Engineering System Integrity
Electrical Network Safety Rules

Engineering Procedure
Electrical Distribution Unit

Electrical Distribution Network Management

PR D 78402

Work on the Low Voltage Distribution System

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Transport Sydney Trains

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Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	11 November 2015	Chris Leung	First issue as a Sydney Trains document, rebranded from previous RailCorp SMS-06-EN-0575 V1.2
1.1	19 February 2019	Nick Loveday	Updated PR D 78402 "Approved by" to Associate Director Electrical Distribution Unit
1.2	1 February 2022	ENSR Project Team	Reviewed as part of the ENSR Project.

Summary of changes from previous version

Summary of change	Section
Minor grammatical updates	All
Updated reference documents	All

Table of Contents

1 Purpose and Scope

This document describes the procedures for working on the Transport Asset Holding Entity of New South Wales (TAHE) Low Voltage (LV) Distribution System.

Work on LV electrical installations is outside the scope of this procedure, and is covered by *D2013/80873 Work on Low Voltage Installations*, please contact your Contract/Interface Manager if you need access to D2013/80873.

2 Definitions

Refer to the **Electrical Safety Definitions** page available on the **RailSafe** site.

3 General Safety Requirements

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

- Isolated
- DANGER Tagged
- Proved dead, as per procedure *PR D 78401 Isolation and Energisation of Low Voltage Equipment*
- where required a Low Voltage Access Permit (refer to *PR D 78503 Low Voltage Access Permits*) issued,

before any work commences.

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

All work on LV distribution equipment shall be carried out by an Authorised Person (refer to *PR D 78701 Personnel Certifications – Electrical*), or by others not authorised or qualified who are under the direct/constant supervision of an Authorised Person. Authorised Persons supervising others should conform to the guidelines set out in *SMS-06-OP-3114 Pre-work Briefings*.

The isolation plan shall 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 supplies, Uninterruptible Power Supplies (UPS) and capacitors. Where circuit configuration warrants, the possibility of induced voltages being present shall also be considered.

WARNING

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

WARNING

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

When working on poles or structures supporting live exposed LV equipment, even when it is not intended to work near or on/within the live equipment, the requirements of *PR D 78108 Pre-Work Hazard Assessment and Controls for Work on Poles with Live Exposed Equipment* shall be fulfilled.

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.

4 Specific Safety Requirements

Supply shall be removed (refer to PR D 78401) before work is to be performed which involves either:

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

If work involves the earth conductor for a portion of the installation becoming discontinuous, supply shall be removed (refer to PR D 78401) from that portion of the installation.

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 *PR D 78104 Securing Systems for Electrical Equipment*).

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 rigger's 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':

a. across insulators
b. between phase conductors
c. between phase conductor(s) and neutral
d. between phase conductor(s) and earth or an earthed metallic structure.

5 Live Work

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

a. 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

b. It is necessary that the electrical equipment to be worked on is energised for the work to be carried out properly, or

c. It is necessary for the purposes of proving dead, testing or fault finding, or

d. There is no reasonable alternative means of carrying out the work.

When work is carried out live, the requirements of *PR D 78403 Work on Live Low Voltage Equipment* shall be complied with at all times.

6 Non-contact LV Proximity Detectors

When carrying out work on LV equipment, all Authorised Persons shall 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 5 above, each conductor, LV electrical equipment or installation shall be proved dead as per PR D 78401 Section 6 Proving Dead of Low Voltage Equipment, and verified as dead using a non-contact LV proximity detector before work is carried out.

The Authorised Person shall use the LV proximity detector to test a LV cable before cutting if:

a. The cable was previously live.

b. Both ends of the cable are not local to the work site and not obviously disconnected.

The only non-contact proximity detectors approved for use in Sydney Trains are as set out in *SP D 79039 Electrical Tools and Test Equipment*.

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

a. Prove the LV proximity detector to ensure correct functioning immediately before use by rubbing on clothing or using a known live LV source.

b. Ensure that the LV electrical apparatus has been de-energised before touching.

c. Immediately after use, prove the LV proximity detector is functioning as in (a).

NOTE

If there is any doubt on the 'live' indication due to induction from nearby live LV circuit or equipment, a contact-type detector shall be used to prove dead. The contact-type detector shall 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.

- 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.
- 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.

7 Warnings

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

Electrical workers are at risk of contacting live parts when:

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

8 Work on Low Voltage Aerial Lines

The aerial line shall be positively identified and proved dead (refer to PR D 78401) before work commences, unless approved live working techniques are to be employed (refer to Section 5).

All work on low voltage aerial lines shall be carried out by an Authorised Overhead Traction Worker, an Authorised Person (Low Voltage) who is also an Accredited Overhead Worker or a Contract Aerial Line (HV & LV) Worker. Refer to PR D 78701 for more information on all electrically Authorised Persons, including the functions they can undertake.

A Low Voltage Access Permit (refer to PR D 78503) shall be issued for work on low voltage aerial lines that requires the line to be isolated and proved dead. However, when the work is being carried out by a Licensed Electrician, a Low Voltage Access Permit is not required.

Portable ladders, having metal or metal reinforced styles, shall not be used for work on low voltage aerial lines.

Procedures for work carried out aloft, near or on/within live low voltage equipment, are described in PR D 78403.

9 Work on Low Voltage Substation Controls and Auxiliaries

All work on low voltage substation equipment, which is not for general power and lighting, shall be carried out or supervised by of an Authorised Person (Substations).

The Authorised Person (Substations) who is supervising any electrical work shall carry out the duties and comply with the requirements of SMS-06-OP-3114.

All work on live LV substation equipment shall be carried out by an Authorised Person (Substations).

NOTE

Work on general power and lighting installations in substations shall be carried out in accordance with D2013/80873.

10 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.

10.1 Phase Identification Using a Multimeter

10.1.1 Test Procedure

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

10.1.2 Test Results

Four possible observations can be seen from the tests.

Table 1: Test Results Using a Multimeter

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 • A lower than normal voltage • Loss of one phase on a 3 phase system
230 Volts	• 230 Volts – one active conductor to earth or neutral
400 or 460 Volts	• 400 Volts – between 2 phases on a 230/400 Volt system • in the case of a 230/460 Volt single phase system, a full output of 460 Volt

10.2 Tests before Paralleling Two Separate LV Services

Prior to paralleling two separate LV services, tests shall be carried out to ensure the correct connection of phases and the neutrals. Either of the tests as described in Section 10.1 may be used.

With the neutral of both services or circuits already identified, a ‘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.

11 Reference documents

D2013/80873 Work on Low Voltage Installations

PR D 78104 Securing Systems for Electrical Equipment

PR D 78108 Pre-Work Hazard Assessment and Controls for Work on Poles with Live Exposed Equipment

PR D 78401 Isolation and Energisation of Low Voltage Equipment

PR D 78403 Work on Live Low Voltage Equipment

PR D 78503 Low Voltage Access Permits

PR D 78700 Working around Electrical Equipment

PR D 78701 Personnel Certifications – Electrical

SMS 06-OP-3114 Pre-work Briefings

SP D 79039 Electrical Tools and Test Equipment