Engineering System Integrity
Electrical Network Safety Rules

Engineering Specification
Electrical Distribution Unit

One Method of Safe Working

SP D 79046

Description and Labelling of the Low Voltage Distribution System

Version 1.0
Date in Force: 1 February 2022

Transport Sydney Trains

Approved by:	Associate Director Electrical Distribution Unit Engineering System Integrity	Authorised by:	Engineering Technical Publications Manager System Integrity

Disclaimer

This document was prepared for use by persons in connection with works near or on/within the rail network electricity system operated by Sydney Trains. Sydney Trains makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation. It is the document user's sole responsibility to ensure that the copy of the document it is viewing is the current version of the document as in use by Sydney Trains. To the extent permitted by law, Sydney Trains excludes any and all liability for any loss or damage, however caused (including through negligence), which may be directly or indirectly suffered in connection with the use of this document.

Copyright

Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	1 February 2022	ENSR Project Team	First issue as Sydney Trains document. Rebranded from PR D 78400 V1.1. Reviewed as part of the ENSR Project.

Document history (previously PR D 78400)

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	28 April 2015	Chris Leung	First issue as a Sydney Trains document. Rebranded from previous RailCorp SMS-06-EN-0573 V1.2.
1.1	31 May 2018	Chris Leung	3 yearly review, no technical change

Table of Contents

1 Purpose and scope

This document describes the:

- boundary between Transport Asset Holding Entity of New South Wales (TAHE) Low Voltage (LV) Distribution System and the Local Distribution Network Service Provider's network or TAHE High Voltage (HV) network (upstream) and the LV installation (downstream)
- description applicable to the TAHE LV Distribution System.

The TAHE LV Distribution System includes the electricity aerial lines and cables and associated equipment and electricity structures that are used to convey and control the conveyance of LV electricity to the rail network's signals and communication premises, sidings and stabling yards, buildings and maintenance centres, stations and some other private consumers.

This document does not apply to:

- the 1500 volt DC traction system
- the LV conductors or equipment that form part of an 'electrical installation' as defined in Clause 145 of the WHS Regulation 2011
- communication and signalling infrastructure
- rolling stock vehicles.

2 Definitions

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

3 General Provisions

TAHE is a state owned Corporation that holds rail property assets, rolling stock and rail infrastructure in NSW. Sydney Trains, NSW Trains and others operate and maintain the TAHE Assets.

The TAHE LV Distribution System comprises a large number of separate LV systems, which are supplied from numerous substations in TAHE high voltage system or from the Local Distribution Network Service Provider's e.g. Ausgrid, distribution system at LV.

Transformers separate TAHE high voltage (HV) distribution system (refer to Figure 1 below) or the Local Distribution Network Service Provider's distribution system (refer to Figure 2 below) from TAHE LV distribution system.

Generally the TAHE distribution substations have separate HV and LV earths. The TAHE LV Distribution System uses an earth that is separate from the Local Distribution Network Service Provider's distribution system earth.

The transformers are also the interface point between the two earthing systems and it should be noted that significant currents may flow if the two earthing systems are inadvertently bridged, even if the active conductors are isolated. There may also be appreciable voltages between the two earthing systems, particularly under fault conditions.

The TAHE LV distribution earthing system consists of an earth grid at the transformer locations with reticulated earths to all downstream installations. The reticulated earth is known as a Safety Conductor and is insulated.

NOTE

For general supply, TAHE uses a 5 wire (A, B, C, N & E) 3 phase system and a 3 wire (A, N & E) 1 phase system.

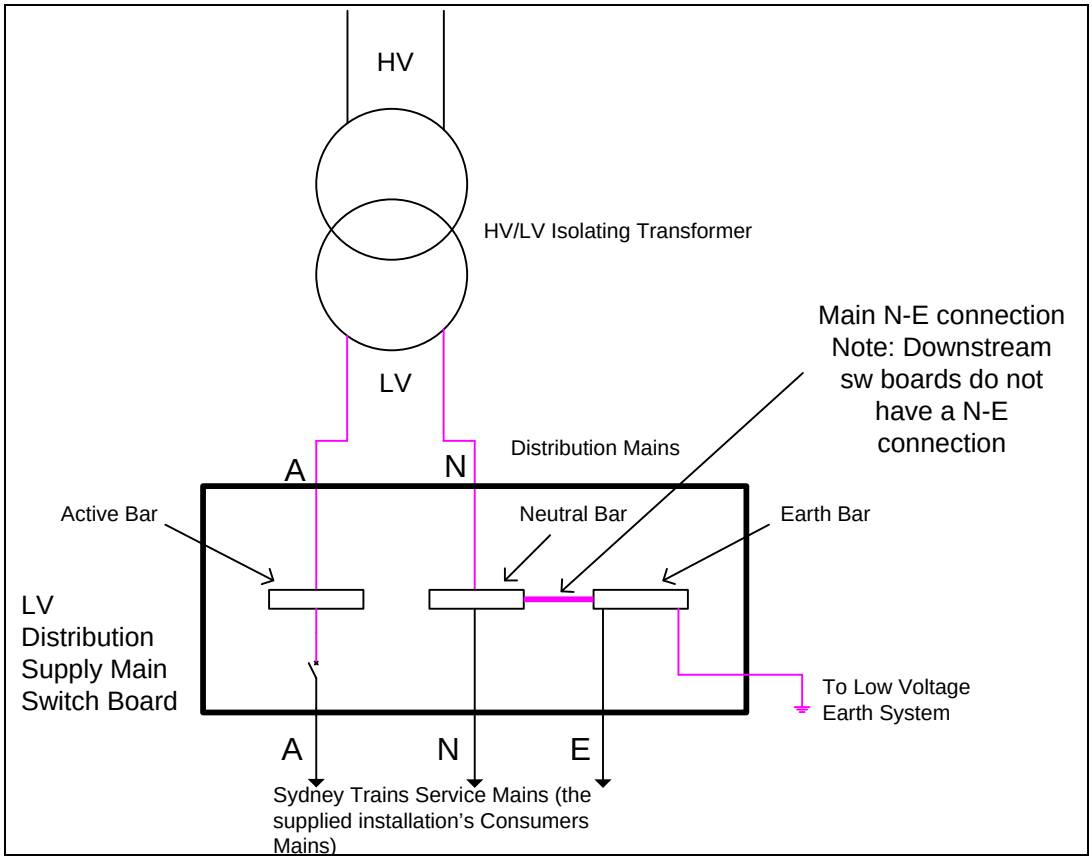


Figure 1: Supply from TAHE High Voltage Network (Main elements ONLY shown)

Where required, an LV supply may also be taken from the Local Distribution Service Provider e.g. Ausgrid.

When an LV supply is taken from the Local Distribution Network Service Provider (refer Figure 2 below), a TAHE isolation transformer is used. No connection shall be made to the isolating transformer screen and the enclosure of the transformer is not to be earthed.

The isolating transformer protects the Local Distribution Network Service Provider's Multiple Earth Neutral (MEN) system from DC leakage currents. This is achieved by physically isolating the Local Distribution Network Service Provider's MEN system, in particular their earth and neutral, from TAHE LV distribution system or a TAHE installation, including earthed metalwork such as pipes, fences, overhead earth wires or troughing.

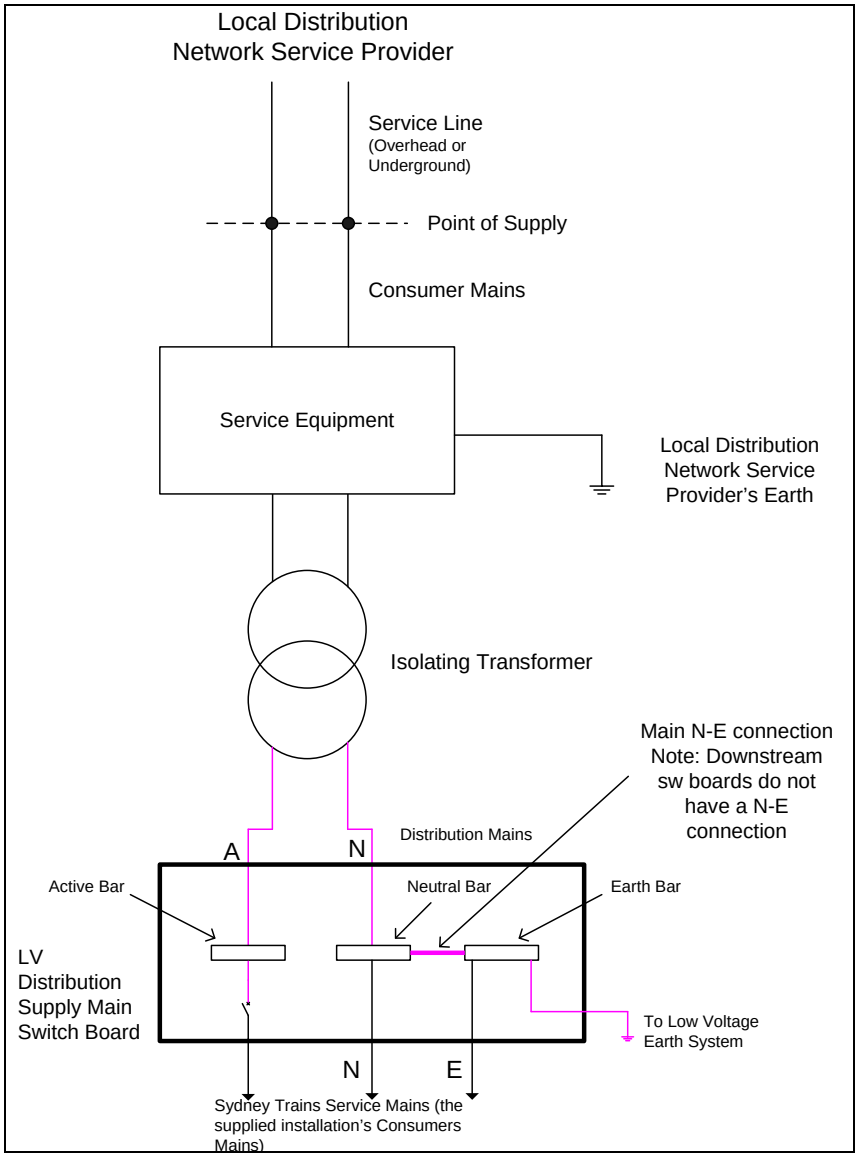


Figure 2: Station Supply from Local Distribution Network Service Provider (Main elements ONLY shown)

WARNING

For 120 V signalling supplies:

The neutral of the isolating transformer secondary winding is not directly connected to earth and the isolating transformer screen shall be connected to the supply earth (and neutral). This connection is required to provide a direct path to earth to ensure the operation of the primary side protection if the double insulation of the isolating transformer breaks down, and

Contrary to Figure 2 above, at the Distribution Supply Main Switch Board, there shall not be any connection between earth and neutral, except as authorised by the Engineer, Signal Standards.

Refer to Transport for NSW (TfNSW) standard *T HR EL 12004 ST Low Voltage Distribution and Installations Earthing*.

Figure 1 and Figure 2 above show the LV Distribution Supply Main Switchboard and the respective Active, Neutral and Earth bars. The LV Distribution Supply Main Switchboard is the location to establish the one AND only connection between earth and neutral of the LV distribution system.

The isolating device, not shown, connected to the Active and Neutral bars represents the Distribution/Installation system boundary. That is, the downstream Active and Neutral connection to the isolating device, not shown, is the Installation's Point of Supply. Thus equipment downstream from the Point of Supply is part of the installation whereas equipment upstream from the Point of Supply is part of the LV Distribution system. (Refer to TfNSW standard *T HR EL 17000 ST Demarcation of RailCorp Low Voltage Distribution System*)

In many locations, automatic or manual changeover equipment is provided, permitting low voltage supply to be sourced from either the Local Distribution Network Service Provider or the TAHE high voltage system i.e. to provide a backup supply.

WARNING

Where back-up supplies are provided, electro-mechanical interlocks usually prevent feedback from the alternative source. However, due to the presence at some locations of electronic changeover equipment or Uninterruptible Power Supplies (UPS), solar grid inverters or capacitors, great care shall be taken when isolating LV circuits.

Refer to T HR EL 12004 ST for detailed earthing requirements for the low voltage equipment on the supply side of the consumer's Point of Supply for all electrical installations which are maintained by Sydney Trains as an Electricity Distributor.

NOTE

16mm^2 is the minimum earth conductor that can be used on TAHE electrical installations in the following scenarios:

- **For connecting the screen on an isolating transformer to the substation/section hut earth grid in accordance with *EP 12 10 00 10 SP System Substation Earthing* Section 7 Technical Characteristics and 8 Integrated System Support Requirements.**
- **For linking the earth bars between two switchboards e.g. between the distribution supply main switchboard and the installation main switchboard, including the sub mains extending from the installation main switchboard to the earth bar of any other switchboard. (Refer to T HR EL 12004 ST Section 6.5 Earth Cables)**
- **For bonding the switchboard earth bar and the station overbridge (Refer to T HR EL 12004 ST Section 6.6 Overbridges) (where the low voltage earthing system is in contact with a 1500V DC structure, e.g. overbridge.**

Appendix A and Appendix B contain sample drawings "highlighted" to show the LV distribution system.

Should any inconsistency occur between these Appendices and T HR EL 17000 ST, then the EP 12 10 00 10 SP and T HR EL 12004 ST **standard takes precedence**.

3.1 Circuit labelling

The labelling of TAHE low voltage circuits is not standardised and may be inaccurate. Circuit labelling shall not be relied on without confirmation by testing.

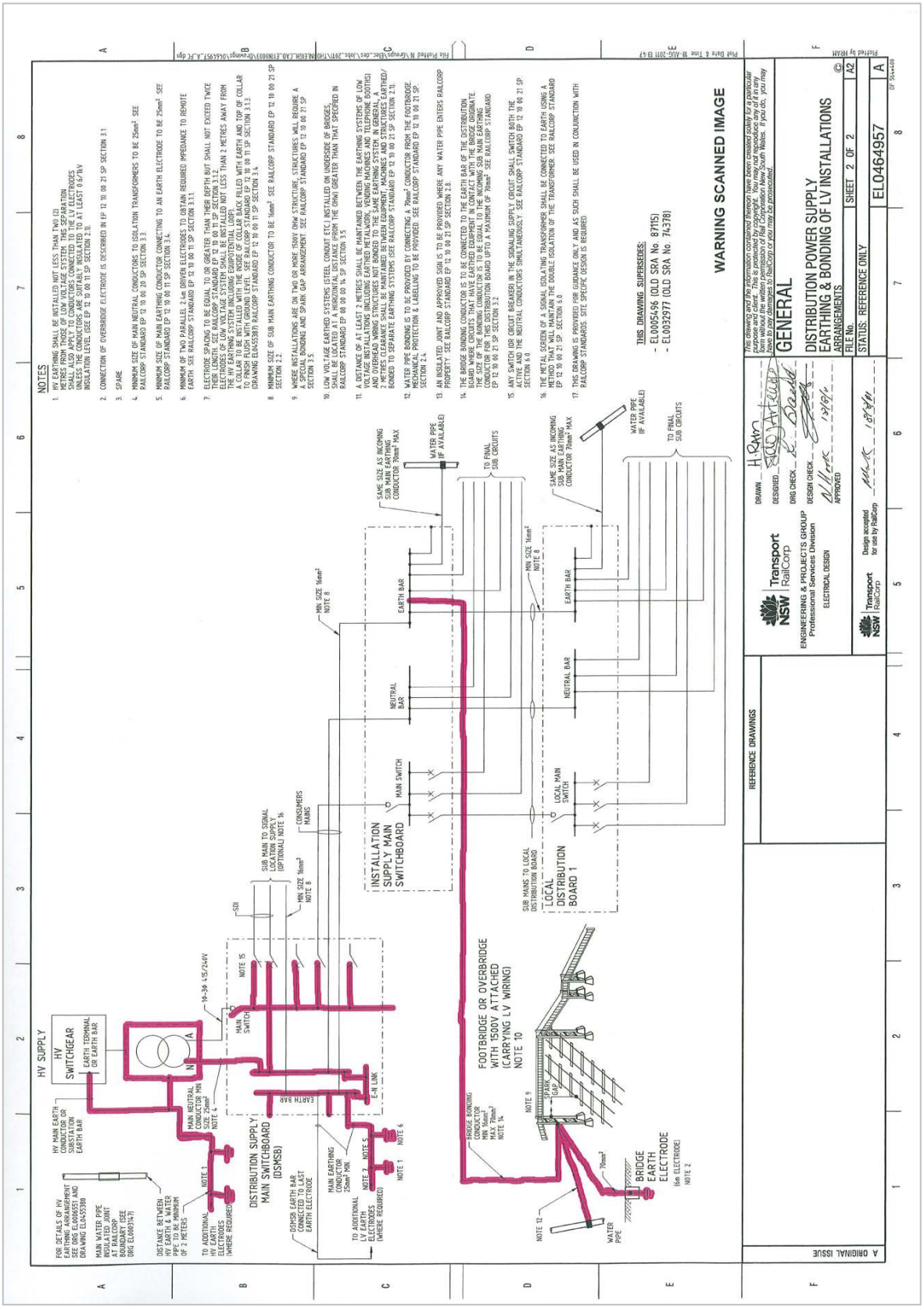
4 Reference documents

EP 12 10 00 10 SP System Substation Earthing

T HR EL 12004 ST Low Voltage Distribution and Installations Earthing

T HR EL 17000 ST Demarcation of RailCorp Low Voltage Distribution System

Appendix A Electrical drawing EL0464957, 'highlighted' to show the LV distribution system.



Appendix B Electrical drawing EL0170330, 'highlighted' to show the LV distribution system.