



AUSTRALIAN RAIL TRACK CORPORATION LTD

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Engineering Standard – NSW

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Electrical

Title
High Voltage and 1500 System Earthing
References and Definitions

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About This Standard

This document lists the publications and drawings that are referenced in the documents contained in Volume 1 of this manual, or that can provide extra background information. The drawings are held in the ARTC Plan Room.

This document also provides a list of definitions of words that have a precise meaning in relation to the documents contained in Volume 1 of this manual.

Document History

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1 References

1.1 General Publications

- AS-3000 - SAA Wiring Rules - 1991
- AS-3108 - Approval and test specification-particular requirements for isolating transformers and safety isolating transformers - 1990
- AS 2067 - Switchgear Assemblies and Ancillary Equipment for Alternating Voltages above 1 kV - 1984
- EC 5 - Guide to protective earthing - Electricity Council of N.S.W. - 1992
- ESAA C(b)1 - Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines
- ESAA - Substation Earthing Guide
- IEEE 80 - Guide for safety in AC substation grounding - 1976
- UIC - 605-1 - International union of railways codes
- Cathodic protection of underground structures by W. K. Woodberry

1.2 Drawings

- A3 90095 Earthing arrangement substation on timber pole with low voltage unearthed
- A3 90094 Earthing arrangement substation on timber pole with low voltage earthed.
- A1 89930 Main Suburban MS 13+261 switching arrangement.
- D 89147 Electrolysis isolating joint for underground water pipe.
- K 89091 33 kV/415 V 3 phase transformer single pole structure arrangement.
- K 89069 11 kV/433-250 V transformer single pole structure and 11 kV switchgear arrangement.
- A 88579 Portal structure typical feeding arrangements.
- C 87206 Earthing System for Fibreglass Padmount Substation.
- C 87115 Earthing Systems. Arrangement of LV Installations in Contact with 1500V Structures.
- C 86939 Pole mounted air break switch & transformer earthing arrangement.
- B 86770 2 kV/240V Transformer and air break switch with 2 kV Aerial to

Cable termination - pole Top Arrangement.

- K 86695 1500 Vdc wall mounted feeder and rail connecting link arrangement.
- D 86513 Frame leakage protection.
- E 85507 33 kV/500-250 V transformer single pole structure operating notice.
- K 85401 33 kV/500-250V Transformer Single Pole Structure Arrangement.
- B 83402 Surge diverter on mast arrangement.
- B 83384 Cable feeding arrangement.
- D 83382 Bonding of mast to rail arrangement.
- K 83349 1500 V wall mounted feeder link arrangement and mounting details.
- C 83055 1500 V feeder link structure cable entry and exit arrangement.
- D 82567 Gosford-Newcastle electrification Sectioning Huts 240 Vac distribution schematic diagram.
- D 82190 Gosford-Newcastle electrification 220 V auxiliary panel schematic diagram.
- B 81680 11 kV line to cable switching arrangement.
- C 80609 1500 V feeder link structure cable entry aerial exit arrangement.
- D 80605 Eastern Suburbs Railway HV and LV equipment earthing arrangement.
- C 79930 HV outdoor equipment typical earthing arrangements.
- B 76031 11 kV/415 V transformer single pole structure arrangement
- C 73920 Northern line substations 220 V auxiliary board schematic diagram.
- C 70372 Train signalling 11 kV/120 V transformer single pole structure arrangement.

2 Definitions Used in This Volume

2.1 1500 V structure

a 1500 V structure or overhead wiring structure is a structure which has 1500 V equipment attached to it with insulators. This includes structures specifically designed for supporting overhead wiring and structures built for other purposes but

also supporting overhead wiring, such as overbridges.

2.2 Bonding conductor

is a conductor connecting two or more metal structures with 1500 V overhead wiring attached for the purpose of carrying traction fault currents during electrical disturbances. The bonding conductor shall have a minimum size of 70 mm² copper and shall be insulated to 0.6/1.0 kV.

2.3 Conductor

is a wire, cable or other form of material suitable for carrying current.

2.4 Distribution Substation

all non-system substations containing high voltage electrical equipment (ie high voltage locations without circuit breakers). This includes automatic reclosers and line air break switches.

2.5 Earth grid (also known as Earth mat)

is a group of conducting elements, both vertical and horizontal, in electrical contact with the earth designed to disperse electrical fault currents into the earth and to control touch and step voltages.

2.6 Earth mesh

is a group of horizontal conductors buried under the area of a substation to reduce the values of prospective step voltages and reduce the earth grid resistance.

2.7 Earth potential rise

is the maximum potential rise of an earthing system, with respect to remote earth.

2.8 Earthing conductor

is a conductor used to connect any metal work required to be earthed to the neutral point of the transformer or such other earthing point as may be determined.

2.9 Earthing system

includes the earth grid and all conductors, piping, electrodes, clamps and other metalwork connected to the grid.

2.10 Electrified area

is the section of railway provided with 1500 V_{dc} overhead wiring, nominally bounded by Bowenfels, Glenlee, Kiama and Newcastle.

2.11 Electrode (also known as Earth rod)

is a vertical conducting element specifically designed or adapted for discharging the earth fault current into the ground as required by the earthing system design.

2.12 Electrolysis

refers to the process where corrosion occurs to a buried metal structure when dc current leaves the structure to enter the electrolyte of the surrounding soil.

2.13 Fault duration

is the time during which a fault current may flow before being cleared by the primary protection.

2.14 High voltage

is a voltage exceeding 1000 Vac or 1 500 Vdc.

2.15 Insulated

means separated from adjoining conducting material by a nonconducting substance which permanently provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, to obviate danger of shock or injurious leakage of current.

2.16 Line air break switch

used for sectionalising transmission lines only. No transformers associated with location.

2.17 Local Electricity Distributor

is any organisation engaged in the supply of electricity, excluding the Australian Rail Track Corporation.

2.18 Low voltage

is a voltage exceeding 50 Vac or 120 Vdc but not exceeding 1000 Vac or 1 500 Vdc.

2.19 Metalwork

includes any reinforced or pre-stressed concrete parts of an installation but shall exclude minor attachments to wood poles and wood pole identification discs.

2.20 Near 1500 V track

is that area inside the railway boundary and within:

- 20 m of the centre-line of any track with overhead wiring which is electrified at nominal 1500 v_{dc} , or
- 20 m of any 1500 v_{dc} negative equipment or conductors, or
- 20 m of any metal which is spark-gapped to the rail measured horizontally at right angles.

2.21 Prospective touch voltage

is the voltage difference which may appear between any uninsulated metalwork located within 2.4 metres of the ground and any point on the surface of the ground separated by a horizontal distance of one metre, which is considered to be equal to a person's normal reach.

2.22 Rail

is the traction rail, that is the rail intended for conduction of the traction return current.

2.23 Railway corridor

is any land owned by one of the four railway entities formed under the Transport Administration Amendment 1996 No 56 of the Transport Administration Act, ie Australian Rail Track Corporation, State Rail Authority of NSW, Freight Corp or Railway Services Authority of NSW.

2.24 Remote earth

a true earth potential of zero volts

2.25 Sectioning Hut

is a System Substation, with dc circuit breakers but without rectifiers, that sectionalises the 1500 Vdc overhead wiring for dc protection and voltage regulation.

2.26 Spark gap

is a device used to connect specific types of 1500 V structures (refer to Specification EP12200001 SP - "Bonding of Overhead Wiring Structures to Rail") to rail when the potential difference between the two rises above 750 V.

2.27 Step voltage

is the voltage which may appear between any two points on the surface of the ground separated by a horizontal distance of one metre, which is considered to be equal to a person's normal step.

2.28 Substation

a substation, traction substation, transformer room, switchroom, sectioning hut, pole or pad mounted transformer location, containing high voltage electrical equipment.

2.29 Supply main switchboard

is the first low voltage switchboard between the transformer terminals and the low voltage installation. The supply main switchboard is owned by ARTC and is the location to establish the one and only connection between earth and neutral.

2.30 Switchboard

is any distribution board or switchboard other than the supply main switchboard or installation main switchboard.

2.31 System Substation

a traction substation, sectioning hut or a substation location that has a voltage greater than 2 kV and includes a high voltage circuit breaker as an item of equipment. The voltage of greater than 2 kV has been selected to exclude the ARTC 2 kV (nominal) distribution system.

2.32 Touch voltage

is the voltage across the body, under fault conditions, in a position described as for the prospective touch voltage but allowing for the voltage drop caused by a current flowing in the body.

2.33 Traction Substation

is a System Substation that supplies 1500 v_{dc} power for the overhead wiring using high speed dc circuit breakers.

2.34 Transfer voltage

is the voltage difference between an earthing system and an exposed metal object connected to a remote earth.

2.35 Transformer mains

for a supply from the ARTC high voltage network are the conductors between the transformer secondary terminal and the supply main switchboard, or change-over panel where there is a back-up supply. For a supply from a local Electricity Distributor network the transformer mains are the conductors on either side of the isolating transformer, that is, between the service equipment and the supply main switchboard, or change-over panel where the supply is installed as a back-up supply.

2.36 Voltage

means nominal potential difference between conductors or the nominal potential difference between a conductor and earth, whichever is applicable.