Network Standard

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NW000-S0071 NS126 CONSTRUCTION OF HIGH VOLTAGE OVERHEAD MAINS

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design and installation of overhead lines, and is for reference by field, technical and engineering staff.

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Where this Standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document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, accredited service provider 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 the variation to a Network Standard or alternative material into a design.

All designers including external designers 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 Network Standard is limited to scope identified below and provides controls for associated risks as listed below:

- ☐ Construction requirements for 11kV or 22kV overhead lines within Ausgrid supply network area
- ☐ Ausgrid's requirements for LV overhead mains are covered separately in NS125 and Sub-transmission voltage overhead mains in NS135
- ☐ Ausgrid will determine which type of HV overhead mains system is to be used in a given situation
- ☐ Covered Conductor Thick (CCT) mains is used in select locations to reduce risks associated with bush fires, conductor clashing and reduced phase separation

Where to for more information?

Section 1 - 3

Selection Details

This section provides guidance for selecting aspects of the construction

- ☐ Selection of
  - Construction type
  - Conductors
  - Insulators
  - Crossarms
  - Poles
  - Surge arresters
  - Lightning protection

Where to for more information?

Section 4

Tools and Forms

None

Construction Details

This section provides details of major design requirements for CCT and bare conductor construction and includes the following:

- ☐ Details of
  - Manufacturing requirements based on Australian Standards
  - Covering material
  - Conductor used
  - Electrical and mechanical characteristics
  - Line design parameters
  - Insulator requirements
  - Lightning protection provisions
  - Fittings and insulating covers
  - Crossarms
  - Pole-top operating devices
  - Pole mounted substations/transformers
- ☐ Special erection considerations and precautions are provided

Where to for more information?

Section 6

Tools and Forms

Annexure A - Standard construction drawings

Other Sections

These sections detail other design considerations:

- ☐ General Design Parameters for CCT, and bare conductor are provided and include:
  - Structural design requirements
  - Railway crossings
  - Crossing navigable waterways
- ☐ Clearance information
- ☐ 11kV UGOH construction
- ☐ Access to stores and materials

Where to for more information?

Section 6 - 7

Tools and Forms

None

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Contents

1.0 PURPOSE

This Network Standard is Ausgrid's specification for the construction of 11kV and 22kV overhead lines that form part of the Ausgrid distribution network.

2.0 SCOPE

This Network Standard and the standard construction drawings listed in Annexure A, describes Ausgrid's requirements for new construction and replacement or refurbishment of existing 11kV and 22kV High Voltage (HV) overhead mains.

Ausgrid's requirements for Low Voltage overhead mains are detailed in NS125 Construction of Low Voltage Overhead Mains. Ausgrid's requirements for sub-transmission overhead mains are detailed in NS135 Construction of Overhead 33kV, 66kV and 132kV Overhead Mains.

Ausgrid's requirements for overhead line design are detailed in NS220 Overhead Design Manual.

3.0 INTRODUCTION

The high voltage overhead mains systems currently in use in the Ausgrid network are:

- Bare conductor,
- Covered Conductor Thick (CCT), and
- High Voltage Aerial Bundled Cable (HV ABC).
- No new SWER systems shall be constructed.

Details of Bare conductor and CCT are documented in this Network Standard. For all proposed designs using HV ABC, the designer is required to refer these to Ausgrid for endorsement.

4.0 SELECTION

In selecting the type of mains, the designer shall follow the general design approach and conductor selection described in NS220. In all cases Ausgrid reserves the right to nominate which overhead mains system to use in a given situation.

4.1 Conductor selection

4.1.1 Bare conductors

To minimise the range of fittings required, the conductors listed in Table 1 shall be used for new construction. Many other conductors exist on the network, and they may continue to be used for minor work (such as replacement after a failure or pole relocation where a short extension to the mains is required). For current ratings and other electrical properties refer to NS220.

Where bare conductor is used, specific effort must be made during design and construction activities to avoid any possibility of conductor clashing throughout the life of the overhead line.

Refer to Annexure A for construction types:

- Construction 2-5 (delta, small) is the preferred construction for all intermediate structures.
- Construction 2-1 is to be used only when under-building the circuit or for under-crossing structures.
- For longer spans, delta (medium) and large delta constructions are available and other construction types (e.g. horizontal offset) may be used under specific circumstances and subject to approval of Ausgrid's Distribution Engineering.

For offset constructions refer to Annexure A and NS167 Positioning of Poles and Lighting Columns.

Table 1 - Mechanical Characteristics of Bare Conductor

Conductor	Mercury	Pluto	Raisin	Apple	Cherry
Ausgrid Stockcode	H13433	H13459	H13734	H13467	H13483
Number of strands/wire diameter	7/4.50	19/3.75	3/4/2.50	6/1/3.00	6/4.74 + 7/1.6
Alloy type/grade	AAC	AAC	ACSR/GZ	ACSR/GZ	ACSR/GZ
Cross sectional area (mm^2)	111.3	209.8	34.36	49.5	120.4
Diameter of conductor (mm) (approx)	13.5	18.8	7.5	9.0	14.3
Mass (kg/m) (approx.)	0.305	0.578	0.193	0.171	0.404

4.1.2 Covered Conductor Thick (CCT)

The CCT system, although not a touch-safe screened cable system, is designed to provide protection from initiation of flash-overs due to clashing of conductors, bird or animal incursions and tree branches or debris which may contact the line.

Ausgrid uses three conductor sizes: CCT80, CCT120 and CCT180. For current ratings and other electrical properties refer to NS220.

Table 2 - Mechanical Characteristics of CCT

Conductor Cable Code	CCT80	CCT120	CCT180
Ausgrid Stockcode	184449	184451	184452
Number of strands/wire diameter	7/3.75	7/4.75	19/3.50
Alloy type/grade	AAAC/1120	AAAC/1120	AAAC/1120
Cross sectional area (mm^2)	77.3	124.0	182.8
Diameter of conductor (mm) (approx)	11.4	14.5	17.7
Insulation thickness (mm) (min. av.)	3.4	3.4	3.4
Diameter over covering (mm)	18.8	21.9	25.0
Mass (kg/km) (approx.)	399	575	792
Minimum bending radius (mm)	280	330	375

4.2 Crossarm selection

4.2.1 Crossarm material

Crossarm material shall be selected in accordance with mechanical strength, insulation coordination, cost implications and shall conform to a standard design.

If steel crossarms are used, 33kV rated insulators shall be considered to meet insulation requirements.

All composite fibre (CF) crossarm installations must be recorded in SAP. Refer to NS220.

4.2.2 Crossarm length

Crossarm lengths shall be chosen to meet design requirements such as midspan separation. The range of suitable crossarms is shown on each standard construction drawing.

Note: The thread diameter of bare conductor insulator pins is 24mm (requiring 26mm crossarm hole), whereas the thread diameter of CCT post insulators is 16mm (requiring 18mm crossarm hole). Therefore, when converting bare conductor to CCT, the crossarms shall be changed, since the use of the 16mm threads in 26mm crossarm holes is not mechanically sound.

4.3 Pole selection

Refer to NS128 Pole installation and Removal for the pole selection criteria.

Poles shall be positioned in accordance with the requirements of NS167.

4.4 Insulator selection

4.4.1 Insulators for CCT

Insulator selection is specified in standard construction drawings.

For line construction, solid-core type pin post insulators shall be used.

Solid-core strain rod insulators and strain clamps shall be used at termination points and with high angle deviation (>50° for horizontal configuration or >30° for vertical configuration). The strain rod insulator currently available has a tongue and clevis designed to attach to a strain clamp.

4.4.2 Insulators for bare conductors

Insulators for the 11kV and 22kV system shall be chosen to meet the performance requirements for the environmental conditions for the location.

4.4.2.1 Through constructions

In areas with known high levels of air pollution or salinity, such as areas within 2km of major bodies of salt water (including bays, lakes and rivers) or high pollution industries, ALP/22/450 shall be used for its higher insulation level. Otherwise use ALP/11/275.

Table 3 – Insulator Selection

Environment and Voltage	Insulator	Stockcode
Normal, 11kV	ALP/11/275	75705
High-pollution 11kV or normal 22kV	ALP/22/450	75697

4.4.2.2 Termination constructions

All new bare conductor termination constructions shall use polymeric longrod insulators.

4.5 Lightning protection

4.5.1 Lightning protection for CCT

CCT lines are more prone to damage due to lightning compared to bare wire mains. For all CCT lines, the distance between surge arresters shall be less than 500m. For locations that are known to be more lightning prone such as hilltops a reduced distance shall be used. Additional surge arresters shall also be used to protect CCT where there are gaps in shielding.

Surge arresters must also be installed at CCT to bare conductor transition points to prevent surges originating in the bare conductor system. If the transition point is an ABS, then the surge arresters shall be installed one span away from the ABS on the CCT side.

4.5.1.1 Shielding from lightning strikes

CCT shall not be used except where the line is sufficiently shielded from direct lightning strikes. A span of mains is considered shielded from direct lightning strikes if:

- there is at least one object (such as a tree) taller than the line, within 5 metres horizontally, and the vertical distance this object is above the line is at least 3 times the horizontal distance this object is away from the line (i.e. inside the cross-hatched section in Figure 1), or;
- there is at least one object on each side of the line that is taller than the line, within 15 metres horizontally, and the vertical distance these objects are above the line is at least half the horizontal distance they are away from the line (i.e. inside both sides of the dotted section in Figure 1).

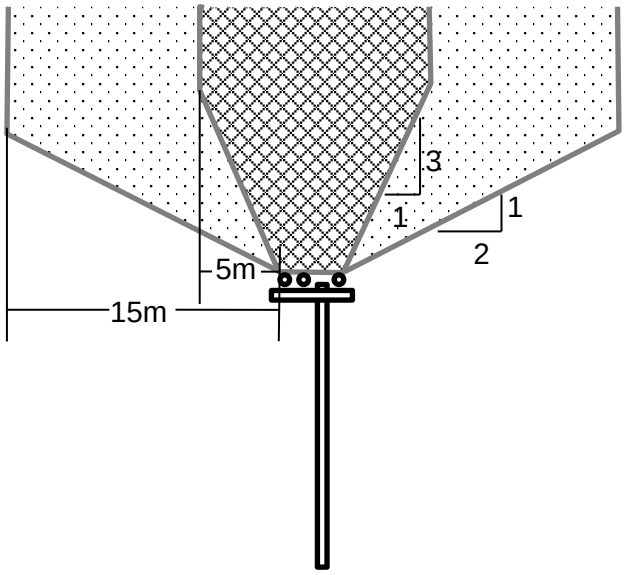

Figure 1 – Shielding zones

Where there are unshielded spans of CCT in an otherwise predominantly shielded line, surge arrestors shall be used to protect the unshielded spans of CCT.

Where the mains are shielded, CCT:

- shall be used where there is a significant risk from tree branches falling onto the mains or wind-blown debris coming into contact with the mains, disrupting supply or initiating bushfires etc. (as evidenced by the location of vegetation relative to the mains or by the frequency of past outages).
- may also be used to achieve a reduced phase separation or in a vertical construction to reduce tree trimming.

4.5.2 Lightning protection at switching locations

Surge arresters shall be earthed in accordance with NS116 Design Standards for Distribution Earthing and shall be designed and constructed in accordance with the relevant standard construction drawings listed in NS116.

4.6 Handling polymeric insulators and surge arresters

Polymeric insulators/surge arresters are fragile and shall be handled with care in accordance with NSA 1494 Polymeric Insulator Handling Guide. They shall be inspected for damage before installation; damaged insulators or surge arresters shall not be installed.

5.0 CLEARANCE CRITERIA

All clearances shall be met at the time the network is built or altered in any way, including construction of new lines, pole replacements or relocations, conductor replacements and crossarm replacements. This includes the clearances to ground and structures specified in in NS220 and the vegetation clearances in NS179 Vegetation Management.

For live-line design principles refer to NS214 Guide to Live Line Design Principles.

6.0 CONSTRUCTION

Lines shall be constructed in accordance with the standard construction drawings listed in Annexure A.

6.1 Conductor erection

The two principle methods of line erection are paying-out and pulling-in. Of the two, pulling-in is the preferred method as it minimises the likelihood of damage to the conductor during the installation process.

When tensioning a new conductor, a suitable allowance shall be made for the initial stretch ("creep") of the conductor.

6.2 Phasing

The configuration of phases shall be according to the particular installation requirements as specified in the design. Where there are no installation constraints, the following configuration shall be used:

- Phase A: Bottom conductor or footpath / property side
- Phase B: Centre conductor
- Phase C: Top conductor or road side

6.3 Clearances and spacing

6.3.1 Phase-to-phase spacing for CCT

For new construction, the minimum phase-to-phase spacing between conductors shall be 500mm. This shall apply at the structures as well as midspan.

Interphase clearance must be strictly adhered to. Small deviations will cause a reduction in Basic Insulation Level resulting in a decrease in performance of the line.

6.3.2 Line stagger for bare conductor

For horizontal pin insulator construction (2-1), the centre conductor is staggered by orienting the centre pin insulator on opposite sides of each successive pole as shown in Figure 2 - Line stagger. This maximises the mid-span separation between conductors.

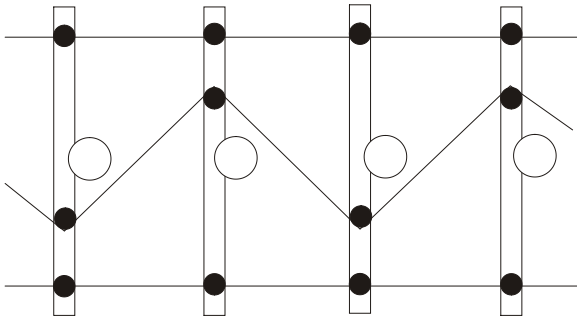

Figure 2 - Line stagger

6.3.3 Separation between HV and LV

The separation between HV and LV circuits at the pole depends on whether the HV network is intended to be worked on using live-line techniques.

Air-break switches designs shall assume the use of live-line techniques and the live-line clearances of NS220 apply.

Spur lines shall be designed and constructed with live-line circuit to circuit separations.

CCT is not maintained with live-line techniques and the non-live-line clearances of NS220 apply.

6.4 Railway crossings

Where poles are positioned near a rail corridor, it must meet the requirements of NS167.

Refer to NS220 for clearances.

6.5 Navigable waterway crossings

Where a section of line crosses a navigable waterway it must meet the requirements of NS268.

Refer to NS220 for clearances.

6.6 Pole Installation and removal

Refer to NS128, NS167 and NS220.

6.7 Staying of poles

Where poles are required to be stayed, it must meet the requirements of NS220.

6.8 11kV UGOH constructions

HV UGOH constructions shall be constructed in accordance with the requirements of:

- NS177 11kV Joints (including Transition Joints) & Terminations - Polymeric Insulated Cables, or
- NS129 11kV Joints and Terminations – Paper Insulated Lead Covered Cables,
- labelled in accordance with NS158 Labelling of Mains and Apparatus.

Earthing requirements are specified in NS116.

6.9 CCT precautions

The following precautions shall be taken when working with CCT:

- When pulling in cables take care not to damage the insulation.
- Never bend the cable tighter than the minimum bending radius.
- Do not drop the cable or drag it along the ground or over any obstacle.
- Do not let the cable rub against poles.
- Where insulation is to be removed from a CCT conductor, it must be removed using tools and procedures specifically designed for this purpose. The conductor MUST NOT be damaged during stripping. The use of incorrect tools and procedures can lead to premature failure of the conductor.
- CCT insulation must not be removed at the pin or post insulator.

6.10 CCT Insulation integrity

To maintain the integrity of the system, it is essential the covering is restored at all points where the covering is stripped or punctured. Special purpose covers shall be installed correctly on each piece of hardware, such as electrical connections and mechanical terminations.

6.11 CCT water-blocking compound

Water-blocking compound is used to prevent the migration of water along the inside of the conductor. The rubbery compound fills the interstices between strands and the space between the aluminium conductor surface and the covering.

The water-blocking between the outer strands must be removed when stripping the conductor to make electrical connections.

6.12 Fittings and insulating covers

6.12.1 Strain clamp and cover for CCT

Strain clamps for CCT lines are made of aluminium alloy and employ wedge action for easy installation on the conductor and taking the full line tension after installation. The rack and pinion mechanism and the conductor holder bolt further assist the installation of the clamp.

Table 5 – Ausgrid Strain Clamp Stockcodes

CCT Cable	Strain Clamp	Strain Clamp Cover
80mm²	144535	144543
120mm²	144527	144543
180mm²	176313	181248

The strain clamp cover folds over the unit and is locked together with tags. It is difficult to remove covers after installation.

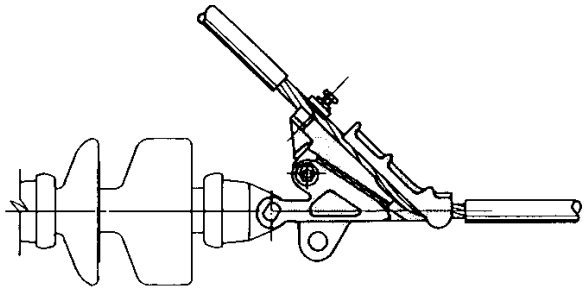

Figure 3 - Strain Clamp (shown without cover)

6.12.2 Parallel groove clamp and cover for CCT

Parallel Groove (PG) clamps are used to make non-tension connections between conductors. The two cast aluminium halves of PG connectors are held together with aluminium bolts and nuts and stainless steel washers. The connectors accommodate the following range of conductor sizes:

- Main conductor: 7/3.75 to 19/3.5 (CCT80, CCT120, CCT180)
- Tapping conductor: 7/3.75 to 19/3.5 (CCT80, CCT120, CCT180)

Table 6 – Ausgrid CCT PG Clamp Stockcodes

PG Clamp	PG Clamp Cover
62414	144576

The PG cover has tapered conductor entries, which are trimmed to size depending on the size of CCT conductor used.

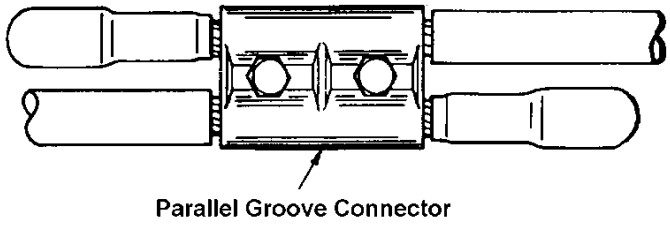

Figure 4 - Parallel Groove Clamp (shown without cover)

PG clamps shall comply with the requirements of AS 1154.1.

6.12.3 Standard earthing point and cover for CCT

Earthing points must be established at all points where it is envisaged that access permit earths or working earths will be required. These locations are on either side of pole mounted equipment, at tee-offs and anywhere else required to ensure working earths can be installed within line-of-sight of the work area.

Where pole mounted equipment requires that access permit earths or working earths be installed from an elevating work platform, they shall be placed at least one metre from the vertical projection of the nearest energised conductor. To accommodate this, the earthing point shall be established at least one metre from the dropper cable.

Such standard earthing points are created by removing 125mm of the insulation on the CCT at each nominated point. An earthing point cover shall be installed at each earthing point. The cover is moved along the conductor to reveal the earthing point by tapping with an earthing stick. The cover must be returned to its correct position after removal of the earths. The stockcode for the earthing point cover is 144741.

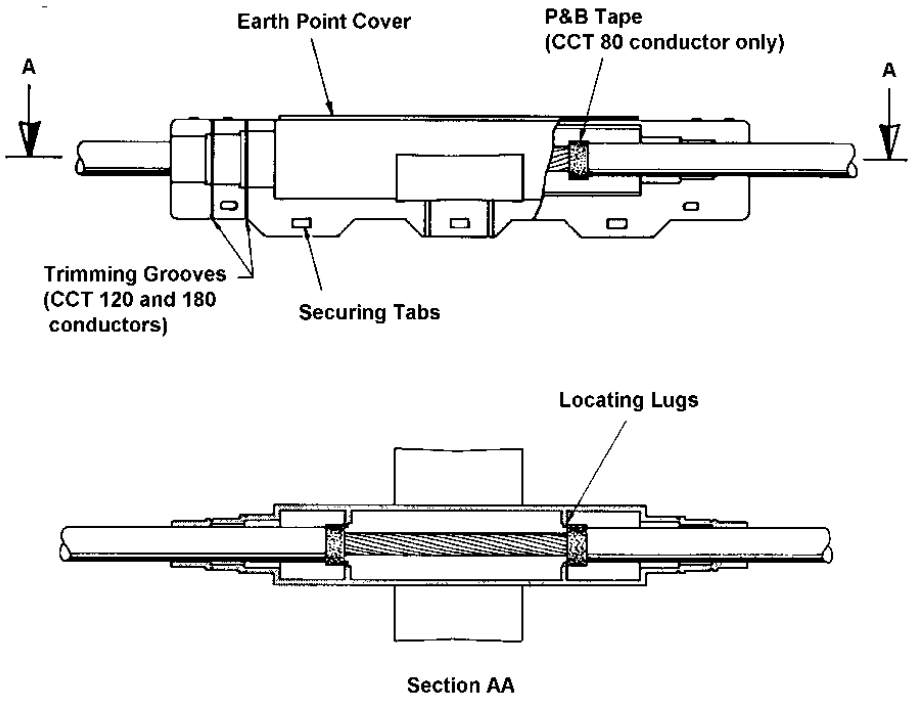

Figure 5 - Earth Point Cover

6.12.4 Full tension joint for CCT

Full tension joints must only be used to joint conductors that are the same size and type. When more than one phase is jointed in a span, joint positions of different phases must be offset by at least 1m. The heatshrink covering will protect the conductor but is not equivalent to the original

conductor covering and care must be taken in the placement of joints to ensure that they are not subjected to abrasion.

Table 7 - Ausgrid Full Tension Joint Stockcodes

CCT Cable	Full Tension Joint sleeve	Mastic coated heatshrink tube
80mm²	144733	Supplied with sleeve
120mm²	144725	Supplied with sleeve
180mm²	176321	Supplied with sleeve

6.12.5 Tie wires

6.12.5.1 Tie wires for CCT

Three tie wire sizes are available for CCT, one to match each conductor size, with colour coded end caps identifying each size. Bare tie wires must not be used on CCT due to the risks with electrical tracking and degradation of the CCT insulation.

Table 8 - Ausgrid Tie Wire for CCT Stockcodes

CCT Cable	Tie Wire
80mm²	144618
120mm²	144600
180mm²	176312

6.12.5.2 Tie wires for bare conductor

Tie wire for bare conductor shall be 5mm diameter annealed aluminium or copper to suit the conductor used.

6.12.6 Sleeves and compression lugs for bare conductor

Compression lugs, full tension and non-tension sleeves shall be installed in accordance with the manufacturer's instructions, particularly the tooling used (e.g. versa crimp or hexagonal die) and number of crimps.

6.12.7 Preparation for joints

Aluminium connectors which are not supplied with factory applied jointing compound shall be wire-brushed and coated with a jointing compound just before the connection is made. Joint compound used with aluminium connections shall seal out air and moisture, minimising oxidation or corrosion and maximising conductivity. In certain applications it shall contain conductive (zinc) particles within the compound to penetrate oxide films that form on the aluminium surfaces.

Oxide coatings on copper components shall be thoroughly removed using either emery paper or a wire brush and an oxide inhibiting and moisture proofing Type 1 jointing compound shall be applied on the contact surfaces before the connection is made.

Aluminium connectors require an aluminium wire brush and copper connectors require a copper wire brush.

6.13 Angle of deviation specifications for CCT

Table 9 - Angle of Deviation Specifications

Angle of Deviation	Required Construction
Vertical construction 0° - 10° deviation	Post insulator on bracket. (stockcode: 144626)
Vertical construction 10° - 30° deviation	Post insulator on angle bracket. (stockcode: 144634)
Vertical construction > 30° deviation	Strain clamp and strain rod arrangement.
Horizontal construction 0° - 25° deviation	Pin post (single crossarm).
Horizontal construction 25° - 50°	Pin post (double crossarm).
Horizontal construction > 50°	Strain clamp and strain rod arrangement.
Delta Construction 0° - 25° deviation	Post insulators on single crossarm and one pole raiser.
Delta Construction 25° - 50° deviation	Post insulators on double crossarms and two pole raisers.
Delta Construction > 50° deviation	Strain clamp and strain rod arrangement.

6.14 Pole-top operating devices

Pole-top operating devices shall be located and oriented so that they can be safely operated. Wherever practical, when installed next to a road, the operating mechanism shall be installed such that they can be operated by standing on the side of the pole away from the road.

On CCT lines, standard earthing points and covers shall be provided on both sides of each operating device.

6.14.1 Air break switches

Air Break Switches (ABSs) and their operating mechanisms shall be installed such that no pole attachments are less than 3.6m above ground level.

All ABSs shall be mounted on poles in accordance with Drawing Nos. 175902 and 255645.

6.15 Redundant mains and hardware

Where overhead mains are redundant, the designer must make provision in the design to remove redundant assets when work is identified on the pole structure.

All redundant hardware, including connectors, shall be removed at the time it is made redundant. Any other redundant hardware already present shall also be removed.

7.0 STORES AND MATERIALS

Only approved materials and equipment may be used in the construction of infrastructure which ultimately forms part of Ausgrid's electrical network. The approved materials and equipment contained in this Network Standard are detailed in Ausgrid's Approved Material List (AML) with manufacturer and supplier information and Ausgrid stockcodes where appropriate. Ausgrid will consider adding alternative materials and equipment to the AML in accordance with NS181.

ASPs may obtain approved materials and equipment items as listed in the AML from any source. Where an ASP wishes to use alternative materials and equipment, application to have the materials or equipment considered for approval is to be made in accordance with NS181. Alternatively, where approved materials and equipment are held as stock in Ausgrid's stores system, ASPs may purchase them from Ausgrid. All enquiries and requests for quotations should be directed by email to aspsales@ausgrid.com.au.

All materials used on Ausgrid's network must be new.

8.0 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 the document repository. The responsibilities of persons for the design or construction work detailed in this Network Standard are identified throughout in the context of the requirements to which they apply.

9.0 RELATED DOCUMENTS

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.

ASPs and other persons external to Ausgrid are responsible for sourcing any required manufacturer's instructions and manuals.

9.1 Ausgrid documents

- Bush Fire Risk Management Plan
- Electrical Safety Rules
- ES4 Service Provider Authorisation
- NS116 Design Standards for Distribution Equipment Earthing
- NS122 Pole Mounted Substation Site Selection and Construction
- NS125 Construction of Low Voltage Overhead Mains
- NS128 Pole Installation and Removal
- NS129 11kV Joints and Terminations – Paper Insulated Lead Covered Cables
- NS135 Construction of 33kV, 66kV and 132kV Overhead Mains
- NS158 Labelling of Mains and Apparatus
- NS167 Positioning of Poles and Lighting Columns
- NS177 11kV Joints (including Transition Joints) & Terminations - Polymeric Insulated Cables
- NS179 Vegetation Safety Clearances
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS214 Guide to Live Line Design Principles
- NS220 Overhead Design Manual
- NS268 Specification for Design and Construction of Waterway Crossings
- NSA 1494 Polymeric Insulator Handling Guide
- Tree Safety Management Plan

9.2 Other standards and documents

- AS 1154 Insulator and conductor fittings for overhead power lines - Series
- AS 1222 Steel conductors and stays – Bare overhead
- AS 1307.2 Surge arresters - Metal-oxide surge arresters without gaps for a.c. systems
- AS 1531 Conductors – Bare overhead, Aluminium and aluminium alloy
- AS 1746 Conductors – Bare overhead – Hard-drawn copper
- AS/NZS 2947 Insulators - Porcelain and glass for overhead power lines - Voltages greater than 1000 V a.c. - Test methods
- AS 3607 Conductors – Bare overhead, Aluminium and aluminium alloy – Steel reinforced
- AS/NZS 3675 Conductors - Covered overhead - For working voltages 6.35/11(12) kV up to and including 19/33(36) kV
- AS/NZS 3599.1 Electric cables - Aerial bundled - Polymeric insulated - Voltages 6.35/11(12) kV and 12.7/22(24) kV - Metallic screened
- AS/NZS 3599.2 Electric cables - Aerial bundled - Polymeric insulated - Voltages 6.35/11(12) kV and 12.7/22(24) kV - Non-metallic screened
- AS/NZS 4676 Structural design requirements for utility services poles

- AS 6947 Crossing of waterways by electricity infrastructure
- AS/NZS 7000 Overhead line design - Detailed procedures
- Crossings of NSW Navigable Waters: Electricity Industry Code
- ENA Doc 001-2019 National Electricity Network Safety Code
- Relevant Industry and SafeWork NSW Guides and Codes of Practice

9.3 Acts and regulations

- All pertinent Environmental Regulations and Acts
- Electricity Supply (General) Regulation 2014 (NSW)
- Electricity Supply (Safety and Network Management) Regulation 2014
- Electricity (Consumer Safety) Act 2004 No 4
- Electricity (Consumer Safety) Regulation 2006
- Electricity Supply Act 1995 No 94
- Electricity Supply (Corrosion Protection) Regulation 2008
- Work Health and Safety Act 2011 and Regulation 2017 (NSW)

10.0 DEFINITIONS

Refer to NS001 Glossary of Terms

11.0 RECORDKEEPING

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

Table 10 - Recordkeeping

Type of Record	Storage Location	Retention Period*
Approved copy of the Network Standard	Document repository Network sub process Standard – Company	Unlimited
Draft Copies of the Network Standard during amendment/creation	Records management Work Folder for Network Standards (HPRM ref. 2014/21250/206)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	Records management Work Folder for Network Standards (HPRM ref. 2014/21250/206)	Unlimited

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

12.0 DOCUMENT CONTROL

Document Owner : Head of Asset Risk & Performance

Distribution Coordinator : Manager Asset Standards

ANNEXURE A – STANDARD CONSTRUCTION DRAWINGS

Note 1: Conical (volute) washers shall be used on all bolts used to secure crossarms to a pole or equipment to a crossarm or pole. The approved method for a crossarm attached to a pole is to use a bolt fitted with a square washer, through the pole, gain block and crossarm then use 1 x square washer, 1 x conical washer, 1 x round washer and finally the nut.

Note 2: Equipment mounted on a crossarm similarly requires either 2 x square washers or the steelwork substituting 1 x square washer, plus 1 x conical washer, 1 x round washer and a nut. Both cases require a large surface area in contact with the timber to prevent indentation.

Table A1 - CCT Conductor Standard Construction Drawings

Description	Construction Number	Drawing Number
11kV Horizontal Pin Construction	2-1CCT	174956
11kV Offset Arm Construction	2-2CCT	174957
11kV ¾ Offset Arm Construction	2-4CCT	175880
11kV Small Delta Construction	2-5CCT	174958
11kV Delta Construction	2-6CCT	174959
11kV Large Delta Construction	2-7CCT	174960
11kV Termination Construction	2-10CCT	174961
11kV Through Termination Construction	2-11CCT	174962
11kV Corner Pole Termination Construction	2-12CCT	174963
11kV Tee-Off Construction	2-14CCT	174964
11kV Large Through Delta Termination Construction	2-30CCT	174965
11kV Large Delta Corner Construction	2-31CCT	174966
11kV Large Through Delta Termination with Tee-Off Construction	2-37CCT	174967
11kV Large Delta with Tee-Off Construction	2-38CCT	174968
11kV Through Termination Construction with Dropout Fuses or Isolating Links	2-60CCT	175886
11kV Tee-Off Construction with Dropout Fuses or Isolating Links	2-61CCT	175887
11kV Horizontal Pin Twin Crossarm Construction	2-101CCT	175883
11kV Delta Twin Crossarm Construction	2-106CCT	175884
11kV Large Delta Twin Crossarm Construction	2-107CCT	175885
11kV Vertical Termination Construction	2-140CCT	163265
11kV Vertical 4 Way Termination Construction	2-142CCT	175878
11kV Vertical Through Termination with Tee Off Construction	2-146CCT	163144
11kV Delta Pin Post Construction	2-200CCT	163146
11kV Vertical Pin Post Construction	2-240CCT	163145
11kV Vertical Pin Post with Tee Off Construction	2-242CCT	175876
11kV Vertical Pin Post 4 Way Crossover Construction	2-243CCT	175877
11kV Distribution Vertical CCT to UGOH Connection Assembly	-	167676*

Description	Construction Number	Drawing Number
Standard Construction 11kV CCT Surge Arrester Arrangements	-	177151

* Only with approval from Ausgrid.

Table A2 - CCT to Bare Conductor Standard Construction Drawings

Description	Construction Number	Drawing Number
11kV CCT to Bare Conductor Through Termination Construction	2-411	154233
11kV CCT to Bare Conductor Corner Pole Termination Construction	2-412	154234
11kV Bare Conductor to CCT Tee-Off Construction	2-414	154235
11kV CCT to Bare Conductor Large Delta Through Termination Construction	2-430	154236
11kV CCT to Bare Conductor Large Delta Corner Construction	2-431	154237
11kV Bare Conductor Large Through Delta Termination with CCT Tee-Off Construction	2-437	154238
11kV Bare Conductor Large Delta with CCT Tee-Off Construction	2-438	154239
11kV CCT to Bare Conductor Vertical Termination Construction	2-4140	177229
CCT Fittings: Overhead Line Compression Fittings Index		514053

Table A3 - Bare Conductor Lines Standard Construction Drawings

Description	Construction Number	Drawing Number
11kV Constructions		
11kV Flat Pin Construction	2-1	513909
11kV Offset Arm Construction	2-2	513910
11kV Angle Suspension Construction	2-3	513911
11kV ¾ Offset Arm Construction	2-4	175879
11kV Small Delta Construction	2-5	513912
11kV Delta Pin Construction (see note)	2-6	520222
11kV Large Delta Pin Construction (see note)	2-7	513913
11kV Horizontal Pin Construction with ABS and UGOH Arrangement	-	166585*
11kV Termination Construction with ABS and UGOH Arrangement located behind termination	-	166590*
11kV Termination Construction with ABS and UGOH Arrangement located under termination	-	166595*
11kV Termination Construction	2-10	513914
11kV Through Termination Construction	2-11	513915
11kV Corner Pole Termination	2-12	513916
11kV Tee-off Construction	2-14	513917

Description	Construction Number	Drawing Number
11kV Railway Termination RHS Galv. Crossarm	2-23	513918
11kV Large Through Delta Termination Construction	2-30	513919
11kV Large Delta Corner Construction (see note)	2-31	513943
11kV Large Through Delta Termination with tee-off construction (see note)	2-37	514180
11kV Large Delta with tee-off construction (see note)	2-38	520410
11kV Through Termination Construction with Drop-out Fuses or Isolating Links	2-60	514007
11kV Tee-Off Construction with Drop-out Fuses or Isolating Links	2-61	513895
11kV Vertical Termination Construction	2-140	175875
11kV Vertical 4 Way Termination Construction	2-142	244675
11kV Vertical Through Termination with Tee Off	2-146	251941
11kV Vertical Delta Construction	2-200	183908
11kV Vertical Construction	2-240	183907
11kV Pole Top Capacitors Construction Detail		162475
Standard Construction Pole Top Regulator Ground Mounted Fibreglass Cabinet Concrete Footing Details		191227
Standard Construction 11kV Underground to Overhead Construction Details		160354
22kV Constructions		
22kV Horizontal Pin Construction	3-1	513993
22kV Small Delta Construction	3-5	513994
22kV Delta Construction	3-6	258023
22kV Large Delta Construction	3-7	255617
22kV Termination Construction	3-10	513991
22kV Through Termination Construction	3-11	513992
22kV Corner Pole Termination Construction	3-12	255618
22kV Large Through Delta Termination	3-30	255619
22kV Through Termination Construction with Dropout Fuses or Isolating links	3-60	255643
22kV Tee-Off Construction with Dropout Fuses or Isolating links	3-61	255644
22kV Vertical Termination Construction	3-140	184959
22kV Vertical Delta Construction	3-200	184958
22kV Vertical Construction	3-240	184957
Bare Conductor Fittings		
Overhead Line Compression Fittings Index		514053
Standard Construction 11/22kV Aerodynamic Insulator and Pin Arrangement		513997

Description	Construction Number	Drawing Number
Standard Construction 11kV Longrod Insulator String Arrangement		565715

* Only with approval from Ausgrid.

Note: Constructions 2-6, 2-7, 2-31, 2-37, 2-38 are for use with long spans only.

Table A4 – Pole Mounted Equipment Standard Construction Drawings

Description	Construction Number	Drawing Number
Standard Construction 2 Unit 11kV Pole Mounted Regulator with Ground Mounted Control Panel		224401*
Standard Construction 3 Unit 11kV Pole Mounted Regulator with Ground Mounted Controllers		224229*
Standard Construction 11kV S&C IntelliRupter Pulse closer without Bypass Air Break Switch		220041*
Standard Construction 11kV S&C IntelliRupter Pulsecloser Controlling Pole Mounted Regulators		224228*
Standard Construction 11kV S&C IntelliRupter Pulsecloser with By-Pass Air Break Switch General Arrangement	-	220251*
Standard Construction 11kV Pole Mounted Regulator with Controlling IntelliRupter		224227
Standard Construction 11kV S&C IntelliRupter Pulsecloser with phase to phase VT mounted on a Composite pole General Arrangement		244230
Standard Construction 11kV S&C IntelliRupter Pulsecloser with phase to phase VT mounted on a Composite pole - Pole drilling details		244231
Standard Construction 2 Unit 11kV Pole Mounted Regulator with Pole Mounted Control Panel		224402*
11kV AK Power Mid Pole Operated Air Break Switch for Timber, Composite, Concrete & Steel Poles	2-455	175902-1
11kV NGK Mid Pole Operated Air Break Switch for Timber, Composite, Concrete & Steel Poles	2-455	175902-2
22kV AK Power Mid Pole Operated Air Break Switch for Timber, Composite, Concrete & Steel Poles	3-455	255645-1
22kV NGK Mid Pole Operated Air Break Switch for Timber, Composite, Concrete & Steel Poles	3-455	255645-2
Standard Construction 11kV NOJA Type OSM15 Recloser with By-Pass Air Break Switch Mounted on a timber pole General Arrangement		255677

* Only with approval from Ausgrid.