T HR EL 10006 ST

Standard

HV Aerial Line Maintenance Standard

Version 1.0

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Important message

Standard governance

Owner: Lead Electrical Engineer, Asset Standards Authority

Authoriser: Chief Engineer, Asset Standards Authority

Approver: Executive Director, Asset Standards Authority on behalf of the ASA Configuration Control Board

Document history

Version	Summary of changes
1.0	First issue

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Preface

The Asset Standards Authority (ASA) is a key strategic branch of Transport for NSW (TfNSW). As the network design and standards authority for NSW Transport Assets, as specified in the *ASA Charter*, the ASA identifies, selects, develops, publishes, maintains and controls a suite of requirements documents on behalf of TfNSW, the asset owner.

The ASA deploys TfNSW requirements for asset and safety assurance by creating and managing TfNSW's governance models, documents and processes. To achieve this, the ASA focuses on four primary tasks:

- publishing and managing TfNSW's process and requirements documents including TfNSW plans, standards, manuals and guides
- deploying TfNSW's Authorised Engineering Organisation (AEO) framework
- continuously improving TfNSW's Asset Management Framework
- collaborating with the Transport cluster and industry through open engagement

The AEO framework authorises engineering organisations to supply and provide asset related products and services to TfNSW. It works to assure the safety, quality and fitness for purpose of those products and services over the asset's whole-of-life. AEOs are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

Compliance with ASA requirements by itself is not sufficient to ensure satisfactory outcomes for NSW Transport Assets. The ASA expects that professional judgement be used by competent personnel when using ASA requirements to produce those outcomes.

About this document

This standard supersedes the RailCorp documents EP 10 01 00 02 SP *Aerial Line Maintenance Standards*, version 2.2 and EP 10 01 00 03 SP *Aerial Line Base Safety and Operating Standards*, version 3.2.

This standard specifies the minimum maintenance requirements for HV aerial lines.

The changes to previous content include the following:

- updates to reflect organisation changes and resulting changes in responsibilities
- amalgamation of the above two standards
- minor amendments and clarification to content
- conversion of the standard to ASA numbering, format and style

This standard is a first issue.

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1. Introduction

Power supply to traction and other substations, railway stations, signalling systems, and other elements of the TfNSW heavy rail network is primarily provided by the RailCorp distribution system. The RailCorp distribution system consists of both high voltage (HV) cables and aerial lines with nominal voltages that vary between 11 kV and 132 kV. A small number of feeders with a nominal voltage of 2 kV are still present in the existing network; however these feeders are gradually being phased out.

2. Purpose

This standard specifies the minimum maintenance requirements for RailCorp's HV aerial lines.

2.1. Scope

The scope of this standard is to set out the following:

- the maintenance policies and parameters for HV aerial lines
- the conditions that trigger corrective maintenance actions but do not require urgent repair work
- the base safety or operating limits, which are the threshold conditions at or below which the urgent or emergency repair work is carried out

Steel poles and their foundations are maintained by the civil discipline. However, this standard requires the maintainers of the HV aerial lines to report any obvious visual defects to the maintainers of the civil assets.

This standard does not include the requirements for preventative maintenance of HV aerial lines; this is covered in the technical maintenance plan (TMP) of the Authorised Engineering Organisation (AEO) maintaining the asset.

2.2. Application

This standard applies to RailCorp's HV aerial lines.

This standard is intended to be used by competent personnel engaged in the provision of services relating to rail infrastructure. In addition to the requirements of this standard, the asset decisions should take into account the life cycle cost considerations specified in T MU AM 01001 ST *Life Cycle Costing*.

If, when using this standard, it is considered that the intent of stated requirements is not clear, a clarification should be sought from the Lead Electrical Engineer, ASA.

3. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Transport for NSW standards

EP 10 00 00 04 SP Transmission Line Easement Conditions

T HR CI 12190 ST Service Installations within the Rail Corridor

T HR EL 00004 ST Buildings and Structures under Overhead Lines

T HR EL 10001 ST HV Aerial Line Standards for Design and Construction

T HR EL 10003 ST Wood Pole Serviceability

T HR EL 10005 ST Requirements for Electric Aerials Crossing RailCorp Infrastructure

T MU AM 01001 ST Life Cycle Costing

Legislation

Electricity Supply (Safety and Network Management) Regulation 2014

Other reference documents

Energy Networks Australia, 2009, ENA Guidelines for safe vegetation management works near overhead lines, ENA DOC 023

NSW Resources and Energy, 2016, Guide for the Management of Vegetation in the Vicinity of Electricity Assets, ISSC 3

NSW Resources and Energy, 2012, Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure, ISSC 20

NSW Resources and Energy, 2013, Guideline for Pre-Climbing and Climbing Assessment of Poles, ISSC 29

Sydney Trains, 2017, Sydney Trains Electricity Distribution Network Bushfire Risk Management Plan, SP E 70956

4. Terms and definitions

The following terms and definitions apply in this document:

ABC aerial bundled cable

AEO Authorised Engineering Organisation

APVMA Australian Pesticides and Veterinary Medicines Authority

ASA Asset Standards Authority

HV high voltage; a voltage exceeding 1000 V ac or 1500 V dc

RailCorp the NSW Government's asset holding entity for the metropolitan heavy rail network assets. RailCorp infrastructure includes rail infrastructure associated with the metropolitan heavy rail network and excludes rail infrastructure that belong to the Sydney metro and light rail networks.

SFAIRP so far as is reasonably practicable

TfNSW Transport for NSW

TMP technical maintenance plan

5. Easements

HV aerial line easements shall be maintained and controlled to satisfy the requirements specified in the following documents:

- EP 10 00 00 04 SP *Transmission Line Easement Conditions*
- ISSC 20 *Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure*

6. Vegetation clearances

Vegetation near HV aerial lines shall be maintained and controlled to satisfy the requirements set out in the following:

- *Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)*
- ISSC 3 *Guide for the Management of Vegetation in the Vicinity of Electricity Assets*
- ENA DOC 023 - *ENA Guidelines for safe vegetation management works near overhead lines*

When undertaking the vegetation cutting activity to achieve the minimum clearances specified in ISSC 3, allowances shall be made for vegetation regrowth between inspection and maintenance cycles. An allowance of 0.5 m shall be added to the minimum vegetation clearances for bare conductors in bushfire prone areas.

Vegetation outside the minimum clearing requirement distances that has been identified as dead, dying or structurally unsound and with a risk of falling, dropping and contacting the HV aerial lines shall also be removed.

Vegetation obscuring the visibility of water crossing signs shall be maintained in accordance with the requirements set out in ISSC 3.

Refer to the figures in ISSC 3 for illustration of clearance envelopes.

For span lengths of existing infrastructure not covered in ISSC 3, the maintainer of RailCorp HV aerial line assets shall perform a risk assessment based on the specific site conditions to determine the appropriate vegetation clearances.

Where the minimum vegetation clearances specified in ISSC 3 have been infringed, the maintainer of the asset shall determine the appropriate mitigation measures and ensure that the risks to personnel safety and train operations are not compromised.

All vegetation control activities shall be undertaken in accordance with relevant environmental and safety management system requirements.

7. Bushfire risk management

Bushfire risks associated with HV aerial lines shall be managed in accordance with the requirements set out by the network operator for the RailCorp distribution system.

For Sydney Trains' bushfire risk management plan, refer to SP E 70956 *Sydney Trains Electricity Distribution Network Bushfire Risk Management Plan.*

8. Alteration of HV aerial lines

Refer to T HR EL 10001 ST *HV Aerial Line Standards for Design and Construction* for design and construction requirements for alteration of existing HV aerial lines.

9. Electric aerial crossings

Electric aerial crossings shall comply with the requirements of T HR EL 10005 ST *Requirements for Electric Aerials Crossing RailCorp Infrastructure*.

Where timber cross-arms on crossing structures are required to be renewed, they shall be replaced with galvanised steel cross-arms.

10. Buildings and structures under aerial lines

The configuration of HV aerial lines shall comply with the requirements of T HR EL 00004 ST *Buildings and Structures under Overhead Lines*.

11. Wood poles

The requirements for determining the serviceability and risk categories for wood poles and the required actions are set out in T HR EL 10003 ST *Wood Pole Serviceability*.

Wood poles shall be inspected above and below the ground for fungal and termite activities.

Treatment of termite-infested poles shall be done by suitably qualified technicians. Chemicals used to treat termite infestation shall be registered with the Australian Pesticides and Veterinary

Medicines Authority (APVMA) for such purpose. Termite-treated poles shall be marked in accordance with the requirements set out in ISSC 29 *Guideline for Pre-Climbing and Climbing Assessment of Poles*.

Products used for the prevention and treatment of pole rots shall be ASA type-approved.

When a pole is required to be decommissioned, the arrangement for the below ground section of the pole shall be determined in accordance with the risks associated with the site. The risks shall be determined in consultation with the civil maintainer of the site. For civil requirements within the rail corridor refer to T HR CI 12190 ST *Service Installations within the Rail Corridor.*

12. Change to road alignments

Where support structures are located in roadways, the risk of vehicular impact shall be assessed when a change in road alignment is proposed. Appropriate mitigation measures shall be implemented to control the identified risks.

The mitigation measures can include the following:

- relocation of the support structures
- installation of barriers
- adjusting the road alignment

13. Conductive paint on timber cross-arms

Where pin-type insulators are used, all wood and metal interface areas shall be painted with a conductive paint. The paint shall be applied to the timber and maintained for a distance of 100 mm minimum from all the following interface areas:

- insulator pin to cross-arm
- cross-arm to pole, including slot
- pole band to pole
- strut to cross-arm
- strut to pole

All sides of the cross-arm shall be painted in the specified areas.

14. HV aerial lines out of service

Where HV aerial lines have been taken out of service but have not yet been dismantled, an agreement in writing between the asset maintainer and the project manager shall be reached on the maintenance of the asset until disposal.

15. Incident investigation

Functional failures of critical items of HV aerial lines shall be thoroughly investigated by the maintainer to establish the root cause and contributing factors of the failure. The results of the investigation and the data of the failed asset shall be documented and recorded.

As a minimum, investigations shall be undertaken for functional failures of support structures, cross-arms and conductors.

15.1. Support structure

The report on the functional failure of a support structure shall include the following details as a minimum:

- structure identification number
- date of failure
- description of failure
- support structure material – timber or steel
- timber species, where applicable
- date of installation
- dates and results of last patrol, pole base and pole top examinations
- location of failure point with reference to the ground line
- climate condition at the time of failure
- root cause of failure
- other contributing factors
- actions to be implemented

15.2. Cross-arms

The report on the functional failure of a cross-arm shall include the following details as a minimum:

- structure identification number
- date of failure
- description of failure
- position of cross-arm and pole top arrangement number
- cross-arm material

- cross-arm timber species, where applicable
- date of installation
- dates and results of last patrol and pole top examination
- climatic condition at the time of failure
- root cause of failure
- other contributing factors
- actions to be implemented

15.3. Conductors

The report on the functional failure of a conductor shall include the following details as a minimum:

- feeder number
- location of failure with reference to structure identification numbers
- date of failure
- description of failure
- conductor type and construction
- date of installation
- dates and results of last patrol and pole top examination, where applicable
- climatic condition at the time of failure
- root cause of failure
- other contributing factors
- actions to be implemented

16. Corrective maintenance triggers

Common conditions that trigger corrective maintenance actions are listed in Section 16.1 to Section 16.9.

The time needed to complete corrective actions shall be determined by the maintainer of the asset and shall be based on the nature and extent of the defect. Care shall be exercised by the maintainer to ensure that the risks to personnel safety and train operations caused by the failure of the identified defect or defects are controlled so far as is reasonably practicable (SFAIRP) and that the base safety and operational limits (refer to Section 17) are not breached before the completion of corrective actions.

16.1. Corrective maintenance triggers for general items

The corrective maintenance triggers for general items associated with HV aerial lines is given in Table 1.

Table 1 - Corrective maintenance triggers – general items

Parameter	Corrective maintenance trigger
Small parts steelwork	Signs of excessive corrosion with more than 20% loss of section or deformation
Fasteners	Loose, missing or corroded fasteners that are not critical to the functioning of the fitting or assembly

16.2. Corrective maintenance triggers for access and easement

The corrective maintenance triggers for aerial line access and easement are given in Table 2.

Table 2 – Corrective maintenance triggers – access and easement

Parameter	Corrective maintenance trigger
Access road	Any obstruction which restricts access
Easement	Any obstruction which restricts access
Easement	Unauthorised controlled activities; refer to EP 10 00 00 04 SP and ISSC 20

16.3. Corrective maintenance triggers for support structures – wood poles

The corrective maintenance triggers for aerial line wood pole supports are given in Table 3.

Table 3 – Corrective maintenance triggers – wood pole supports

Parameter	Corrective maintenance trigger
Pole integrity	Signs of impact damage, cracks, burns, fire damage, rot or termite activity
Foundation	Eroded ground or excavation in immediate vicinity of pole foundation (report to maintainer of civil assets)
Foundation	Pole leaning in excess of 10 degrees
Pole cap	Corroded, loose or missing
Pole steps	Corroded, loose or missing
Earth wire cover board	Damaged or missing
Earth electrode	Broken, damaged or disconnected
Vegetation clearance	Refer to ISSC 3
Pole identification and markings	Missing, incorrect or obscured information

Parameter	Corrective maintenance trigger
Attachments	Unauthorised attachments to poles

16.4. Corrective maintenance triggers for support structures – steel poles

The corrective maintenance triggers for aerial line steel pole supports are given in Table 4.

Table 4 – Corrective maintenance triggers – steel pole supports

Parameter	Corrective maintenance trigger
General	Signs of impact damage, cracks, bending or excessive corrosion with more than 20% loss of section (report to maintainer of civil assets)
Foundation	Degraded or missing nuts, bolts or washers from base plate (report to maintainer of civil assets)
Foundation	Eroded ground, movement or excavation in immediate vicinity of pole foundation (report to maintainer of civil assets)
Foundation	Soil and silt covering foundation or base of structure (report to maintainer of civil assets)
Earth strap connection	Broken, damaged or disconnected
Earth electrode	Broken, damaged or disconnected
Pole steps	Loose, missing or corroded
Vegetation clearance	Refer to ISSC 3
Pole identification and markings	Missing, incorrect or obscured information
Attachments	Unauthorised attachments to poles

16.5. Corrective maintenance triggers for guy arrangements

The corrective maintenance triggers for aerial line guy arrangements are given in Table 5.

Table 5 – Corrective maintenance triggers – guy arrangements

Parameter	Corrective maintenance trigger
Stay pole	Signs of impact damage, cracks, burns, fire damage, rot or termite activity
Stay pole cap	Corroded, loose or missing
Sight guard	Damaged or missing
Guy insulator	Degradation or damage
Guy pole foundation	Eroded ground, movement or excavation in immediate vicinity of foundation (report to maintainer of civil assets)
Ground anchor	Eroded ground or excavation in immediate vicinity of foundation (report to maintainer of civil assets)
Ground anchor	Mechanical damage or excessive corrosion with more than 20% loss of section

Parameter	Corrective maintenance trigger
Guy wire and attachments	Stranding, slackness, mechanical damage or excessive corrosion with more than 20% loss of section
Guy wire	Signs of slippage on pole
Guy wire	Guy wire covered by soil
Earth electrode	Broken, damaged or disconnected
Earth connection	Missing, broken or damaged earth wire
Earth wire cover board	Missing or damaged

16.6. Corrective maintenance triggers for pole top arrangements

The corrective maintenance triggers for aerial line pole top arrangements are given in Table 6.

Table 6 – Corrective maintenance triggers – pole top arrangements

Parameter	Corrective maintenance trigger
Insulators	Flashed over or broken insulators
Insulators	Degradation, cracks, breaks and burns
Insulators	Excessive corrosion with more than 20% loss of section of insulator end fittings
Timber cross-arm	Timber degradation, cracking, bowing, splitting, lightning damage, termites or rot
Cross-arm	Vertical and horizontal misalignment
Pin type arrangement	Loose or misaligned pin
Pin type arrangement	Missing or degradation of conductive paints at interface areas
Conductor and insulators attachment	Loose, damaged or corroded attachment fittings
Earth wire attaching staples	Missing or loose
Earth wire stand-off bracket	Loose or missing
Earth wire	Down lead broken or detached from staples or stand-off brackets

16.7. Corrective maintenance triggers for conductors

The corrective maintenance triggers for aerial line conductors are given in Table 7.

Table 7 – Corrective maintenance triggers – conductors

Parameter	Corrective maintenance trigger
General	Signs of annealing, burning and stranding
Aerial bundled cable (ABC)	Signs of damage to cable insulation

Parameter	Corrective maintenance trigger
Clearances	Reduced clearances to ground, crossings, other structures and other circuits from design configuration
Vegetation clearance	Refer to ISSC 3
Sags	Dissimilar sags between conductors of the same circuit

16.8. Corrective maintenance triggers for conductor fittings and accessories

The corrective maintenance triggers for aerial line conductor fittings and accessories are given in Table 8.

Table 8 – Corrective maintenance triggers – conductor fittings

Parameter	Corrective maintenance trigger
Connection clamp	Loose, overheating, burning or corrosion with more than 20% loss of section
Splice	Signs of overheating, burning or annealing
Vibration dampers	Missing, damaged or out of position
Aircraft warning markers	Missing, damaged, faded or out of position
Bird flight diverters	Missing, damaged, faded or out of position

16.9. Corrective maintenance triggers for signs

The corrective maintenance triggers for signs are given in Table 9.

Table 9 – Corrective maintenance triggers – signs

Parameter	Corrective maintenance trigger
Navigable waters warning signs	Missing, damaged, incorrect information or obscured
Vegetation clearance to navigable waters warning signs	Refer to ISSC 3
Access road direction signs	Missing, damaged, incorrect information or obscured

17. Base safety or operating limits

Common base safety or operating limits are listed in Section 17.1 to Section 17.6.

The time to complete repairs shall be determined by the maintainer of the asset. Except where immediate repair action has been identified, a risk analysis shall be performed immediately after a breach of any of the base safety and operating limits is found. Immediate action shall be

initiated if there is a risk of imminent failure. Consideration shall be given to the applicable site specific operating environment and the implementation of temporary measures.

17.1. Base safety or operating limits for general items

The base safety or operating limits for general items associated with HV aerial lines is given in Table 10.

Table 10 – Base safety or operating limits – general

Parameter	Base safety or operating limit	Immediate checks and temporary measures
Safety clearances	Infringement of safety clearances to structures, ground line and other circuits	Install barricade with warning signs or isolate feeder, as required by risk analysis
Vegetation clearance	Refer to Section 6 in this document	Refer to Section 6 in this document

17.2. Base safety or operating limits for access and easement

The base safety or operating limits for aerial line access and easement are given in Table 11.

Table 11 – Base safety or operating limits – access and easement

Parameter	Base safety or operating limit	Immediate checks and temporary measures
Unauthorised access	Unauthorised installation at or near support structures or conductors that may facilitate unauthorised access to exposed live equipment	Isolate feeder, or as determined from risk analysis
Bushfires	Within immediate vicinity of aerial line feeders posing a potential safety hazard	Isolate feeder
Floods	Flooded aerial line easement or right of way	Isolate feeder
Easement	Unauthorised prohibited activities	Refer to EP 10 00 00 04 SP and ISSC 20

17.3. Base safety or operating limits for wood pole supports and stay poles

The base safety or operating limits for aerial line wood pole supports and stay poles are given in Table 12.

Table 12 – Base safety or operating limits – wood pole supports

Parameter	Base safety or operating limit	Immediate checks and temporary measures
Foundation	Pole with excessive leaning and at risk of falling	Temporary support of pole
Pole integrity	Refer to T HR EL 10003 ST	Refer to T HR EL 10003 ST

17.4. Base safety or operating limits for pole top arrangements

The base safety or operating limits for aerial line pole top arrangements are given in Table 13.

Table 13 – Base safety or operating limits – pole top arrangements

Parameter	Base safety or operating limit	Immediate checks and temporary measures
Conductor support	Failure of any pole top equipment, such as broken cross-arm or damaged insulator string that can result in conductor detachment	Isolate feeder

17.5. Base safety or operating limits for conductors

The base safety or operating limits for aerial line conductors are given in Table 14.

Table 14 – Base safety or operating limits – conductors

Parameter	Base safety or operating limit	Immediate checks and temporary measures
General	Signs of damage (for example stranding) with less than half the original conductor cross-sectional area remaining	As required from risk analysis
General	Signs of excessive burning that can cause failure of the conductors	As required from risk analysis
Foreign objects	Foreign objects hanging from the aerial line causing a safety or operation hazard	Isolate feeder

17.6. Base safety or operating limits for conductor fittings

The base safety or operating limits for aerial line conductor fittings is given in Table 15.

Table 15 – Base safety or operating limits – conductor fittings

Parameter	Base safety or operating limit	Immediate checks and temporary measures
Connection clamp	Signs of excessive burning that can cause imminent failure of the conductors	N/A
Splice	Signs of excessive burning that can cause imminent failure of the conductors	N/A

18. Data set associated with HV aerial line maintenance

The maintainer shall ensure that the data set associated with high voltage aerial line, as stipulated in T HR EL 10001 ST, is up to date and in accordance with the as-built configuration.

Where urgent repairs are carried out, the maintainer shall ensure that the data set associated with the aerial line is updated in accordance with the as-built configuration as soon as possible, and not more than a month after completion of the repairs.