

Engineering Procedure  
Electrical Distribution Unit

PR D 78400

# Description and Labelling of the Low Voltage Distribution System

Version 1.1

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# Procedure

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## Document control

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

## Summary of changes from previous version

Summary of change	Section

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## 1 Purpose and scope

This document describes the:

- boundary between Sydney Trains Low Voltage (LV) Distribution System and the Local Distribution Network Service Provider's network or Sydney Trains High Voltage (HV) network, (up stream) and the LV installation (downstream); and
- labelling applicable to the Sydney Trains LV Distribution System.

The Sydney Trains 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, stations and some other private consumers. (Refer to PR D 78100 for a more detailed definition.)

This document does not apply to:

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

## 2 General Provisions

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

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

Generally the Sydney Trains distribution substations have separate HV and LV earths. The Sydney Trains 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 Sydney Trains 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.

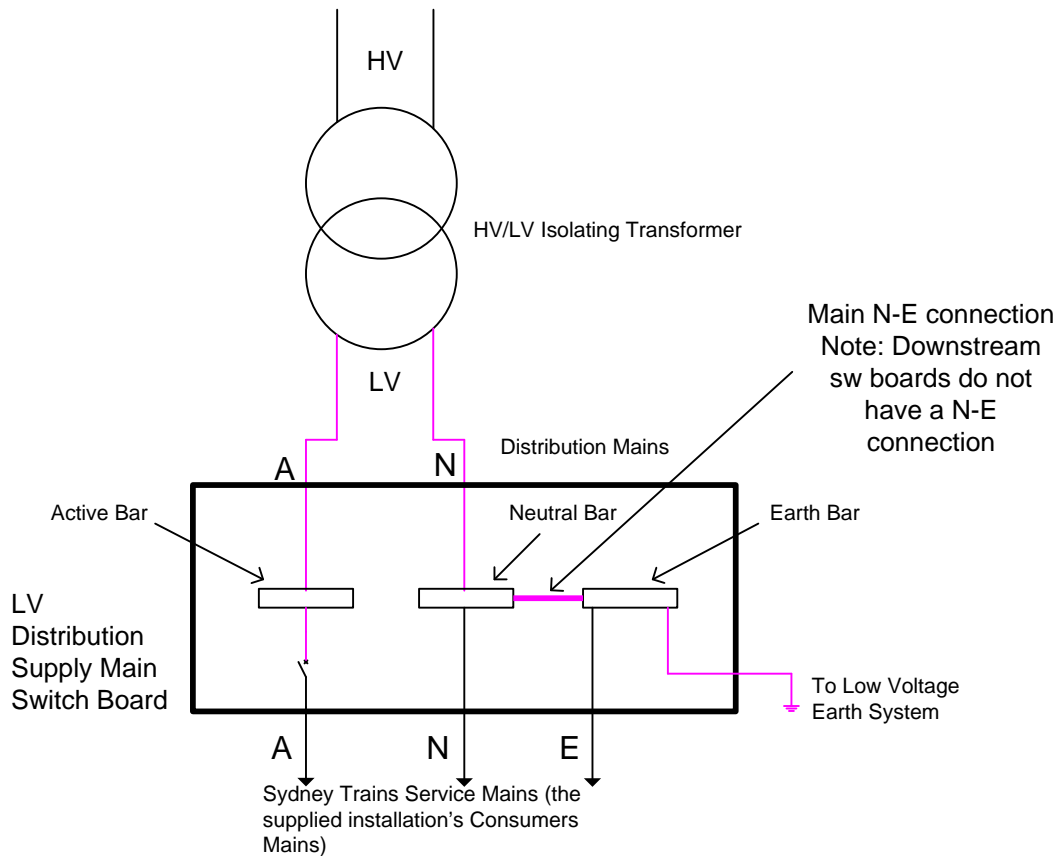


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**NOTE:**

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

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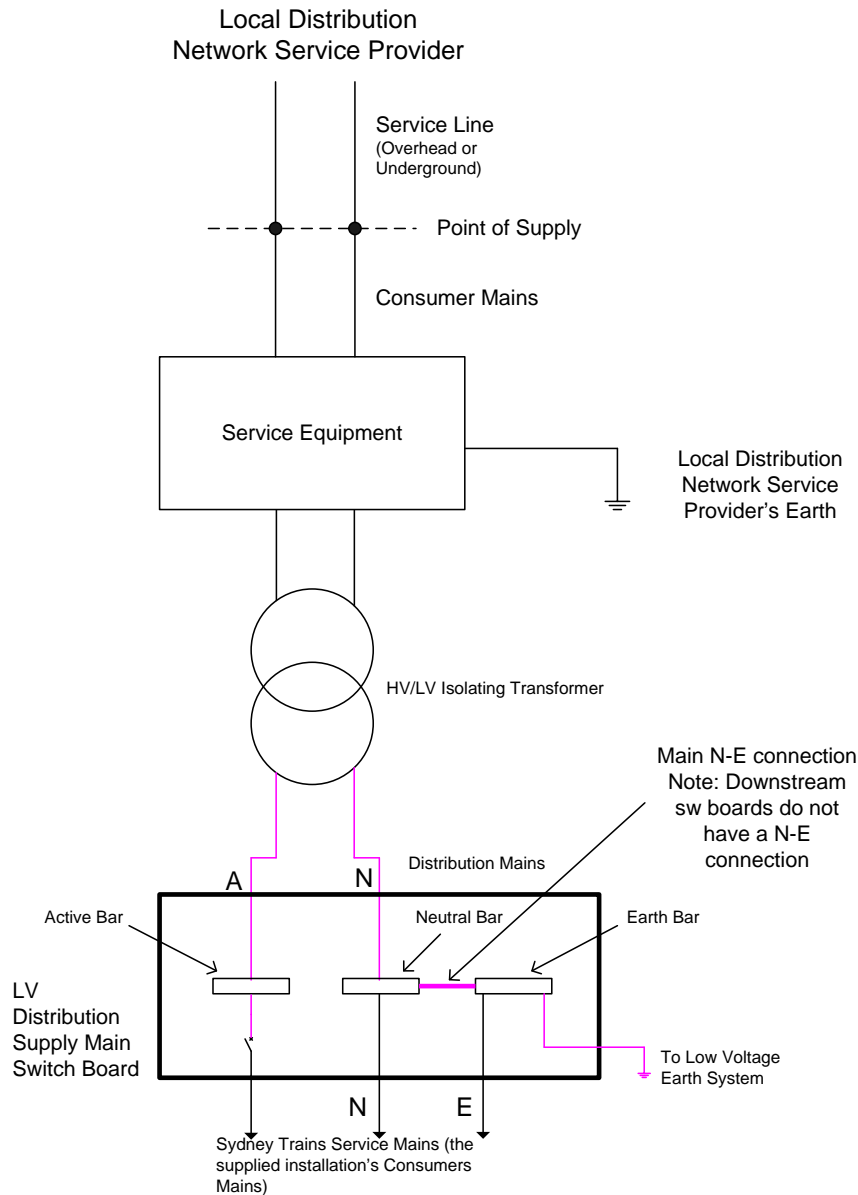


**Figure 1 - Supply from Sydney Trains High Voltage Network (Main elements ONLY shown)**

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 Sydney Trains 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 Sydney Trains LV distribution system or a Sydney Trains 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 Specification *EP 12 10 00 21 SP Low Voltage Installations Earthing***

Figure 1 and 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 down stream 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 TH 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 Sydney Trains high voltage system i.e. to provide a back –up 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 EP 12 10 00 20 SP Low Voltage Distribution Earthing 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 owned and operated by Sydney Trains as an Electricity Distributor.



### NOTE

16mm<sup>2</sup> is the **minimum** earth conductor that can be used on Sydney Trains 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, section 7 and 8.
- 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 EP 12 10 00 21 SP, section 2.2.)
- For bonding the switchboard earth bar and the station overbridge (Refer to EP 12 10 00 21 SP, section 3.2) (where the low voltage earthing system is in contact with a 1500V DC structure, e.g. overbridge).

Appendices A and B contain sample drawings "highlighted" to show the LV distribution system. Should any inconsistency occur between these Appendices and TH HR EL 17000 ST Demarcation of RailCorp Low Voltage Distribution System, then the EP standard takes precedence.

## 2.1 Circuit labelling

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

### 3 **References**

<u>EP 12 10 00 10 SP</u>	<i>System Substation Earthing</i>
<u>EP 12 10 00 20 SP</u>	<i>Low Voltage Distribution Earthing</i>
<u>EP 12 10 00 21 SP</u>	<i>Low Voltage Installations Earthing</i>
<u>T HR EL 17000 ST</u>	<i>Demarcation of RailCorp Low Voltage Distribution System</i>
<u>PR D 78100</u>	<i>Definitions and Conventions for Electrical Safety</i>
<u>Work Health and Safety Regulation 2011 (NSW)</u>	

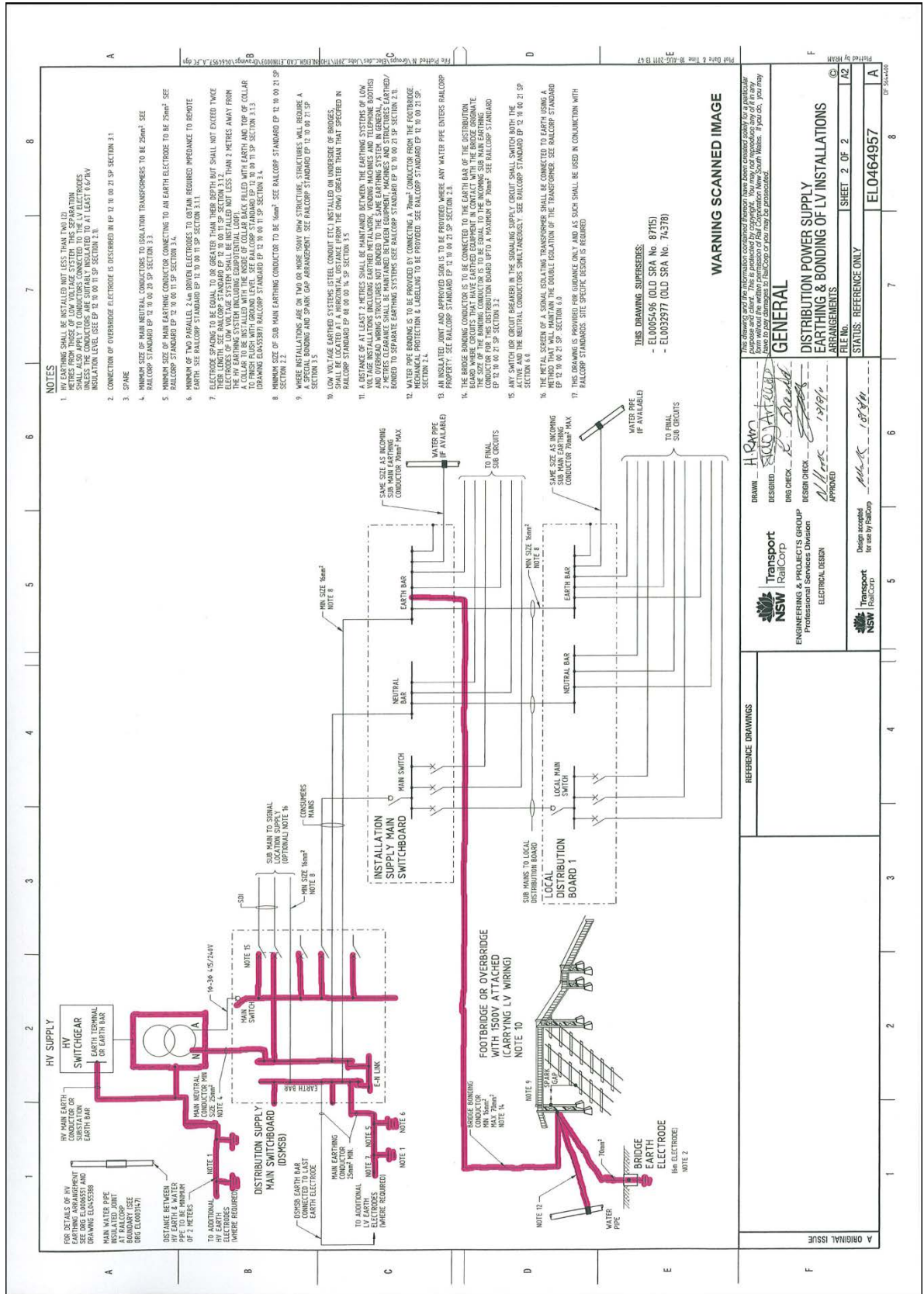
### 4 **Appendices**

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

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



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



- NOTES**
1. HV EARTHINGS SHALL BE INSTALLED NOT LESS THAN TWO (2) METRES FROM THOSE OF LOW VOLTAGE SYSTEM. THIS SEPARATION SHALL BE MAINTAINED THROUGHOUT THE ENTIRE LENGTH OF THE EARTHING SYSTEM UNLESS THE CONDUCTORS ARE SUITABLY INSULATED TO AT LEAST 6.6kV INSULATION LEVEL. (SEE EP 12 10 01 21 SP SECTION 2.1)
  2. CONNECTION OF OVERBRIDGE ELECTRODE IS DESCRIBED IN EP 12 10 01 21 SP SECTION 3.1
  3. SPARE
  4. MINIMUM SIZE OF MAIN NEUTRAL CONDUCTORS TO ISOLATION TRANSFORMERS TO BE 25mm<sup>2</sup>. SEE RAILCORP STANDARD EP 12 10 01 20 SP SECTION 3.3
  5. MINIMUM SIZE OF MAIN EARTHING CONDUCTOR CONNECTING TO AN EARTH ELECTRODE TO BE 70mm<sup>2</sup>. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 3.4
  6. MINIMUM OF TWO PARALLEL 2.4m DOWN ELECTRODES TO OBTAIN REQUIRED IMPEDANCE TO DISMANTLE EARTH. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 3.1.1
  7. ELECTRODE SPACING TO BE EQUAL TO OR GREATER THAN THEIR DEPTH BUT SHALL NOT EXCEED TWICE THEIR LENGTH. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 3.1.2
  8. ELECTRODES SHALL BE INSTALLED NOT LESS THAN 3 METRES AWAY FROM THE HV EARTHING SYSTEM INCLUDING EQUIPOTENTIAL LINES
  9. A COLLAR TO BE INSTALLED WITH THE INSIDE OF COLLAR BACK FILLED WITH EARTH AND TOP OF COLLAR DRAWING CLASSIFIED RAILCORP STANDARD EP 12 10 01 21 SP SECTION 3.4
  10. MINIMUM SIZE OF SUB MAIN EARTHING CONDUCTOR TO BE 16mm<sup>2</sup>. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 2.2
  11. WHERE INSTALLATIONS ARE ON TWO OR MORE ISMV OR HV STRUCTURES, STRUCTURES WILL REQUIRE A SPECIAL BONDING AND SPARK GAP ARRANGEMENT. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 3.5
  12. LOW VOLTAGE EARTHED SYSTEMS (STEEL CONDUIT ETC) INSTALLED ON UNDERSIDE OF BRIDGES SHALL BE BONDING TO THE OWN ORIGINATOR THAN THAT SPECIFIED IN RAILCORP STANDARD EP 40 00 00 14 SP SECTION 3.5
  13. A DISTANCE OF AT LEAST 2 METRES SHALL BE MAINTAINED BETWEEN THE EARTHING SYSTEMS OF LOW VOLTAGE INSTALLATIONS INCLUDING EARTHED METALWORK, VENDING MACHINES AND TELEPHONE BOOTHS)
  14. WHERE EARTHING SYSTEMS ARE INSTALLED BETWEEN EARTHING SYSTEMS AND THE CONDUCTORS BONDING TO SEPARATE EARTHING SYSTEMS (SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 2.1)
  15. WATER PIPE BONDING IS TO BE PROVIDED BY CONNECTING A 70mm<sup>2</sup> CONDUCTOR FROM THE FOOTBRIDGE MECHANICAL PROTECTION & LABELLING TO BE PROVIDED. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 2.4
  16. AN ISOLATED JUNCTION AND APPROVED SIGNALS IS TO BE PROVIDED WHERE ANY WATER PIPE ENTERS RAILCORP PROPERTY. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 2.3
  17. CONDUCTORS SHALL BE CONSIDERED TO BE INSTALLED TO THE EARTH BAR OF THE DISTRIBUTION BOARD UNLESS OTHERWISE STATED TO THE CONTRARY
  18. THE SIZE OF THE BONDING CONDUCTOR IS TO BE EQUAL TO THE INCOMING SUB MAIN EARTHING CONDUCTOR. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 3.2
  19. THE CONDUCTOR SHALL BE INSTALLED TO THE INCOMING SUB MAIN EARTHING CONDUCTOR TO BE MAINTAINED BETWEEN EARTHING SYSTEMS AND THE CONDUCTORS BONDING TO SEPARATE EARTHING SYSTEMS (SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 2.1)
  20. ANY SWITCH (OR CIRCUIT BREAKER) IN THE SIGNALING SUPPLY CIRCUIT SHALL SWITCH BOTH THE ACTIVE AND THE NEUTRAL CONDUCTORS SIMULTANEOUSLY. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 6.6
  21. THE METAL SCREEN OF A SIGNAL ISOLATING TRANSFORMER SHALL BE CONNECTED TO EARTH USING A CONDUCTOR OF THE SAME SIZE AS THE INCOMING SUB MAIN EARTHING CONDUCTOR. SEE RAILCORP STANDARD EP 12 10 01 21 SP SECTION 6.6
  22. THIS SYSTEM IS FOR INFORMATION ONLY. ANY 15kV SWITCH SHALL BE USED IN CONJUNCTION WITH RAILCORP STANDARDS. (SEE SPECIFIC DESIGN IS REQUIRED)

**WARNING SCANNED IMAGE**

THIS DRAWING SUPERSEDES:  
- EL0005456 (OLD SRA No. 8715)  
- EL0032977 (OLD SRA No. 74378)

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**DISTRIBUTION POWER SUPPLY  
EARTHING & BONDING OF LV INSTALLATIONS**

FILE NO. [REDACTED]  
SHEET 2 OF 2  
STATUS: REFERENCE ONLY  
DRAWN: [REDACTED]  
DESIGNED: [REDACTED]  
ISSUED: [REDACTED]  
APPROVED: [REDACTED]

DESIGN INCORPORATED FOR USE BY RAILCORP

EL0464957  
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## Appendix B Electrical drawing EL0170330, 'highlighted' to show the LV distribution system.

