authorised roles are set out in Table 5.

	Work to Reduced Safe Approach Distance	Enter a substation (inspection only)	Enter & work in a substation	Electrical Permit to Work	Test Permit	Electrical Switching	Engineering Controller	Suspend Authorisations	Issue & Cancel Authorisations
<b>Electrical Safety Awareness</b>	Reduced as per <b>instructed</b> person	May only enter a substation under the supervision of a permit holder							
<b>Substation Access</b>		✓	May only work in a substation under the supervision of a permit holder						
<b>Permit Holder (restricted)</b>	Reduced as per <b>instructed</b> person			Restricted to 1500v OHW Only					
<b>Authorised Electrical Worker</b>	Reduced as per <b>authorised</b> person		If Substation Access is held						
<b>Permit Holder</b>	Reduced as per <b>authorised</b> person	✓	✓	✓					
<b>Switching Operator</b>	Reduced as per <b>authorised</b> person	✓	✓	✓	✓	✓			
<b>Electrical Engineering Controller</b>	Reduced as per <b>authorised</b> person	✓	✓	✓	✓	✓	✓	✓	
<b>Electrical Network Manager</b>								✓	✓

Table 5 Instructed and authorised roles



### 4.1.1 Requirements for work on the Electrical Network

A person must not carry out work on electrical network equipment to which these rules apply, and the person must not be permitted or required to carry out such work, unless:

- That person fulfils the requirements for the role being undertaken as listed in NWRL0TS-NRT-SWD-HV-SPC-720350 Electrical Certifications., or
- That person is undertaking training for the role being undertaken., and
- The person is physically fit to safely perform the required work.

### 4.1.2 Qualifications required for authorised roles

MTS requires that a person undertaking an authorised role hold appropriate underpinning qualifications and knowledge. This ensures that the person undertaking the authorised role can complete their duties safely and effectively.

Where AQF qualifications are identified, the qualification must be issued by a Registered Training Organisation or an Australian recognised issuing body.

### 4.1.3 Training scope

A person who fulfils the requirements for an authorised role, and has completed training beyond their initial qualification, is permitted to undertake activities to the extent of the recognised training which they have received.



**Example:**

Persons qualified to work on or near overhead or underground electrical apparatus (other than live high voltage lines) can perform the work if they:

- Possess a relevant certification issued by a Registered Training Organisation, or recognised issuing body; or
- Are undertaking work for which they have been trained. For example, an Electrician may do work on an overhead line, if that work falls within the limits of their training and competency, or a Cable Jointer may attach fittings or make connection to an overhead line.

### 4.1.4 MTS Approved Electrical Network Qualifications

A person seeking certification under these rules, must fulfil the requirements for the role as listed in NWRL0TS-NRT-SWD-HV-SPC-720350 Electrical Certifications.

## 4.2 Communication

MTS requires that clear and effective communication takes place between all personnel when undertaking safety critical tasks.

Further detail on electrical switching communication can be found in MTS-AEL-PR-78213 Electrical Switching Communication Procedure.

### 4.2.1 Verbal Communication

Adherence to the communication protocol is essential to maintain understanding, safety, and to prevent incidents.

Effective communication involves three principles:

Clear	Ensure that what you say is easy to understand and is not confusing
Concise	Minimise banter and use proper and specific terms (simplified instructions are preferred over complex instructions)
Confirmed	Information must be repeated by the receiver for confirmation

*Table 6 Communication principles*

It is essential to speak clearly, listen carefully, and thoroughly understand verbal communications. A clear communication protocol is shown in Table 7

Stage	Purpose / Activity
Introduction	Greeting and purpose ( <i>name and role</i> )
Confirm	Scope of the work and that both parties are working on the same task ( <i>switching program number</i> )
Context	Establish the present status of the job/work ( <i>location and switching activities</i> )
Communicate	Clearly and concisely communicate and confirm the tasks are understood ( <i>receive and repeat back the communication</i> )
Close	Clearly close out the call

*Table 7 Communication protocol*

Safety critical instructions must be confirmed by repeating them back to the communicator. This prevents misunderstandings between parties.

## 4.2.2 Written communication

Written communication must be legible, clear, concise, and unambiguous. Documents must be filled-in using MTS terminology.

Where an approved form or template is provided for an activity, this form should be used. Forms should be completed fully, with all required sections filled out.

Where documents are issued for field use, the currency of the document must be confirmed prior to commencement of the work activity. This is essential for switching programs – operators should confirm the version of the switching program they hold with engineering control prior to commencement of switching.

Changes to forms is controlled using the MTS document management process. Superseded forms should not be used.

## 4.3 Tags & warning signs

### 4.3.1 Danger do not operate tags (Danger tags)

'Danger Do Not Operate' tags are a notice attached to a controlling switch or other equipment as a warning not to operate such equipment where this could cause injury to staff or damage to equipment. This tag must be a label, tape or other device with the word "DANGER – DO NOT OPERATE" displayed on it along with other relevant details.

'Danger Do Not Operate' tags should:

- be durable and securely fixed to the controlling switch,
- clearly list the device & switching program under which the tag is applied,
- be dated by the worker applying the tag,
- be attached in a prominent position on each isolation point or device (locked to the controlling switch or shutter where this facility is available),
- only be removed with the authorisation of the duty Engineering Controller.



Figure 1 Danger - Do not operate tag



**WARNING:** DANGER Do Not Operate Tags must not be interfered with or removed without authorisation from the duty Engineering Controller.

### 4.3.2 Restricted use tags

'Restricted Use' tags are a notice attached to a controlling switch or other equipment associated with an earthing or rail connecting device as a warning that the equipment is only available for restricted use associated with a test permit. This tag must be a label, tape, or other device with the words "RESTRICTED USE" displayed in black text on a white background along with other relevant details.

'Restricted Use' tags should:

- be durable and securely fixed to the controlling switch,
- clearly list the device & switching program under which the tag is applied,
- be dated and signed by the worker applying the tag,
- be attached in a prominent position on each device (locked to the controlling switch or shutter where this facility is available),
- only be lifted temporarily at the instruction of the test permit holder,
- only be removed with the authorisation of the duty Engineering Controller.



Figure 2 Danger - Restricted use

### 4.3.3 Out of service tags

'Out of service' tags are a notice attached to a controlling switch or other equipment as a warning that the equipment is not fit for service. This tag must be a label, tape or other device with the words "OUT OF SERVICE" displayed on a yellow background along with other relevant details.

'Out of service' tags should:

- be durable and securely fixed to the isolator
- clearly state the reason why the equipment is out of service
- be dated and signed by the worker applying the tag,
- be attached in a prominent position on each isolation point or device (locked to the controlling switch or shutter where this facility is available).
- only be removed after notifying the duty Engineering Controller.



Figure 3 Out of service tag

### 4.3.4 Application of Tags

Tags must be affixed to the controlling device or switch using an operator lock Figure 4 Operator lock where this facility is available. Locks must be secured to prevent unauthorised removal.



*Figure 4 Operator lock*

### 4.3.5 Warning signs and protection measures

Appropriate permanent or temporary work area markers, safety fences, demarcation taping, warning signs, barriers, guards, plates, warning lights and other protective devices, must be used as required where hazards exist to employees, contractors, or the public.

**NOTE:** Section 6 provides further information on the use of work area markers

## 4.4 Access to substations

### 4.4.1 General

Access to MTS operated electrical substations is limited to those persons with:

- a demonstrated need, and;
- certified for substation access or higher (see Table 5) or,
- be under the supervision of a permit holder

Prior to entering a substation all persons must:

- confirm that they have a demonstrated need to enter the substation, and;
- assess the risk of their planned activity and apply controls, and;
- apply any other mandated safe access procedures including isolation of gas suppression if required

On exit of a substation all persons must:

- ensure all equipment is returned to normal operating state or as agreed with the duty engineering controller, and;
- ensure all workgroup waste, tools, and equipment is removed from the substation, and;
- ensure gas suppression is restored if required, and;
- ensure the substation is secured, and;
- contact the duty engineering controller and advise that they are clear of the substation

### 4.4.2 Ordinary Persons

Ordinary Persons may enter a substation for inspection purposes only under the supervision of an authorised permit holder. A maximum of four ordinary persons may be supervised by a permit holder at a time.

Ordinary Persons may undertake work in a substation only under the direct supervision of an authorised permit holder.

Work must be risk assessed and any hazards identified must be controlled to the satisfaction of the supervising permit holder prior to commencement.

### 4.4.3 Substation Access

Persons holding Substation Access are permitted to enter a substation without supervision for inspection activities only.

Holders of this authorisation are only permitted to undertake work under the supervision of a permit holder and are not permitted to supervise ordinary persons.



#### **4.4.4 Permit Holder (restricted)**

A permit holder (restricted) is considered an ordinary person for the purpose of substation access.

#### **4.4.5 Authorised Electrical Workers**

Where an Authorised Electrical Worker holds Substation Access they are permitted to enter and work in a substation without supervision.

#### **4.4.6 Permit Holders**

Permit holders are permitted to enter a substation without supervision. Permit holders may also undertake work unsupervised and supervise the work of persons holding substation access.

Where a permit holder is providing direct supervision of ordinary persons, they are only permitted to supervise a maximum of four workers inclusive of inspection and work activities, at a single location within the substation.

#### **4.4.7 Switching Operators**

Switching Operators are permitted to enter, work, and supervise the work of others in a substation

## 5 Safe approach to electrical equipment

### 5.1 General

To ensure the safety of persons in the vicinity of electrical apparatus Safe Approach Distances (SADs) must be maintained.

Safe Approach Distances in these Electrical Safety Rules are based on an exclusion zone surrounding exposed electrical equipment where access is prohibited. This defines an area around exposed electrical equipment into which no part of the worker, mobile plant, or object (other than approved insulated tools) may encroach.

When working in the vicinity of electrical equipment work practices must be established to ensure workers, mobile plant and unapproved objects do not encroach on the safe approach distances.

Refer to Table 8 to determine the minimum clearance that must be maintained from exposed conductors for ordinary persons, instructed persons and authorised persons.

Approach to electrical equipment must be kept to a minimum and must be restricted to the period required to perform the work.

## 5.2 Safe approach distances - persons

Safe approach distance (mm) to live conductors for ordinary, instructed and authorised persons.

Voltage Nominal phase to phase AC (kV)	Ordinary Person	Instructed Person	Authorised Person [See NOTE a) - e)]
Insulated low voltage aerial lines up to 1kV, including low voltage aerial bundled cables	1000	500	500
Low voltage - above 50V AC but not exceeding 1kV	3000	1000	500
Above 1kV up to and including 11kV	3000	1200	700
Above 11kV up to and including 33kV	3000	1200	1000
Above 33kV up to and including 66kV	3000	1400	1000
Above 66kV up to and including 132kV	3000	1800	1500
<b>DC - Nominal Voltage</b>			
Above 120V but not exceeding 600V	3000	1000	500
Above 600V including 1500V	3000	1000	500

Table 8 Safe approach distances - persons



### NOTE:

- a) Deliberately avoid movements that could result in distances being infringed.
- b) The distances specified are based on conductors not protected by a barrier of rigid material. For electrical equipment protected by a barrier of rigid material the safe approach distance is the barrier itself
- c) The distances specified are based on work from a stable surface. Appropriate allowance must be made for conductor sag and sway.
- d) These figures are the minimum safe approach distance that must be used for a person.
- e) When operating electrical equipment with approved tools (eg operating handle) the safe approach distance may be reduced.

### 5.2.1 Safe Approach distance - Ordinary Persons

The safe approach distances for an ordinary person approaching insulated, covered or exposed live conductors are shown in Table 8.

These are the distances beyond the reach of any part of the ordinary person's body or any conducting or unapproved object touching any part of the ordinary person's body. To maintain these minimum distances from overhead conductors, appropriate allowance must be made for inadvertent movement, and conductor sag and sway under a variety of conditions.

### 5.2.2 Safe Approach distances – Ordinary Persons under the supervision of Instructed and Authorised Persons

Where an ordinary person is undertaking work under the direct supervision of an Instructed or Authorised person, instructed person safe approach distances must apply.

Where continuous direct supervision is not provided to an ordinary person, default ordinary person safe approach distances apply. Dependent on the activity undertaken consideration must be given to applying greater approach distances than those given in Table 8.

### 5.2.3 Work by Instructed Person

When instructed persons are required to work in the vicinity of electrical equipment, the instructed person performing the work, the person in control of the work and the authorised person in charge of the electrical equipment must cooperate to ensure that the work is performed safely and that specific precautions taken.

Instructed Persons are those persons performing non-electrical work at or above track level in the vicinity of live electrical equipment, have completed the MTS MIRS course and MTS electrical safety instruction and demonstrated competence to perform such non-electrical work in the vicinity of live electrical equipment safely.

The safe approach distances for the instructed person approaching insulated, covered, or exposed live conductors are shown in Table 8.

These are the distances beyond the reach of any part of the instructed person's body or any conducting or unapproved or uninsulated object touching any part of the instructed person's body. To maintain these minimum distances from overhead conductors, appropriate allowance must be made for inadvertent movement, and conductor sag and sway under a variety of conditions.

### 5.2.4 Work by Authorised Person

The safe approach distances for the authorised person approaching insulated, covered, or exposed live conductors are shown in Table 8.

These are the distances beyond the reach of any part of the authorised person's body or any conducting or unapproved or uninsulated object touching any part of the authorised person's body. To maintain these minimum distances from overhead conductors, appropriate allowance must be made for inadvertent movement, and conductor sag and sway under a variety of conditions.

## 5.3 Safe approach distance – vehicles

Table 9 Safe approach distance - vehicles, sets out the Safe Approach Distance (mm) to live conductors for motor vehicles and mobile plant [note a)]

Voltage Nominal phase to Phase AC (kV)	Vehicle		Ordinary Person	Mobile Plant	
	Ordinary Person	Instructed or Authorised Person [note b) and c)]		Instructed or Authorised Person [note b) and c)]	
				Uninsulated	Insulated
LV	600	600	3000	1000	Contact
HV – up to and including 33kV	900	700	3000	1200	700
66kV	2100	1000	3000	1400	1000
132kV	2100	1200	3000	1800	1800
<b>Nominal DC Voltage</b>					
120V to 1500V	900	900	3000	1000	1000

Table 9 Safe approach distance - vehicles



**NOTE:**

- a) The distances specified are based on work from a stable surface. Appropriate allowances must be made for conductor sag and sway and for uncontrolled movement of the vehicle or plant due to any reason.
- b) A safety observer is required.
- c) An appropriate risk assessment must be undertaken before work is performed.

### 5.3.1 Ordinary persons in vehicles

An ordinary person in control of any vehicle, excepting mobile plant when in working mode must ensure no part of the vehicle or its load is placed or moved within the distances shown in Table 9.

### 5.3.2 Instructed or Authorised Persons in vehicles

Instructed or authorised persons in control of any vehicle, excepting mobile plant when in working mode, must ensure that no part of the vehicle or its load is placed or moved within the distances shown in Table 9.

## 5.4 Safe Approach Distances – mobile plant

Because of the physical capabilities of, and potential hazard to mobile plant working adjacent to live conductors and or electrical equipment, specific consideration (including earthing) must be given to the use of mobile plant during the planning of the work.

For safe approach distances to exposed live conductors for mobile plant refer to Table 9.

### 5.4.1 Use of mobile plant

Mobile plant must only be used in the vicinity of live conductors and /or electrical equipment after precautions appropriate to the circumstances have been considered and action taken to control the associated hazards and risks.

When mobile plant is operating in working mode in the vicinity of electrical equipment, the possibility of inadvertent contact with live conductors must be considered during the planning and execution of the work.

The control measures to be considered with the risk assessment must include:

- isolating and earthing electrical equipment; and
- positioning the mobile plant such that the safe approach distance can be maintained in all circumstances; and
- the use of safety observers, barriers and signs; and
- the use of other precautions such as physical restrictions or control devices in conjunction with barriers; and
- the suppression of auto- reclose; and
- de-energising the conductors and/ or equipment.

When mobile plant may come near live electrical equipment, the mobile plant must be earthed. This must be achieved by an approved earthing conductor directly connected to the substation earth, rail, or other approved earthing system.

When mobile plant is in operation, precautions must be taken to protect the operator from hazardous step and touch potentials. No worker other than the mobile plant operator must touch the mobile plant whilst in operation.

Suspended loads must be controlled by means of non-conductive rope (tag line) or other approved insulating medium. Neither the mobile plant or conductive winch rope/load must be touched by any worker while the mobile plant or any conducting object attached is in motion.

During operation of the mobile plant only those workers at ground level involved in the work associated with the mobile plant must be near the plant; all other workers must remain clear.

## 5.5 Handling objects/loads

When objects are being handled manually or by mechanical equipment, care must be exercised to prevent the objects or mechanical equipment infringing safe approach distances.

For manual handling, appropriate work methods and an appropriate number of workers must be used to maintain safe approach distances.

For manual handling where there is a risk of infringing the safe approach distances to electrical conductors (refer Table 9), the movement of loads must be controlled by means of approved non-conducting ropes (tag lines) or other approved means.

## 5.6 Erection of Scaffold

Persons erecting conductive metal scaffold must comply with the Safe Approach Distances applicable to mobile plant. These safe approach distances must include an additional allowance for the inadvertent movement of scaffold components where movement cannot be sufficiently controlled.

## 5.7 Emergency situations

### 5.7.1 General precautions

In emergency situations where there is a likely risk of electric shock to workers or the public from electrical conductors or electrical equipment, prompt action must be taken to ensure people are kept well clear of the hazard at greater than safe approach distances.

### 5.7.2 Fallen conductors to be considered live

All electrical equipment and conductors must be considered live until proven de-energised by approved means.

Initially for fallen or exposed electrical conductors a safe approach distance of 8m for HV conductors and 3m for LV/1500V conductors must be maintained.

### 5.7.3 Reduced SADs

Safe approach distances less than those specified in 5.7.2 must only be applied after Engineering Controller (via a Switching Operator) has confirmed that conductors will remain de-energised.

### 5.7.4 Protection of workers and public

Where practicable an Authorised Person is to remain on site to issue oral warnings to any worker or members of the public making an unsafe approach to fallen or exposed electrical conductors and/or access may be controlled using barriers, signs, or other appropriate means.

### 5.7.5 Emergency switching

Where required to protect life or prevent further equipment damage, a switching operator may operate a suitable isolating device without prior approval from Engineering Control. Where this occurs the switching operator is to notify Engineering Control immediately once it becomes safe to do so.



Go to section 7.5 for information on a Rescue Power Outage

### 5.7.6 Fires

#### 5.7.6.1 1500V Equipment

Electrical testing has confirmed that fires associated with **live** 1500V electrical equipment can be extinguished using hand-held extinguishers and fire hoses when all the following conditions are complied with:

- fire extinguishers are marked "Suitable for use on electrical fires". The extinguisher's nozzle is not to be used closer than 1.5m to live 1500V equipment.
- fire hoses may be used. However, the nozzle or branch of the hose is not to be used any closer than 3m to the live 1500V equipment.



- fresh water is used., or
- Brackish or saltwater may only be used after the electrical supply has been removed.

If a major fire occurs in a train, vehicle, or plant within an electrified area, arrange with the Engineering Controller for supply to be removed from the 1500V overhead wiring so that fallen live wires do not create additional hazards.

In case of fire in the vicinity of 1500V equipment along the railway lines, take care to prevent persons contacting the equipment, either by falling material or through water that might eject from broken pipes or hoses.

### **5.7.6.2 High Voltage Equipment**

If the fire is in the vicinity of HV equipment the Engineering Controller will arrange for the equipment to be immediately de-energised followed by isolation and earthing.

## 5.8 Reduced SADs

### 5.8.1 Testing and earthing

Testing and earthing procedures on some equipment might bring the operator within the specified SAD.

Only Switching Operators trained in testing and earthing procedures may undertake this work. The work is to be done in accordance with written instructions.

### 5.8.2 Work on low voltage equipment by Electrical Personnel

Authorised electrical workers, i.e. Qualified Electricians / Linesmen / Cable Jointers may carry out work on low voltage equipment with these rules at less than 0.5m after the associated risks are identified and the risks of contact with live parts controlled through live work procedures or other approved control measures.

### 5.8.3 1500V cables

#### 5.8.3.1 Unscreened 1500V cable

Treat 1500V unscreened insulated cable as exposed 1500V equipment.

Authorised Persons may approach an unscreened insulated 1500V cable to a distance of not less than 50mm, on condition that:

- The reduced SAD is applied to the normally insulated cable only, and not applied to exposed conductor or conductive components connected to the conductor, and
- Extra care is taken when working at the reduced SAD.

#### 5.8.3.2 Screened 1500V cable

Persons may touch a screened 1500V cable provided it is visually inspected and found to be in good condition.

#### 5.8.3.3 Rail and Negative Return Cables

Rail and negative return cables form part of the traction power system, however, are designed to remain at, or close to earth potential using voltage limiting equipment. No safe approach distance applies to rail and negative return cables although unnecessary contact should be avoided. Refer to section 3.12 and section 3.12 for information on disturbing rail and negative cable connections.

## 5.8.4 Approach to live high voltage (HV) insulated cables

When work is performed near live HV insulated cables, appropriate precautions must be taken to ensure that the insulation is not damaged:

- Cables must not be moved whilst live.
- Insulated cables must not be directly stood upon wherever practical.
- Where it is unavoidable to stand upon live insulated cables a risk assessment must be conducted, controls applied, and cables protected before any work is carried out.

In excavated cable trenches or cable joint pits if there are cables that are live, as well as the de-energised cables are to be worked on, those live cables should be covered by a minimum of 100mm of sand or barriers should be installed for mechanical protection.

Potholing to confirm live cable locations are allowed. Any excavation work including potholing within 2m of cables with voltages of 33kV and above cables or 0.3m for 11kV cables must be risk assessed and controls implemented as per section 6.2



**WARNING:** Abandoned or de-commissioned cables must be treated as live until proven otherwise.

## 5.8.5 Earthed metallic sheathed or screened high voltage (HV) cable

Contact by workers may be made to external surfaces of live HV cables protected with earthed metallic sheaths or screens.

No contact must be made to external surfaces of cable terminations that are not screened.

## 6 Access for work on or near Electrical equipment

### 6.1 General

To protect people and equipment, access to electrical equipment on the MTS electrical network must be completed in accordance with these rules. These rules are written to provide safe access by minimising electrical risks. Safety is maintained by;

- Separation; maintaining Safe Approach Distances
- Isolation & earthing; removal and discharge of electrical energy
- Permit issue; administrative control of access

### 6.2 Risk assessment

Before any work is performed a risk assessment must be completed. Control measures and the precautions undertaken must be recorded. Where control measures are identified during the risk assessment process, then instructions must be issued to the workers outlining these controls.

Control measures may include:

- (a) defining the work area
- (b) isolating and earthing of the electrical equipment; or
- (c) de-energising live electrical equipment adjacent to the work area; or
- (d) the use of barriers and signs; or
- (e) the use of approved covering; or
- (f) the use of safety observers; or
- (g) the issue of an electrical permit; or
- (h) defining access routes.

Any electrical permits must be issued in accordance with these rules.

### 6.3 Permits

An Electrical Permit must be issued for all work that requires isolation and earthing of electrical equipment except:

- Electrical equipment (cables, OHW etc...) under construction.
- work on abandoned HV cables.
- Low voltage isolation undertaken in accordance with the MTS Lock Out, Tag Out procedure.

- for work by another Network Operator where an Operating Agreement (OA) may be issued.

Where isolation and earthing of another Network Operator's services is required for completion of work, an Operating Agreement must be received from the Network Operator concerned before commencement of work near the Network Operators services. It is the responsibility of the Switching Operator in charge to receive the OA from the Network Operator.

Arrangements for the isolation of another Network Operators services are to be made through Engineering Control.

Before the commencement of any work requiring electrical supply to be removed from equipment, the equipment must be isolated, proved dead, earthed (rail connected) and an electrical permit issued.

## 6.4 Use of Work Area Markers

Where the risk of inadvertent access to live equipment exists, the Electrically Safe Work Area must be defined using demarcation tape / chain and temporary warning signs.

Where a 'barrier in' method is used, access to the work site must be defined by appropriate access markers.

Work area markers may be installed by an authorised switching operator or permit holder and must be recorded on the associated register.

## 6.5 Removal of supply

Electrical equipment is to be made safe for access by, isolation, earthing or rail connecting and the issue of permits.

No high voltage or 1500v equipment is to be taken out of service without the prior approval of the Engineering Controller, except where a life-threatening situation exists.

- A Switching Program must be issued in accordance with these rules.
- Prior to the commencement of a Switching Program, the Switching Operator in charge must contact the Engineering Controller and advise their name, the number of the Switching Program held and the staff arrangements for field switching.

The Engineering Controller must only give clearance to proceed with switching to the Switching Operator in charge.

The Engineering Controller must:

- (a) Obtain approval to remove supply from the responsible traffic controller (where traction supply is impacted)
- (b) Arrange for or undertake the completion of switching operations listed on the Switching Program including the application of the listed earths or rail connections
  - Earths must be applied to high voltage equipment at each point of supply.
  - At least one rail connection must be applied to each 1500v section.
- (c) Where another Network Operator's services need to be isolated:
  - Request the other Network Operator to remove supply from its services, and
  - Obtain confirmation from the Switching Operator in Charge of the Switching Program that the required Operating Agreement has been received.
- (d) On completion of the switching and earthing operations, confirm with the Switching Operator in charge that:
  - Supply has been removed,
  - Earths have been applied and
  - Clearance is given to proceed with the issuing of Electrical Permits to Work and / or Operating Agreements.

### 6.5.1 Transition from a “live” to “earthed” state

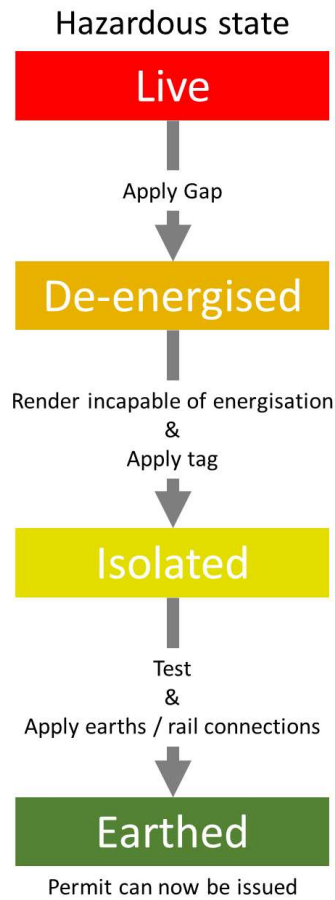


Figure 5 Transition from a live to earthed state

## 6.6 Restoration of supply

Permit holders are responsible to ensure that electrical equipment is safe to return to service on the completion of their work. If equipment is not available for return to service, the duty engineering controller is to be advised and arrangements made to isolate the equipment as Out of Service (OOS).

High voltage equipment must not be returned to service until all necessary tests and phase checks have been satisfactorily carried out, and approval has been obtained from the Engineering Controller.

After successful completion of the activities detailed in Section 9.1.14;

(e) The Switching Operator in charge of the Switching Program must:

- i. Confirm that all Electrical Permits to Work and Operating Agreements have been returned and cancelled.
- ii. Sign off all other Network Operators' Operating Agreements if received.
- iii. Advise the Engineering Controller that;
  - all working earths & working rail connections have been removed,
  - all Electrical Permits have been cancelled,
  - all other Network Operators' Operating Agreements have been signed off, and
  - supply may be restored to the isolated equipment

(f) The Engineering Controller must:

- iv. Accept clearance to restore supply only from the Switching Operator in charge of the Switching Program.
- v. Arrange for earths and rail connections to be removed.
- vi. Arrange for the relevant DANGER Tags to be removed and for the necessary switching operations to restore supply to be carried out.
- vii. Advise other Network Operators that their Operating Agreements have been signed off and that their supply may be restored as far as MTS is concerned.
- viii. On restoration of supply, advise the Switching Operator in charge of the Switching Program that supply has been restored.
- ix. Advise the responsible traffic controller that traction supply has been restored.



### 6.6.1 Transition from an “earthed” to “live” state

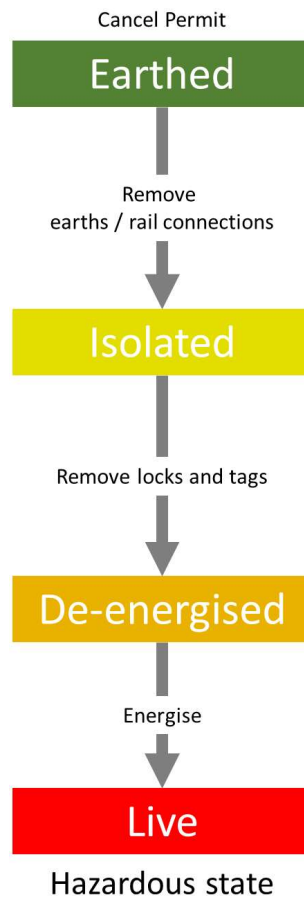


Figure 6 Transition from an earthed to live state

# 7 Switching Programs

## 7.1 General

Access to electrical equipment is managed using switching programs. A switching program sets out the steps required to transition electrical equipment from a “live” hazardous state to an “earthed” (or rail connected) safe state including the reciprocal operations.

MTS uses a single type of switching program to manage safe access to the electricity network. This allows the application of consistent switching principles irrespective of the component of the electricity network operated.

Where work involves the removal of supply from a 1500v OHW section, an 'Authority for removal of supply from 1500v section' must be used in conjunction with the switching program.

### 7.1.1 Information on switching programs

Switching programs specify the following information:

- (a) High and low voltage equipment to be isolated and earthed.
- (b) 1500v equipment to be isolated and rail-connected
- (c) The date and time of isolation.
- (d) Any necessary special instructions. These may include:
  - Details of any nearby equipment for which a permit must be received to allow work to be carried out at a specific location.
  - Details of other electrical network operators' services for which an operating agreement must be received to allow work to be carried out.
  - Warnings of adjacent live equipment.
  - Reference to any other switching program which may be affected by or is associated with this switching program.
- (e) All switching operations required to isolate the electrical equipment and to earth it where applicable, and the location of safety earths.
- (f) The area in which permits and/or operating agreements may be issued.
- (g) Any special tests which need to be done before the equipment is returned to service.

## 7.2 Issue of planned Switching Program's

### 7.2.1 Preparation of a Switching Program

Switching programs are to be prepared under the coordination of engineering control and are to be prepared by personnel authorised as a switching operator or engineering controller. Programs are to be prepared in accordance with the current switching program procedure.

### 7.2.2 Checking and Approval of a Switching Program

Programs are to be checked and approved in accordance with the current switching program procedure.

#### 7.2.2.1 Checking of a switching program

Switching programs must be checked by a switching operator or engineering controller. The person who checks a switching program cannot be the person who prepared the switching program.

#### 7.2.2.2 Approval of a switching program

Switching programs may only be approved by an engineering controller authorised to undertake this function. All switching programs must be approved before issue.

### 7.2.3 Issue of a switching program

Switching programs are to be issued by engineering control in accordance with the current switching program procedure.

### 7.2.4 Alterations to Switching Program's

No alteration to a switching program may take place without the approval of engineering control.

Should a switching program need to be altered before switching commences a revision of the switching program should be prepared and issued.

If, once switching has commenced, a need for alteration of the switching program is identified the engineering controller and switching operator are to discuss and agree the changes required.

Changes are to be recorded on both the controller and field copy of the switching program.



**NOTE:** No changes to isolations, earthing or rail-connection points are permitted once permits are issued against a switching program. If required, permits must be cancelled and a new switching program issued.

## 7.3 Issue of unplanned switching program's

Where possible unplanned switching programs should be issued as per planned switching programs.

In exceptional circumstances where it is not reasonably practical to issue a planned switching program, and where delays will result in a detrimental impact to the operation of the network an engineering controller may undertake switching by ensuring the following actions are completed;

- Engineering controllers are;
  - i. to record switching steps in the controller's log and are to discuss and agree field operations with the duty switching operator.
  - ii. to record details of the circumstances in the controller's log.
- Switching operators are:
  - iii. to record field operations in the substation log.




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**NOTE:** Refer to section 7.5 for information on removal of 1500v supply under emergency conditions.

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## 7.4 Responsibility of the Person in Charge of the Switching Program

### 7.4.1 Multiple Switching Operators

A Switching Operator in charge of a Switching Program where multiple switching operators will be switching must ensure that each switching operator has a copy of the current version of the approved Switching Program.




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**NOTE:** Contact Engineering Control to confirm the latest version of the switching program.

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### 7.4.2 Responsibilities Relating to Removal of Supply

#### 7.4.2.1 Clearance to commence and removing supply

A person in charge of a switching program must obtain approval from the engineering controller prior to commencing isolation.

#### 7.4.2.2 Isolation

Isolation is to be conducted in the sequence set out in the switching program or as agreed with the engineering controller. Completion times are to be recorded in the field provided on the switching program.

#### 7.4.2.3 Overlapping switching programs

If switching programs overlap, an individual "DANGER do not operate tag" for each switching program must be applied to the shared isolation point/s.

#### 7.4.2.4 Prove de-energised

All isolated equipment must be proven de-energised prior to the application of portable earths or rail connections. Proving de-energised must take place at the point where the portable earth or rail connection is to be applied.

Isolated cables must be proved de-energised at the supply point switchgear, and cable to equipment junctions if there is provision for testing at this point.




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**NOTE:** For 1500v isolations where overlapping switching programs exist, the portable rail connections applied in the overlapping "areas in which permits may be issued" must be recorded on each of the overlapping switching programs.

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### 7.4.2.5 Spiking of cables

Before cutting a HV cable, the cable must be proved dead by spiking at the work site with an approved cable spiking device by a person trained in its use.

For LV cables spiking is not required where:

- the LV cable is located clear of HV cables, and
- cable markings clearly indicate that the cable is an LV cable.

In these circumstances it is appropriate to arrange for normal isolation and proving dead to be carried out.



**NOTE:** Cables should not be proved dead by spiking when performing:

- Sheath, screen or serving repairs, or:
- Insulation or joint repairs where the cable is not cut.

Under these circumstances, the cable must be identified by two independent methods.

## 7.4.3 Responsibilities relating to permit issue and transfer

### 7.4.3.1 Issue of Permits and/or Operating Agreements

Upon completion of all the necessary isolation, proving dead and earthing procedures, the person in charge of the switching program must:

- Ensure that each switching operator who will be issuing a permit and/or an operating agreement has a copy of the approved switching program.
- Arrange for an electrical permit and/or an operating agreement to be issued for each separate work group to carry out work on or near the specified equipment.
- Advise the engineering controller of the permits issued. The duty engineering controller is to record the details of the permits issued.

The switching operator in charge of the switching program is not required to remain in the vicinity of the work unless holding the electrical permit.



**NOTE:**

Where the Switching Operator in charge of the Switching Program is also the Person in charge of a work group, that person must be the Permit Holder.

If the switching operator in charge of the switching program becomes aware that work will not be completed in time for supply to be restored by the time stated on the switching program, the engineering controller is to be immediately informed. The switching program remains in force until all issued permits and/or operating agreements have been cancelled.

### 7.4.3.2 Insufficient space

If there is insufficient space on the switching program for the recording of all information additional permit register pages are to be attached to the switching program. Additional permit register pages form part of the switching program.

### 7.4.3.3 Transfer of Responsibility

The switching operator must advise the engineering controller:

- Before ceasing to be in charge of the switching program, and
- Where the switching program and any operating agreements, if received, will be left for the next shift.

When ceasing duty, the switching operator in charge of the switching program relinquishes responsibility for holding the switching program and the operating agreements if received.

The switching operator taking over the switching program must:

- Advise the engineering controller, and
- Take responsibility for the switching program and the operating agreement if received, by printing their name and signing the switching program in the space provided and entering the date and time.

### 7.4.4 Procedure in Case of the Switching Program Being Lost

If the original copy of the switching program is lost, the switching operator in charge of the switching program must contact the engineering controller immediately and arrange for a replacement copy switching program.

The replacement copy of the switching program must be annotated "replacement - original lost".

Switching operators are to ensure the permit register of the replacement document is populated with the identifying numbers of all permits and operating agreements issued on the lost switching program as recorded on the engineering controllers copy.

### 7.4.5 Responsibilities relating to restoration of Switching Program's

#### 7.4.5.1 Cancellation of permits

The switching operator is to arrange for all electrical permits to work and operating agreements issued on the switching program to be cancelled. Cancelled permits are to be recorded against the permit register and the engineering controller advised.

#### 7.4.5.2 Testing

Before supply is restored, the switching operator in charge of the switching program must ensure that any tests required before the equipment is energised have been completed satisfactorily.

#### 7.4.5.3 Restoration

Switching operators are to undertake restoration in the sequence set out in the switching program or as agreed with the engineering controller. Completion times are to be recorded in the field provided on the switching program.

Completed switching programs are to be returned to engineering control for retention.

## 7.5 Removal of 1500 Volt Supply Under Emergency Conditions

### 7.5.1 Threat to human life – Rescue Power Outage

Where there is an immediate threat to human life, the following arrangements, termed a “Rescue Power Outage” (RPO), may be used, in order to:

- (a) Protect casualties from further injury, and
- (b) Allow rescuers to come near or touch the 1500-volt overhead wiring for the purpose of effecting a rescue.

Immediately on becoming aware of the need for an RPO, the engineering controller is to;

- i. Remotely de-energise and (if available) remotely rail connect the incident section/s and notify the affected Traffic Controller
- ii. Verbally issue the RPO
- iii. Dispatch the nearest available Switching Operator to effect isolations
- iv. Record the completed remote switching operations on an RPO form
- v. On completion of isolations issue the RPO as an emergency Switching Program

Engineering controllers are to record the timing of each of the above activities.

### 7.5.2 Network operation for an RPO

Prior to issuing an RPO the engineering controller is to ensure that;

- i. The incident section is rail connected. or,
- ii. Each of the adjacent sections or sub-sections are de-energised and there are a minimum of two open circuit breakers or switches between the incident section(s) and any source of supply. or,
- iii. A manually operated switch is used and the switch has been locked in the OPEN or To Rail position. or,
- iv. A combination of i, ii or iii are used. or,
- v. The incident section is isolated.

### 7.5.3 Adjacent section(s)

For the purpose of an RPO, adjacent section refers to the section at each end of and adjacent to (beside) the incident section. Once the incident section is rail connected, or isolated and rail connected the adjacent section/s can be re-energised.

### 7.5.4 RPO issue process

The Engineering Controller must complete the following steps to issue the RPO:

- i. Undertake the necessary switching operations (or arrange for the operations to be completed).



- ii. On completion of switching operations, allocate and issue an RPO number – normally to the Traffic Controller (communications should be recorded)
- iii. Communicate the RPO number to the organisation undertaking the rescue, such as Police Rescue or Fire Brigade – normally via the onsite MTS representative

Notwithstanding the above, the section(s) at the incident site should be isolated and rail connected as soon as possible. Once isolating and rail connecting the incident section is completed, adjacent non-incident sections may be re-energised.



**WARNING:** No repair or maintenance work may be carried out under an RPO. A switching program with full isolation and rail connection must be completed and permits issued before repair work may commence.

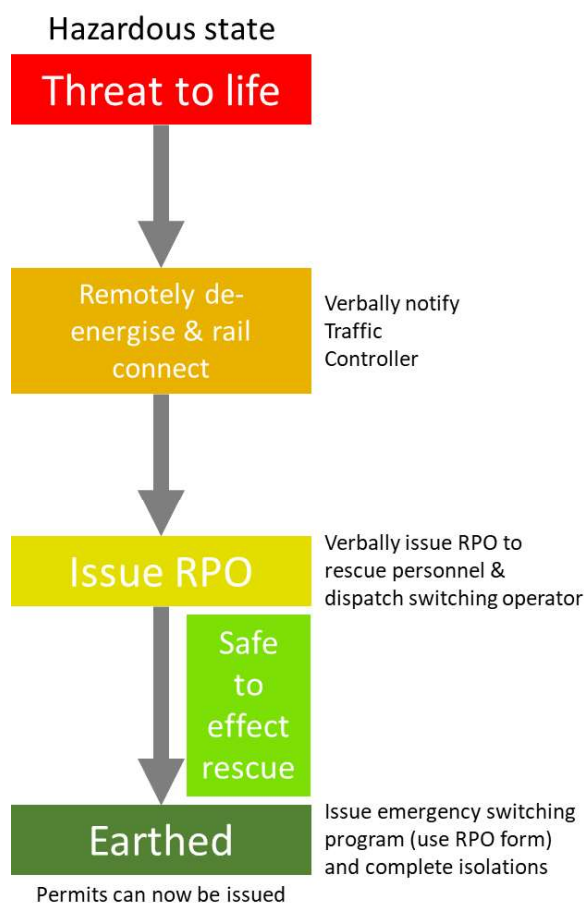


Figure 7 RPO process

## 7.6 Protection of infrastructure and sustained faults

Under emergency or fault conditions, where there is a sustained fault, risk to infrastructure or a train operation irregularity, supply may be removed without a Switching Program being issued

In such circumstances the Engineering Controller must undertake remotely or arrange for local switching to be completed to protect infrastructure and isolate a faulted section. Each switching operation is to be recorded.

In cases where there is danger to persons from live equipment due to damaged overhead wiring or other reasons, or where such danger is reported or suspected to exist, an RPO is to be initiated.

If work is to be completed within the safe approach distance for the equipment an Emergency Switching Program and permit(s) is to be issued.

## 7.7 Pantographs in Emergency Conditions

Special care must be taken when electric vehicles are stranded at air gaps or section insulators.

A Permit must not be issued for work on a section/subsection of the overhead wiring above the pantograph of an electric vehicle if there is live overhead wiring above the other pantograph, regardless of that pantograph being lowered and/or isolated.

As soon as practicable, steps must be taken to determine that the isolated and adjacent overhead wiring sections are not being bridged by individual pantographs and to restore supply to unaffected sections once an appropriate clearance has been obtained from the Traffic Controller.

Consideration must be given to removing supply from adjacent overhead wiring sections to prevent energising the section in which the danger exists by pantographs bridging the sections.

## **7.8 Additional requirements for 1500V Switching Programs**

### **7.8.1 Authority for removal of supply from 1500v section**

Where work involves the removal of supply from a 1500v OHW section, an 'Authority for removal of supply from 1500v section' must be used in conjunction with the switching program.

### **7.8.2 Switching Programs for Section Overlaps or Section Insulators**

Where work is required within a Section overlap or on a section insulator, the isolated area must extend beyond the full length of the section overlap.

## 8 Low voltage distribution system

This procedure describes the procedures for working on the Low Voltage (LV) Distribution System.

### 8.1 General

Requirements for the safe isolation of general LV equipment is contained within the MTS Lock Out, Tag Out (LOTO) procedure. This section is limited to LV systems immediately associated with High Voltage (HV) equipment, 1500v traction power equipment and the LV distribution system.

### 8.2 Safety Requirements

In general, supply should be removed from exposed low voltage equipment prior to work on or near such equipment. When supply is to be removed for work on or near LV equipment, the equipment must be:

- Isolated, and
- DANGER Tagged, and
- Proved dead, and
- where required a Low Voltage Access Permit issued,

before any work commences.

The isolation plan must consider the presence of alternate supplies. It is essential to check the possibility of back-feed or feeding from other energy sources such as back-up supplies, Uninterruptible Power Supplies (UPS) and capacitors. Where circuit configuration warrants, the possibility of induced voltages being present must also be considered.



**WARNING:** When supply is removed for the work, each conductor must be proved dead prior to work commencing. \* TEST BEFORE YOU TOUCH \*



**WARNING:** Where a low voltage conductor cannot be proved dead, it must be treated as being live even though it may have been isolated.

Insulated tools should be used where practicable, even if the supply has been removed.

Avoid simultaneous contact with more than one conductor at any time as they may be at different potentials.

#### 8.2.1 Specific Safety Requirements

Supply must be removed before work is to be performed which involves either:

- The connection between the main neutral and the earthing system being disturbed, or
- A neutral conductor which is carrying load current is broken.

If work involves the earth conductor for a portion of the installation becoming discontinuous, supply must be removed from that portion of the installation.

LV isolation points must be DANGER Tagged and should be secured either directly with a Operator lock or by securing the switchboard or switch room

LV insulating gloves must be worn where there is a risk of inadvertent contact with exposed live LV conductors. At other times, where practicable, mechanical protection gloves should be worn to provide limited protection against electric shock and against minor injuries such as cuts and splinters.

Where possible, the isolated equipment to be worked on should be checked to ensure correct isolation. Ideally the equipment to be worked on should be monitored as supply is being removed, so that upon operation of the identified isolator the equipment to be worked on becomes de-energised.

Where possible, non-bridging work techniques should be adopted. It is a good work practice to avoid simultaneous contact with conductors and/or equipment that could, if the power is not isolated, be at different potentials. That is, avoiding bridging 'hand to hand':

- Across insulators, or
- Between phase conductors
- Between phase conductor(s) and neutral, or
- Between phase conductor(s) and earth or an earthed metallic structure.

## 8.2.2 Live Work (Low Voltage only)

Work should only be carried out live when it can be performed safely, and either:

- It is necessary in the interests of health and safety that the electrical work is carried out on the equipment while the equipment is energised, or
- It is necessary that the electrical equipment to be worked on is energised for the work to be carried out properly, or
- It is necessary for the purposes of proving dead, testing or fault finding, or
- There is no reasonable alternative means of carrying out the work.

## 8.2.3 Non-contact LV Proximity Detectors

When carrying out work on LV equipment, all qualified persons must have immediate access to an approved non-contact LV proximity detector, also commonly known as a 'volt stick'.

Unless working live in accordance with section 8.2.2 above, each conductor, LV electrical equipment or installation must be proved dead and verified as dead using a non-contact LV proximity detector before work is carried out.

The Switching Operator must use the LV proximity detector to test a LV cable before cutting if:

- The cable was previously live, or
- Both ends of the cable are not local to the work site and not obviously disconnected.

The following non-contact proximity detectors are recommended for use:

- Greenlee GT-11 and
- Hioki 3120.

Persons using a non-contact LV proximity detector must always:

- Prove the LV proximity detector to ensure correct functioning immediately before use by rubbing on clothing or using a known live LV source.
- Ensure that the LV electrical apparatus has been de-energised before touching.
- Immediately after use, prove the LV proximity detector is functioning.



**NOTE:**

If there is any doubt on the “live” indication due to induction from nearby live LV circuit or equipment, a contact-type detector must be used to prove dead. The contact-type detector must also be proved to be working immediately before and after the test.

Non-contact LV proximity detectors have limited application and cannot be used:

On DC electrical equipment or installations.

On extra low voltage equipment, outside of the operating range of the non-contact LV detector.

Near another live circuit or electrical equipment, the non-contact LV detector works on induction principles and can give a false “live” due to proximity of other conductors.

On neutral conductors – if there is any doubt about the identification of a neutral conductor and there is potential for it to be carrying current – test with a clamp type ammeter before disconnecting.



**WARNING:** The use of testers that detect an electric field surrounding an energised conductor are not suitable for cables that are surrounded by a metallic screen, cables carrying direct current and in similar circumstances. (AS/NZS 4836 clause 3.2.5)

## 8.3 Warnings

Always ensure that all circuits are isolated, otherwise use live work techniques.

Electrical workers are at risk of contact with live parts when:

- Altering or adding to switchboards.
- Cutting into cables, conduits and other wiring enclosures.
- Making connections in junction boxes that contain numerous circuits.
- Touching parts of installations that are not isolated by a main switch, eg consumer’s mains.
- Touching neutrals without proving dead (as neutrals may become live due to possible cross connections).
- Dual supplies are connected to appliances, eg hot water service or emergency lighting.
- Circuits are not isolated by control switches, eg switch wires.
- Supply could be readily reconnected by others.

### 8.3.1 Work on Low Voltage Substation Controls and Auxiliaries

All work on low voltage substation equipment, which is not for general power and lighting, must be carried out by or supervised by a Switching Operator.

### 8.3.2 Phase Identification of 3-Phase Low Voltage Services

It is essential to identify the neutral and the correct phase conductors for 3-phase LV services. Two methods are normally employed – using a multimeter and using test lamps, both of which are described below.

### 8.3.3 Phase Identification

#### 8.3.3.1 Test Procedure using a Multimeter

The testing probes of the multimeter (set to the Voltage ac Range) are applied to two (2) conductors or terminals at a time.

#### Test Results

Four possible observations can be seen from the tests:

Meter reading	Possible indication
No Voltage	Mains not alive. Testing between conductors of the same polarity. An incomplete circuit. Faulty meter. Very high resistance in a circuit.
Less than 230 Volts	A high resistance in the circuit; or A lower than normal voltage.
230 Volts	230 volts – one active conductor to earth or neutral.
400 or 460 Volts	400 volts – between 2 phases on a 230/400 V system; or in the case of a 230/460V single phase system, a full output of 460 V

*Table 10 Multimeter phase identification results*

### 8.3.3.2 Test procedure Using Test Lamps

The test lamps may be used to correctly identify the phase and neutral conductors. A testing device comprising two (2) series test lamp globes of the same wattage may be used and must be checked to be in good working order prior to testing, and immediately after testing.

The testing probes of the test device are applied to two (2) conductors or terminals of an individual circuit at a time.

#### Test results

The possible test results are listed in Table 11.

Status of test lamp	Possible Indication
No Glow	Mains not alive. Testing between conductors of the same polarity. An incomplete circuit. Faulty lamps. Very high resistance in a circuit.
Dull Glow	A high resistance in the circuit; or A lower than normal voltage
Half Glow	230 volts – one active conductor to earth or neutral (120 volt across each globe).
Full Glow	400 volts – between 2 phases on a 230/400 V system; or in the case of a 230/460V single phase system, a full output of 460 V

*Table 11 Test lamp phase identification results*



### 8.3.4 Tests before Paralleling Two Separate LV Services

Prior to paralleling two separate LV services, tests must be carried out to ensure the correct connection of phases and the neutrals.

With the neutral of both services or circuits already identified, a 'no glow' or 'no voltage' indication across the 2 conductors of different circuits will indicate that they belong to the same phase. On the contrary, a 'full glow' or '400 volts' will indicate out of phase condition.

This test may not be required if the two separate LV sources have been paralleled previously, and it is sure that there is no subsequent change in phasing of either circuit.

### 8.3.5 Isolation of Low Voltage Equipment

#### 8.3.5.1 General

Low voltage equipment must be isolated from **all** sources of supply by providing at least one break in each active conductor through which the equipment could be made live from these sources.

Breaks must be provided by:

- Opening a circuit breaker, or
- Removing fuses, or
- Opening isolating switches, or
- Disconnecting conductors.

Devices operating in a control circuit, such as an emergency stop or limit switch, are not to be used as the sole means of providing isolation.

The devices providing isolating breaks must be DANGER Tagged and where practicable locked.

When an isolating device can also be operated by remote control, the remote control must be rendered inoperative, and the means of ensuring that it remains inoperative DANGER Tagged.




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**WARNING:**

An isolating device with a DANGER Tag attached must not be operated.

Isolation of an installation or apparatus must not be achieved by a remote-control device alone.

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#### 8.3.5.2 Isolation by the Operation of High Voltage Switches

High voltage (HV) equipment must be operated in accordance with the High Voltage Procedure.

#### 8.3.5.3 Isolation by the Breaking of Connections

When isolation of LV equipment is achieved by the breaking of connections, the active conductors must be disconnected first, followed by the neutral conductor and the earth

conductor last. Disconnected conductors are to be secured in a position which will prevent possible contact with any live terminals or apparatus.

The reverse of this disconnection procedure must be followed for reconnection on restoration of supply.

#### **8.3.5.4 Isolation of Back Feeds or Alternative Feeding**

Where isolation has been undertaken by the opening of HV or LV switches, it is essential to check the possibility of back feed or feeding from other energy sources such as back-up power supplies, Uninterruptible Power Supplies (UPS), solar grid inverters and capacitors. Where the circuit configuration warrants, the possibility of induced voltages being present must also be considered.

## 9 Permits

### 9.1 General

#### 9.1.1 Overview

Permits are used under these rules to manage the safe access to electrical facilities and equipment. Work within the Safe Approach Distance for the equipment is considered access.

Permits are used for access to the following;

- High Voltage (HV) equipment
- 1500 V DC equipment
- Low Voltage (LV) distribution equipment

Access to general low voltage equipment is controlled through the MTS, Lock Out, Tag Out (LOTO) procedure.

MTS uses the following permits under these rules;

- Electrical Permit to Work (EPTW)
- Test Permit
- Operating Agreement

Electrical permits must be issued in accordance with the relevant switching program.

#### 9.1.2 Details Specified on Permits

Permits specify;

- Date and time for the work
- Location of the work
- Isolation points
- Earthing and rail-connecting points
- Any special conditions applied to the work
- Safe work area
- Permit holder

#### 9.1.3 Issuing Officers

##### 9.1.3.1 Eligible Persons

An issuing officer is the person trained and authorised to issue permits under these rules. An issuing officer is normally the nominated Switching Operator or may be a person specifically authorised for this task.

### 9.1.3.2 Responsibilities

Issuing officers are responsible for the following tasks when issuing and cancelling a permit;

- i. Preparation of the permit
- ii. Coordinate checking of the permit (where required)
- iii. Instructing the Permit Holder on, and confirming their understanding of the requirements and conditions contained within the permit
- iv. Registering the permit with Engineering Control
- v. Receiving the permit from the permit holder
- vi. Cancelling the permit with Engineering Control

### 9.1.3.3 Instruction of the Permit Holder

The Permit Holder must be instructed, by the issuing officer prior to a Permit being issued. Instruction must take place;

- vii. At the worksite (mandatory where the safe work area is within 200m of live 1500v OHW), or
- viii. Face to face remote from the worksite, or
- ix. Remotely, at the discretion of the issuing officer

In all cases the requirements of sections 6.5 must be met.

Additional Permit Holders may be instructed in accordance with this document including after work has commenced.

### 9.1.3.4 Cancellation of Permits

When receiving a permit from a permit holder, switching operators must:

- Ensure that all members of the work group have signed off the permit before allowing the permit holder to leave the worksite.
- Ensure that the permit holder has confirmed the state of the equipment covered by the permit as set out at section 9.1.4.5

## 9.1.4 Permit Holders

### 9.1.4.1 Eligible Persons

Permit holders must:

- hold authorisation from MTS as a permit holder for the permit held, and
- have been instructed on the details of the permit by an authorised switching operator.

Persons who do not hold appropriate certification are not permitted to hold a Permit. See Table 12 Eligible Permit Holders.

An Operating agreement may be issued to the nominated representative of the organisation requesting the work.

	Electrical Permit to Work	Test Permit	Operating Agreement
Ordinary Person			✓
Permit Holder ®	1500v DC OHW equipment only		
Permit Holder	✓		
Switching Operator	✓	✓	
Engineering Controller	✓	✓	

Table 12 Eligible Permit Holders

### 9.1.4.2 Receiving and holding a permit

Permit Holders are responsible for the following tasks when receiving, holding, and working under a permit:

- Ensuring that they understand all the requirements of the permit
- Ensure that all members of their work group sign on to the permit.
- Comply with the requirements of the permit
- Notifying the issuing officer if they transfer a permit
- Applying and removing working earths and working rail connections

### 9.1.4.3 Permit Holder in Charge

At all times there may only be one person holding a permit at a time, however the permit may be transferred to a relieving Permit Holder.

The person to whom the Permit is issued (i.e. the Permit Holder) will normally be the person in charge of a work group. If only one person in the work group is required to work on or near the subject equipment, the Permit may be issued to that person.

It is the responsibility of the Permit Holder to ensure that all members of their work group sign on to the Personnel Register contained in the Permit booklet prior to commencing work. Permit holders must also ensure that all members of the work group sign off the Personnel Register on completion of their shift or prior to cancellation of the Permit.

#### 9.1.4.4 Transfer of a permit

A permit may be transferred to a relieving permit holder where:

- The relieving permit holder has been briefed by a switching operator on the requirements of that permit.
- The issuing officer has been notified of the transfer, or
- Where the issuing officer is unavailable, the duty engineering controller has been notified of the transfer.

Relieving permit holders are required to record the change on the permit.

#### 9.1.4.5 Return of the Permit

Permit Holders are responsible for the following tasks before returning or relinquishing a permit:

- Ensure that all members of their work group have signed off the permit
- Ensuring that all working earths / working rail connections applied by the work party are removed from the electrical equipment.
- Ensuring that the equipment is safe to return to service and energise. Where the equipment is not safe to return to service this is to be noted by the permit holder on the permit and the switching operator is to be advised.
- Sign off and return the permit to the nominated switching operator.

#### 9.1.5 Additional Work

No additional work is to be carried out on or near the isolated equipment other than that specified on the Permit.

#### 9.1.6 Deletions or Alterations

No deletions or alterations to a permit can take place once that permit has been issued. If changes are required the existing permit is to be cancelled and a new permit is to be issued.

#### 9.1.7 Multiple Work Groups or Work Locations

Where a single person in charge can adequately and safely control the work to be undertaken, the person may hold multiple Permits. A separate Permit must be issued for each:

- Work location, or
- Group of work locations.

In assessing if it is practicable for a single person to effectively supervise the work, the issuing officer must consider the:

- extent of the Electrically Safe Work Area,
- proximity of the electrical hazards,
- number of persons working under the Permit,
- physical separation of work locations,
- mobility of the work process, and
- capability and competence of the work group

## 9.1.8 Warnings

Permits are to include any warnings or limitations on the work as identified by special instructions, the Switching Operator issuing the permit or the workgroup completing the work.

Consideration should be given to:

- Live electrical equipment
- Identification of risk management required for the proposed work
- Limits on the scope of the proposed work
- Demarcation of the worksite using barriers, safety fences, demarcation taping and / or temporary warning signs where required

## 9.1.9 Personnel Registers

### 9.1.9.1 General

Every person working under a permit must be signed on to the personnel register for that permit.

Each person is responsible to ensure that they sign on to the personnel register before accessing the safe work area and before leaving site or at the end of their shift.

### 9.1.9.2 Insufficient Space

If there is insufficient space on the Personnel Register for all members of the work group to sign on, then the Permit Holder must attach one or more Personnel Registers. Each Personnel Register forms part of the Permit, and persons signing onto a personnel register are subject to the same conditions as if they had signed onto the Permit form itself.

### 9.1.9.3 Multiple Shifts

A Permit may be issued to accommodate multiple shifts if all the conditions below are confirmed prior to the commencement of each shift:

- The scope of work, including the extent and type of work, remains unchanged.
- The permit holder on the completed Permit, remains unchanged.
- The members comprising the work group have been instructed as required.

- No additional electrical hazards have been introduced to the work area.
- A procedure for the management of the Permit in between shifts is nominated by the person in charge.

If any one condition cannot be met, the Permit must be cancelled and then a new Permit must be issued for each shift.

For **each** shift, members of the work group must sign on to the Personnel Register prior to commencing work and must sign off the Personnel Register at the completion of their shift.

## 9.1.10 Responsibilities

### 9.1.10.1 Responsibilities general

This section sets out specific responsibilities for persons undertaking the following tasks:

- Writing and checking Permits
- Instructing Permit Holders
- Issuing and cancelling Permits
- Holding Switching Program's for Test Permits
- Carrying out electrical tests - Persons undertaking the tests are responsible for ensuring that the testing is carried out safely.

### 9.1.10.2 Writing of permits

Electrical permits may only be written by authorised switching operators or engineering controllers - (or by a "trainee" under the supervision of the authorised switching operator or engineering controller).

### 9.1.10.3 Checking of permits

Permits may only be checked by a switching operator or engineering controller (who may be the author where a second switching operator or engineering controller is not practically available).

### 9.1.10.4 Instructing of Permit Holders

Permit holders may only be instructed by a switching operator or engineering controller (or by a "trainee" under the direct supervision of the authorised switching operator or engineering controller - the authorised switching operator or engineering controller must counter-sign the permit).



### 9.1.10.5 Issuing and cancelling of permits

Permits may only be issued and cancelled by an authorised switching operator or engineering controller (or by a “trainee” under the direct supervision of the authorised switching operator or engineering controller – the authorised switching operator or engineering controller must counter-sign the permit).



#### NOTE:

The person checking the written Permit or instructing prospective Permit Holders must ensure that all relevant information including any special instructions and warnings on the Switching Program is entered on the Permit. All information entered on the Permit in items 1 to 6, when implemented, would provide an Electrically Safe Work Area, as required for the work detailed on the request.

### 9.1.10.6 Limitations on writing, checking, issuing, and holding of permits

A single authorised person is prohibited from carrying out all functions of writing, checking, issuing, and holding for a single permit. As a minimum, at least two suitably authorised persons must undertake the listed activities.

### 9.1.11 Instruction of Permit Holders

#### 9.1.11.1 Responsibility of the Person Instructing Prospective Permit Holders

The person instructing a prospective Permit Holder must be authorised to issue a Permit and must:

- (a) Have access to an approved copy of the relevant Switching Program, the permit register, and up-to-date Operating/Sectioning Diagrams, and
- (b) Ensure that all relevant information including any special instructions and warnings on the Switching Program is entered on the Permit. All information entered on the Permit in items 1 to 6, when implemented, would provide an electrically safe work area as required for the work detailed on the Request for Electrical Permit to Work form, and
- (c) Ensure that the person to be instructed is an authorised Electrical Permit Holder.

It is not necessary that the Switching Operator who instructed the Permit Holder be the same Switching Operator who will issue the Permit.

### 9.1.12 Issuing of Permits

#### 9.1.12.1 Preliminary Checks

The Switching Operator issuing the Permit must ensure that:

- (a) All relevant information including any special instructions and warnings on the switching program is entered on the Permit and check that the information is clearly legible on the Permit issuer’s copy (self-duplicating).
- (b) The person in charge of the switching program has:

- Confirmed that the specified high and low voltage cables have been isolated and earths/rail connections applied as required.
- Confirmed that the specified electrical equipment has been isolated and has advised the locations of the associated earths/rail connections.
- Confirmed that other Electrical Network Operator's services where involved have been isolated and earthed as required and an Operating Agreement has been received.
- Advised the Permit number.

(c) the Permit is correctly numbered.

(d) all 1500-volt equipment covered by the Permit is rail connected.

(e) The Prospective Permit Holders listed on the Permit concerned are authorised Electrical Permit Holders.

### 9.1.12.2 Issuing actions

The Switching Operator issuing the Permit must then:

- (a) Make the Permit "in force" by writing their name, signing in the space provided and entering the time and date "in force" and issue the Permit.
- (b) Ensure that the Permit Holder understands all details are entered at items (1) to (6) of the Permit prior to writing their name and signing on the Permit in acknowledgment and acceptance of the associated responsibilities.
- (c) Confirm the details of the Permit with the Switching Operator in charge of the Switching Program.

It is not necessary that the person issuing the Permit be the same person who instructed the Permit Holder.

The person issuing the Permit must advise the person holding the Switching Program so that they can record the issue of any Permit on the back of the Switching Program. If the Permit is issued against multiple Switching Program's, the record of issue must be indicated on **all** associated Switching Program's.

The person issuing the Permit is not required to remain in the vicinity of the work unless holding the Permit.

### 9.1.13 Return of the Permit

Permit Holders are required to return the Permit to the Switching Operator retrieving and cancelling the Permit or as instructed by the switching operator. Where practical switching operators should check and ensure that the Permit Holder and all members of the work group have signed off before allowing the Permit Holder to leave the work site.

### 9.1.14 Responsibility of the Person Cancelling the Permit

#### 9.1.14.1 Preliminary Checks When Retrieving the Permit

Prior to cancelling the Permit, the Switching Operator retrieving the Permit must:

- (a) Check that the Permit Holder has certified that the Permit may be cancelled, and
- (b) Check that all persons signed on to the Permit or Personnel Registers have signed off, and
- (c) If it appears that any work group member may not have signed off, confirm that the Permit Holder:
  - Has made reasonable attempts to check that any person failing to sign off has left the work site and it is impracticable to get them back for signing off;
  - Accepts responsibility for that person, and an appropriate notation must be made on the Personnel Register and;
  - The Permit Holder is required to undertake a joint site inspection with the Person retrieving the Permit or nominated Switching Operator to ensure that all persons, tools and machinery are outside the minimum Safe Approach Distance for safe energisation of supply.
- (d) If the Permit Holder has not signed off and/or already left the work site and is not reasonably practicable for them to return to sign off the Permit, then the Person retrieving the Permit or nominated Switching Operator must undertake a site inspection to ensure that all persons, tools and machinery are outside the minimum Safe Approach Distance for safe energisation of supply.
- (e) In the case of incident (c) or (d) above, report the incident to the Engineering Controller and the person in charge of the Switching Program.
- (f) Check that the electrical equipment for which the Permit was issued has been inspected, tested if required, and is safe to be energised.
- (g) In the case of incident (c) or (d) above, report the incident to the Electrical Manager

#### 9.1.14.2 Cancellation of the Electrical Permit

Once the preliminary checks have been satisfactorily completed, the Switching Operator cancelling the Permit must:

- (a) Ensure that the Permit Holder of the final shift has, in addition to signing off the final shift Personnel Register, also signed off the Permit, certifying that;
  - the work has been completed, and;
  - the equipment is available to return to service, and;
  - the Permit is no longer required.
- (b) Cancel the original copy of the Permit by signing in the space provided and entering the time and date.
- (c) Ensure that the person in charge of the Switching Program advised that the Permit has been cancelled.
- (d) Forward the cancelled Permit to the Engineering Controller.

### 9.1.14.3 Removal of Portable Earths and Rail Connections

Earths and portable rail connections applied as a step in a switching program must only be removed by authorised switching operators (or under the direct supervision of an authorised switching operator) under the instruction of the duty engineering controller.

Working earths and portable rail connections applied by the permit holder, must be removed by the permit holder prior to the return of the permit.

### 9.1.15 Loss of an Electrical Permit

If the Permit is lost or damaged, the Permit Holder must immediately report the loss to one of the following:

- The person who issued the Permit, or
- The person who will cancel the Permit, and
- The Engineering Controller.

#### 9.1.15.1 Loss of Permit with Work still in Progress

A Switching Operator must issue a duplicate Permit with the same number. A duplicate Permit must be annotated "Replacement Permit". The Switching Operator must instruct the Permit Holder to ensure that all persons still engaged in the work sign onto the Personnel Register of the duplicate Permit. The Switching Operator must also ensure that the loss and replacement action is recorded on the back of the Switching Program.

#### 9.1.15.2 Work Already Completed and Replacement Permit not Issued

The Switching Operator who would have cancelled the Permit must obtain written notification from the Permit Holder that:

- All persons and material are clear of all electrical equipment for which the Permit was issued, and
- All persons who signed on to the original Permit have been instructed to treat the equipment as live.

If the Issuing Officers copy of the Permit is available, written notification may be provided by making a notation on the Issuing Officers copy stating that:

- The original Permit has been lost, and
- As far as practicable, all persons signed on to the original Permit have been contacted and told that it is no longer safe to work at the locations covered by the Permit.

### 9.1.16 Linked Permits

#### 9.1.16.1 Linked Permits General

If work requires access to multiple work areas; the issuing officer may elect to issue a single permit listed against each of the switching programs or authorities in force. This is known as a linked permit

Prior to issuing the permit, the issuing officer must ensure that all isolation, earthing / rail-connecting is complete, and clearance has been provided by the engineering controller to issue permits against the applicable switching programs.

### 9.1.16.2 Registering of a linked permit

Linked permits must be recorded on each switching program under which the permit is issued.

Where the permit number refers to the switching program, the permit should be numbered using the format "switching program & switching program / 1" etc..

**Electrical Permit to Work** No. 19-101 & 19-102 & 19-103 / 1

Permits must be recorded on the permit register for each Switching Program using the composite Permit number.

## 9.2 Electrical Permit to Work

### 9.2.1 Overview

An Electrical Permit to Work is the primary safety document for work on or *near* the following electrical equipment:

- High Voltage (HV) equipment
- 1500 V DC overhead wiring or cables
- Low Voltage (LV) distribution equipment

Throughout this sub-section the term 'Electrical Permit to Work' is, where appropriate, abridged as 'Electrical Permit', EPTW or just 'Permit'.

An EPTW is issued by an issuing officer (Switching Operator) to a Permit Holder as confirmation that the listed electrical equipment has been:

- Isolated,
- Proved dead, and
- Earthed and / or rail-connected,
- within the defined Electrically Safe Work Area, and;
- The above conditions will remain in place until the Permit is returned and cancelled.

### 9.2.2 Inclusion of Low Voltage equipment

Where LV distribution (including LV direct current) equipment must be isolated and proved dead for the work, it must be included on the Electrical Permit to Work.

### 9.2.3 Construction of New electrical equipment

Where construction of new electrical equipment does not encroach on the SAD (Safe Approach Distance) to existing electrical equipment the issue of an electrical permit is not required.

## 9.3 Test Permit

### 9.3.1 Overview

Where it is necessary to apply a hazardous voltage or remove earths or rail connections to enable test equipment to be used, a Test Permit must be issued.

The following work may be carried out under a Test Permit:

- Connection and disconnection of the test equipment,
- Application of hazardous voltages for the purpose of testing,
- Adjustment of the test equipment,
- Minor works associated with testing (such as making or breaking connections).

Application of test equipment must be carried out with the electrical equipment earthed or rail connected unless it is carried out in a manner that does not require persons to come within the Safe Approach Distance of the electrical equipment.

Control of earthing and rail connection equipment made available for operation by the “Test Permit” holder and fitted with “restricted use” tags pass to the “Test Permit” holder for the duration that the Test Permit remains “in-force”. This equipment may then be operated only at the discretion and direction of the “Test Permit” holder.

### 9.3.2 Special Requirements

The electrical equipment to be tested must be isolated and earthed or rail connected in accordance with the relevant Switching Program prior to the issue of the Test Permit.




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**WARNING:**

Equipment capacitance can result in a dangerous voltage remaining on the equipment after the test equipment has been turned off.

The equipment must be discharged to earth at the conclusion of the test, prior to persons coming within the electrical Safe Approach Distances.

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Whilst the Test Permit is current:

- All other Permits associated with the Switching Program must be cancelled prior to the Test Permit being issued.
- The equipment must remain isolated.
- The earths or rail connections must only be removed for the time required to conduct the test.
- The Switching Program is not permitted to be cancelled.

All conditions applicable to an Electrical Permit to Work, other than the removal of earths or rail connections, apply to the Test Permit.

### 9.3.3 Adjustment of Safe Approach Distances

To allow completion of testing adjustment (reducing or increasing) of safe approach distance may be required. Additional care is required during the period for which earths or rail connections are removed and all persons should remain outside of the required Safe Approach Distance from the electrical equipment. Recommended distance is the greater of that prescribed in Table 8 Safe approach distances - persons for:

- The nominal equipment operating voltage, and
- The test voltage.

### 9.3.4 Adjacent 1500v DC OHW Sections

Where the test voltage exceeds the rated voltage of the equipment, the overhead wire sections adjacent to the test section must be rail connected to protect against:

- Leakage across section insulators and insulated knuckles, and
- Danger from pantographs bridging live to dead sections.

### 9.3.5 Person Holding a Switching Program for a Test Permit

The person in charge of the Switching Program must:

- Be in charge of all current Switching Program's covering the electrical equipment, which is being tested, and
- Prior to the issuing of the Test Permit, check with the person carrying out the tests:
  - The details of tests to be carried out, and
  - The isolation and earthing or rail connecting arrangements.
- Ensure that no other Electrical Permit is in force for the electrical equipment being tested during the currency of the Test Permit, and
- Be present during the tests to ensure that the agreed arrangements are followed, and
- Authorise the removal and replacement of earths or rail connections when required, in co-ordination with the Engineering Controller.

### 9.3.6 Person Carrying Out the Test

The person carrying out the tests must have sufficient knowledge of the test procedures and is responsible for ensuring that the testing is carried out safely.



## 9.4 Operating Agreements

### 9.4.1 Overview

Operating agreements are an administrative control used to communicate an agreed MTS network state to another electrical network operator.

In issuing an Operating Agreement for equipment nominated by the other Electrical Network Operator, MTS gives no assurance that it will be safe to carry out the proposed work with that equipment isolated. An Operating Agreement only certifies the equipment state and confirms that the nominated equipment will remain in the listed state until the Operating Agreement is returned.

### 9.4.2 Instruction of the Person Receiving the Operating Agreement

As Network Operators use unique procedures and documents it is important that issuing officers ensure the holder of the operating agreement clearly understands the content of the Operating Agreement.

Issuing officers must ensure that the representative of the other electrical Network Operator understands:

- which electrical equipment is covered by the operating agreement,
- the requirements of the operating agreement,
- time and date restrictions of the operating agreement,
- equipment state and location relative to the other network operator's equipment.

Issuing officers must ensure the holder of the operating agreements provides their name and contact details in the space provided.

# 11 Related documents

## 11.1 Related documents

#	Document title	Signature
1	MTS SMS Element 32 – Management of Electrical Distribution Network	NWRLOTS-NRT-SWD-RS-FRW-720732
2	Request for Electrical Permit to Work	NWRLOTS-NRT-SWD-SF-PRM-726003
3	Electrical Permit to Work	NWRLOTS-NRT-SWD-SF-PRM-726004
4	Authority for Removal of Supply from 1500 Volt Sections	NWRLOTS-NRT-SWD-SF-PRM-726006
5	Personnel Register	NWRLOTS-NRT-SWD-SF-REG-726007
6	Operating Agreement	NWRLOTS-NRT-SWD-SF-FRM-726009

*Table 13 Related documents*

## 11.2 Document map

