Engineering Standard

Electrical

CRN EL 002

LOW VOLTAGE INSTALLATIONS EARTHING

Version 1.1

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Revision	Date of Approval	Summary of change
V2.0	March 2005	EP 12 10 00 21 SP Low Voltage Installations Earthing
V1.0	January 2012	Conversion to CRN Electrical Standard CRN El 002
V1.1	August 2016	Review and Update

Summary of changes from previous version

Section	Summary of change
	Update ownership of CRN to TfNSW
	Remove section relating to Train Maintenance Centres, lighting on 1500v structures, welding machines and Train Radio masts and equipment

Contents

1 General

The following standards and figures contain the words “RIC’ this will now be read to mean “JHR CRN” John Holland Country Regional Network maintaining and on operating the assets on the behalf of the asset owner Transport for New South Wales (TfNSW).

This standard contains information about High Voltage and in particular the 1500 Volt overhead wiring and traction return.

Sydney Trains is the authority of this Infrastructure and a Sydney Trains Engineering Standards should be referenced in relation to this (High Voltage and in particular the 1500 Volt overhead wiring and traction return) type infrastructure and systems.

The low voltage installations covered in this document are to be earthed in accordance with AS 3000 - 1991 clause 5.10.2(b). Figure 1, represents the relationship between the John Holland Rail Country regional network JHR CRN low voltage distribution system and the two general types of low voltage installations that may be connected. Diagrams representing the JHR CRN distribution system covering a supply originating from the JHR CRN high voltage network and from a local Electricity Distributor are contained in Voltage Distribution Earthing”.

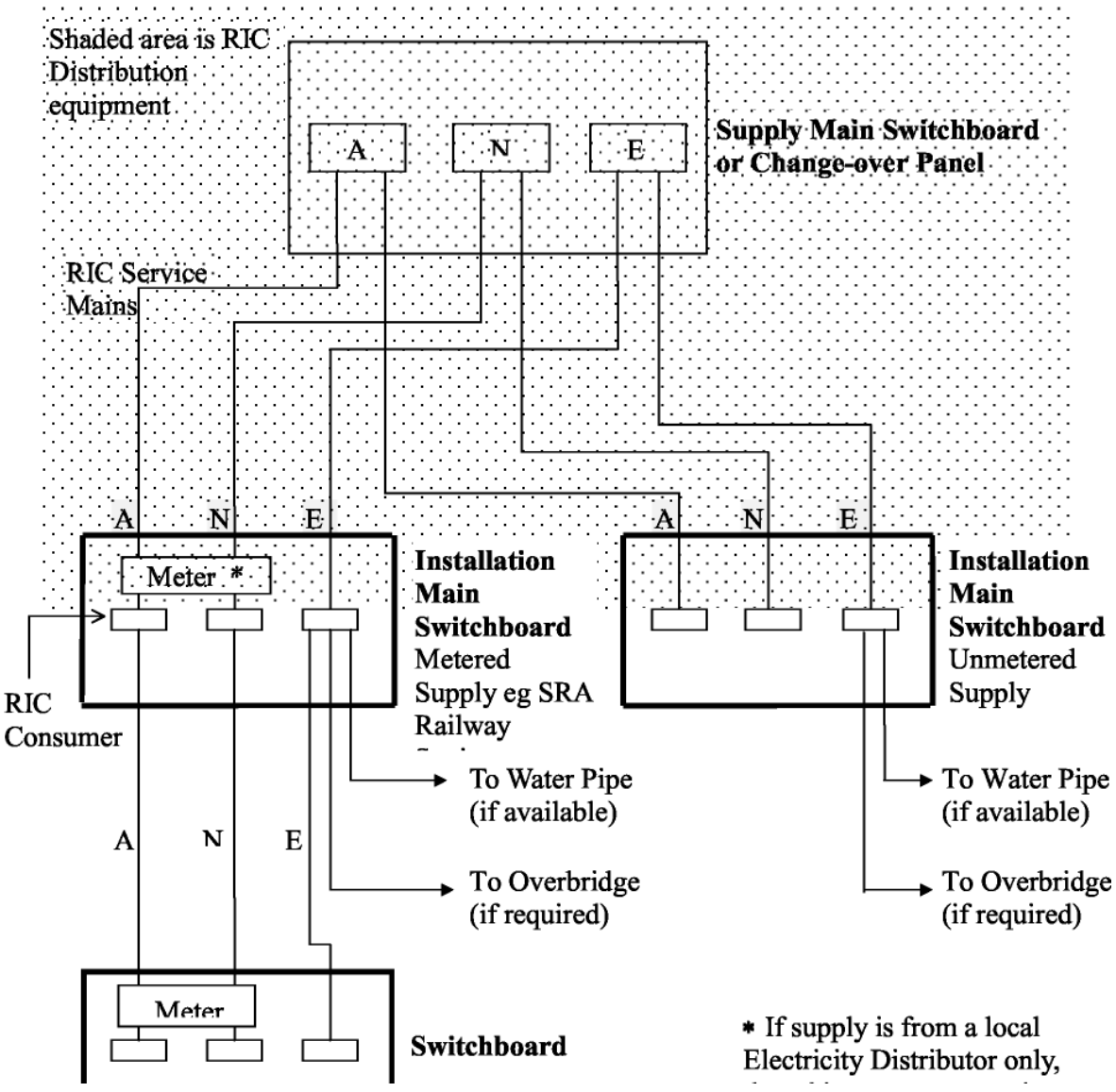

Figure 1 Connection of Installation Main Switchboards

1.1 Clearances from 1500 V Structures and Other Earthed Metalwork

A 2 m distance shall be maintained between the earthing system of the low voltage installation, including earthed metalwork for example fences, vending machines and telephone cabinets, and any overhead wiring structures which are not bonded to the same earthing system or metalwork connected to a separate earthing system.

1.2 Switchboards

An earthing conductor of not less than 16 mm^2 copper shall be used for linking the earth bars of any two switchboards, including the sub-mains extending from the installation main switchboard to the earth bar of any other switchboard.

When there is a substantial metallic water pipe in the vicinity refer to section 1.4.

1.3 Earthing Conductors with Final Sub-circuits

Each final sub-circuit shall contain an earthing conductor as prescribed by AS 3000.

1.4 Water Pipe Equipotential Bonding

The earth bar of a switchboard shall be connected to the nearest substantial metallic water pipe (on the railway station side of the water pipe isolating joint, refer to section 1.8) with a bond of the same size as the incoming submain earthing conductor, to a maximum size of 70 mm^2 copper. The bond conductor is to be effectively protected from mechanical damage as detailed in section 1.5.

There shall only be one connection between a waterpipe and a switchboard for each low voltage installation. The location of the water pipe connection is to be clearly labelled on the switchboard from which the equipotential bond originates.

1.5 Mechanical Protection of Earthing Conductors

In situations where an earthing conductor may be exposed to mechanical damage, the conductor shall be effectively protected from ground level to a height of 2.4 m. This protection shall be in the form of a galvanised metallic conduit or by installing the conductor in PVC conduit and protecting the PVC by a galvanised steel sleeve to the full height of 2.4 m.

1.6 Lineside Metal Fencing or Signal Troughing

A 2 m clearance must be maintained between any metal connected to the railway stations low voltage earth and any continuous metal structure, such as a fence or signal troughing that is not intentionally connected to the earthing system. Where the 2 m clearance cannot be obtained, a suitable approved method such as installing two isolating breaks 2 m apart in the continuous metal structure shall be used. Alternatively the situation can be proved safe by calculation and testing for dangerous touch voltages in accordance with the ESAA Substation Earthing Guide.

1.7 Metallic Conduits

In general metallic conduits are not permitted to be installed underground or in concrete within the electrified area due to the presence of stray 1500 V dc leakage currents. However, in practice short lengths should not present a problem, therefore, if a situation arises where a short length of buried metallic conduit is the preferred method then the definition of appreciable dc leakage current from Specification CRN EL 001- “Low Voltage Distribution and Installations Earthing References and Definitions” can be applied.

1.8 Metallic Pipes

All underground metallic pipes entering railway land in the 1500 V electrified area shall be electrically isolated by the permanent installation of an approved isolating joint one metre outside the boundary,

as shown on drawing D/89147. Isolation is to provide protection against stray 1500 V dc leakage currents.

An approved sign, as shown on drawing D/89147, is to be secured to the fence directly above the pipe.

2 Overbridge having 1500 V Overhead Wiring and Low Voltage Wiring Attached

2.1 Connection to Electrode

An overbridge at any railway station in the electrified area having low voltage cables in contact with the bridge will require the bridge to be connected to a 6 m electrode using a 70 mm^2 copper conductor, refer to section 2.1.1. The electrode is to be located as close as possible to the bridge and installed as detailed in sections 2.1.2 and 2.1.3. The 70 mm^2 conductor shall be protected against mechanical damage as detailed in section 1.5 and be secured to the over bridge by no lesser security than a crimped closed lug, lock-nutted onto a stud of minimum size 12 mm.

2.1.1 Standard Electrode

The standard electrode for an overbridge is a 6 m length of thick copper tube (14.29 mm outside diameter, 11.03 mm inside diameter, this internal dimension will allow a 70 mm^2 conductor to be a close fit for a crimped joint). A driven electrode may be used.

2.1.2 Installation of Electrode

The electrode may be driven where conditions are suitable, otherwise use a drilled hole (50 mm diameter) back filled with a conducting medium mixture, for example bentonite, gypsum and sodium sulphate (50%, 45% and 5% by weight respectively) mixed to AS 2239 - Cathodic Protection, or similar. The top of each electrode is to finish 200 mm below ground level.

The earth electrode is to have a collar installed with the inside of the collar backfilled with earth. A lid is to be placed over the collar.

2.1.3 Electrode Connection

The earthing conductor is to be connected to the electrode by crimping. The earth conductor will need 75 mm of insulation removed, the 75 mm of bare 70 mm^2 conductor inserted inside the copper tube electrode and either of the following crimp methods used:

Hydraulic crimp: 2 crimps with a 70 mm^2 die over the 75 mm of insert. Hand crimp: 5 crimps over the 75 mm of insert.

2.2 Connection to Switchboard

Where the low voltage earthing system is in contact with a 1500 V structure, eg overbridge, the 1500 V structure is to be bonded to the switchboard earth bar from which the low voltage installation circuits originate.

The earth bar of the switchboard required to be bonded to the station overbridge is connected by a bonding conductor equivalent to the incoming submain earthing conductor up to a maximum size of 70 mm^2 copper (minimum size is 16 mm^2). The same requirements for mechanical protection as for the main earthing conductor apply to this bonding conductor, refer to section 1.5.

The bonding conductor shall be secured by means of not lesser security than a crimped closed lug, lock-nutted onto a stud of minimum size 12 mm. The location of the point of connection of the bonding connection to the overbridge shall be indicated at the switchboard where the overbridge is connected to the earth bar.

The incoming earthing conductor and the overbridge bonding conductor are to be terminated adjacent to each other at one end of the switchboard earth bar. Clear labelling is to be provided to identify each conductor, such as overbridge bond, or earth conductor.

2.3 Connection to Water pipe

At a railway station, the overbridge shall be bonded to the railway station internal water pipe (the station side of the water pipe isolating joint, refer to section 1.8) by means of a 70 mm^2 copper bonding conductor. The location of both the water pipe and overbridge connections shall be clearly labelled on the switchboard where the overbridge is connected to the earth bar. The water pipe bond conductor is to be effectively protected from mechanical damage as detailed in section 1.5.

2.4 Other Metalwork

Refer to RailCorp Specification EP08000014SP - “Services Erected Above OHW”.

2.5 Spark Gap

The overbridge must have an approved spark gap fitted, refer to RailCorp publication EP12200001 SP - “Bonding of Overhead Wiring Structures to Rail” contained in Volume 1.

If two, or more, 1500 V overhead wiring structures are electrically connected by a low voltage earthing system then the structures shall be bonded together by a minimum 70 mm^2 copper conductor and only one spark gap shall be provided.

3 Railway Station Interfaces

Where a railway station adjoins with another building or structure, such as a bus rail interchange or a footbridge that connects a railway station with a shopping centre, the design shall not allow the extension of the JHR CRN low voltage earthing system beyond the railway corridor. This includes all metallic structures and services, such as awnings, fences, pipes and electrical wiring and conduits. The interface should be well defined and easily observable and where any doubt exists the situation shall be proved safe by calculation and testing for dangerous touch voltages in accordance with the ESAA Substation Earthing Guide.

The metalwork of the structure that has been isolated from the station may be connected to an MEN earthing system.

4 Single Point Trackside Supplies

Where a local Electricity Distributor provides a supply to a small single load such as the lighting of a billboard or a sign near the 1500 V track then an isolating transformer will not be required as a single footing encased in concrete is not likely to pick-up appreciable dc leakage current, refer to Specification CRN EL 001- “Low Voltage Distribution and Installations Earthing References and Definitions” for definition.

No other supplies are allowed from the same service equipment. There shall also be no other metallic services such as water pipes in close proximity to the supply point. If there is any doubt the supply or service can be tested for appreciable dc leakage current as described in Specification CRN EL 001- “Low Voltage Distribution and Installations Earthing References and Definitions”.

5 Signalling Supplies

The 120 V signalling supply is considered to be unearthed for the purposes of this document. The earthing of the Signalling system, that is the electrical installation at 120 V and below, is covered in the appropriate Signalling documents.

Where supply is provided from a JHR CRN 415 V or 240 V source or a local Electricity Distributor, the active and neutral conductors from the main supply switchboard, or service equipment, shall be double insulated to the 415/120 V or 240/120 V isolating transformer. The metal screen shall be connected to earth using a method that will maintain the double insulation of the transformer. Depending on the connection details for a particular transformer this may involve over sleeving the earth conductor for the section internal to the transformer and taping the connection. The connection shall be mechanically secure. Double insulated active and neutral conductors shall be run from the isolating transformer to the signal hut switchboard. Any switches in the circuit shall switch both the active and neutral conductors simultaneously.

Where supply is from a JHR CRN high voltage location stepped down directly to 120 V, double insulated active and neutral conductors shall be run from the transformer to the supply main switchboard and on to the signalling location switchboard. Any switches shall switch both active and neutral conductors simultaneously. The metal screen of the transformer shall be connected to the high voltage earth.

Refer to Specification CRN EL 003- “Low Voltage Distribution Earthing” for more information on isolating transformers.

6 Permanent Standby Generators

The earthing system employed for a 415 V or 240 V permanent standby generator shall follow the same principles set out in this document and Specification EP12100020SP - “Low Voltage Distribution Earthing”.

The earthing system employed for a 120 V permanent standby generator for a signalling supply is covered in the appropriate Signalling documents.

7 Telecommunication and Protection Equipment

Standard requirements for this configuration have not yet been determined.