AUSTRALIAN RAIL TRACK CORPORATION LTD

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Discipline

Engineering Standard – NSW

Category

Electrical

Title

ARTC Electrical System General Description

Reference Number

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Document Control

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The technical content of this document has been approved by the relevant ARTC engineering authority and has also been endorsed by the ARTC Safety Committee.

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About This Standard

This document provides some general background to the electrical assets belonging to the Australian Rail Track Corporation (ARTC).

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Document History

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List of Amendments –

ISSUE	DATE	CLAUSE	DESCRIPTION
1.1	11/03/2005	Disclaimer	Minor editorial change

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Contents

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1 General

ARTC operates a high voltage ac distribution network and a 1500V dc traction system.

ARTC is a Network Operator, Electricity Distributor and a Retail Supplier under the Electricity Supply Act 1995 and also an 'Electricity Supply Authority' under the "Electricity Safety Act 1945".

The whole of the HV and 1500V system (except the overhead wiring) is designed so that the failure of any ONE item of equipment does not affect the running of trains. This is known as 'single contingency' failure mode. At some special locations such as the City Underground, double or even triple contingency is required to provide a more secure supply.

2 High Voltage Transmission Lines & Underground Cables

Supply for traction (and other) substations is provided by high voltage ac transmission lines and underground cables connected to the local Electricity Distributor.

The transmission lines are basically of wood pole construction with the conductors of copper or aluminium supported by glass disc insulators from crossarms.

High voltage cable types used include paper insulated lead sheathed and XLPE insulated PVC sheathed.

Standard voltages used are 11 kV, 33 kV, 66 kV and 132 kV.

3 1500V Traction System

The ARTC traction system is a nominal 1500 volt direct current system.

Power for electric traction is supplied from substations to the trains by means of the overhead wiring (OHW) system. The train pantograph sliding under the contact wire, collects current to operate the motors, the current returning to the substations through the traction rails. The design and maintenance of the traction return circuits is carried out by the Signalling Discipline. (See SC 00 15 00 SP “Signalling Standard Specification, Traction Return, Track Insulation & Bonding”)

The overhead wiring is positive and the rail negative. The rails are not intentionally earthed, to reduce electrolysis, but are 'close to' earth potential.

4 Substations

The most common traction substation configuration comprises two 4MW rectifiers supplied from 33kV transformers with two 33kV supply feeders.

The transformer and rectifier convert the high voltage 33kV alternating current supply to 1500 volt direct current for train operation.

Substation spacing varies between 4km in high load areas to 15km on flat country with predominantly suburban passenger traffic.

Substation spacing is a complicated problem which takes into account loads, grades,

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OHW types (resistance & thermal rating), train headways, losses, rail-earth potentials and electrolysis.

Protection for the overhead wiring system is provided by high speed circuit breakers and overall control and monitoring of the substations is by a supervisory remote control system. (SCADA).

Sectioning Huts, containing dc circuit breakers, are provided between substations for protection and sectioning of the overhead wiring system and, on multiple tracks, to improve voltage regulation.

Generally, a section of OHW is fed by two dccbs - one at each end - both of which are normally closed.

5 Overhead Wiring

Three basic types of overhead wiring (OHW) are in use:

1) A simple catenary, where the contact wire is supported from the catenary wire by droppers spaced along the catenary. Both single and twin contact wire arrangements are used.

2) A compound catenary, where a main catenary supports an auxiliary catenary which in turn supports the contact wire by means of droppers.

3) Contact only which has no catenary or droppers.

The majority of overhead wiring is the simple catenary type, the compound catenary is used west of Penrith and contact only is used in yards for slow running. Types (a) and (c) can be either fixed anchored, where the tensions in the wires vary with temperature, or regulated tension, where the wire tensions are held approximately constant by means of weight or gas tensioning devices. Type (b) system is fixed anchored.

In all three types the supports for the overhead wires can take the form of wire polygons (suspended between wood poles or steel masts), cantilever arrangements (erected on wood poles or steel masts), or portal structures.

The contact wire is steadied against wind and directed around curves by pull-off arms. In span wire construction the pull-off arms are held by span wires stretched across the tracks between masts. In independent registration arrangements the pull-off arms are attached to the structure or cantilever so that the wiring for each track is mechanically and electrically independent of adjacent tracks.

Insulators are used to separate the live 1500 volt overhead wires and equipment from the support structures and to provide electrical separation between the wiring for each track.

Stranded bare copper is used for the catenary, the most common size being 37 strands of 3.05mm diameter (270mm^2). Other sizes used are 510 mm^2, 327mm^2 and 165mm^2. In early construction, steel catenary was used but is now being replaced due to corrosion problems.

Two sizes of contact wire are used, 193 mm^2 and 137mm^2. The material is hard drawn copper for the regulated systems and cadmium-copper or tin-copper for the

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fixed anchor systems which have to withstand higher tensions. The 137 mm^2 contact is preferred because it is easier to install and does not 'kink' as readily as the 193 mm^2.

The preferred type of OHW is a 270 mm^2 catenary with twin 137 mm^2 hard drawn contacts, regulated, supported by steel masts with independent registration of each track.

For protection, operation and maintenance purposes, the overhead wiring is divided into switchable sections at substations, sectioning huts and field switches.

6 Signalling Supply

Electrical supply for signalling operation is from two separate sources to ensure reliability of supply.

The standard arrangement is for the 'normal' supply to be obtained from the ARTC high voltage distribution system via substations fed at 2.2 kV, 11 kV or 33 kV. The 'standby' supply is obtained from the local electricity Distributor at 240 V.

Where supply is taken from a local electricity distributor, precautions have to be taken to prevent stray traction current leakage into the MEN system.

7 Station, Building and Workshop Supply

These supplies are also from the high voltage distribution system. Substations transform the voltage to 415V or 240V as required.

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