Technical Standard – TS117

Design and Construction near Railway and Tram Lines

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Empowering South Australia

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1. Introduction

This document sets out the requirements for the design and construction of overhead and underground powerlines crossing railway and tram tracks, as well as poles and conductors located in the vicinity of these rail corridors.

Works adjacent to or over railway/tram infrastructure are subject to additional requirements beyond those for standard overhead or underground installations and shall comply with the requirements of the relevant railway operator.

The requirements set out in this document are intended to ensure that design and construction in proximity to railway and tram lines minimises the risks associated with working near these lines and complies with the Rail Safety National Law Act 2012.

This standard should be used in conjunction with all other relevant SA Power Networks standards including, but not limited to, TS107, TS085, and TS100.

2. Definitions and Abbreviations

2.1 Definitions

Balloon loop	A portion of line that allows rail traffic to change direction of travel without change to the leading end.
Low Voltage	Voltage exceeding 50 Vac or 120 Vdc ripple free and not exceeding 1000 Vac or 1500 Vdc.
Main Line	The running line normally used for running rail traffic through and between locations.
Pantograph	An apparatus fixed to the roof of electric traction vehicles to draw current from the overhead supply.
Rail Corridor	Everywhere within 15 metres of the outermost rail, or • within the boundary fence if it is located closer than 15 metres from the outermost rail, or • within the property boundary if it is less than 15 metres from the outermost rail, or • up to any permanent structure (such as a fence, wall, or level crossing) that separates the operational rail corridor from leased or non-operational land.
Siding	A portion of track where vehicles can be placed clear of the running lines.
Sighting distance	The distance someone can clearly see along a track.
Yard	A system of track within defined limits.

2.2 Abbreviations

AB	Aurizon Bulk
AMPRN	Adelaide Metropolitan Passenger Rail Network
APRN	Adelaide Passenger Rail Network (refer to AMPRN)
ARTC	Australian Rail Track Corp
DIT	Department for Infrastructure and Transport
EWP	Elevated Work Platform
GWA	Genesee and Wyoming
HV	High Voltage
LV	Low Voltage
PRRPS	Pichi Richi R.P.S
RFAM	Rail First Asset Management
SHR	SteamRanger Heritage Railway
TS	The SA Power Networks Technical Standard

2.3 Terminology

Shall or Must	Indicates a mandatory requirement.
May or Should	Indicates a recommendation that will not be mandatory but can be imposed as deemed appropriate by SA Power Networks.

3. Relevant Rules, Regulations, Standards and Codes

3.1 Standards and Codes

The following listed documents are for additional information and other documentation may be required on a project specific basis.

Please Note: It is the responsibility of the customer/customer's agent to ensure you have complied with all applicable, SA Legislative Regulations (under Acts), ESCOSA/ENA/AEMC/IEC documentations, relevant AS/NZS standards, the SA Power Networks publications, and you have ensured their current publications, before implementing them.

Australian Standards publications

AS 1074	1989	Steel tubes and tubulars for ordinary service
AS 2067	2016	Substations and high voltage installations exceeding 1kV a.c.
AS 2832.1	2015	Cathodic protection of metals – Part 1: Pipes and cables
AS 4799	2000	Installation of underground utility services and pipelines within railway boundaries
AS 5577	2013	Electricity network safety management systems
AS/NZS 3000	2018	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 7000	2016	Overhead Line Design

Railway publications

RLS-PR-044	2024	ARTC Emergency Management
RLS-PR-003	2025	ARTC Protocol for Entering the ARTC Rail Corridor
EEG-001-01	2021	Requirements for Electric Aerials Crossing ARTC Infrastructure
TP1-DOC-000390	2023	Overhead Wiring System Requirements for the 25kV Electrified Train Network (DIT and Keolis Downer)
TP1-DOC-00389	2023	Electrical and Mechanical Clearances for the 25kV Electrified Train Network (DIT and Keolis Downer)
TC4-DOC-000357	2013	Non-Rail Service Installations Within the Rail Corridor (DIT and Keolis Downer)

The SA Power Networks publications

Technical Standards	
TS085	Trenching and Installation of Underground Conduits and Cables (up to and including 33kV)
TS100	Electrical Design Standard for Underground Distribution Networks (up to and including 33kV)
TS102	Easement Standard for Distribution Networks (up to and including 33kV)
TS107	Overhead Line Design Standard for Sub-Transmission and Distribution Systems
TS109	Earthing of the Distribution Network
TS110	Electrical Design, Civil/Electrical Works and Testing for 66kV Underground Sub-Transmission Networks

3.2 Legislation and Regulations

This section provides a list of the relevant legislation and regulations which shall apply to the design, manufacture, installation, testing and commissioning, and operations and maintenance of all plant and equipment for the distribution network.

In an event where there is any inconsistency between legislation and regulations and these technical requirements, the legislation and regulations shall prevail.

- Electricity Act 1996 and Electricity (General) Regulations 2012
- Rail Safety National Law Act 2012
- Environment Protection Act 1993 and Environment Protection Regulations 2023
- Planning, Development and Infrastructure Act 2016 and Planning, Development and Infrastructure (General) Regulations 2017
- Work Health & Safety Act 2012 and Work Health & Safety Regulations 2012
- National Electricity Rules

4. Railway track/corridor locations

When designing or constructing over or adjacent to rail corridors, as defined in Section 4.4, the relevant railway owner/operator must be consulted. Where the rail corridor is shared, the requirements of each respective owner/operator must be met.

Contact the SA Power Networks Easement Branch, which will liaise with the relevant rail owner/operator and obtain their specific requirements.

Ensure that the relevant approvals and access permits have been obtained well in advance of construction, as the approval process may take weeks.

4.1 Operational vs. non-operational lines

All railway tracks shall be treated as operational unless confirmed otherwise by the relevant rail controlling authority. Refer to Location SA Viewer for the location of all operational/non-operational railway lines. These maps contain information on the line status and track ownership.

Note: A non-operational status in Location SA Viewer must be confirmed by the track owner.

4.2 Additional maps

Refer to the following pages for additional mapping:

- SA Track and Signal
- ARTC Rail Network Map

4.3 Railway owners/operators

Table 1 summarises the main railway owner/operators that may be consulted during the design and construction processes.

Table 1 Rail owner/operator

Railway owner/operator	Comments
Aurizon Bulk (AB)	Located in regional locations including the 2,200-kilometre Tarcoola-to-Darwin railway line and lines around Whyalla and Thevenard. Bought out OneRail, formerly 'Genesee and Wyoming' (GWA), in 2021.
Australian Rail Track Corp (ARTC)	Most South Australian railway tracks are managed by ARTC which is owned by the Commonwealth Government.
Department of Infrastructure and Transport (DIT)	DIT owns the Adelaide Metropolitan Passenger Rail Network (AMPRN) on behalf of the South Australian Government. The AMPRN network comprises of train lines with 25kV overhead wires, and tram lines powered by 600V DC (overhead or direct buried). These networks are maintained by Keolis Downer Adelaide and Torrens Connect. DIT is listed as the owner for many other non-operational lines.
Pichi Richi R.P.S (PRRPS)	Tourist rail from Port Augusta to Quorn.
SteamRanger Heritage Railway (SHR)	Tourist railway from Mt Barker to Victor Harbour operated by the SA division of Australian Railway Historical Society.

4.4 Situations requiring consideration near railways

SA Power Networks prefers that new designs are located to avoid any interference with the railway network when possible, eliminating the need to engage with the rail owner or operator.

4.4.1 Overhead

The overhead network is considered to be in proximity to the rail network in the following scenarios:

- Where construction occurs adjacent to railways and, if a pole or elevated work platform (EWP) were to fall, any part of it could encroach into the rail corridor.
- Where aerial crossings of railways are proposed.

4.4.2 Underground

The underground network must meet the requirements outlined in this document when located on land that is owned/operated by a railway owner/operator. This will include lines running adjacent to or crossing railways.

4.5 Risk Assessment

When constructing in proximity to railway lines, a risk assessment shall be undertaken and additional factors considered, including rail and/or tram safety, environmental requirements, and any applicable mandatory procedures.

5. Overhead Lines

Higher safety factors apply for overhead designs near railways. This is to increase the longevity of the line and minimise maintenance requirements. This in turn minimises the disruptions to the rail network. For this reason, a security level of II, as defined in AS/NZS 7000 shall be applied to overhead lines that are in proximity to the rail network as defined in Section 4.4.

5.1 Aerial Crossings

The following requirements apply to all aerial lines crossing electrified/non-electrified train lines:

5.1.1 Poles

The following requirements apply to poles used in aerial crossings:

1. Pole locations shall be selected, in consultation with the rail owner/operator, to ensure that the required sighting distances for both approaching trains and road users are maintained.
2. For new designs or modifications to existing overhead crossings, poles supporting the crossing span, where land tenure permits, shall be located outside the rail corridor.
3. Poles supporting crossing spans shall be brace constructions capable of withstanding full line tension in the event of all conductors breaking. Crossarms shall be fitted to the side of the pole which is not facing the rail tracks.
4. Crossing span tensions shall be less than the adjoining span tensions.

5.1.2 Conductors

The following requirements apply to conductors used in aerial crossings:

1. Conductors used for aerial crossing spans shall be ACSR, AAC, AAAC, or ABC types, comprising a minimum of seven strands and having a cross-sectional area of not less than 16 mm^2. In high corrosion areas, use of ACSR should be avoided unless greased.
2. The angle of crossing between the aerial conductors and the railway tracks shall be between 90 and 45 degrees.
3. No electrical connections (such as joints or splices) shall be made to any conductor on any span over the rail corridor.
4. All ferrous metal fittings shall be galvanized, or be stainless steel, to the relevant Australian Standard.

5.2 Crossing clearances

The clearance between overhead lines and railways is dependent on:

- The rail operator
- If the line is electrified/non-electrified
- The voltage of the overhead line

In the event that the clearances of the rail owner/operator are greater than the clearances specified in this document, the higher of the two clearances shall prevail.

Note:

1. Existing electrical clearances shall not be reduced during re-design of any overhead crossing.
2. Refer to E1204 for alternative crossarm options to achieve increased clearances if necessary.

5.2.1 Horizontal Clearances (Poles)

Poles supporting aerial crossings shall be located at a distance equal to the pole height plus 2 m from the outside rail of the nearest railway track as shown in Figure 1. Where this is not practicable, poles may be placed with the approval of the rail owner/operator.

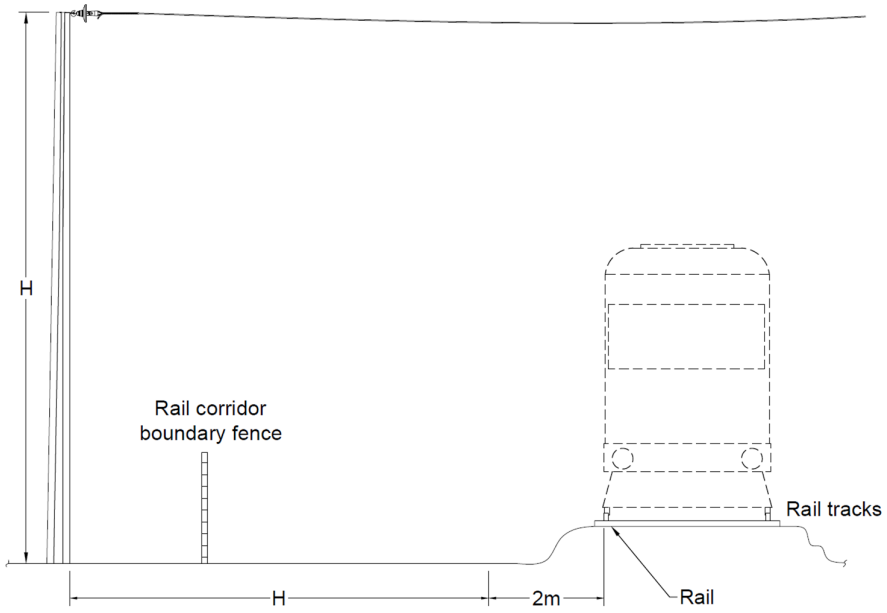

Figure 1 Horizontal pole clearance

5.2.2 Vertical clearances (Conductors)

5.2.2.1 Non-electrified tracks

The clearance between overhead lines and non-electrified railway tracks is the distance between the overhead conductor under worst sag conditions as defined in TS107, and the rail tracks as shown in Figure 2. The aerial crossing clearances are given in Table 2.

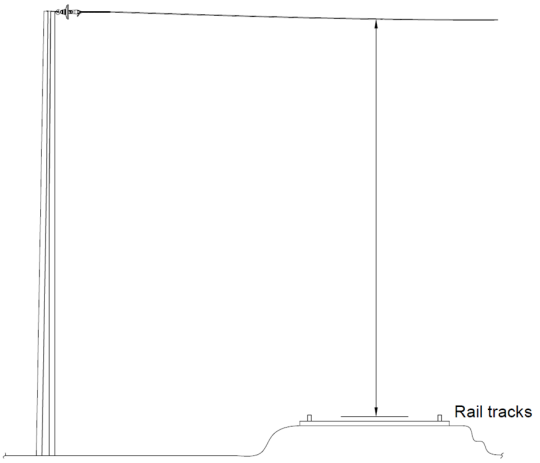

Figure 2 Clearance above non-electrified mainline track

Table 2 Non-electrified tracks - clearances above rail tracks

Voltage (U) of overhead powerline	Minimum height above rail tracks (m)	
	Mainline track	Yard, sidings, and balloon loops
0 < U ≤ 1000V	9	9.45
1000V < U ≤ 33kV		10.45
33kV < U ≤ 132kV	10	11.25

5.2.2.2 Electrified tracks

For electrified tracks, there are minimum separation requirements between the overhead powerlines and the overhead traction wires (25kV or 600V_{DC}) which are given in

Table 3. The separation between the overhead lines is measured between the following points:

- The overhead powerline under worst sag conditions, as outlined in TS107.
- The highest point of the overhead traction wire. This may be whichever is higher of the height of the pantograph, or the height of the supporting structure as shown in Figure 3.

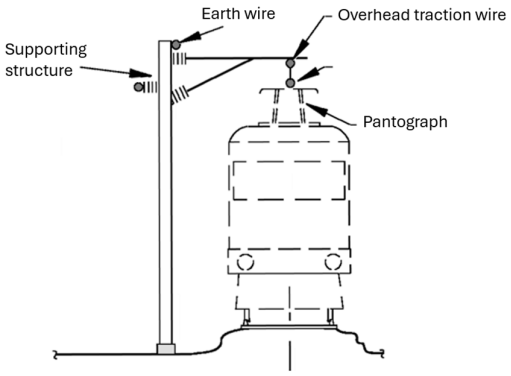

Figure 3 Train on electrified tracks

Table 3 Electrified tracks - clearances above overhead wires

Voltage (U) of overhead power line	Clearance from overhead power line to overhead traction lines (m)
2000V < U ≤ 33kV	3.7
33kV < U ≤ 132kV	4.6

5.3 Adelaide Metro (25kV electrified and tram lines)

All tram line crossings shall be undergrounded unless approved by DIT. Aerial power line crossings (<66kV) over Electrified 25kV lines belonging to Adelaide Metro shall also be undergrounded unless approved by DIT.

5.4 Third-party telecommunication carrier owners

Third-party telecommunication carrier owners shall consult DIT in relation to the separation requirements with $25kV_{AC}$ railway or $600V_{DC}$ tram lines network.

5.5 Construction requirements for overhead lines

Requirements for constructing overhead lines in the vicinity of a railway include the following:

1. Prior to any excavation within the vicinity of the rail corridor, an underground services search shall be carried out to identify any ARTC or other underground services.
2. No excavation shall be done within 5m of rail infrastructure without analysis of structural stability on rail infrastructure by a civil engineer.
3. No excavated soil is to come into contact with the rail ballast.

6. Underground lines

Underground designs shall comply with the requirements of the rail/tram authority where specified. However, if this is not specified, these designs shall comply with AS 4799. For general requirements of conduit installation refer to TS085 and TS100. Refer to TS110 for additional requirements for 66kV underground lines.

6.1 General requirements

The following are the general requirements for designing underground conduits and cable systems within rail and/or tram corridors:

1. The electrical infrastructure design shall comply with the requirements of AS 4799 and AS/NZS 3000.
2. Where multiple HV feeder circuits cross under the railway and/or tram network, a separate bore hole for each circuit is required.
3. Where applicable, provide results of the geo-technical survey and testing performed including assessment of the types and quantum of contaminants as well as recommendations regarding the need or otherwise of an encasing pipe within the rail corridor to resist subsidence.
4. Submit necessary information to the relevant SA Power Networks Project Manager. This shall include the relevant section of 'Digital Cadastral Data Base' (DCDB) with street names, rail/tram lines information, any crossing point etc, clearly marked on the preliminary design drawing for the assessment.

6.2 Cables and conduits

1. Cable sizing shall be determined in accordance with the cable rating factors specified in TS100.
2. The requirements for electrical and telecommunications conduits, including spare conduits, are specified in TS085.
3. Underground crossings shall cross at 90±5° to the tracks and shall not have bends within the rail corridor.
4. Cable joints/splices are not permitted for the entire cable length of the railway and/or tram corridor's reserve crossing.
5. Where specified by the authorities, the cables shall be enclosed or covered by polymeric cable protection cover.
6. Where power cables cross under tracks, they shall be enclosed in a 'Category A' system in accordance with AS/NZS 3000. Refer to Section 6.3 for the requirements of encasing pipes.

6.2.1 Telecommunication conduit installation requirements

The following requirements shall be considered for the installation of telecommunication conduits crossing under railway networks:

1. Pits shall be P8 size (Stock item RA 5461).
2. Outer bore pipe is to enter pit body using a bell-mouth spigot diameter Ø63 mm.
3. Pole side of pit is to have bell-mouth installed in preparation for the SA Power Networks installers to extend conduit to pole.
4. Pits to be installed nominally 3 m from the edge of pole.

6.3 Encasing pipes

The following requirements apply to encasing pipes for underground cable crossings.

1. The encasing pipes shall be designed to withstand the construction loading, railway loading specified by the rail operator, ground loads, and any other relevant loads.
2. Where metallic casing is used, it shall be protected against electrolysis, corrosion, and induced currents in accordance with AS 2832.1 and statutory requirements. The steel bore casings shall be electrically isolated from any type of cable pits.
3. Where steel pipes containing SA Power Networks' underground cables (e.g. 3xsingle core, distribution feeder cables or communication etc) are attached to the railway line's and/or tram line's bridge crossing structure and are bonded to the electrified rail and/or tram network, then all single core cables for a given circuit shall be contained within the same (single) steel pipe. (Do not install 3 single core cables within 3 steel pipes as current will be induced within the pipe).
4. Where medium or heavy seamless stainless-steel tubing is required, the designer shall ensure that it complies with AS 1074 and the relevant SA Power Networks Project Manager is notified.

6.4 Underground separations

The minimum vertical and horizontal separations for underground crossings and cables within the rail corridor are specified in AS 4799.

6.4.1 Underground crossings

The following sections specify the horizontal and vertical clearances between railways and underground cables.

6.4.1.1 Horizontal separations

Pits shall also be located outside the rail corridor and shall not be located within 6 m of the toe of embankment or top of cuttings, or within 10 m of the nearest rail.

To maintain sufficient clearance from railway facilities, pits shall be laid at least 3 m clear of: railway structures, cattle pits and stops, drains, signalling equipment, overhead masts, poles, underground cables, buildings, points and crossings, bridges and culverts.

The encasing pipe depth shall be maintained for a minimum of 3 m beyond the outer rails, measured at right angles to the track.

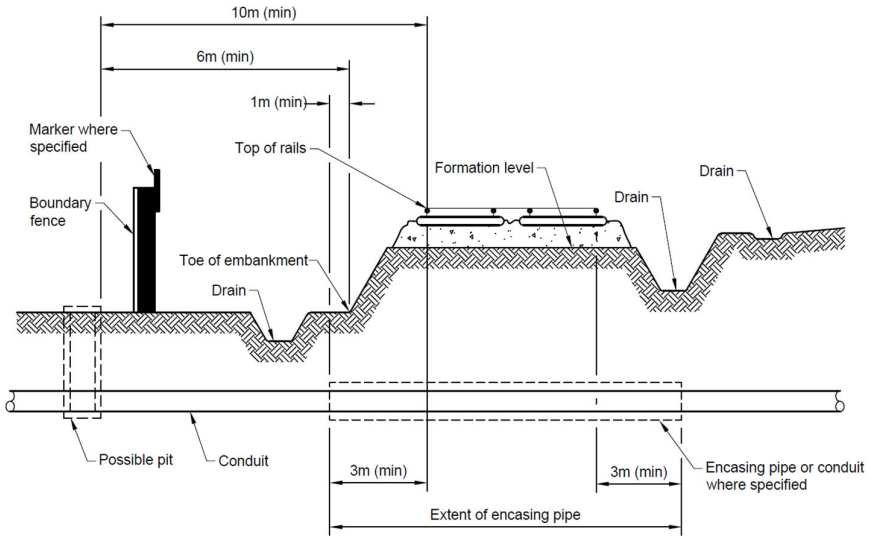

Figure 4 Horizontal separations for underground railway crossings

Pipeline routes, cable routes, carrier pipes and encasing pipes shall maintain a horizontal separation of at least 600 mm from other pipelines and from power and communication cables, unless agreed to otherwise in writing, by all relevant parties.

6.4.1.2 Vertical separations

The top of the encasing pipe or conduit shall be at a depth of not less than 2 m below the top of rail (Refer to Figure 5 and Table 4, for more details).

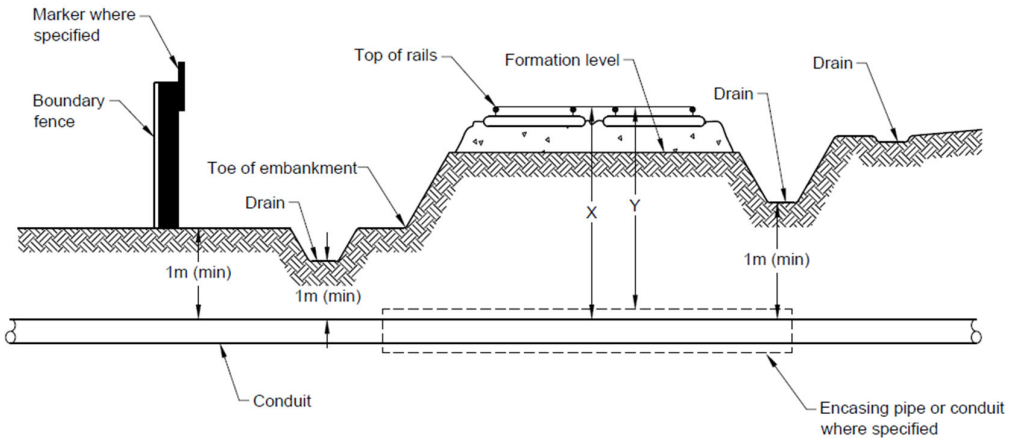

Figure 5 Vertical separations for underground railway crossings

Table 4: Minimum depth of railway/tramway tracks

Dimension (Refer to Figure 5)	Description	Minimum Depth (mm)
X	Depth between top of rail/tram and conduit	Between 1200/1500 (directly buried Optic Fibre Cables)
		2000 (Electrical Power Cables)
Y	Depth between top of the rail/tram tracks and encasing pipe	2000

6.4.2 Separations in rail/tram corridors

Elsewhere in the rail/tram corridor, where conduits run adjacent to railways lines, conduits and pits shall not be located within 6 m of the toe of embankment or top of cuttings, or within 10 m of the nearest rail.

To maintain sufficient clearance from railway facilities, all conduits and pits shall be laid at least 3 m clear of: railway structures, cattle pits and stops, drains, signalling equipment, overhead masts, poles, underground cables, buildings, points and crossings, bridges and culverts.

Conduits shall be laid at a depth of not less than 1 m below ground level.

Figure 6 shows the horizontal and vertical separations for conduits/cables in rail corridors.

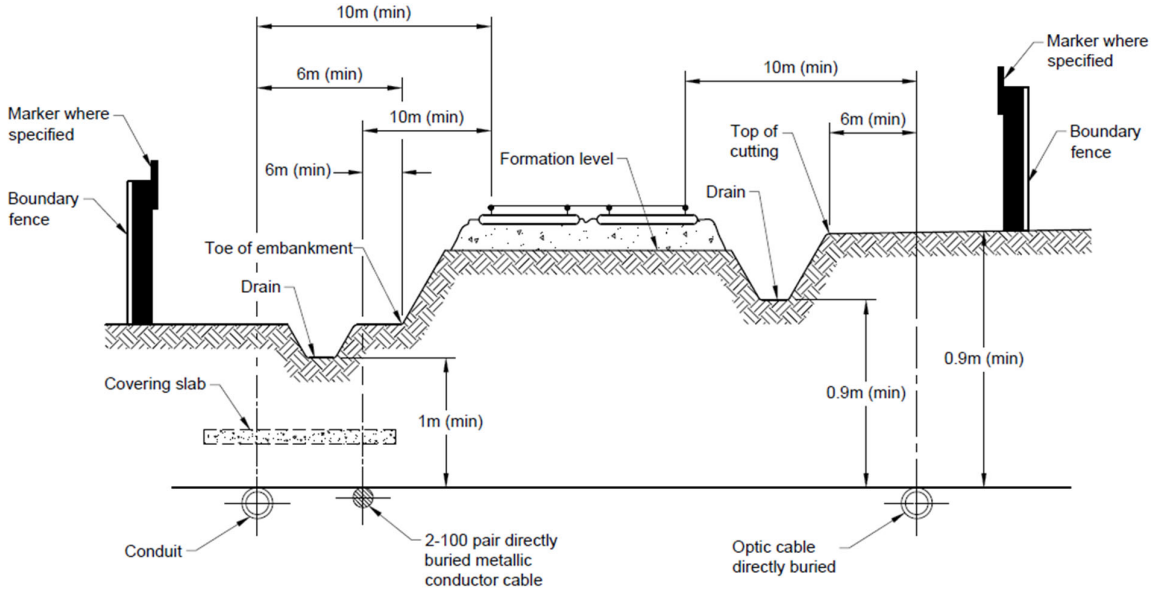

Figure 6 Separations for underground cables within the rail corridor

6.5 Markers

Markers, as shown in Figure 4, Figure 5, and Figure 6, shall be provided at the following locations to indicate the presence of underground cables in accordance with AS 4799:

- When crossing the property boundary of the railway owner.
- At any change of direction.
- At points of potential hazard.
- Where specified, at each end of the underground rail crossing (defined as 3 m from the outer rail or toe of embankment.
- Every 200 m, or when out of line of sight. Spacing between markers may be increased to 400 m in open country.

Tracer wires are to be installed with optical wires. Additional marker requirements for underground cables are provided in TS085.

6.6 Construction requirements for underground lines

1. Prior to any excavation within the vicinity of the rail corridor, an underground services search shall be carried out to identify any rail or other underground services.
2. No excavation shall be done within 5m of rail infrastructure without analysis of structural stability on rail infrastructure by a civil engineer.
3. No excavated soil is to come into contact with the rail ballast.
4. When boring, the diameter of the bored hole shall exceed the diameter of the conduit by more than 50 mm.
5. The trench width shall be only as wide as necessary to permit installation and compaction. As a minimum, the trench width shall be the pipe diameter plus 150 mm on each side.

7. Earthing requirements

Refer to TS109 for earthing requirements near railways.

8. Who Should You Talk To?

Project support for designers should be supplied by provider of the design scope. Support for this design standard is available through the Technical Standards Team.

8.1 Deviation from this Standard

Deviation from any specific requirement(s) of this standard will only be permitted with the written approval of SA Power Network Technical Standards Manager.