AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline: Engineering (Electrical) **Category: Standard**

Above Ground Cable Installation Systems – Selection Guide

PDS 13

Applicability

ARTC Network Wide	✓	**CRIA (NSW CRN)**	

Primary Source

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Document Status

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Amendment Record

Version	Date Reviewed	Clause	Description of Amendment
1.1	5 January 2005		Reformatted to ARTC Standard
1.2	11 March 2005	Disclaimer	Minor editorial change
1.3	1 September 2010	2, 4.7.1, 5.4, 6.4	Replaced reference to superseded NSW Standard BSS 02 with applicable Australian Standard for tunnel fire safety

Contents

1 Scope and Application

This publication sets out the requirements for above ground cable installation systems for high voltage ac and 1500 volt dc traction cables including cable trays, cable ladders, ducts and conduits. This publication includes ground line troughing systems.

Aerial and underground systems are excluded.

It is intended that this standard be used in determining the suitability of proprietary cable installation systems for specific applications.

The publication applies to outdoor and indoor situations, including tunnels.

This standard is applicable to new works and for major rehabilitation of existing infrastructure.

2 References

AS 1214:1983 Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series).

AS/NZS4680:1999 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.AS1397:2001 Sheet steel and strip – Hot-dip zinc-coated or aluminium/zinc-coated.

AS 1660.5.3:1998 Test methods for electric cables, cords and conduits – Fire tests - Determination of the amount of halogen acid gas evolved during the combustion of polymeric materials taken from cables.

- AS 1939: 1990 Degree of protection provided by enclosures for electrical equipment (IP Code).
- AS/NZS 2053.1:2001 Conduits and fittings for electrical installations Part 1: General requirements
- AS/NZS 4296:1995 Cable trunking systems.
- AS/NZS 3000:2000 Electrical installations (known as Australian/New Zealand Wiring Rules).
- Applicable Australian Standard for tunnel fire safety
- SAA HB 29:2000 Communications Cabling Manual, Module 2: Communications Cabling Handbook.
- PCP 03 Cable Route Selection Guide.
- PDS 08 Low Voltage Installations Earthing.
- SCP 21 Construction of Cable Route and Associated Civil Works.
- C(b)2 – 1989 ESAA Guidelines for the Installation of Cables Underground.

3 Definitions

3.1 Cable Installation System

A cable tray, cable ladder, duct or conduit and includes fasteners brackets and supporting structure(s) erected specifically for the cable installation system. Any cable restraints used to attach the cable to a cable ladder or similar shall be considered to be part of the cable installation system.

3.2 Stray Traction Electrolysis Currents

In a DC electrified rail system, it is possible for some traction return current to “leak” from the rails and flow in an electrically parallel return path to the substation. This path may be along any continuous metallic item running geographically parallel to, or repeatedly crossing the rail corridor. This path may be along underground pipes, cable sheaths or along above ground paths such as metallic signal troughing and ‘continuous’ fences. Where the current leaves this

alternate metallic circuit to return to earth, the metal is lost through the electro-chemical process called electrolysis.

3.3 Touch Voltage

The voltage which may appear between any point of contact with un-insulated metalwork located within 2400 mm of the ground and any point on the surface of the ground within a horizontal distance of one metre from the vertical projection of the point of contact with the un-insulated metalwork.

3.4 Transferred Potentials

When an electrical fault to earth occurs the earth potential near the fault is different to the potential at a remote earth. The presence of a long conductive structure such as a metallic fence, metallic cable troughing, or the like near a fault can transfer the 'remote' earth potential into the local area near the fault. Should a person then be able to bridge between these two potentials, the person may experience an electric shock. Similarly an electrical fault near a long conductive structure may transfer a local fault potential to a remote location, and a person remote to the actual fault may experience an electric shock.

4 General

4.1 Strength

The cable installation system shall have adequate strength to:

- support the static weight of the cable,
- resist the handling forces that might reasonably be expected during installation or repair of the cable,
- resist the forces that may result from thermal expansion of the cable and/or cable installation system, and
- resist the electromagnetic forces that may result during an electrical fault.

In some cases additional strength may be required due to local conditions; in particular see 5.1, 5.2 and AS/NZS 4296.

4.2 Cable Support Points

If the cable installation system does not support the cable continuously, the spacing between support points shall be such that the cable does not sag more than the cable manufacturer's recommendation. The cable support points shall be smooth, rounded and of sufficient width so as not to subject the cable to damaging mechanical surface stress.

4.3 Joins and Couplings

The cable installation system shall include appropriate means of joining lengths or modules together in a manner that does not compromise the continuity of support or protection requirements. If the cable installation system is intended for multiple cables, any "Y" or "T" couplings needed shall also meet this requirement.

4.4 Radius of Bends

The cable installation system shall be able to accommodate the minimum bending radius prescribed by the cable supplier without the continuity of support or protection being compromised. Where the cable installation system is of a form that requires the cable to be drawn through a duct or conduit, the bend radius that the cables are subjected to shall not be less than the minimum bending radius as specified by the cable manufacturer.

4.5 Cable Rating

Cable Installation System characteristics, such as shading, ventilation and heat dissipation, shall be assessed to ensure that the required cable capacity is achieved. The choice of cable size and cable installation system cannot be decided independently and shall be determined in combination.

4.6 Temperature Range

The cable installation system shall maintain all aspects of its integrity whilst subject to frequent temperature cycles between the minimum expected ambient temperature and the greater of the maximum operating temperature of the cable and the maximum temperature of the cable or cable support system due to solar radiation. The minimum ambient temperature shall normally be taken to be -5^{o}C.

4.7 Corrosion Resistance

The cable installation system shall have adequate corrosion resistance to ensure that the design life of the installation is achieved without significant loss of strength or the appearance of hazards such as sharp edges.

In assessing the corrosion protection the following factors shall be taken into account:

- moisture
- electrolysis currents
- dissimilar metals in contact
- contaminants, both natural, eg salt, and man made pollutants.

If components are galvanised to provide corrosion resistance, they shall be hot dip galvanised in accordance with AS/NZS 4680 and AS 1397. (Threaded fasteners shall be galvanised in accordance with AS 1214).

4.7.1 Rail Tunnels

Galvanised steel components may be used in dry Rail Tunnels.

In tunnels where sections of the cable installation system is exposed to water seepage marine grade aluminium shall be used. Stainless steel (grade 316) fasteners shall be used in conjunction with the marine grade aluminium components.

The installation system shall comply the applicable Australian Standard for tunnel fire safety.

4.8 Vibration Resistance

The cable installation system, including supporting structure(s), foundations and fasteners shall have adequate long term resistance to vibration from rail traffic and other sources.

4.9 Electrical Discontinuities

In order to avoid problems with transferred earth potentials and electrolysis currents, metallic cable installation systems shall include provision for electrical discontinuities along the length of the cable installation system.

Electrical discontinuities shall be achieved by the provision of an air gap of not less than 30 mm or by the use of a non-conductive insert.

Where lids are provided, positive measures shall be taken to prevent the lids being replaced in a manner which short-circuits the electrical discontinuities.

The maximum distance between discontinuities shall not exceed 300m. The distance between discontinuities shall be reduced if the cable installation system is erected where a touch voltage

hazard may exist in relation to an overhead wiring structure or similar. These requirements are specified in PCP 03 “Cable Route Selection Guide” and SCP 21 “Construction of Cable Route and Associated Civil Works”.

If the cable installation system is in close proximity to an overhead wiring structure, the discontinuities shall be located to prevent hazards due to touch potentials. See

PDS 08 Low Voltage Installations Earthing and SCP 21 Construction of Cable Routes and Associated Civil Works.

4.10 Cutting and Snagging Hazards

When assembled, the cable installation system shall be free from sharp edges, burrs, flashes and the like that may cause injury to persons installing or replacing the cable, injury to persons under any circumstances.

4.11 Cable Joints

The cable installation system shall support and accommodate standard cable joints. The system shall also permit cable jointing operations without compromising the integrity of the cable installation system, the completed joint, the adjacent cable or the safety of the cable jointing personnel.

5 Protection from Specific Hazards

Protection from the following hazards may be required in some circumstances. Where protection from a listed hazard is required, the cable installation system shall comply with the additional requirements listed under that hazard.

5.1 Work in the Vicinity of the Cable Route

Where the cable route is near the track, or in another location where maintenance personnel and equipment are likely to be in the vicinity of the cable, the cable installation system shall provide protection for the cable from, and shall itself withstand, impacts that can reasonably be expected to result from such work. This protection shall include loads that may arise from persons standing or sitting on the cable support system, or placing material on or against it.

Where the cable installation system is installed more than 2000 mm above ground this hazard can normally be disregarded.

5.2 Falling Rocks, etc

Where the cable route is at the bottom of a cutting or embankment, the cable installation system shall be designed and positioned to minimise the risk exposure of the cable and the cable installation system from falling rocks and articles that may be illegally dumped such as motor vehicle tyres.

The cable installation system shall have a heavy impact resistance in accordance with AS/NZS 4296.

5.3 Wind Load

Where the cable route is exposed to strong winds or is near the track and subject to train induced wind, any removable lid required must be positively secured. “Snap on” lids are not acceptable in these situations.

5.4 Fire

If the cable installation system is required to protect the cable against external fire, the cable installation system shall protect the cable from convected and radiated heat, and from burning particles that may fall, or be blown, onto the installation system.

The cable installation system shall be designed to minimise the build-up of litter around the cable or cable installation system and to facilitate the easy removal of any accumulated litter or other fuel.

Where the cable installation system is in a rail or pedestrian tunnel, it shall comply with the requirements of the applicable Australian Standard for tunnel fire safety.

5.5 Vermin

If required to protect the cable from rats the cable installation system shall provide continuous enclosure of metallic or other suitably resistant material with a a rating of IP3X as specified in AS 1939.

5.6 Moving Vehicles

If protection from de-railed trains is required the cable route shall be altered in accordance with PCP 03 “Cable Route Selection Guide”.

If protection from motor vehicles and plant is required the preferred option is alteration of the cable route in accordance with PCP 03 “Cable Route Selection Guide”. If an alternative route is not feasible vehicle barriers independent of the cable installation system shall be provided.

In circumstances where it is necessary for vehicular traffic to cross a ground line troughing route, load carrying plates shall be provided over the troughing route.

Such load carrying plates shall be supported clear of, and independent of, the troughing. Alternatively, an underground system may be used.

5.7 Water / Moisture

If required to protect the cable from water or moisture the cable installation system shall be classified and tested as a system for its level of protection against the ingress of water in accordance with AS 1939.

5.8 Ultra-Violet (Solar) Radiation

If to be installed outdoors the cable installation system shall be sufficiently resistant to ultra violet solar radiation to ensure that the design life of the installation is achieved.

If required to protect the cable from ultra-violet solar radiation the cable installation system shall provide the required level of protection over the full range of angles of incidence present at the location.

5.9 Vandalism

Any cable installation system that is not in a secured area must be considered to be subject to vandalism. The degree of risk should be assessed on a case by case basis and protective measures taken accordingly.

Any cable installation system that is not in a secured area must be tamper proof without the use of tools ie no snap on lids, etc.

Resistance to graffiti may be appropriate in some circumstances in which case a graffiti removal system/plan must be available for the particular cable installation system prior to its selection being confirmed.

6 Optional Features

6.1 Restraint of cables

Positive restraint of the cables may be required to ensure segregation of cables, for uniformity, to ensure adequate cooling or to maintain constant circuit impedance where three individual cables are used for a three phase circuit.

If positive restraint of the cable is required (as opposed to reliance on gravity), the cable restraints used shall be spaced such that the cable does not deflect more than the cable manufacturer's recommendation between restraints as a result of gravitational, electromagnetic or other forces that the cable may be subjected to.

Note that where cables are not resting on a continuous surface it shall be supported by a suitable means as required by AS/NZS 3000 (section 3..9.3)at intervals recommended by the cable manufacturer.

6.2 Identification of cables installed

If the cable installation system fully encloses the cables, the cable installation system shall provide a suitable means of cable identification labelling. If the cable installation system does not fully enclose the cables the cable identification labelling may be direct on the cables.

The means of cable identification labelling shall not compromise any other characteristics of the cable installation system and shall facilitate labelling at intervals of not more than 20m. The labelling shall include the words "Danger - High voltage".

6.3 Earthing

If the design, or the ARTC Earthing/Bonding/Electrolysis standards requires earthing of the cable support system, provision shall be made for earthing each component except where an assembly is classified as having electrical continuity, in which case provision shall be made for earthing each such assembly.

An assembly classified as having electrical continuity for the purpose of earthing shall pass a test similar to that prescribed by AS/NZS 2053.1:1995 Appendix F.

6.4 Combustion Products

If required not to emit toxic combustion products, the cable support system shall be classified as halogen free. When tested in accordance with AS 1660.5.3, halogen free fittings and materials shall evolve not more than the equivalent of 5 mg of hydrochloride-acid per gram of sample.

Trunking or conduit systems in railway tunnels are to be low smoke, low toxicity and halogen free.

6.5 Aesthetics

If the cable installation system is to be erected in station environs or in other places open to public view aesthetics must be considered. The cable installation system should be un-obtrusive. The need to match surface finish with other items should be checked.

6.6 Segregation in "Joint Use" Situations

If the cable installation system is also to accommodate other cables of different systems the segregation requirements of each system must be met. In particular SAA HB 29 must be met for all communications cables. Other issues to be considered are electromagnetic coupling, under 'fault' and 'normal' conditions, cumulative thermal effects, and segregation of earthing systems.