

## Work on Low Voltage Installations

<b>Document no.</b>	<b>Work description</b>	
D2013/80873	To provide information about the hazards, controls and the safety requirements to be complied with for working on Low Voltage (LV) electrical installations.	
	<p><b>Scope</b></p> <p>This SWI is applicable to all workers, employees or contractors, who carry out work on Low Voltage electrical installations that form part of Transport for NSW (TfNSW) rail assets or such assets maintained by Sydney Trains.</p> <p>Refer to <i>PR D 78100 Definitions and Conventions for Electrical Safety</i> for a definition of a Low Voltage installation.</p> <p>Work on LV electrical equipment which forms part of the Low Voltage Distribution System is outside the scope of this SWI. Such work is to be performed in accordance with <i>PR D 78402 Work on the Low Voltage Distribution System</i>. <i>PR D 78400 Description and Labelling of the Low Voltage Distribution System</i> provides guidance to the boundary between the Low Voltage Distribution System and a Low Voltage installation (often referred to as an Electrical Installation).</p>	
<b>Review date</b>	<b>References</b>	
11/12/2018	<ul style="list-style-type: none"> <li>• AS/NZS 3000:2007 Wiring Rules</li> <li>• AS/NZS 3012:2010 Electrical installations – Construction and demolition sites</li> <li>• AS/NZS 4509.1:2009 Stand-alone power systems – Safety and installation</li> <li>• AS/NZS 4836:2011 Safe working on or near low-voltage electrical installations and equipment</li> <li>• Electricity (Consumer Safety) Act 2004</li> <li>• Electricity (Consumer Safety) Regulation 2015</li> <li>• WorkCover Managing Electrical Risks in the Workplace: Code of Practice - July 2015</li> <li>• PR D 78101 General Requirements for Electrical Work</li> <li>• PR D 78108 Pre-Work Hazard Assessment and Controls for Work on Poles with Live Exposed Equipment</li> <li>• PR D 78402 Work on the Low Voltage Distribution System</li> <li>• PR D 78401 Isolation and Energisation of Low Voltage Equipment</li> <li>• PR D 78503 Low Voltage Access Permits</li> <li>• PR D 78403 Work on Live Low Voltage Equipment</li> <li>• PR D 78105 DANGER Tags for Electrical Equipment</li> <li>• PR D 78700 Working around Electrical Equipment</li> <li>• PR D 78701 Personnel Certifications – Electrical</li> <li>• SMS-06-SW-0271 Rescue from Live Low Voltage Equipment (Including Rescue Kit Care)</li> <li>• SMS-06-SW-0538 PPE for Electrical Work</li> <li>• Work Health and Safety Act 2011</li> <li>• Work Health and Safety Regulation 2011</li> </ul>	
<b>PPE and precautions</b>	<b>Competencies or qualifications</b>	<b>Licences or permits required</b>
D2013/80874 PPE for Electrical Work As determined by Risk Assessment	Refer to Personnel Certification section below	Refer to Personnel Certification section below
<b>Tools and equipment required</b>		
As determined by the task to be performed and Risk Assessment		

### Warning



Severe injury or death may result if a conducting path is formed allowing electric current to pass through the body.  
Read this SWI in conjunction with supporting SMS documents and standards.

### Warning

Electrical workers often risk contacting live parts when:

- altering or adding to switchboards or installations;
- cutting into cables, conduits and other wiring enclosures;
- making connections in junction boxes which contain numerous circuits;
- touching parts of installations not isolated by a main switch, e.g. consumer's mains;
- touching neutrals without proving dead (as neutrals may become live due to possible cross connections);
- working on appliances with dual supplies connected, e.g. hot water service, emergency lighting;
- working on circuits not isolated by control switches, e.g. switch wires;
- undertaking testing of the electrical installation which remains live during the test; or
- supply could be readily reconnected by others.



## Work on Low Voltage Installations

### Compliance with regulations / standards

All work on LV electrical installations, the LV installation or parts of an LV electrical installation shall be installed, tested and maintained in accordance with the requirements of the Electricity (Consumer Safety) Regulation 2006.

All work on electrical installations, the installation or parts of an electrical installation shall comply with applicable TfNSW rail asset engineering standards, the Service and Installation Rules of NSW and Australian Standards (AS), such as AS/NZS 3000 and AS/NZS 3012.

Where a conflict between the abovementioned three types of documents, the order of precedence shall be: a TfNSW engineering standard, the NSW Service and Installation Rules and lastly an AS standard.

AS/NZS 3000 sets out requirements for the “design, construction and verification of electrical installations, including the selection and installation of electrical equipment forming part of such electrical installations”. (AS/NZS 3000:2007 clause 1.1)

The following electrical installations, or parts of electrical installations, shall not be energised unless the Local Distribution Network Service Provider, i.e. Sydney Trains first authorises it:

- any new electrical installation (other than a free-standing electrical installation) that has not previously been energised,
- any alteration of, or addition to, an electrical installation (other than a free-standing electrical installation) will require a change to the network connection or metering arrangements.

An electrical installation, or part of an electrical installation, shall not be energised unless its safe operation and compliance with AS/NZS 3000 has been established by a safety and compliance test.

A free-standing electrical installation shall not be energised unless the stand-alone power system to which it is to be connected complies with the requirements for such systems specified in AS/NZS 4509.1.

### Personnel Certification / Responsibilities

Workers performing risk assessments must hold a NSW Office of Fair Trading (OFT):

- Qualified Supervisor Certificate (Electrician) or
- Contractor Licence (Electrical - Q).

Workers performing electrical work on LV installations, such as connecting/disconnecting electrical supply, installing, removing, adding, testing, replacing, repairing, altering or maintaining electrical equipment, must hold a NSW OFT:

- Qualified Supervisor Certificate (Electrician) or
- Contractor Licence (Electrical - Q), or
- be under the direct/constant supervision of a worker holding either of the abovementioned NSW OFT certificates.

A Person Conducting a Business or Undertaking (PCBU – refer WHS Act section 5), e.g. a Pty Ltd company, working on a LV installation must:

- be registered with the [Australian Securities and Investment Commission](#) (ASIC), and
- provide a current certificate of currency for Public and Product Liability insurance to the value of \$10M, and
- provide a current certificate of currency of Workers Compensation, and
- hold a NSW OFT Qualified Supervisor Certificate (Electrician), or Contractor Licence (Electrical - Q)

Sydney Trains Line Managers shall ensure that either the Sydney Trains staff or the external company required to perform work on LV installations meet the particular requirements indicated above.




Persons planning work around electrical equipment shall ensure that the work is assessed and planned to enable the highest practicable level of risk control to be applied. (Refer to *PR 78700 Working around Electrical Equipment* section 5.2.)

Authorised Persons supervising others should conform to the guidelines set out in *PR D 78101 General Requirements for Electrical Work* section 10, Pre-Work Briefings and Supervision.

Workers are to carry out their work in accordance with this instruction and seek guidance and / or supervision before attempting to carry out a task for which they have not demonstrated and maintained satisfactory competence.




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## Work on Low Voltage Installations





<p><b>General Safety Requirements</b></p>	<p>All work on or near exposed LV equipment shall be planned and carried out in accordance <i>with PR D 78700 Working around Electrical Equipment</i>.</p> <p>Appropriate testing equipment, tools and accessories shall be properly used and well maintained. These must be inspected or checked to be in sound serviceable conditions prior to use. Where practicable, insulated tools are to be used, even if the supply has been removed.</p> <p>In general, supply shall 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 shall be:</p> <ul style="list-style-type: none"> <li>• Isolated, and</li> <li>• DANGER Tagged (refer to PR D 78105 DANGER Tags for Electrical Equipment), and</li> <li>• Proved dead,</li> <li>• where required a Low Voltage Access Permit (refer to PR D 78503 Low Voltage Access Permits) issued,</li> </ul> <p>before any work commences.</p>
	<p><b>Warning</b>  <i>When supply is removed for the work, each exposed conductor shall be proved dead prior to work commencing. * TEST BEFORE YOU TOUCH *</i></p>
	<p><b>Note</b>  <i>Before you break an insulated conductor/termination you shall test to determine if the insulated conductor/termination is not live and after you break the insulated conductor/termination you shall test to verify that the now <b>exposed</b> conductor is still not live.</i></p>
	<p><b>Warning</b>  <i>Where an exposed low voltage conductor cannot be proved dead, it shall be treated as being live even though it may have been isolated.</i></p>
	<p>When working on poles or structures supporting live exposed LV equipment, even when it is not intended to work on or near the live equipment, the requirements of instruction <i>PR D 78108 Pre-Work Hazard Assessment and Controls for Work on Poles with Live Exposed Equipment</i> shall be fulfilled.</p> <p>Workers shall avoid simultaneous contact with more than one conductor at any time as the conductors may be at different potentials.</p>

<p><b>Specific Safety Requirements</b></p>	<p>Supply shall be removed before work is to be performed which involves:</p> <ul style="list-style-type: none"> <li>• the connection between the main neutral and the earthing system being removed, or</li> <li>• a neutral conductor which is carrying load current becoming discontinuous.</li> </ul> <p>If work involves the earth conductor for a portion of the installation becoming discontinuous, supply shall be removed from that portion of the installation.</p> <p>Where practicable, the power isolation point shall be DANGER Tagged and should be secured either directly with a Special Lock or by securing the switchboard or switch room (refer to <i>PR D 78105 DANGER Tags for Electrical Equipment</i>).</p> <p>LV insulating gloves shall be worn where there is a risk of inadvertent contact with exposed live LV conductors. At other times, where practicable, leather riggers gloves should be worn to provide limited protection against electric shock and against minor injuries such as cuts and splinters.</p> <p>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':</p> <ul style="list-style-type: none"> <li>• Across insulators, or</li> <li>• Between phase conductors</li> <li>• Between phase conductor(s) and neutral, or</li> <li>• Between phase conductor(s) and earth or an earthed metallic structure.</li> </ul> <p>If the work involves breaking the Multiple Earth and Neutral (MEN) link of the installation and the installation includes an uninterruptible power supply (UPS) that will remain in service during the work, particular care must be taken to ensure that there is still a MEN connection for the output circuit of the UPS. If this cannot be provided, then the UPS must be taken out of service for the duration of the work.</p> <p>When supply is removed for the work, each exposed conductor is to be proved dead prior to work commencing and the procedures set out in <i>PR D 78105 DANGER Tags for Electrical Equipment</i> are to be followed. Where an exposed LV conductor cannot be proved dead, it is to be treated as being live even though it might have been isolated.</p>
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## Work on Low Voltage Installations

<b>Specific Safety Requirements (Cont.)</b>	<b>Testing and fault finding</b>	<p>Where it is necessary to leave supply on to facilitate testing or fault finding, a risk assessment shall be conducted and safe systems of work to conduct the testing developed and implemented. The system of work is to include, but not be limited to:-</p> <ul style="list-style-type: none"> <li>• the provision of suitable protection from inadvertent contact;</li> <li>• the use of appropriate Personal Protective Equipment where necessary; or</li> <li>• the provision of test equipment suitable to the electrical installation and the location of the test points.</li> </ul>
<b>Work on ISOLATED LV installations</b>	<b>Removal of supply</b>	<p>Prior to removing supply, the worker carrying out the isolation shall ensure that all affected parties have been advised of the commencement, and duration times of the proposed interruption to supply.</p> <p>Any local requirements for isolation and lockout are to be determined and included in the isolation plan.</p> <p>Particular attention must be given to ensuring that all possible sources of contact (including apparatus adjacent to the area where the work is being performed) are identified and isolated.</p>
	<b>Possibility of back feeds or alternative supplies</b>	<p>The required electrical isolation must consider the presence of alternative supplies. 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) and capacitors. Where the circuit configuration warrants, the possibility of induced voltages being present must also be considered.</p>
		<p><b>Warning</b>  <i>Pay special attention to illumination control circuits, changeover contactors and transfer switches etc. Make sure that they are isolated, if necessary.</i></p>
		<p><b>Warning</b>  <i>Signalling supplies are not to be interrupted without the prior knowledge and agreement of the Electrical System Operator or a responsible person for areas not covered by the Electrical System Operator.</i></p>
	<b>Method of isolation</b>	<p>LV installations or apparatus are to be isolated from all sources by providing at least one break in each active conductor through which the equipment could be made live from these sources.</p> <p>Breaks are to be provided by:</p> <ul style="list-style-type: none"> <li>• opening a circuit breaker, or</li> <li>• removing fuses, or</li> <li>• opening isolating switches, or</li> <li>• disconnecting conductors.</li> </ul> <p>Where possible, the isolated equipment to be worked on shall 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.</p> <p>Devices providing isolating breaks shall be protected in accordance with <i>PR D 78105 DANGER Tags for Electrical Equipment</i>.</p> <p>Devices operating in a control circuit (such as an emergency stop or limit switch) shall not to be used as the sole means of providing isolation for plant or equipment.</p> <p>When an isolating device can also be operated by remote control, the remote control is to be rendered inoperative, and the means of ensuring that it remains inoperative protected in accordance with <i>PR D 78105 DANGER Tags for Electrical Equipment</i>.</p>
		<p><b>Warning</b>  <i>Isolation of an installation or apparatus shall not to be achieved by a remote control alone.</i></p>
<b>Isolation by the breaking of connections</b>	<p>When isolation of LV equipment is achieved by the breaking of connections, the active conductors shall be disconnected first, followed by the neutral conductor and the earth conductor last. Disconnected conductors shall be secured in a position which will prevent possible contact with any live terminals or apparatus.</p> <p>The reverse of the disconnection procedure shall be followed for reconnection on restoration of supply.</p>	

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Work on ISOLATED LV installations (Cont.)	<b>Securing the Isolation</b>	The requirements of the <i>PR D 78105 DANGER Tags for Electrical Equipment</i> are to be followed for all Low Voltage isolations.
	<b>Proving Dead</b>	Each exposed conductor, LV electrical equipment or installation that has been isolated, shall be proved dead by a voltage-testing device (where practicable, a contact-type voltage detector shall be used in preference to a non-contact type voltage detector) to verify that the equipment is dead.
		<b>Warning</b> <i>The tester shall be checked immediately prior to proving dead, and at the completion of the test to make sure that it has not failed during the test. This checking shall be done on a known live source using safe systems of work or by means of a self-check facility of the tester.</i>
		The worker shall use an LV proximity detector to test a LV cable, <b>and label the proved dead cable before cutting</b> if: <ul style="list-style-type: none"> <li>the cable was previously live, or</li> <li>both ends of the cable are not local to the work site and not obviously disconnected.</li> </ul>
	<b>Non-contact LV Proximity Detectors</b>	Non-contact LV proximity detectors have limited application and shall not be used: <ul style="list-style-type: none"> <li>On DC electrical equipment or installations.</li> <li>On extra low voltage equipment, outside of the operating range of the non-contact LV detector.</li> <li>In close proximity to 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.</li> <li>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.</li> </ul>
		<b>Warning</b> <i>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.</i>
		<b>Warning</b> <i>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)</i>
	<b>Energising LV installations</b>	Before LV equipment is energised, the worker restoring supply is to: <ul style="list-style-type: none"> <li>make sure that the installation or equipment is inspected, tested if required and is safe to be energised;</li> <li>check that there are no Isolation Locks or DANGER Tags attached to the isolation points to be operated; and</li> <li>if connections have been disturbed, then tests are to include (as required by the work performed): <ul style="list-style-type: none"> <li>insulation resistance</li> <li>phase rotation</li> <li>phase check</li> <li>earth conductor integrity</li> <li>correct connection and continuity of the neutral.</li> </ul> </li> </ul> <p>When appropriate, notify the affected parties that supply is about to be restored.</p>
		<b>Warning</b> <i>Signalling supplies shall not to be restored without the prior knowledge and agreement of the Electrical System Operator or a responsible person for areas not covered by the Electrical System Operator.</i>

## Work on Low Voltage Installations

### Work ON or NEAR LIVE LV installations

The WHS Regulation generally prohibits work on an electrical installation while the circuits and apparatus of the part of the installation being worked on are energised. However, particular allowable exceptions permit work to be carried out live ONLY in the following circumstances:

- it is necessary in the interests of health and safety that the electrical work is carried out on the equipment while the equipment is live, or
- it is necessary that the electrical equipment to be worked on is live in order for the work to be carried out properly, or
- it is necessary for the purposes of testing to determine whether or not the equipment is live, or
- there is no reasonable alternative means of carrying out the work.

In the specific instance(s) when work ON or NEAR live exposed electrical equipment work is justified, the requirements set out in the following instructions shall be complied with:

*PR D 78403 Work on Live Low Voltage Equipment, and*

*D2013/ 80870 Rescue from Live Low Voltage Equipment (Including Rescue Kit Care)*

In addition to the above requirements, under NO circumstances is work to be performed live which involves:

- the connection between the main neutral and the earthing system being removed, or
- a neutral conductor which is carrying load current becoming discontinuous.

### Additional controls

NIL

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