

Engineering Instruction Electrical Distribution Unit	EI D 18/05
<b>Approved by:</b> Paul Poynton, A/Professional Head Electrical Engineering, Sydney Trains <b>Authorised by:</b> Joanna Santos, A/Engineering Technical Publications Manager, Sydney Trains	Date in Force: 12 February 2018 Date Expires: 12 February 2019
This Engineering Instruction includes urgent engineering information. Adherence to the information in this Instruction is <b>MANDATORY</b> .	
<h2>Photo Voltaic Systems Integration</h2>	
<b>Audience:</b> <ul style="list-style-type: none"> <li>Network Maintenance Division - Electrical Discipline</li> <li>Engineering, Safety and Integrity</li> <li>Major Works Division - Electrical Discipline</li> <li>Infrastructure &amp; Services Transport Project Office</li> </ul>	<b>Main Points:</b> <ul style="list-style-type: none"> <li>Photo Voltaic Systems on the Sydney Trains electrical system.</li> </ul>
<b>Primary Affected Document:</b> <b>PR D 78401 Isolation and Energisation of Low Voltage Equipment</b>	

## Scope

This Engineering Instruction sets the requirements for work on the High and Low Voltage systems associated with Photo Voltaic Systems on the Sydney Trains Electrical Network.

## Background

Photo Voltaic (PV) systems that operate on the Sydney Trains electrical network shall not export power into the RailCorp LV Distribution system as per Transport for NSW technical note TN031:2016.


This is achieved by ensuring the PV system incorporates the following two independent controls:

- An anti-islanding function built into the inverter that disconnects the PV network from the installation when the power supply is removed
- An anti-export control that disconnects the PV inverter from the network if the installation load falls below 5 amps.

Both of these functions operate via mechanical contactor's ensuring the PV equipment cannot back-feed into the RailCorp Distribution system.

The PV system must also be designed and commissioned by an AEO holding the appropriate accreditation.

## Action required

- PV installations shall be indicated on Electrical Operating Diagrams as a fixed generator by the symbol  and a note that it is a PV system including the name and location of the installation switch board that the PV system is connected to;
- For all work and emergencies involving the PV equipment or the Distribution Board it is connected to, the PV system must be shut down and isolated as per the Installers Operation and Maintenance Manual.

## Contact

Wayne Halls, Safety Systems Engineer, E: [Wayne.Halls@transport.nsw.gov.au](mailto:Wayne.Halls@transport.nsw.gov.au)

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Engineering Procedure  
Electrical Distribution Unit

PR D 78401

# Isolation and Energisation of Low Voltage Equipment

Version 1.1

Date in Force: 3 July 2018

# Procedure

Approved by: Paul Poynton  
A/Professional Head  
Electrical Engineering  
Engineering System Integrity

Authorised by: Jonathon McKinnon  
Engineering Technical  
Publications Manager  
System Integrity

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## Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	28 July 2015	Chris Leung	First issue as a Sydney Trains document, rebranded from previous RailCorp SMS-06-EN-0574 V1.2
1.1	3 July 2018	Chris Leung	3 Yearly Review

## Summary of changes from previous version

Summary of change	Section
Minor updates	

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## 1 Purpose and scope

This procedure describes the procedures applicable to the isolation and energisation of RailCorp's Low Voltage (LV) Distribution Equipment.

This procedure sets down the precautions that shall be taken by all persons intending to carry out any work on or near LV equipment and the procedures required to make the LV equipment safe for work.

This procedure should be read conjunction with procedures:

- PR D 78101 General Requirements for Electrical Work
- PR D 78102 Electrical Hazards and Warnings
- PR D 78108 Pre-Work Hazard Assessment for Work on Power Poles with Live Exposed Equipment

Work on LV electrical installations is outside the scope of this procedure, and is covered by D2013/80873 Work on Low Voltage Installations.



### NOTE

In the case of work on LV, the requirements of any local system for isolation and lockout shall be understood, and any conflicts with this procedure resolved prior to work proceeding.

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## 2 General

All work on or near exposed LV equipment shall be carried out in accordance with PR D 78700 Working around Electrical Equipment.

When supply is to be removed for work on or near LV equipment, the equipment shall be isolated, proved dead and where required a Low Voltage Access Permit (refer PR D 78503) issued, before any work commences.

Where another Network Operator's services have to be isolated for the work, an Operating Agreement shall be received from the Network Operator concerned, for the work near its services.

Prior to removing supply, the appropriately Authorised Person (refer PR D 78701 Personnel Certifications – Electrical) carrying out the switching to remove supply shall ensure that all affected parties have been advised of the commencement and duration times of the proposed interruption to supply.

All communication with the Electrical Operating Centre shall be carried out in accordance with PR D 78103 Electrical Operational Communication and Records.



### Warning

Signalling supplies shall not be interrupted or restored without the prior knowledge and agreement of the Electrical Operating Centre.

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## 3 Isolation of Low Voltage Equipment

### 3.1 General

Low voltage equipment shall 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 shall 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 shall be DANGER Tagged as described in PR D 78105 DANGER Tags for Electrical Equipment and where practicable locked open.

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



#### **Warning**

An isolating device with a DANGER Tag attached shall not be operated. Isolation of an installation or apparatus shall not be achieved by a remote control device alone.

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

High voltage (HV) equipment shall be operated in accordance with Procedure PR D 78201 Removal and Restoration of High Voltage Supply.

When the isolation of LV equipment is achieved by the operation of a switch on the HV side of a transformer, and the LV neutral of the transformer will not be disconnected from earth, HV earths and a Substation Access Permit are not required. (Refer PR D 78500 Electrical Permits).

High voltage earths and a Substation Access Permit are not required for an unearthed LV system with an earthed screen within the transformer.

If the LV neutral is to be disconnected from earth, earths are to be placed on the high voltage side, and a Substation Access Permit shall be issued to ensure that the earths are not removed until work is completed.

### 3.3 Isolation by the Breaking of Connections

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

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

### 3.4 Isolation of Back Feeds or Alternative Feeding

Where isolation has been effected 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 shall also be considered.



**Warning**

Pay special attention to illumination control circuits, changeover contactors and transfer switches etc. Ensure that these are isolated, if necessary.

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## 4 DANGER Tags

The requirements for DANGER Tagging are described in PR D 78105 DANGER Tags for Electrical Equipment. In particular, Clause 5.2 specifies the additional requirements on the removal of DANGER Tags from LV equipment.

## 5 Proving Dead of Low Voltage Equipment

Low voltage equipment that has been isolated electrically shall be proved dead by a voltage-testing device to confirm that the equipment is dead. Such a device could be:

- contact type voltage tester, or
- a non-contact LV voltage detector as per section 2.2 of PR D 78402 Work on the Low Voltage Distribution System.



**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)

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Before the proving dead of a LV aerial line, any oxide coating shall first be removed from the point at which the test equipment is to be applied. During this process the LV aerial line must be assumed live, accordingly live low voltage work methods utilising, as a minimum, insulated tools, gloves and protective eye protection shall be used while removing any coating and proving dead.



**Warning**

Each exposed part shall be treated as energised until it is isolated and determined not to be energised.

“All electrical conductors and parts, including neutral and earthing conductors, shall be treated as energised until proven de-energised.

\* TEST BEFORE YOU TOUCH \*\* (AS/NZS 4836 clause 3.2.1)

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“Any voltage tests used to prove de-energisation shall be conducted in the following sequence:

- i. Test the voltage tester on a known voltage source for correct operation.
- ii. Test between all conductors and a known earth.
- iii. Test between all conductors.
- iv. Retest the voltage tester on a known voltage source for correct operation.”

(AS/NZS 4836 clause 3.2.5)

## 6 Energising Low Voltage Equipment

Before LV equipment is energised, the appropriately Authorised Person carrying out the switching shall:

- i. Ensure that the equipment is inspected, tested if required and is safe to be energised, (when an Electrical Permit is issued, the Authorised Person cancelling the Electrical Permit is responsible for this).

If connections have been disturbed then tests shall include:

- Insulation resistance, and
  - Phase rotation (where applicable), and
  - Voltage check (where applicable), and
  - Correct connection and continuity of the neutral.
- ii. Ensure that the relevant Electrical Permits, if issued, have been cancelled.
  - iii. Where applicable advise other Network Operators’,
    - that their Operating Agreement(s) have been signed off,
    - that their supply may be restored as far as Sydney Trains is concerned, and
    - when the Operating Agreement(s) is associated with a Working High Voltage Instruction (WHVI) inform ICON EOC that the Operating Agreement has been signed off.
  - iv. Check that there are no DANGER Tags attached to the switches to be operated.
  - v. When appropriate, notify the affected parties that supply is about to be restored.



## 7 References

<b>AS/NZS 4836:2011</b>	Safe working on or near low-voltage electrical installations and equipment
<b>PR D 78101</b>	General Requirements for Electrical Work
<b>PR D 78102</b>	Electrical Hazards and Warnings
<b>PR D 78108</b>	Pre-Work Hazard Assessment for Work on Power Poles with Live Exposed Equipment
<b>PR D 78201</b>	Removal and Restoration of High Voltage Supply
<b>PR D 78402</b>	Work on the Low Voltage Distribution System
<b>PR D 78500</b>	Electrical Permits
<b>PR D 78105</b>	DANGER Tags for Electrical Equipment
<b>PR D 78103</b>	Electrical Operational Communication and Records
<b>PR D 78701</b>	Personnel Certifications – Electrical
<b>PR D 78700</b>	Working around Electrical Equipment
<b>D2013/80873</b>	Work on Low Voltage Installations