

Engineering Procedure  
Electrical Distribution Unit

PR D 78100

# Definitions and Conventions for Electrical Safety

Version 1.2

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# Procedure

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## Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	26 February 2016	Chris Leung	First issue as a Sydney Trains document, rebranded from previous RailCorp SMS-06-EN-0551 V1.3
1.1	10 September 2018	Amy Atkins	Update of WHS regulation reference
1.2	19 February 2019	Nick Loveday	Update roles and position names to reflect the current organisation

## Summary of changes from previous version

Summary of change	Section
Updated "Electrical Manger ESI" to " Associate Director Electrical Distribution Unit" for the terms "approved" and "Electrical Authorising Officer"	3

## 1 Purpose and scope

To define the Electrical terms used in Sydney Trains Electrical Network Safety Rules (PR D 78000).



## 2 Conventions used in the Sydney Trains Electrical Network Safety Rules




Where instructions contain bullet points, the order in which the list is carried out is not critical. Where instructions contain a list using alphabet letters or Roman numerals, the points shall be carried out in the exact sequential order.


## 3 Definitions

For the purpose of the Electrical Network Safety Rules, the following meanings and definitions apply:

<b>Term</b>	<b>Definition</b>
<b>aerial line</b>	Any aerial conductor or conductors with associated supports, insulators and other equipment erected, or in the course of erection, for the purpose of the transmission, distribution or conveyance of electrical energy.
<b>Aerial Line Earthing Set</b>	A set of earthing equipment used to electrically connect isolated high voltage aerial conductors together (including overhead earth wire, where installed) to earth. Aerial Line Earthing Sets are suitable for earthing up to 4 conductors and are provided with a single long down lead to reach from the pole top to the ground.
<b>approved</b>	Unless otherwise stated, this means approved in writing by the Associate Director Electrical Distribution Unit or a person nominated for that purpose by the Associate Director Electrical Distribution Unit.
<b>Authorised / Authorisation</b>	Has the permission of the appropriate organisation in writing for the duty concerned as detailed in <i>PR D 78701 Personnel Certifications – Electrical</i> .
<b>Authorised Person</b>	A person who is specifically authorised to perform electrical work on, near and in the vicinity of equipment that forms part of the RailCorp electrical network.
<b>Authorised Person (Low voltage)</b>	An Authorised Person (Low voltage) or a Qualified Electrician who is authorised for the relevant duties. Refer to <i>PR D 78701 Personnel Certifications – Electrical</i> for details of relevant duties.
<b>Authorised Person (Mains)</b>	An Authorised Overhead Traction Worker, Authorised Traction Operator, an Authorised Traction Live Line Worker, an Authorised Cable Joints, or an Authorised Officer (Mains) who is authorised for the relevant duties. Refer to <i>PR D 78701 Personnel Certifications – Electrical</i> for details of relevant duties.

<b>Term</b>	<b>Definition</b>
<b>Authorised Person (Substations)</b>	<p>Means an Authorised Attendant, or an Authorised Operator, or an Authorised Officer (Substations), who is authorised for the relevant duties. Refer to <i>PR D 78701 Personnel Certifications – Electrical</i> for details of relevant duties.</p> <hr/> <p> <b>NOTE</b>                      A person authorised as 'Authorised for Entry' is not an Authorised Person (Substations).</p>
<b>Authorised Person In Charge of the Authority</b>	The Authorised Person (Mains) who is authorised to and holds the Authority for Removal of Supply from 1500 volt Sections.
<b>Authority for Removal of Supply from 1500 Volt Sections, (Authority)</b>	The Sydney Trains form (refer to <i>PR D 78302 FM 01</i> ), completed and signed, used whenever it is necessary to organise the isolation, proving dead and rail connecting of a section/subsection of the 1500 volt overhead wiring system.
<b>DANGER Tag</b>	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 shall be a label, tape or other device with the word "DANGER" displayed on it along with other relevant details.
<b>dead</b>	Below a voltage at which it is safe to apply earths or rail connections.
<b>de-energised</b>	Separated from all sources of supply, but not necessarily isolated, earthed / rail connected or out of commission.
<b>dead section</b>	<p>A section of 1500 volt overhead wiring from which supply has been removed.</p> <hr/> <p> <b>Warning</b>                      Although electrical equipment or a section of OHW is "dead" or de-energised, this does not mean that the equipment or the section of the OHW is safe to work on.</p>
<b>discharged to earth, discharged</b>	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.
<b>disconnected</b>	<p>Electrical equipment to which there are no electrical connections, and which can not 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>
<b>earthed</b>	Connected to the general mass of earth in the approved manner so as to ensure the immediate effective discharge of electrical energy in the event of the electrical equipment concerned being or becoming live.

<b>Term</b>	<b>Definition</b>
<b>Electrical Authorising Officer</b>	A person who has been delegated by the Associate Director Electrical Distribution Unit as the Authorising Authority for specified personnel Authorisations, as detailed in <i>PR D 78701 Personnel Certifications – Electrical</i> .
<b>Electrical Distribution System</b>	<p>The independent electricity distribution network operated by Sydney Trains as an integral part of its rail operations. The network interfaces with the high voltage networks of the external adjacent Distribution Network Service Providers (DNSP) and Transmission Network Service Provider (TNSP) via bulk supply points.</p> <p>The network consists of aerial lines and underground cables and operates as a HVAC and LVAC power distribution network.</p> <hr/> <p> <b>NOTE</b>  <i>The 1500VDC Overhead Wire is not considered part of the electricity distribution network.</i></p> <hr/>
<b>Electrical Engineer</b>	A person with the appropriate delegated authority and electrical engineering competence and experience to make judgements concerning electrical safety.
<b>Electrical Permit</b>	<p>An Electrical Permit to Work, a Substation Access Permit, Low Voltage Access Permit or variant as appropriate (refer to <i>PR D 78500</i>).</p> <hr/> <p> <b>NOTE</b>  <i>In some cases, this is abbreviated to Permit where is clear from the context that it is referring to an Electrical Permit.</i></p> <hr/>
<b>Electrical Permit to Work</b>	The pre-printed form (refer to <i>PR D 78703</i> ), completed and signed, which is issued by an Authorised Person to an Accredited Electrical Permit Holder, to define the high voltage mains or 1500 volt overhead wiring and 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.
<b>electrical equipment</b>	<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> <hr/> <p> <b>NOTE</b>  <i>Electric rolling stock and electrical equipment within rolling stock are not regarded as electrical equipment.</i></p> <hr/>



<b>Term</b>	<b>Definition</b>
<b>electrical system</b>	The: <ul style="list-style-type: none"> <li>• low voltage, high voltage electrical distribution system; and,</li> <li>• 1500 volt dc overhead wiring system; and</li> <li>• the associated protection and monitoring systems of the Rail Corporation New South Wales.</li> </ul>
<b>Electrical System Operator (ESO)</b>	The Sydney Trains Electrical System Operator, controlling the RailCorp electrical system.
<b>electrical work</b>	<p>The actual physical work of:</p> <ul style="list-style-type: none"> <li>• constructing, installing, maintaining, repairing, altering, removing testing, replacing or adding to, or</li> <li>• removing or restoring supply to, electrical equipment on RailCorp's electrical system or the supervising of that work.</li> </ul> <hr/> <p> <b>NOTE</b>  <i>The erection, modification and dismantling of 1500 V OHW support structures is not considered to be electrical work.</i></p> <hr/> <p>Exemptions to 'electrical work' are listed in the Work Health and Safety Regulation section 146.</p>
<b>energised</b>	Refer to <i>live, alive, livened up</i> .
<b>exposed electrical equipment</b>	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.
<b>extra low voltage</b>	A nominal voltage not exceeding 50V ac or 120V ripple-free dc.
<b>floating</b>	Insulated from earth, rail and all sources of supply but where failure of such insulation may result in it becoming live.
<b>height measuring stick</b>	Insulated stick for measuring the height of live aerial conductors or electrical equipment. They are usually telescopic with the lower sections being hollow.
<b>high voltage</b>	A nominal voltage exceeding low voltage. 1500 volt dc is treated as a separate case in the Sydney Trains Electrical Network Safety Rules.
<b>Induction</b>	Production of a magnetic or electrical state in a body by proximity (without contact) of an electrified or magnetised body.
<b>insulator</b>	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.

<b>Term</b>	<b>Definition</b>
<b>Isolated (electrically)</b>	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.
<b>Line Manager</b>	Is a Sydney Trains employee who has management responsibility, or in the case of a non Sydney Trains employee, "a person conducting a business or undertaking" (PCBU).
<b>live, alive, livened up</b>	Connected to a source of supply, or subject to hazardous induced or capacitive voltages.
<b>live line work</b>	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.
<b>local instruction</b>	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, found in procedures <i>PR D 78203 High Voltage Operating Procedures</i> and <i>PR D 78305 1500V Operating Procedures</i> , are not sufficient.
<b>low voltage</b>	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 a separate case in the Sydney Trains Electrical Safety System ( <i>PR D 78000 Electrical Network Safety Rules</i> and related documents).
<b>Low Voltage Access Permit (LV Access Permit)</b>	The pre-printed form ( <i>PR D 78503 FM 01</i> ), completed and signed, which is issued by an Authorised Person to define the low voltage electrical 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.
<b>low voltage distribution system</b>	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 in one or more 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.



<b>Term</b>	<b>Definition</b>
<b>low voltage installation</b>	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.
<b>low voltage aerial line</b>	A low voltage aerial conductor or conductors together with insulators, hardware, crossarms, or other associated electrical equipment erected, or in the course of erection, out-of-doors. A low voltage aerial line may be part of a low voltage distribution system or part of an installation.  Insulated aerial conductors which are part of an installation and which are erected between a pole or a building and a lighting pole, or between buildings, are not considered to be a low voltage aerial line.
<b>Network Operating Protocol</b>	An agreement between Electrical Distributors for the isolation and restoration of assets interfaced between the two organisations.
<b>OHW rail connection stick</b>	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.
<b>Operating Agreement</b>	A pre-printed form (refer to <i>PR D 78504 FM 01</i> ), 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.  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.
<b>Operating Diagrams</b>	The set of electrical diagrams comprising 1500 volt Sectioning diagrams, Substation AC Diagrams, Substation DC Diagrams, Reticulation and System Diagrams, Signalling and Lighting Feeder Diagrams.
<b>operating stick (rod)</b>	An insulated stick used for operating or working on live high voltage or 1500V conductors or electrical equipment.



<b>Term</b>	<b>Definition</b>
<b>operating work</b>	Work involving any of the following: <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>
<b>Operations Control Officer</b>	The Train Control Officer having jurisdiction over the relevant portion of the rail system.
<b>overhead line</b>	See <i>aerial line</i> .
<b>Overhead Wiring or 1500 Volt Equipment or 1500 Volt Overhead Wiring or OHW</b>	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.
<b>overhead wiring structure</b>	Any structure that supports or registers a catenary and/or contact wire, 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.
<b>person / worker</b>	Has the same meaning as 'worker' as defined in the Work Health and Safety Act 2011.
<b>Person conducting a business or undertaking (PCBU)</b>	Has the same meaning as 'PCBU' as defined in the Work Health and Safety Act 2011.
<b>Personnel Register</b>	A pre-printed form used as follows: <ul style="list-style-type: none"> <li>• In the case of a Substation Access Permit or Low Voltage Access Permit, to record the names and signatures of all persons working under the Permit, where the space on the Permit is insufficient to record all persons working, or where the same Permit is to be used for multiple shifts.</li> <li>• In the case of an Electrical Permit to Work, to record the names and signatures of all persons working under the Permit, and this form is bound with the Permit to form an Electrical Permit to Work booklet.</li> </ul>
<b>portable earthing equipment</b>	Portable HV aerial line earthing set or substation earthing set.

<b>Term</b>	<b>Definition</b>
<b>portable rail connecting equipment</b>	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.
<b>Professional Head Electrical Engineering, ESI</b>	The Professional Head Electrical Engineering of the Sydney Trains Engineering and System Integrity Division.
<b>proving dead</b>	The process of proving that electrical equipment is dead.
<b>rail connected or rail connections</b>	The connection of the 1500 volt overhead wiring to the negative return rail (traction rail) in the approved manner to ensure the immediate effective discharge of electrical energy from the 1500 volt overhead wiring equipment to the rail in the event of the equipment concerned being, or becoming, live.
<b>Railway Signalling Electric System</b>	<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>
<b>reasonably practicable</b>	<p>Has the same meaning as 'reasonably practicable' as defined in the Work Health and Safety Act 2011.</p> <hr/> <p> <b>NOTE</b>  <i>Safe Work Australia provides an interpretive guideline for the meaning of 'reasonably practicable'.</i></p> <hr/>
<b>Safe Approach Distance (SAD)</b>	<p>The minimum separation, in air, from an exposed conductor or exposed electrical equipment that shall 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> <hr/> <p> <b>NOTE</b>  <i>Safe Approach Distances are defined in PR D 78700 Working around Electrical Equipment.</i></p> <hr/>

<b>Term</b>	<b>Definition</b>
<b>safety earths</b>	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.
<b>Safe Work Method Statement (SWMS)</b>	A statement that: <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>
<b>section hut, sectioning hut</b>	A building generally located between Substations containing dc circuit breakers providing protection and sectioning of the Overhead Wiring System and, on multiple tracks, improving voltage regulation.
<b>shall</b>	Indicates that a statement is mandatory.
<b>short circuiting</b>	The connecting together of conductors by approved means to ensure that there can be no potential difference between the conductors.
<b>short circuit and earth</b>	The procedure for connecting conductors together and connecting them to earth by approved means so that the conductors are at earth potential.
<b>spiking, spiked</b>	The procedure for proving that a high voltage cable is dead prior to cutting the cable.
<b>Stringing</b>	The running out of the conductor from the cable drum, lifting into aerial position and securing of the ends of the conductor which have been detached from the cable drum.
<b>substation</b>	A substation, traction substation, transformer room, switchroom, sectioning hut, 1500V link area, 1500V switch area containing switches that connect DCCBs to OHW sections, pole or pad mounted transformer locations, containing either high voltage or 1500V electrical equipment.
<b>Substation Access Permit</b>	The pre-printed form ( <i>PR D 78502 FM 01</i> ), completed and signed, which is issued by an Authorised Person to define the high voltage or 1500 volt 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.
<b>Substation Earthing Set</b>	A set of earthing equipment used to electrically connect isolated high voltage equipment within RailCorp's substations to earth. Substation Earthing Sets have only three earthing heads and the cables come together at a plate designed for direct connection to an earthing point.

<b>Term</b>	<b>Definition</b>
<b>Supervision (of unauthorised persons)</b>	<p><u>Direct / constant supervision</u>                      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 the first time and until skill is demonstrated for the complexity of the task and work environment.</p> <p><u>General intermittent supervision</u>                      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.</p> <p><u>Broad supervision</u>                      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.</p>
<b>traction rail (negative return rail)</b>	The rail(s) by which a return path is provided for the 1500 volt dc traction current from the train to the traction substation.
<b>totally enclosed equipment</b>	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.
<b>work on (exposed electrical equipment)</b>	Work that requires contact with the normally live parts of the electrical equipment, either directly or indirectly.
<b>work near (exposed electrical equipment)</b>	<p>Work within or potentially within the Safe Approach Distance.</p> <hr/> <p> <b>NOTE</b>                      The work near distance varies with the equipment voltage and competence of the people performing the work.</p> <hr/>
<b>work in the vicinity of (exposed electrical equipment)</b>	<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> <hr/> <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> <hr/>

<b>Term</b>	<b>Definition</b>
<b>working earths</b>	Earths that are applied to all conductors on which the work is being carried out, on each side of the worksite, in order to ensure equipotential conditions at the worksite.
<b>Working High Voltage Instruction (WHVI)</b>	The Sydney Trains form (refer to <i>PR D 78202 FM 01</i> ), completed and signed, for work to be carried out on high voltage conductors or cables outside substations.

## 4 References

PR D 78000 Electrical Network Safety Rules

PR D 78305 1500V Operating Procedures

PR D 78500 Electrical Permits

PR D 78203 High Voltage Operating Procedures

PR D 78502 FM 01 Substation Access Permit

PR D 78503 FM 01 Low voltage Access Permit

PR D 78504 FM 01 Operating Agreement

PR D 78302 FM 01 Authority for Removal of Supply from 1500 volt Sections

PR D 78202 FM 01 Working High Voltage Instruction (WHVI)

PR D 78700 Working around Electrical Equipment

PR D 78703 Printing and Supply of Electrical Permit to Work Booklets

PR D 78701 Personnel Certifications – Electrical

Work Health and Safety Regulation 2017