Network Standard

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Review Date Changed and Approved - 30.08.2019

NW000-S0077 NS166 ROUTINE OVERHEAD LINE INSPECTION

ISSUE

For issue to all Ausgrid staff involved with the inspection of overhead lines, and is for reference by field, technical and engineering staff.

Where Ausgrid maintains a copy of this and other Network Standards together with updates and amendments on www.ausgrid.com.au.

Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.

DISCLAIMER

As Ausgrid's standards are subject to ongoing review, the information contained in this document may be amended by Ausgrid at any time. It is possible that conflict may exist between standard documents. In this event, the most recent standard shall prevail.

This document has been developed using information available from field and other sources and is suitable for most situations encountered in Ausgrid. Particular conditions, projects or localities may require special or different practices. It is the responsibility of the local manager, supervisor, assured quality contractor and the individuals involved to make sure that a safe system of work is employed and that statutory requirements are met.

Ausgrid disclaims any and all liability to any person or persons for any procedure, process or any other thing done or not done, as a result of this Standard.

All design work, and the associated supply of materials and equipment, must be undertaken in accordance with and consideration of relevant legislative and regulatory requirements, latest revision of Ausgrid's Network Standards and specifications and Australian Standards. Designs submitted shall be declared as fit for purpose. Where the designer wishes to include a variation to a network standard or an alternative material or equipment to that currently approved the designer must obtain authorisation from the Network Standard owner before incorporating a variation to a Network Standard in a design.

External designers including those authorised as Accredited Service Providers will seek approval through the approved process as outlined in NS181 Approval of Materials and Equipment and Network Standard Variations. Seeking approval will ensure Network Standards are appropriately updated and that a consistent interpretation of the legislative framework is employed.

Notes: 1. Compliance with this Network Standard does not automatically satisfy the requirements of a Designer Safety Report. The designer must comply with the provisions of the Workplace Health and Safety Regulation 2011 (NSW - Part 6.2 Duties of designer of structure and person who commissions construction work) which requires the designer to provide a written safety report to the person who commissioned the design. This report must be provided to Ausgrid in all instances, including where the design was commissioned by or on behalf of a person who proposes to connect premises to Ausgrid's network, and will form part of the Designer Safety Report which must also be presented to Ausgrid. Further information is provided in Network Standard (NS) 212 Integrated Support Requirements for Ausgrid Network Assets.

2. Where the procedural requirements of this document conflict with contestable project procedures, the contestable project procedures shall take precedent for the whole project or part thereof which is classified as contestable. Any external contact with Ausgrid for contestable works projects is to be made via the Ausgrid officer responsible for facilitating the contestable project. The Contestable Ausgrid officer will liaise with Ausgrid internal departments and specialists as necessary to fulfil the requirements of this standard. All other technical aspects of this document which are not procedural in nature shall apply to contestable works projects.

INTERPRETATION

In the event that any user of this Standard considers that any of its provisions is uncertain, ambiguous or otherwise in need of interpretation, the user should request Ausgrid to clarify the provision. Ausgrid's interpretation shall then apply as though it was included in the Standard, and is final and binding. No correspondence will be entered into with any person disputing the meaning of the provision published in the Standard or the accuracy of Ausgrid's interpretation.

KEYPOINTS

This standard has a summary of content labelled "KEYPOINTS FOR THIS STANDARD". The inclusion or omission of items in this summary does not signify any specific importance or criticality to the items described. It is meant to simply provide the reader with a quick assessment of some of the major issues addressed by the standard. To fully appreciate the content and the requirements of the standard it must be read in its entirety.

AMENDMENTS TO THIS STANDARD

Where there are changes to this standard from the previously approved version, any previous shading is removed and the newly affected paragraphs are shaded with a grey background. Where the document changes exceed 25% of the document content, any grey background in the document is to be removed and the following words should be shown below the title block on the right hand side of the page in bold and italic, for example, Supersedes – document details (for example, "Supersedes Document Type (Category) Document No. Amendment No.").

KEY POINTS OF THIS STANDARD

Scope and Risks Addressed

This standard applies to Ausgrid's overhead pole lines and associated infrastructure. It addresses the risks presented by defective components, and provides guidance on how to categorise these defects in a consistent manner.

Where to for more information?
Sections 1, 2

Risks and Defect Prioritisation

Information on factors that can influence the rectification priority is given in Section 5. This includes information on the effect different pole configurations, High Priority Areas, and Bushfire Prone Areas can have.

Where to for more information?
Section 5

Tools and Forms
None provided

Line Inspection Process

The scope of the inspection and the reporting requirements are described in Section 6

Where to for more information?
Section 6

Tools and Forms
None provided

Defect Library

A library showing examples of defects that may be identified from a ground based line inspection is included as an external annexure.

Where to for more information?
External Annexure A

Tools and Forms
None provided

Network Standard
NS166
Routine Overhead Line Inspection

Contents

1.0 INTRODUCTION

This Network Standard describes the scope for inspection of Ausgrid's overhead pole lines and associated infrastructure.

All inspection and resulting corrective work tasks are to be recorded in Ausgrid's asset management system.

Information concerning pole defects may be found in Ausgrid's Network Standard NS145 Pole Inspection and Treatment Procedures.

Overhead line inspection is to be carried out in a meticulous and systematic manner to ensure that every visible point is carefully scrutinised and assessed for its serviceability. The assessment will take into account the risk associated with each defect and the associated prioritisation for repair or review.

The external annexure to this document (Annexure A – Line Inspection Defect Library) aims to identify and prioritise those defects that may fail before the next scheduled inspection, and provide guidance on how to categorise these defects in a consistent manner.

2.0 SCOPE

2.1 General

The routine overhead line inspection applies to all overhead pole lines on Ausgrid's network. It extends from outside the boundary fence of substations (Bulk Supply Points, transmission and zone substations), to the point of attachment for low voltage customers.

It does not include transmission tower lines, isolated poles in a predominantly tower line, equipment inside substation enclosures, Façade Mounted Aerial Bundled Cable, private mains or High Voltage Customer equipment.

This standard does not include below ground or internal inspection of poles. These inspection tasks are described in detail in Ausgrid's Network Standard NS145 Pole Inspection and Treatment Procedures.

The detailed scope of the inspection is included in Section 6. The lists provided are not exhaustive, and are intended as examples of the types of items to be inspected.

This standard describes the routine line inspection process. Any follow-up inspections performed by climbing a pole or using an Elevated Work Platform are corrective actions, and those procedures are not described in this standard.

2.2 Line Inspection Defect Library

Where the body of this standard can be considered the scope of the inspection (that is, what to look at), the Line Inspection Defect Library of Annexure A contains the defects that inspectors should look for.

The Line Inspection Defect Library contains the failure modes arranged in the Part/Failure/Cause trees found in SAP. This will assist inspectors in performing a thorough inspection of the overhead line, correctly identifying defects, recording defects against the correct parts, and categorising defects with a consistent priority for rectification.

3.0 REFERENCES

3.1 General

All work covered in this document shall conform to all relevant Legislation, Standards, Codes of Practice and Network Standards. Current Network Standards are available on Ausgrid's Internet site at www.ausgrid.com.au.

3.2 Ausgrid documents

- Bushfire Risk Management Plan
- Company Form (Governance) - Network Technical Document Endorsement and Approval
- Company Procedure (Governance) - Network Technical Document Endorsement and Approval
- Company Procedure (Network) – Network Standards Compliance
- Company Procedure (Network) - Production / Review of Engineering Technical Documents within BMS
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- External Annexure A – Line Inspection Defect Library
- Maintenance Standard OH0105 (Combined Pole and Line Inspection)
- MRPA101 Network defect prioritisation matrix
- NEG-OH21 Vegetation Safety Clearances
- NS128 Specification for Pole Installation and Removal
- NS145 Pole Inspection and Treatment Procedures
- NS220 Overhead Design Manual
- Public Electrical Safety Awareness Plan
- Public Lighting Management Plan
- Tree Safety Management Plan

3.3 Other standards and documents

- AS/NZS 7000 - Overhead line design – Detailed procedures
- ENA Doc 001-2008 National Electricity Network Safety Code
- Networks NSW Vegetation Management Common Requirement Ausgrid/Endeavour Energy/Essential Energy October 2014
- NSW Maritime Crossings of NSW Navigable Waters: Electricity Industry Code
- Service and Installation Rules of New South Wales

3.4 Acts and regulations

- Electricity Supply (General) Regulation 2014 (NSW)
- Electricity Supply (Safety and Network Management) Regulation 2014
- Work Health and Safety Act 2011 and Regulation 2011

3.5 Ausgrid drawings

- 515297 Standard construction overhead powerlines minimum conductor clearances

4.0 DEFINITIONS

Accredited Service Provider (ASP)	An individual or entity accredited by the NSW Department of Industry, Division of Resources and Energy, in accordance with the Electricity Supply (Safety and Network Management) Regulation 2014 (NSW).
Assess	The identification, recording and prioritisation of defects arising from an examination.
Business Management System (BMS)	An Ausgrid internal policy and procedure framework that contains the approved version of documents.
Check (task)	A scheduled task requiring measurement of some parameter and its comparison to a required standard (accept/reject criteria).
Corrective	The actions performed, as a result of defects or functional failures to restore a defective item to a specified condition.
Customer	A customer is an individual or an entity who is an end-user of electricity.
Defect	Any unacceptable departure of a characteristic of an entity (system, equipment, assembly, part) from specified requirements.
Document control	Ausgrid employees who work with printed copies of document must check the BMS regularly to monitor version control. Documents are considered “UNCONTROLLED IF PRINTED”, as indicated in the footer.
Examine	Carry out a visual survey of the condition of an item (without disassembly / from the ground).
Inspection	The examination, defect identification and defect assessment of multiple assets executed as single grouped task.
Low Voltage Distributor	An electricity line rated at not more than 1000V AC which originates at the low voltage end of a distribution substation and serves to convey electrical energy to end users via their service mains. Low voltage distributors are constructed in public roadways or through easements on private land.
Network Standard	A document, including Network Planning Standards, that describes the Company's minimum requirements for planning, design, construction, maintenance, technical specification, environmental, property and metering activities on the distribution and transmission network. These documents are stored in the Network Category of the BMS repository.
Overhead Service mains	The dedicated overhead mains extending from the overhead low voltage distribution network to customers point of attachment.
Pole	Overhead mains conductor support, substantially composed of either wood, concrete or metal.
Review date	The review date displayed in the header of the document is the future date for review of a document. The default period is three years from the date of approval however a review may be mandated at any time where a need is identified. Potential needs for a review include changes in legislation, organisational changes, restructures, occurrence of an incident or changes in technology or work practice and/or identification of efficiency improvements.
SAP	Ausgrid’s asset management system

5.0 RISKS AND DEFECT PRIORITISATION

5.1 General

The assessment of corrective work required to address defects shall be undertaken using the prioritised framework defined in Maintenance and Replacement Planning Advice MRPA101 Network Defect Prioritisation Matrix.

While Annexure A – Line Inspection Defect Library contains examples of overhead line defects and the corresponding actions and priorities, it is not possible to include examples of all defects that may be encountered, or the full range of deterioration or severity.

The following information may assist in applying the methodology to overhead lines.

5.2 Defect rectification works 'Action' selection

The line inspector shall identify the corrective works required for each defect identified during the examination, and raise an appropriately prioritised corrective notification. This can be achieved by selecting the appropriate SAP Part / Failure / Cause tree(s) from the defect tables provided in Annexure A, and then selecting the appropriate 'action' that should be undertaken from the 'Task Field'.

5.3 Effect of pole configuration on prioritisation

A poles circuit configuration can have an influence on the risk assigned priority for a defect. This is because under different circuit configurations, different conductor loading and forces are applied to the pole and its crossarm(s). For the purpose of defect risk prioritisation, pole circuit configurations can be grouped into four main types. Each of these will be described under the headings following.

5.3.1 Termination pole configuration

In the termination pole circuit configuration the resultant force is in the direction of the circuit as shown in the diagram below.

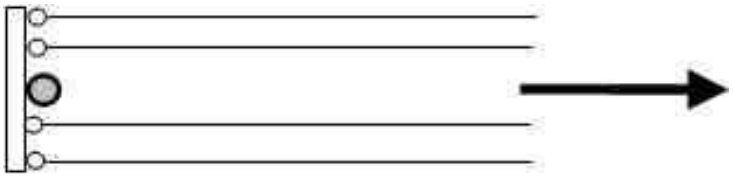

Figure 1 Terminal pole configuration

The loading on a termination pole is due to any wind loading and the tension in the conductors. The maximum resultant load is directed away from the pole in the direction of the conductors (i.e. in this case to the right of the pole and crossarm).

It must be noted that depending on the type of defect, a pole in a termination pole configuration could require a higher priority action to be assigned than a straight line pole configuration due to the unbalanced forces applied to the pole and crossarm(s).

5.3.2 Straight line (or in-line) pole intermediate configuration

A pole in a straight line intermediate configuration will have longitudinal forces on either side of it that will cancel each other out (assuming the loading on each circuit is the same). As a result the sustained load on a straight line pole will be zero. Any resultant force will be due to transverse wind loading or service mains that may be attached and will generally be comparatively small and at right angles to the line.

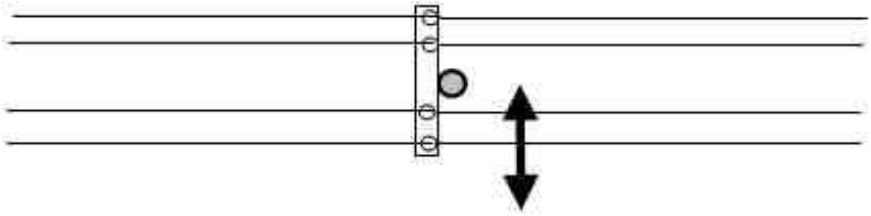

Figure 2 Straight line pole intermediate configuration

Assuming the worst case wind direction at right angles to the conductors, the maximum resultant load will also be at right angles to the conductors. If service mains are present the loading will be a combination of the wind forces and tension in the service mains.

5.3.3 Deviation angle, corner, tee-off or complex pole configuration

For deviation angle, corner, tee-off and complex pole circuit configurations the resultant force on the pole will be the sum of the force vectors for each circuit, and non-zero. A diagram showing the resultant force in each of these cases is shown below.

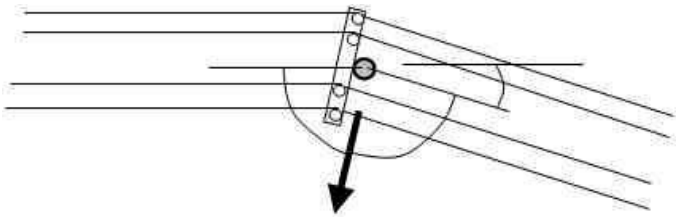

Figure 3 Deviation Angle Intermediate Pole Configuration

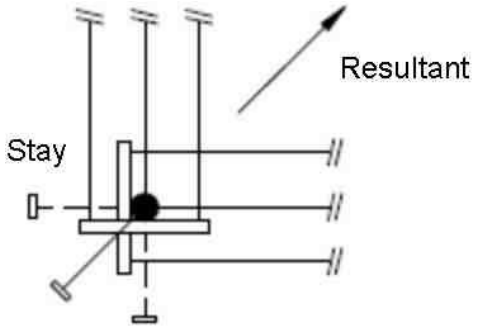

Figure 4 Corner Pole Configuration

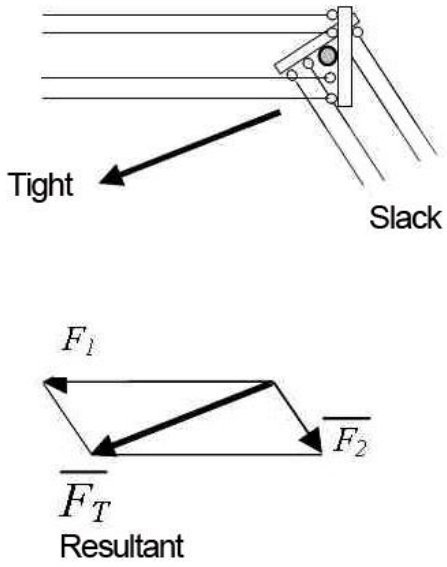

Figure 5 Complex Pole Configuration

As with the termination pole configuration, depending on the type of defect, if a pole is in any of these configurations where the sustained load is non-zero then they may require a higher repair / inspection priority to be assigned than a straight line pole configuration due to the unbalanced forces applied to the pole and crossarms.

5.3.4 Athwartship pole configuration

This scenario occurs if conductor tension is the same in all directions. As a result an athwartship pole has no specific neutral axis, and the loading on the pole is effectively zero.

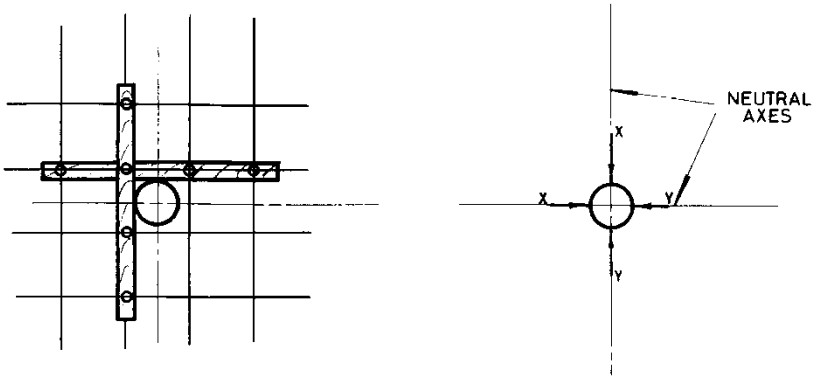

Figure 6 Athwartship pole configuartion

It must be noted that depending on the type of defect, a pole that is in an athwartship pole configuration could be assigned a 'lower' priority than the same defect on a straight line pole configuration. This is due to the nature of the balanced loading on the pole in both directions.

5.4 High priority areas (HPA)

It must be noted that the ultimate priority assigned to a defect may be influenced by a number of site specific factors. For the purpose of this document a number of important potential site specific factors have been identified as they are likely to exacerbate many of the issues being investigated. Bushfire Prone Areas (BPA's) are a special case and have been considered under a separate heading following.

In order to simplify defect descriptions provided later in this document these important site specific factors have been grouped under the banner of “High Priority Areas” (HPA), and are listed below:

- Near a school or school crossing.
- Near an area with high pedestrian conditions (e.g. bus stop).
- Near an area with high traffic conditions (e.g. RMS road).
- Part of a rail crossing.
- Part of a major roadway crossing.
- Part of a major river crossing.

Some other areas that may need to be considered on a ‘case-by-case’ basis for inclusion as HPA include the following:

- Large areas under irrigation, where safety clearances could be impacted by booms or large machinery / plant.
- Areas near mining operations.
- High load traffic routes.
- Obvious building construction sites where third party construction works are in progress with low mains and public access to the site.
- Logging plantations, or
- Any other areas where large plant are utilised and could impact upon electrical safety clearances.

If a defect is located on an asset in a HPA then it must be flagged against the notification (using the descriptive / long text field.

Defects on OH assets located in HPA’s will need to have the details of the type of HPA provided in conjunction with the type of defect when raising the notification. This will assist the overall task packaging / prioritisation process.

5.5 Bushfire prone areas (BPA)

According to the NSW Rural Fire Service (RFS) a bushfire prone area (BPA) is an area of land that is capable of supporting a bushfire or likely to be subjected to bushfire attack.

To identify the bushfire prone areas in Ausgrid’s distribution area, the “bushfire prone” land maps prepared by local councils (in accordance with the requirements of section 146 of the Environmental Planning and Assessment Act 1979) are used. Ausgrid overlays the council maps with its geospatial asset information to identify assets located in bushfire prone areas. Since September 2005, Ausgrid has had access to a complete set of bushfire prone land maps from councils within its network area.

The maps prepared by local councils are reviewed by the Rural Fire Service prior to being formally certified by the Commissioner for the NSW Rural Fire Service (RFS). Ausgrid has a formal agreement with the RFS regarding use of the certified maps for management of bushfire risks in its network area and loads the latest version of these certified maps into its Geospatial Information System (GIS) and SAP system annually prior to the bushfire season.

The bushfire danger period nominally extends from 1 October each year to 31 March the next year. These areas are also identified in Ausgrid’s Bushfire Risk Management Plan.

To allow for the determination and reporting of genuine bushfire risk, there are four selectable values for the "system effect" field that can be used to identify whether the particular defect is capable of initiating a bushfire. These are:

- **Effect (1) – "No Effect":** The defect does not pose a genuine risk of igniting a bushfire.
- **Effect (2) – "In Service – Limited Operation":** The defect does pose a genuine risk of igniting a bushfire and is currently in service with limited operation. (This option can be used to better describe the state of the network if applicable).
- **Effect (3) – "In Service – Bushfire Risk":** The defect does pose a genuine risk of igniting a bushfire and is currently in service.
- **Effect (4) – "Out of Service":** The defect does not pose a risk of igniting a bushfire and is out of service. (This option can be used to better describe the state of the network if applicable).

For the purpose of this document only ***Effect (1)*** and ***Effect (3)*** will be considered. Essentially when undertaking the defect assessment the following should be considered: ***"If the particular component fails in its current location is it capable of starting a bushfire?"***. If the answer is YES then "Effect (3)" should be chosen under the system effect field, otherwise "Effect (1)" should be chosen. Where a conflict exists, the higher order risk shall take precedence, i.e In Service – Bushfire Risk takes precedence over In Service – Limited Operation. Some considerations that may be taken into account when making this assessment include:

- Is the location of the defect in a bushfire prone area?
- Would the failure of the pole/hardware cause a conductor, spark or molten metal to fall?
- Is there a source of fuel that could be ignited in the event of the pole/hardware failure? (This needs to take into consideration adjacent or nearby property or parcels of land, and the likelihood of ignition taking into account wind and adverse weather).

A blank "system effect" field for an asset located in a bushfire area by default indicates that a risk assessment of the notification has not been completed and as such is reported as a genuine bushfire risk until such time as an assessment has been undertaken to prove otherwise. As a result any defect on a pole located in a bushfire area will default to an 'Effect (3)' (i.e. In Service – Bushfire Risk) until such time an assessment is undertaken.

As with HPA's, if there is a defect located in a BPA then this shall be flagged against the notification.

Some examples of general issues that typically would not be allocated a high priority in a non-BPA, but would in a BPA because they could cause a bushfire during the bushfire danger period include (but not limited to):

- Birds' nests on poles with bare/exposed conductors.
- Conductors that clash.
- Foreign objects attached to poles / conductors.
- Vegetation encroachment.
- Conductors not secured to insulators.
- Pole top or crossarm burn damage.

Examples of OH lines that pose a higher bushfire risk are typically found adjacent to, or within the following general environments:

- National parks.
- Nature reserves.
- State recreation areas.
- State forests.
- Bushland reserves.
- Crown land.
- Other heavily vegetated areas (including grasslands and areas covered by dry crops).

Although bushfire prone land maps are provided by the NSW RFS, any risk analysis undertaken during line inspection should also take these general environmental areas into account when prioritising defects and / or raising notifications.

6.0 LINE INSPECTION PROCESS

6.1 General

The primary purpose of line inspection is to identify defects that may cause a system failure or present a hazard to employees, contractors, members of the general public or the environment before the next line inspection is carried out. Line inspections are to be conducted on a periodic basis in accordance with Ausgrid's Maintenance Standard OH0105 (Combined Pole and Line Inspection).

With the exception of height measurement and pole sounding, examination of all above ground assets is to be performed visually, and from the ground only. Not all defects will be visible or identifiable from a single viewpoint during the examination, and it will be necessary to move around the pole to get the best view of each asset or assembly.

The line inspection seeks to identify and report defects that may fail within the period of the next inspection cycle. It is also used to identify and report non-conforming use of materials; that is, defective constructions. The inspection will not attempt to identify old constructions that do not meet the current Ausgrid standard, but should consider whether materials have been used in a manner other than that for which they are intended.

6.2 Electrical precautions

6.2.1 General

Line inspectors shall be aware that it is possible for voltage gradients to exist on or near a pole in the event of conductor breakage or insulation breakdown. They shall take precautions to safeguard themselves and others against inadvertent contact with step and touch voltages.

A proximity type voltage detector capable of identifying voltages of 50 volts and above shall be used to test each pole for touch potential prior to initial contact with the pole. Further information may be found in NEG SE05-06 Safety Equipment – Care, Use and Inspection - Low Voltage Instruments.

Any dangerous touch potential identified shall be reported immediately Ausgrid's Emergency Line on 13 13 88 and your immediate supervisor or the contract manager.

Defects that can lead to voltages on poles include conductors resting on crossarms, cracked insulators, and conductive foreign objects in contact with live conductors.

6.2.2 Broken earth wires

Earth wires form a part of an earthing system and they can become damaged in many ways.

If earth wires are present on a pole, the above ground condition of the earth wire shall be assessed by a visual examination prior to making initial contact with the pole.

Any broken earth wires identified shall be reported immediately as a dangerous situation to Ausgrid's Emergency Line on 13 13 88 and your immediate supervisor or the contract manager.

WARNING

Line inspectors SHALL NOT attempt to re-join broken earth wires. Full phase to earth voltage may exist between the severed ends. Broken earth wires must be treated as live conductors in accordance with Ausgrid's Electrical Safety Rules.

6.3 Tools and equipment

At a minimum, line inspectors will need the following equipment to perform effective line inspections:

- Binoculars, with sufficient magnification, brightness and stability to aid identification of physically small defects, such as cracked insulators, burns marks on conductors, corrosion of insulator pins and the like.
- A device to safely measure the height of conductors above ground, to an accuracy of 50mm.
- Digital camera with optical zoom, capable of resolving 800 pixels across the head of a pole when standing at the distance and angle required to view the relevant component or defect. This precludes the use of most phone cameras, which are only capable of resolving approximately 80 pixels across the head of a pole.
- Ball pein hammer, suitable for the pole sounding described in NS145.
- A proximity type voltage detector, suitable for performing the testing described in Clause 6.2.

6.4 Verify existing asset details

The line inspection process includes verifying that all existing Ausgrid asset details are correctly recorded in Ausgrid's asset management system. Inspectors shall verify asset numbers, address details, and equipment characteristics. Missing or incorrect information shall be recorded and updated in Ausgrid's asset management system. This includes pole numbers, switch numbers, feeder numbers, any other identifying marks, and whether the pole or attached assets are owned privately or by Ausgrid.

Line inspectors shall assess the condition, legibility and presence of the asset numbers and labels described above.

6.5 Poles

Line inspectors shall examine the condition of all poles on the overhead network, regardless of type, material, voltage or application. These include:

- Poles made of timber, concrete, steel, fibreglass, fibre-cement, composite materials, and any other material.
- Poles used as part of the network from low voltage up to 132kV, streetlighting poles, communications poles, substation poles, stay poles, and any other Ausgrid owned pole.
- Single piece poles, multi-piece poles, and multi-pole structures, including poles extended with timber pole raisers.

The routine overhead line inspection does not include:

- Poles located inside substation fences.
- Steel transmission pole lines, and isolated poles in a predominantly tower line (these are included in Maintenance Standard OH0103).

- Poles not owned by Ausgrid, such as customer's private poles, and poles owned by other utilities. (Ausgrid assets attached to these poles are still inspected as described in this standard).

The entire above ground length of the pole is to be visually examined. The area from groundline to approximately 2 metres above ground level shall also be sounded as described in NS145 – Pole Inspection and Treatment Procedures.

Where the line inspection described in this standard is performed in conjunction with the full pole inspection procedure described in NS145, there will be an overlap in this area above ground level. In this case, the above ground sounding need only be performed once, in the sequence described in NS145.

6.6 Foundations and pole base

Line inspectors shall examine the condition of the ground around the pole (the foundation). This includes looking for signs of degradation, erosion, subsidence and alterations to the natural ground level.

The pole base (the part of the pole below ground line) is to be inspected by a pole inspector in accordance with NS145, and is not included in this standard.

6.7 Conductors

The entire length of overhead cables and conductors shall be examined, from the termination or support at one end of the span to the other.

The examination includes, but is not limited to:

- Wires (strands) of bare conductors, as well as the wires of insulated or covered conductors where they are visible.
- Insulation, in the case of low voltage aerial bundled cable (LV ABC), high voltage aerial bundled cable (HV ABC), high voltage covered conductor (CCT), and any other covered system.
- Conductor accessories, including joints, repair fittings, low voltage spreaders, vibration dampers, warning marker balls and temporary insulation.

Line inspectors shall check for the presence of:

- Conductor accessories, and whether they have been installed correctly, incorrectly, or not at all. This may include joints, repair fittings, low voltage spreaders, vibration dampers, aircraft marker balls and temporary insulation.
- Foreign objects, that have become attached or entangled in the conductors, either deliberately or by chance. This may include tree branches, shoes, chains, balloons and kites.

6.8 Clearances

Line inspectors shall examine conductors to identify adequate clearance in the following situations:

- From each conductor to ground.
- From one conductor to each other conductor in the span, whether attached or unattached to the same support structure.
- From each conductor to other objects, such as trees, buildings and fences.

Where low conductor clearances are suspected this should be confirmed by taking a measurement reading, and the measurement included in the defect notification description and within the "Actual Quantity" field of the notification.

6.9 Terminations (both tension and suspension)

Line inspectors shall examine the condition, presence, and suitability of the fittings between the conductor and the insulators. Line inspectors shall also examine the fittings to confirm that they are correctly seated on the conductor, on the insulator, and on other fittings, and are not jammed, twisted, loose or attached in any manner other than that for which they are intended.

The termination fittings include:

- Tie wires (hand formed or applied by live-line stick)
- Helical ties (“preforms”)
- Bolted terminations (U-bolts, wedge clamps, “snail” clamps)
- Suspension clamps
- Compression deadends.

6.10 Insulators

Line inspectors shall examine the condition of all insulators on the overhead network, regardless of type, material, voltage or application. Insulators can take many forms, and include:

- Low voltage insulators, which may be porcelain or glass, and may be on pins or shackles.
- 11kV or 22kV insulators, which may be porcelain, glass, polymeric/composite, and may be pins, posts, discs or longrods.
- 33kV, 66kV or 132kV insulators, which may be porcelain, glass, polymeric/composite, and may be pins, posts, discs or longrods.

Inspection of the insulator includes the insulating medium itself, as well as the integral steel components supporting it, such as the pin of a pin insulator, the cap and pin of disc insulators, and the end fittings of longrod insulators.

6.11 Crossarms

Line inspectors shall examine the condition of all crossarms on the overhead network, regardless of type, material, voltage or application. These include:

- Crossarms made of timber, steel, fibreglass, composite fibre, and any other material.
- Crossarms used for the support of conductors from low voltage up to 132kV, whether for terminations or intermediate support, or whether they are fixed centrally to the pole, or offset, or whether they are horizontal, angled (such as in a wishbone configuration) or vertical (such as in a box construction for services). Crossarms spanning two poles (such as in H-pole transmission structures) are also included.
- Crossarms used for the support of other assets, including communications cables, switchgear, and reactive plant.

6.12 Bonds

Line inspectors shall examine the condition of all bonds to overhead conductors. In this context, bonds include all cables and conductors not under tension (that is, not in the span), as well as the electrical connectors associated with them. This includes connections between conductors on each side of a through-termination (jumpers), connections between parallel circuits, tee offs, transpositions, and droppers and tails to equipment such as fuses, links and transformers.

Connectors include parallel groove clamps (PG clamps), split bolts, wedge clamps, insulation piercing connectors (IPCs), bail clamps and live line clamps.

6.13 Switchgear

Line inspectors shall examine the condition of all high and low voltage switchgear on the overhead network. Switchgear may include LV links, LV fuse switches, LV ABC link boxes (fuse switch disconnector), HV drop-out fuses, HV links, and air break switches, and the associated operating

mechanisms. Enclosed switches (those with a tank) such as enclosed HV load break switches, reclosers and smart switches are described in Clause 6.14.

6.14 Pole-top plant

Line inspectors shall examine pole-top plant for obvious visual signs of damage, deterioration and leakage. Plant may include transformers, voltage regulators, capacitors, reclosers, enclosed switches, and associated fittings. Detailed inspection of these items is not required, but any obvious defects that pose a risk to people or the environment shall be reported, such as evidence of a large loss of oil. Note that the presence of pole top plant may affect the priority assigned for defect rectification.

6.15 Third party assets

Line inspectors shall examine third party assets for damage that may encroach upon the conductor clearances, cause consequential damage to Ausgrid's network, or pose a risk to the public. The examination is not aimed at assessing the function or performance of third party assets. Third party assets may include communications cables, antennas, signs and banners, special small services, and the like.

6.16 Unauthorised attachments

Line inspectors shall examine the pole for the presence of unauthorised attachments. While it may be difficult to distinguish between authorised and unauthorised attachments in some circumstances, line inspectors shall look for attachments that are obviously unauthorised, which may take the form of advertisements, political placards, cameras, antennas, or cables.

In the case of advertising materials (typically taped or stapled to the pole), these shall be removed prior to the inspection to enable effective examination of the pole.

6.17 Unauthorised climbing

Line inspectors shall examine the pole for any attachments or fittings that may facilitate climbing by unauthorised persons. This includes third party attachments and nearby trees and structures, as well as Ausgrid attachments. NS128 Specification for Pole Installation and Removal contains further information on prevention of unauthorised access.

6.18 Underground cables and UGOHs

Line inspectors shall examine the condition of UGOHs (the transition from overhead conductors to underground cables) and the cable to the point at which it goes into the ground. The examination shall include the cable, cable termination, support insulators, surge arresters, cable cleats, cable covers, and supporting fittings.

Low voltage dropper cables from the overhead mains to the low voltage cable termination generally have a bolted connection underneath heatshrink and appear as a continuous cable, and are also included in the UGOH inspection.

When the line inspection is being performed in conjunction with the pole inspection (that is, in accordance with Maintenance Standard OH0102), the excavation to 350mm below ground line provides an opportunity to examine the below ground components of the UGOH, and line inspectors shall examine the cable and cable covers in this area as well.

Where metallic cable covers show signs of vehicle impacts (such as dents), line inspectors are reminded of the electrical precautions of Clause 6.2.

6.19 Earth downleads

Line inspectors shall examine the condition and presence of all earth downleads. Earth downleads may be used for earthing of:

- Overhead earthwires
- Surge arresters
- Cable screens

- Distribution transformers (including SWER transformers)
- Switchgear power supplies.

The examination shall include the cable or conductor, the battens or covers, and the attachment hardware.

When the line inspection is being performed in conjunction with the pole inspection (that is, in accordance with Maintenance Standard OH0102), the excavation to 350mm below ground line provides an opportunity to examine the below ground components of the earth downlead, and line inspectors shall examine the cable, conductor and covers in this area as well.

Note: Severed earth down leads must be reported immediately so they can be assessed by a suitably authorised person. See Clause 6.2.2 for more information.

WARNING

Line inspectors SHALL NOT attempt to re-join broken earth wires. Full phase to earth voltage may exist between the severed ends.

6.20 Street lights

Line inspectors shall examine the condition of the streetlight attachments to the pole. This includes outreach arms and associated fasteners, the luminaire, and any streetlighting control system present. The pole or column itself is included in Clause 6.5.

6.21 Steel fittings and other metallic fittings

Line inspectors shall examine the condition of all steel and metallic fittings. This includes:

- Crossarm braces, gain blocks, transformer mounting brackets.
- Pole caps.
- Pole bands.
- Pole reinforcements.
- Earthwire risers and raiser brackets for conductors.
- All screws, nuts, bolts and washers, including kingbolts, eyebolts, coachscrews, flat washers, square washers, volute washers etc.
- Steel fittings between the end of the insulator and the conductor support (thimbles, clevis-tongues etc).
- Steel fittings between the insulator and the pole or crossarm (bow shackles, K-straps (flat steel shackles), etc).

Line inspectors shall also examine the fittings to confirm that they are correctly seated and are not jammed, twisted, loose or attached in any manner other than that for which they are intended.

6.22 Stays (guys)

Line inspectors shall examine the condition of all stays or guys. This includes stays connected to the ground, to dedicated stay poles, to footpath stays, between poles (H-pole structures) and to poles carrying other conductors or circuits. Inspectors shall examine all parts of the stay arrangement, including:

- the stay wire
- the attachment to the pole being supported
- the attachment to the stay pole (where a stay pole is used)
- the attachment to the ground anchor, where it enters the ground (in the case of a ground stay)
- the stay insulator
- any barriers or guards used to prevent contact with the stay wire, especially in the case of a ground stay.

Examination of the stay pole itself is included in Clause 6.5.

6.23 Service mains

Inspectors shall assess the condition of overhead services. This includes the service wire, connections to the mains, connections at the point of attachment, and any associated equipment. Clearances to the service wire and suitability of the point of attachment shall also be inspected.

6.24 Access tracks

Line inspectors shall examine the condition of access tracks and associated infrastructure. This includes the track surface, vegetation encroaching upon the track, gates and locks, signs directing workers towards the feeder, and anything that may prevent access to the assets by the vehicles that need to use the access track.

6.25 Waterway crossing signs

Inspectors shall assess the presence and condition of waterway crossing warning signs. This includes the legibility, alignment, information content, structural integrity, suitability for the location, and any obstructions such as vegetation. Further information can be found in the NSW Maritime Crossings of NSW Navigable Waters: Electricity Industry Code.

6.26 Redundant or obsolete items

Inspectors shall examine the pole for redundant, obsolete or dangerous equipment. Examples include lead-in poles that are no longer required, the need for replacement of rubber-alloy wrap lock ties (particularly in the Hunter), and the requirement to install bail clamps where live line clamps have been fitted directly on to the mains.

7.0 RECORDING OF DEFECTS

Defects shall be recorded in Ausgrid's asset management system (SAP), either directly or via an external interface. For each defect identified, the line inspector shall nominate the part, failure and cause of the defect, the remedial action or task required, and the appropriate priority for the rectification work. The text fields can be used to provide additional details about the defect where appropriate.

Annexure A should be used as guidance for the classification of defects.

8.0 RECORDKEEPING

The table below identifies the types of records relating to the process, their storage location and retention period.

Table 1 – Recordkeeping

Type of Record	Storage Location	Retention Period*
Approved copy of the network standard	BMS Network sub process Standard – Company	Unlimited
Draft Copies of the network standard during amendment/creation	HPRM Work Folder for Network Standards (HPRM ref. 2014/21250/179)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	HPRM Work Folder for Network Standards (HPRM ref. 2014/21250/179)	Unlimited

* The following retention periods are subject to change eg if the records are required for legal matters or legislative changes. Before disposal, retention periods should be checked and authorised by the Records Manager.

9.0 AUTHORITIES AND RESPONSIBILITIES

For this network standard the authorities and responsibilities of Ausgrid employees and managers in relation to content, management and document control of this network standard can be obtained from the Company Procedure (Network) – Production / Review of Engineering Technical Documents within BMS. The responsibilities of persons for the design or construction work detailed in this network standard are identified throughout this standard in the context of the requirements to which they apply.

10.0 DOCUMENT CONTROL

Content Coordinator : Transmission and Distribution Mains Engineering Manager

Distribution Coordinator : Engineering Information and Services Manager

Annexure A – Line Inspection Defect Library

The Line Inspection Defect Library is attached to this Network Standard as an external annexure.