Engineering Procedure
Electrical Distribution Unit

PR D 78402

Work on the Low Voltage Distribution System

Version 1.1

Date in Force: 19 February 2019

Procedure

Transport Sydney Trains

NSW GOVERNMENT

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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

Summary of changes from previous version

Summary of change	Section

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1. Purpose and Scope

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

Work on LV electrical installations is outside the scope of this procedure, and is covered by SMS-06-SW-0276 Work on Low Voltage Installations.

2. General Safety Requirements

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

All work on LV distribution equipment shall be carried out by an Authorised Person (refer *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 *PR D 78101 General Requirements for Electrical Work* section 10, Pre-Work Briefings and Supervision.

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 shall be:

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

before any work commences.

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 can not 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 on or near the live equipment, the requirements of procedure *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.

3. Specific Safety Requirements

Supply shall be removed (refer *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, or

(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 *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 *PR D 78105 DANGER Tags 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 riggers 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, or

(b) Between phase conductors

(c) Between phase conductor(s) and neutral, or

(d) Between phase conductor(s) and earth or an earthed metallic structure.

4. 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 procedure *PR D 78403 Work on Live Low Voltage Equipment* shall be complied with at all times.

5. 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 4 above, each conductor, LV electrical equipment or installation shall be proved dead as per *PR D 78401* Clause 5 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, or

(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 the:

- Greenlee GT-11 and
- Hioki 3120.

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 curent and in similar circumstances. (AS/NZS 4836 clause 3.2.5)

6. 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, eg 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, eg hot water service or emergency lighting.

(g) Circuits are not isolated by control switches, eg switch wires.

(h) Supply could be readily reconnected by others.

7. Work on Low Voltage Aerial Lines

The aerial line shall be positively identified and proved dead (refer *PR D 78401*) before work commences, unless approved live working techniques are to be employed (refer section 4).

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 System Procedure *PR D 78701* for more information on all electrically Authorised Persons, including the functions they can undertake.

A Low Voltage Access Permit (refer *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, on or near live low voltage equipment, are described in procedure *PR D 78403*.

8. 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 *PR D 78101* section 10, Pre-Work Briefings and Supervision.

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 instruction SMS-06-SW-0276 Work on Low Voltage Installations

9. 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.

9.1. Phase Identification Using a Multimeter

9.1.1. 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.

9.1.2. 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; 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

9.2. Phase Identification Using Test Lamps

The test lamps may be used to correctly identify the phase and neutral conductors.

9.2.1. Test Equipment

A testing device comprising two (2) series test lamp globes of the same wattage may be used, and shall be checked to be in good working order prior to testing, and immediately after testing.

9.2.2. Test Procedure

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

9.2.3. Test Results

The possible test results are listed in Table 2.

Table 2 – Test Results Using Test Lamps

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

9.3. 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 sections 9.1 or 9.2 may be used.

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.

10. References

AS/NZS 4836:2011	Safe Working on Low Voltage Electrical Installations
PR D 78700	Working around Electrical Equipment
PR D 78101	General Requirements for Electrical Work
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 78503	Low Voltage Access Permits
PR D 78403	Work on Live Low Voltage Equipment
PR D 78105	DANGER Tags for Electrical Equipment
SMS-06-SW-0276	Work on Low Voltage installations
PR D 78701	Personnel Certifications – Electrical

Work Health and Safety Regulation 2017 (NSW)
