

Network Standard

NETWORK

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NW000-S0056

NS122 POLE MOUNTED SUBSTATION SITE SELECTION AND CONSTRUCTION



ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design, construction or equipping of pole mounted substations 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Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document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 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.

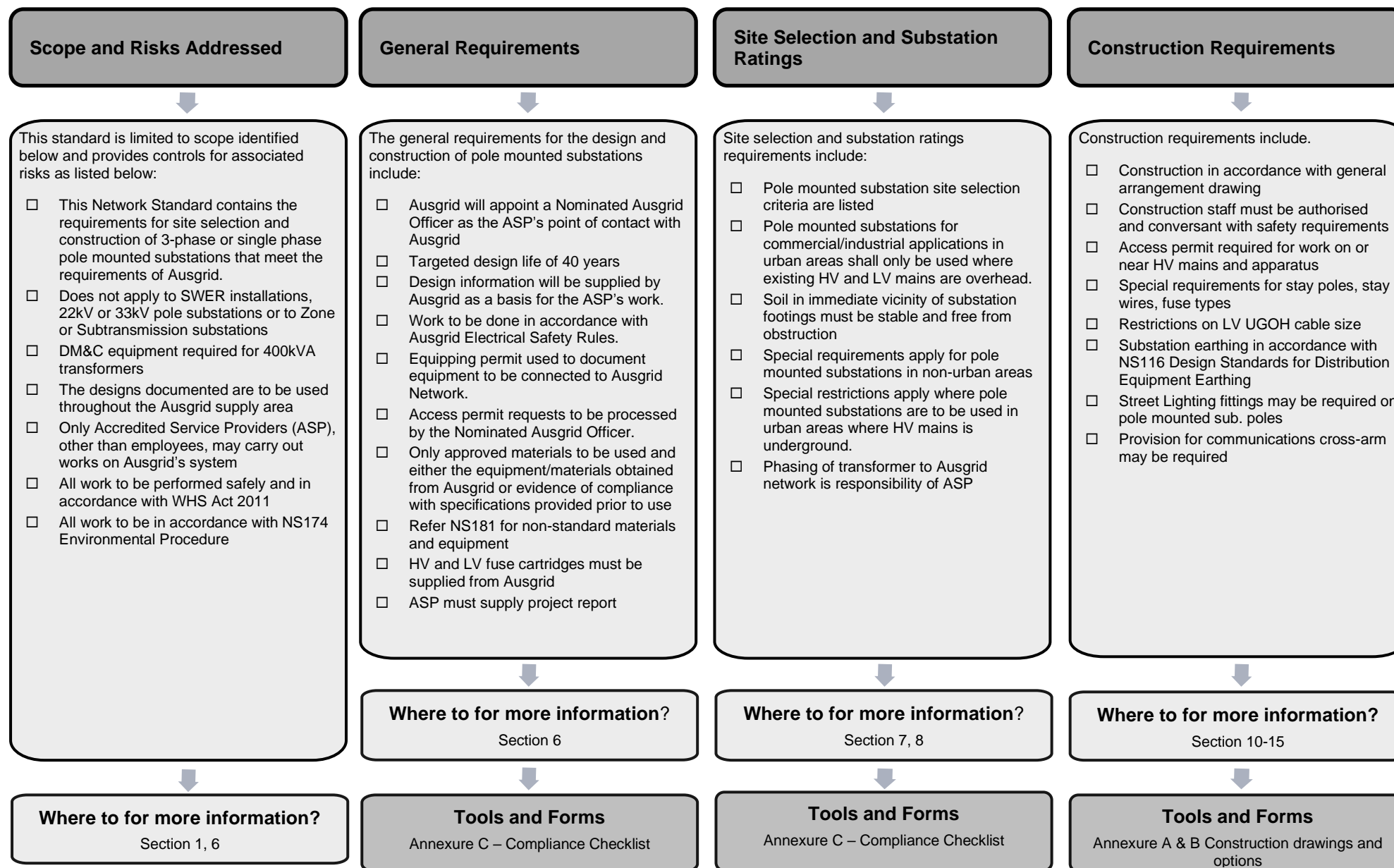
KEYPOINTS

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



Network Standard NS122 Pole Mounted Substation Site Selection and Construction

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1.0 PURPOSE

This Network Standard sets out the requirements for site selection and construction of pole mounted substations used for the reticulation of electricity to domestic, commercial and industrial customers supplied by Ausgrid.

The Network Standard specifies the requirements for the electrical construction of pole mounted substations designed to provide 3-phase four wire 415/240 Volt or single phase 500/250 Volt AC supply.

Ausgrid is responsible for the management and operation of Ausgrid's electricity supply network. The network is a major infrastructure investment and is required to operate economically and reliably under all weather and other environmental conditions.

The requirements in this Network Standard are intended to satisfy a range of functions far wider than basic electrical performance and economy. These functional requirements include meeting all statutory and safety obligations, operating effectively under adverse environmental conditions and utilising approved new components that have demonstrated reliability.

This Network Standard may be amended or updated at any time to reflect advances in design and technology. The Accredited Service Provider shall make sure that the latest version of this Network Standard is used for the equipping of the substation to which it applies.

The requirement of this Network Standard must be adhered to.

Any proposed deviation from this Network Standard must be submitted to Ausgrid's Engineering Branch via the Contestable Projects Co-ordinator for consideration / approval prior to implementation.

2.0 SCOPE

This Network Standard applies to:

- 11kV/433 Volt 3-phase pole substations
- 11kV/500-250 Volt single phase pole substations
- 22kV/500-250 Volt single phase pole substations

This standard does not apply to:

- Single Wire Earth Return (SWER) installations
- 22kV/433 Volt 3-phase pole substations
- 33kV/433 Volt 3-phase pole substations.
- Zone or sub-transmission substations, 11kV regulators or auto transformers

Note to Accredited Service Providers:

Accredited Service Providers are advised to make sure they refer to Master Drawing Option List for 11kV and 22kV single phase and 3-phase pole substations, shown in Appendix B. This list is essential for ensuring the correct construction methods and equipment selection for each substation.

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. 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

- Bush Fire Risk Management Plan
- Company Form (Governance) - Network Document Endorsement and Approval
- Company Procedure (Governance) - Network Document Endorsement and Approval
- Company Procedure (Network) - Production / Review of Network Standards
- Connection Policy - Connection Charges
- Contract for Design Related Services (CDRS)
- Customer Connection Contract (NECF) and related documents
- Customer Installation Safety Plan
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- ES 4 Service Provider Authorisation
- NEGOSH21 Vegetation Safety Clearances
- NS100 Field Recording of Network Assets
- NS104 Specification for Electrical Network Project Design Plans
- NS109 Design Standards for Overhead Supply Developments and Distribution Centres
- NS112 Design Standards for Commercial and Industrial Development
- NS116 Design Standards for Distribution Equipment Earthing
- NS119 Street Lighting Design and Construction
- NS125 Construction of Low Voltage Overhead Mains
- NS126 Construction of High Voltage Overhead Mains
- NS127 Specification for Low Voltage Cable Joints and Terminations
- NS128 Pole Installation and Removal
- NS129 11kV Joints and Terminations – Paper Insulated Lead Covered Cables
- NS130 Specification for Laying Underground Cables up to 11kV
- NS146 Inspection Procedure for Working on Poles
- NS148 Overhead Line Support, Street Light Column, Pits and Pillar Numbering
- NS158 Labelling of Mains and Apparatus
- NS161 Specification for Testing of Underground Cables
- NS167 Positioning of Poles and Lighting Columns
- NS174 Environmental Procedures
- **NS179 Vegetation Management**
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS209 Operating Cranes & Plant in Proximity to Overhead Power Lines
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS220 Overhead Design Manual
- NS230 Testing of Distribution Substations
- Policy for ASP/1 Premises Connections
- Public Electrical Safety Awareness Plan
- Public Lighting Management Plan

- Tree Safety Management Plan
- TS4200 Fuse Standard

The current revision of NS122, including all relevant Network Standard Advices (NSA's), must be on site at all times during construction, testing and commissioning.

A current revision of the Electrical Safety Rules, including all relevant Network Standard Advices (NSA's) must be on site at all times during construction, testing and commissioning.

3.3 Other standards and documents

- AS 1214-1983 Hot dipped galvanised coatings on threaded fasteners (ISO metric coarse thread series)
- AS 3818.11-2009 - Timber - Heavy structural products - Visually graded - Utility poles
- AS/NZS 4680:2006 Hot dipped galvanised (zinc) coatings on fabricated ferrous articles
- AS/NZS 60079.10.1:2009 Explosive atmospheres - Classification of areas - Explosive gas atmospheres (IEC 60079-10-1, Ed.1.0(2008) MOD)
- ENA Doc 001-2019 National Electricity Network Safety Code
- ISSC3 Guideline for Managing Vegetation Near Power Lines
- SafeWork NSW Codes of Practice

3.4 Acts and regulations

- Electricity Supply (General) Regulation 2014 (NSW)
- Electricity Supply (Safety and Network Management) Regulation 2014
- Electricity Supply (Safety Plan) Regulation 1997
- Work Health and Safety Act 2011 and Regulation 2017

4.0 DEFINITIONS

Refer to NS001 Glossary of Terms.

5.0 ASBESTOS

All materials and equipment used for construction of Ausgrid's assets are to be free from Asbestos and or Asbestos related products. Suppliers are expected to comply with the Work Health and Safety Act 2011 (NSW) together with the Work Health and Safety Regulation 2017 (NSW). Suppliers shall confirm in writing that all products supplied to Ausgrid contain no Asbestos related materials.

6.0 GENERAL REQUIREMENTS

6.1 General

Only the pole mounted substation designs documented in this Network Standard shall be used throughout the Ausgrid supply area.

6.2 Design life

The target design life of pole mounted substation electrical equipment is 40 years. This target design life sets particular requirements for careful selection of materials and equipment and for high standards of workmanship.

Accredited Service Providers shall make sure that their actions in installing and constructing the substation will always assist in developing a substation that will meet its performance requirements, including the design life.

6.3 Design information

Ausgrid will provide design information for the preparation of a design that meets the requirements of Ausgrid.

For further information on Design Information refer to Ausgrid's Website documentation Contract for Design Related Services (CDRS) and Policy for ASP/1 Premises Connections.

6.4 Equipping permit

Work on or near Ausgrid's mains and apparatus may only be carried out in accordance with the Electrical Safety Rules. In particular, Accredited Service Providers may only commence work at the substation site after they have completed an Equipping Permit for the particular project. The purpose of the Equipping Permit is detailed in the Electrical Safety Rules.

The Equipping Permit must be displayed at the substation construction site at all times and is available from the nominated Ausgrid officer.

The Electrical Safety Rules and other regulations include but are not limited to the following requirements:

- Correct personal protective equipment / clothing for the task is worn when working on or near the network.
- First aid kit to be on site.
- Pole rescue kit to be at the base of the pole.
- Approved fall-arrest equipment must be worn when there is a risk of falling 2 or more metres.
- Hazard Assessment Check (HAC) to be completed at the start of the construction and each subsequent day.
- Safety equipment and tools to be checked before each use.
- Environmental requirements shall be identified and controls are in place.
- Traffic control procedures are to be implemented where required.
- Work site to be defined and marked using reflective cones where the work is undertaken in a public street.

6.5 Access permit

It is the Accredited Service Provider's Responsibility to notify the nominated Ausgrid Officer of any requirements to be fulfilled prior to the issue of an Access Permit. The Ausgrid Officer will liaise with Network Control. The relevant documentation shall be completed by the Accredited Service Provider and forwarded to the Ausgrid Officer a minimum of 20 full working days in advance.

Details of issue, acceptance and the conditions under which an Access Permit is issued are contained in the Electrical Safety Rules. The Accredited Service Provider must work in accordance with the provisions of these Electrical Safety Rules.

6.6 Provision of approved materials

All materials necessary for contestable work shall be new Approved Materials supplied by the Service Provider and shall be in accordance with the Ausgrid Approved Materials List which is available on the Ausgrid website under Network Standard NS181.

Ausgrid's ASP Materials Sales can provide Approved Materials from its stores system at commercial rates. Whilst this method of obtaining materials may have a number of advantages for Service Providers, it is not compulsory. Materials may instead be purchased directly from the manufacturer, in accordance with the Approved Material List.

To order any of the pole transformer substation items from Ausgrid, quote the appropriate stockcode number from the Standard Construction drawings listed in the Annexures-Ausgrid's ASP Materials Sales can be contacted via email – aspsales@ausgrid.com.au

6.7 Reporting

The Accredited Service Provider shall provide Ausgrid with a detailed project report. The report shall be provided to Ausgrid's Compliance Officer as soon as possible after completion of testing and before termination of HV and LV conductors to Ausgrid's network. (ie before substation commissioning).

The details of the Project Report required are shown in NS 100 Field Recording of Network Assets and NS104 Specification for Electrical Network Project Design Plans.

6.7.1 Substation identification code

Each substation is to be identified by the drawing modules used to construct the substation. The Master Drawing Option list at the end of Annexure B has provision for identifying each drawing module used in the construction.

A complete identification code is required for each substation. The following is an example:

1A/2A/3B/4C/6A/7A/8A/9A/10A/11A/12A/13A/14B/15A.

6.8 Testing and auditing

The Accredited Service Provider is responsible for pre-commissioning testing to make sure the completed substation complies with this Network Standard.

Ausgrid reserves the right to audit the work performed by the Accredited Service Provider. The level of inspection carried out on any particular project will depend upon the level of accreditation of the Accredited Service Provider, the project complexity and the reports of Ausgrid's Officers.

6.9 Safety

All work shall be carried out in accordance with the relevant legislation, regulations and codes of practice. These include:

- WorkCover Codes of Practice
- Work Health and Safety Act 2011 and Regulation 2011
- Electrical Safety Rules.

6.10 Environment

All work must be carried out in accordance with NS174 Environmental Procedure.

6.11 Reporting of accidents/incidents

The Accredited Service Provider is responsible for the reporting of all injuries or accidents that occur to employees or the general public. The Accredited Service Provider must also report damage to equipment owned by Ausgrid or others. Reports shall be made to the nominated Ausgrid Officer immediately, as well as to statutory authorities as required.

Should an accident occur during the lead up work or construction, which damages other network equipment, the damage shall be rectified by Ausgrid at the Accredited Service Provider's cost.

7.0 SITE SELECTION

7.1 General

NS109 Design Standards for Overhead Supply Developments and Distribution Centres and NS112 Design Standards for Commercial and Industrial Developments must be complied with for projects involving an extension to either the HV or LV mains. The selection of substation type is normally dependent on the mains installed. In general, kiosk substations are installed in locations with underground HV mains. Pole mounted substations are installed in locations with overhead HV mains. The substation type will be specified by Ausgrid.

7.2 Pole mounted substation site selection

The pole mounted substation shall be located in an area that is well-drained and clear of overhead obstructions. The substation and access route shall not be within an area that is classified as hazardous by AS/NZS 60079.10.1:2009 Explosive atmospheres - Classification of areas - Explosive gas atmospheres (IEC 60079-10-1, Ed.1.0(2008) MOD).

The immediate area surrounding the pole mounted substation should provide a firm, level base with sufficient space to safely erect a standard 4m/7m extension ladder. A space for the ladder 1 metre square with the centre of the space 1.5 metres from the base of the pole is satisfactory.

The visual impact on the streetscape must be considered when locating the pole mounted substation.

A review of environmental factors shall be carried out and the risks assessed at the stage prior to selecting the site.

A pole mounted 11kV or 22kV substation shall not be located:

- Within an overhead or underground transmission line easement.
- On 132kV, 66kV or 33kV poles.
- Where possible, within 3 metres of a concrete driveway.
- In locations which are clearly hazardous as detailed in NS167 Positioning Poles and Lighting Columns.
- In reclaimed land, land-fill sites, wetlands or similar locations.
- At sites with an unsatisfactory evaluation of environmental impact.
- Within the easement or footpath allocation of another utility (eg communication carrier, gas, water, rail, etc) without the prior written permission being obtained from the relevant utility – refer to NS130 Specification for Laying Underground Cables up to 11kV - Annexure C for footway allocations.

To minimise oil spill risk to the environment, pole mounted substations should not be located in close proximity to rivers, creeks, natural or man-made water courses and storm-water drains. Locations near paved surfaces or concrete aprons that drain into the storm-water system are also unacceptable.

Wherever possible, pole mounted substations should not be located:

- Within 40 metres upstream of a waterway or sensitive environment (eg wetland, national park or nature reserve).

- Within 5 metres upstream of a grated drain or pit, where there would be less than 500mm of permeable strip between the substation pole and the kerb.
- Within an area of high ground water (where the ground water would be normally less than 1 metre below ground level).
- Within an area prone to flooding, or containing a drainage path or storm water ponding area
- Adjacent to steep downhill slopes of 10% grade or more.
- Within high bushfire risk areas (Vegetation Category 1).
- Additional factors affecting pole positioning are detailed in NS167 Positioning of Poles and Lighting Columns.

7.3 Height restrictions

All parts of transformers, supporting structures and equipment which are mounted on or attached to the poles or cross arms are to be at heights not less than in Table 1. Conductors are exempt from this table.

Table 1: Height Restrictions

Location	Height above ground
More than 500mm from the vertical projection of the kerb line in the direction away from the vehicular carriageway	3600mm
Elsewhere	***5000mm (***Government gazette for high loads)

The equipment height above ground must not exceed that shown on the pole detail drawings:

- Drawing No.228821 - 11kV 3 phase pole substations
- Drawing No.228831 - 11/22 kV single phase pole substations

Any attachments to the pole shall not facilitate unauthorised climbing as per NS128 Pole Installation and Removal.

A locality sketch as per NS104 Specification for Electrical Network Project Design Plans of the site selected for a pole mounted substation shall be prepared and submitted to the local council. This allows council to advise Ausgrid of any future developments in the area. Council submission must take place at least 40 days before the programmed commencement of construction. This requirement does not apply to the replacement of a pole mounted substation on a condemned pole, provided, the replacement pole mounted substation is adjacent to the existing substation.

7.4 Foundations

The soil in the immediate vicinity of the substation footings shall be stable and clear of any obstructions that could interfere with the installation of the substation and the associated earthing system. See NS128 Pole Installation and Removal.

7.5 Requirements for commercial/industrial application in urban areas

As specified in NS109 Design Standards for Overhead Supply Developments and Distribution and NS112 Design Standards for Industrial and Commercial Developments, pole mounted substations shall only be used for commercial and industrial developments where the existing HV and LV mains are overhead.

7.6 Pole mounted substation site selection in non-urban areas

Where a pole mounted substation is not being established on a dedicated roadway, minimum requirements are:

- provision for wet weather access to the substation for heavy mobile crane and trucks (max 22,500 kg). Delays in access due to wet weather ground conditions could affect the repair time.

- pole mounted substation and associated Ausgrid's mains shall be accommodated on a 15 metre wide easement.
- pole mounted substation and associated mains shall be clear of trees and vegetation as detailed in NS179.

7.7 Requirements for pole mounted substation in urban areas supplying the LV network

Pole mounted substations may be connected to the existing overhead HV mains in urban areas where the substation is to be installed on a dedicated roadway for supply to the LV network.

Pole mounted substations may only be used in urban residential areas with underground HV mains when:

- there is insufficient space on the dedicated roadway for a kiosk type substation and no other suitable site can be negotiated
- the installation is approved by Ausgrid's Engineering Branch.
- HV UGOH's are not permitted on pole mounted distribution transformer poles. If required, the HV UGOH is to be installed on an adjacent pole (new pole if required) and HV connection to pole transformer via aerial cable.

7.8 Fire segregation requirements for pole mounted substation

The siting of pole mounted substations shall comply with the requirements of all relevant authorities (including fire control authorities) in relation to segregation from buildings, structures, etc.

Pole mounted substations shall be separated from building air intake and exhaust openings and natural ventilation openings by separation distances that meet the requirements of all relevant authorities and Australian Standards.

In addition to the requirements of relevant authorities, the following specific additional Ausgrid requirements shall be satisfied:

- The vertical projection of open fire evacuation routes from buildings (excluding single residential dwellings) shall not encroach within 1.5 metres of a pole mounted substation transformer up to 63 kVA, increasing pro-rata to 3 metres for a 400 kVA substation. This is to ensure the route is not impacted in the event of a substation fire.
- The emergency exit doors from buildings shall not be directly downslope of a pole mounted substation. This is to ensure that the emergency exit door is not impacted in the event of burning oil on the ground.
- Any portion of a building within 3 metres of a pole mounted substation transformer shall have a Fire Resistance Level (FRL) of not less than 120/120/120. This requirement does not apply to a NCC (BCA) Class 10a structure constructed from non-combustible materials.
- Openable or fixed windows or glass blockwork or similar, irrespective of their fire rating, are not permitted within 3 metres of a pole mounted substation transformer.
- The vertical projection of an area which may be used for outdoor storage of combustible material (excluding combustible liquids) shall not encroach within 3 metres of a pole mounted substation transformer.
- A site-specific fire hazard assessment shall be completed for areas that may be used for outdoor storage of combustible liquids, where the vertical projection of the area is within 6 metres of a pole mounted substation transformer.
- Areas which may be used for outdoor storage of combustible material or combustible liquids shall not be directly downslope of a pole mounted substation.
- In addition to the requirements above, an exclusion zone shall apply for a 1 metre distance around the sides of a pole mounted substation transformer and extending vertically down to ground level. There shall be no structure, or any other item listed above, within the exclusion zone.

Separation distances shall be measured from the exterior of the pole mounted transformer tank. Refer to Figures 1 and 2.

The requirements of this Clause do not apply to the replacement of an existing pole mounted substation within the same area, provided that:

- any existing encroachments, and the associated fire risks, are not increased;
- an equivalent sized replacement unit is installed; and
- a site fully compliant with this Clause is not reasonably available.

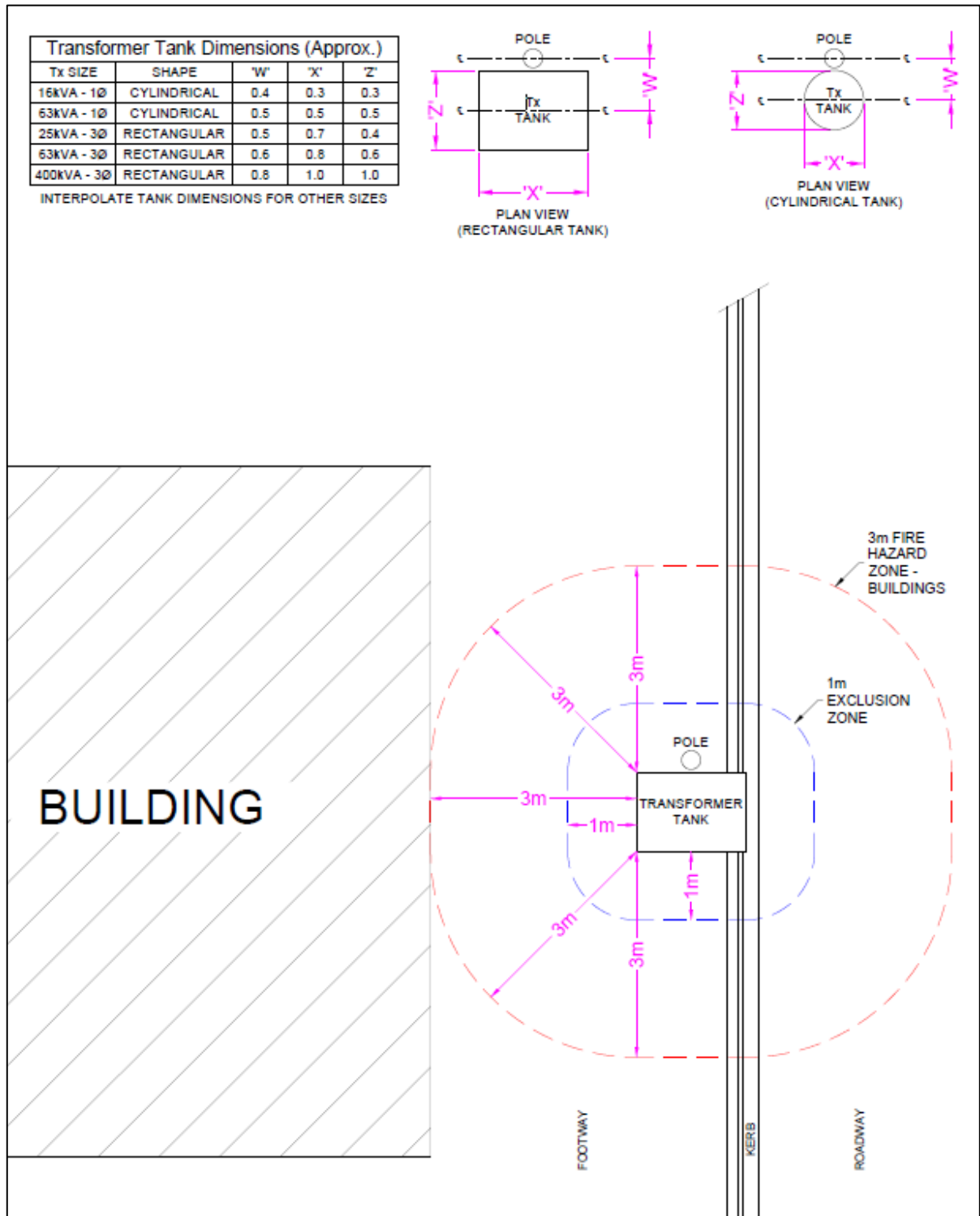


Figure 1 – Fire Segregation – Plan View

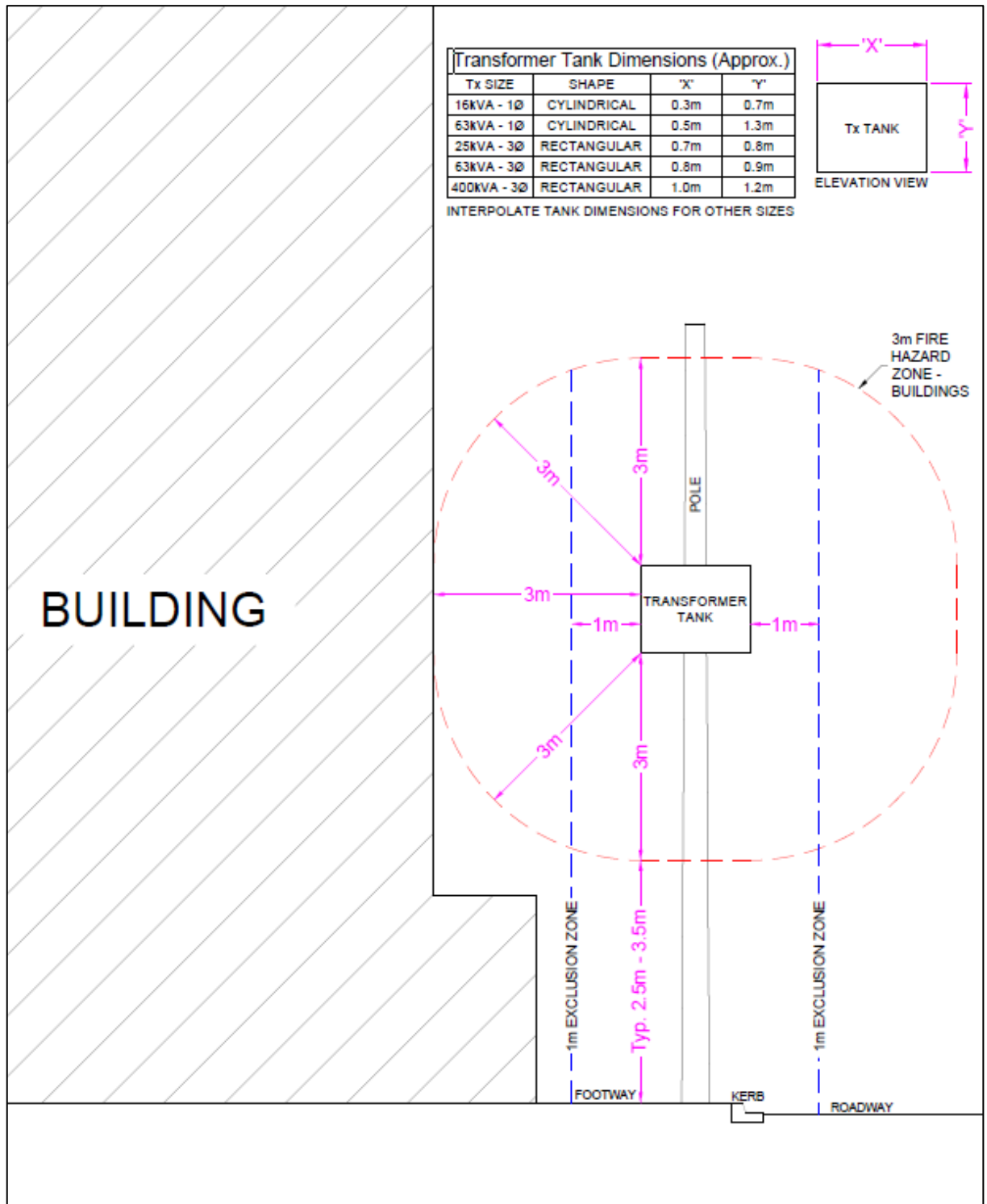


Figure 2 – Fire Segregation – Elevation View

8.0 SUBSTATION RATINGS

8.1 General

Ausgrid's standard pole mounted substation design type, alternatives and options will be detailed in the design information document. The transformer rating can be from 16kVA single phase up to a maximum of 400kVA 3-phase.

The actual future maximum fault levels for the substation shall also be included in the Design Information document. This will determine the type of HV dropout fuses to be used.

At present there are four types of HV dropout fuses approved for use in Ausgrid.

Table 2 – Ausgrid Approved HV drop-out Fuses

Fault Level	Voltage	Fuse Base and Carrier Type
Up to 8kA	11/22kV	Fuse base and expulsion fuse link in accordance with Ausgrid's current specification (S/C H84350)
8kA – 11.2kA	11kV	S & C 12kV SMD-20 fuse base and boric acid fuse link (S/C H70029)
8kA – 10kA	22kV	S & C 24kV SMD-20 fuse base and boric acid fuse link (S/C 181441)
>11.2kA (11kV) or > 10kA (22kV)	11/22kV	Pole substations installed in locations where the high voltage fault level exceeds 11.2kA (11kV) or 10kA (22kV) should be avoided due to the technical difficulties associated with HV protection. Kiosk substations should normally be installed in such situations. However, where the installation of a kiosk substation is not practical and where Ausgrid approval is given, a pole substation may be installed, provided the substation is equipped with appropriate fault current limiting HV fuses. Further advice should be obtained from the Manager – Engineering

Dyn1 vector transformers shall not be installed in the ex-Hunter area. The ex-Hunter area encompasses all local council areas north of the Hawkesbury River except the Central Coast.

It is the responsibility of the Accredited Service Provider to make sure that the pole transformer substation will phase out correctly with the surrounding network after construction.

8.2 Pole mounted substation options

Ausgrid offers 3-phase pole mounted transformers for 11kV with ratings ranging from 25kVA up to 400kVA. Ausgrid also offers single phase pole mounted transformers for 11kV with ratings ranging from 16kVA up to 63kVA. and for 22kV with a rating of 25kVA.

The Master Options List table in Annexure B details the options that are available for 11/22kV substations.

8.2.1 Transformer ratings

The available transformer ratings are detailed in Table 3.

Table 3 – Transformer ratings available at Ausgrid

11kV Single Phase 11kV/500-250V (Pole Mounted)	11kV 3-Phase 11kV/433-250V (Strap Hung)	22kV Single Phase 22kV/500-250V (Pole Mounted)
16kVA, 25kVA, 63kVA	Dyn11 - 25kVA, 63kVA, 100kVA, 200kVA, 400kVA Dyn1 – 400kVA	25kVA

Refer to 8.1 regarding 3 phase Dyn1 and Dyn11 requirements.

8.2.2 Recycled transformers

Recycled transformers can only be used on network funded projects. Materials used for contestable work must be new.

9.0 SUBSTATION CONSTRUCTION

9.1 General

The equipment shall be installed in accordance with the pole transformer General Arrangement drawing and associated module drawings that detail the configuration specified.

Ausgrid will not formally accept the substation until all specified work, including the repair of any damage resulting from the course of the works, has been completed to the satisfaction of Ausgrid's Compliance Officer.

9.2 Ausgrid substation drawings

Annexure A lists the drawings for the construction of pole mounted substations.

The drawings required to meet the project requirements will be selected by Ausgrid from the Master Drawing Options List as per Annexure B.

9.3 Safety clearances

The safety clearances to be observed by the Accredited Service Provider whilst constructing the substation are contained or referenced in the Electrical Safety Rules.

The Accredited Service Provider shall be responsible for ensuring that all construction employees are authorised and fully conversant with the necessary clearances for personnel, tools and construction plant (Work Health and Safety Regulation 2011, ISSC3, Guideline for Managing Vegetation Near Power Lines and NS209 Operating Cranes & Plant in Proximity to Overhead Power Lines) from exposed live mains and apparatus. Where construction is located near an existing LV open wire network, the Accredited Service Provider shall have all exposed LV mains and earth situations suitably screened.

LV rubber gloves shall not be used to approach HV lines closer than the minimum safe working distances. Only employees specifically trained and qualified in live line procedures are exempt.

An Access Permit is required for any work on or near HV mains and apparatus.

10.0 CONSTRUCTION STANDARDS APPLICABLE TO ALL POLE MOUNTED SUBSTATIONS

10.1 Construction standards

The following construction standards apply to all pole-mounted substations installed in Ausgrid's supply area:

- The pole mounted substation shall be sited in accordance with the locality sketch.
- The pole shall be installed in accordance with NS128 Pole Installation and Removal.
- The orientation of the transformer on the pole shall be aligned for correct phasing and where possible, pole climbing access is on the pole side opposite the direction of traffic flow.
- The pole foundation shall be installed in accordance with arrangement 3 of drawing 508726 (Cement Stabilised backfill).

Note: Before installing the transformer on the pole either on the same day or in the subsequent days, the stability of the pole must be assessed by an experienced worker to make sure the safety of employees. The provision of the overhead mains and/or stay poles will increase the pole stability.

- Bolts, nuts and washers used for the connection of all electrical equipment and earthing conductors to pole mounted substation equipment shall be stainless steel grade 316 or better. Before installation of any stainless steel bolt/setscrew, the thread shall be lubricated with specially formulated anti-seize grease incorporating nickel. Loctite Nickel anti-seize (stockcode 177212) or equivalent is acceptable.
- Where the lubricating grease will be in contact with an electrical insulating medium, the supplier of the insulating medium shall be consulted to make sure of product compatibility.
- Stainless steel bolts must never form part of a current carrying circuit; they must be only used to clamp the current carrying components together.
- All steelwork, including bolts passing through timber, shall be hot dipped galvanised to AS/NZS 4680:2006 (Hot dipped galvanised (zinc) coatings on fabricated ferrous articles) and/or as appropriate to AS-1214-1983 (Hot dipped galvanised coatings on threaded fasteners).
- The threaded section of all galvanised bolts shall be coated before installation with KOPR-KOTE anti-seize lubricant (stockcode 177211).
- Galvanised conical (volute) washers shall be used on all bolts used to secure cross-arms to a pole and/or equipment to cross arms or a pole. The approved method for a cross-arm attached to a pole is to use a bolt fitted with a square washer. Install the bolt through the pole, gain block and cross arm. To secure use a square washer, conical washer, round washer and a nut.
- Equipment mounted on a cross arm requires 2 x square washers, or the steelwork substituting one square washer, plus a galvanised conical washer, round washer and a nut. Both techniques require a large surface area in contact with the timber to prevent indentation. The conical washer is used to allow for timber shrinkage.
- LV surge arresters shall be installed on each phase of all pole transformers in accordance with the relevant LV detail drawing.
- Where the transformer is of the free air breathing type, a check shall be made to ensure the breather is free to breath. Any seal fitted to prevent oil spillage during transport shall be removed.
- Hexagonal compression lugs compatible to the cable size and crimp die and tool compatible with the lug shall be used for all terminations on bare and insulated cables greater than 6mm².

Note: Split bolt clamps are acceptable for auxiliary connections, as detailed on earthing drawings.

- Bi-metallic hexagonal compression lugs compatible to the cable size and crimp die shall be used for all aluminium to copper terminations.
- Shrouds shall be installed on all HV and LV phase bushings and on the line side of HV surge arrester terminations. Where bare cable lugs extend external to the shrouds, install medium walled mastic lined black heat shrink over the bare lug barrel and cable insulation.

- Where 240mm² flexible cable is installed between the transformer bushings and the LV fuses, the interface between the end of the cable and the compression lug is to be covered with a mastic lined medium walled black heat shrink a distance of 50mm either side of the end of the lug. This aims to prevent water ingress and oxidation of the flexible conductors.
- All poles used for new pole mounted substations shall be of timber construction which is to Ausgrid's specifications and detailed in the Approved Materials List.
- Existing 11kV single phase substations may be up-rated to a 3-phase substation rated less than 100kVA. This is done by installing additional HV drop-out fuses, LV fuses and a transformer mounting bracket. Transformer LV cables must adhere to the LV cable sizes in Table 4 of this Network Standard.
- HV and LV fusing shall comply with Ausgrid's fusing schedule.
- In situations where a new pole substation is to be installed into an existing LV open wire construction, the LV open wire construction can be retained if it meets the requirements listed in Network Standard 125. In situations where an existing pole substation is to be uprated or altered and LV open wire construction exists, the LV open wire construction can be retained if it meets the requirements listed in Network Standard 125.
- The requirements for handling, drilling and after treatment following pole damage are detailed in NS128 Pole Installation and Removal.
- A Maximum Demand Indicator (MDI) and associated current transformer which displays the maximum twenty minute demand shall be installed on all 3-phase substations rated at 100kVA and above. It shall also be installed on single phase substations where specified. The MDI CT is supplied with all transformers.

Note: MDI's are not required on 3 phase substations supplying a single customer unless specified.

- An engraved label, affixed to the MDI shall display the constant K of the MDI.
- Pole steps shall be installed in accordance with the relevant pole detail drawing. A minimum distance of 3.6 metres must be allowed between the finished ground level and the lowest pole step. Pole step spacing shall not exceed 450mm. The clearance from HV equipment (especially the earthing bolts on drop-out fuses) to any pole step, shall not be less than 200mm for 11kV and 300mm for 22kV. The pole step must be removed if this clearance cannot be achieved.
- Permanent and removable pole steps or holes for pole steps must not be provided between ground level and 3.6 metres above ground level.
- New or upgraded service connections at pole transformers are only permitted where there are no reasonable alternatives. A new private pole or mid span connected service (where LV ABC distribution mains exist) must be installed if this would avoid a service connection at a pole transformer.
- No other fixtures except those detailed in the design drawings listed in Annexure A shall be fitted on the pole for new installations (refer to NS128).
- Existing poles that require replacement shall not have any existing meter boxes re-installed on the new pole.
- The pole mounted distribution substation number shall be located approximately 3.2 metres above ground level.
- The pole mounted distribution substation number shall be supplied and installed as detailed in NS158 Labelling of Mains and Apparatus.
- LV distributor labelling shall be supplied and installed as detailed in NS158.
- A single customer fuse ID is not required.
- HV surge arresters shall be installed on each high voltage phase of all pole transformers in accordance with general arrangement drawing. A shroud shall be placed over each surge arrester to eliminate interference from birds or animals.
- LV cable between the transformer LV bushings, LV fuses and mains shall have a minimum rating of V90, 0.6/1.0kV black XLPE insulated, stranded copper conductor. The cable shall have a minimum size as specified in Table 3. A shroud shall be placed over each phase bushing to eliminate interference from birds or animals.

Table 4 - LV Cable Sizes

Transformer Rating	LV Cable Size Phase Conductors Copper /XLPE Black insulation	LV Cable Size Neutral Conductor Copper/XLPE Black insulation
Up to 25kVA single phase	1 x 35mm ² (19/1.35)	1 x 70mm ² (19/1.35)
63kVA single phase Up to 100kVA 3-phase	1 x 95mm ² (37/1.78)	1 x 95mm ² (37/1.78)
200kVA 3-phase	1 x 185mm ² (37/2.52)	1 x 185mm ² (37/2.52)
400kVA 3-phase	1 x 240mm ² (1211/0.50)	1 x 240mm ² (1211/0.50)

10.2 Stays

10.2.1 Stay poles and stay wires

A pole that will be subjected to unbalanced loads which would exceed the permissible design load limits of the pole must be stayed in accordance with NS128.

The stay wire is to be attached to the pole at a distance of 600mm above the HV drop-out fuse cross-arm. A minimum clearance of 350mm is required between the stay wire and the HV equipment.

10.2.2 Stay cross arms

A LV cross arm that will be subjected to unbalanced loads which would exceed the permissible design load limits of the cross arm, must be stayed in accordance with drawing numbers 228823 and 228833 prior to attaching the unbalanced load to the cross arm.

10.3 Fuses

Only Ausgrid specified HV and LV fuse bases, carriers and fuse link can be used.

The Design Information document specifies the high and low voltage fuse link types and ratings to be used.

10.4 Phasing

The HV and LV connections to the substation must 'phase' with the surrounding HV and LV networks where they exist. Phasing of the substation means the orientation of the HV and LV conductors and connections will exactly match with the orientation of the surrounding network.

The Accredited Service Provider is responsible for constructing the connections between the HV mains and the transformer and between the transformer and the LV fuse switch assembly. The connections will phase with either the existing and/or the new primary and secondary distribution systems.

Ausgrid will test the phasing of the new substation at the time of commissioning. The Accredited Service Provider is required to attend the commissioning to witness the phasing tests. The Accredited Service Provider will be responsible for any alterations resulting from incorrect phasing.

11.0 SUBSTATIONS LV UGOH CABLE INSTALLATION AND TERMINATION

LV UGOH cables on PT poles must be in accordance to NS127 Specification for Low Voltage Cable Joints and Terminations.

The total number of UGOHs that can be attached to a pole substation is detailed in NS127.

Insulated mechanical protection, as specified for LV cables, is to be provided 300mm below ground to 3000mm above ground level. Refer to NS127 for full details.

All LV cable terminations shall be in accordance with NS127.

All cables shall be tested as required in NS161 Specification for Testing of Cables after Installation.

12.0 SUBSTATION EARTHING

The substation earthing shall comply with drawing numbers 228822, 228832 and NS116 Design Standards for Distribution Equipment Earthing.

Refer to individual site earthing design to determine earthing system required, electrode minimum spacing and number of electrodes required (minimum of 2 per group). Refer to NS116 for further details.

The electrodes shall be driven in a direct line between the pole mounted substation and the adjacent 11kV feeder poles.

13.0 STREET LIGHTING

Although not the preferred option, street light fittings may be required to be mounted on pole substation structures where:

- the code lighting scheme demands an installation in the vicinity, and
- it would be necessary to erect an additional pole solely for the purpose of mounting the street light fitting.

An approved fitting shall be installed if required.

The types of fittings required will depend upon the lighting classification code.

The design information will indicate if a street light is required and the type of fitting to be installed.

Depending on the region of the construction, the street light fitting shall be installed to comply with the requirements of NS119 Street Lighting Design and Construction.

In addition, the fittings shall be:

- attached to the pole at the height nominated on the relevant street light drawing numbers 228826 for 3 phase or 228836 for single phase;
- controlled by a photo electric cell internally fitted in the lamp fixture by the light manufacturer; and
- supplied from the load side of a LV distributor fuse or distribution mains at the pole transformer by means of a 2.5mm² double insulated cable and installed as detailed on the street lighting module drawing.

Notes:

1. The bracket and associated fitting must not be earthed.
2. Double insulated cable shall be used within the bracket and fitting up to the point of termination.
3. Floodlights shall not be installed on a pole substation.

14.0 COMMUNICATIONS ARM

Pole mounted substation poles shall have a communications cross-arm installed only if a communications cable exists. The position on the pole and type of cross arm is detailed on drawing numbers 228821 for 3 phase and 228831 for single phase.

Communication cables are not to be mounted directly on the pole or via a standoff bracket, but must be mounted on a communication cross arm.

Where communications cables are required on a pole substation, the cable shall be installed on the property side of the communication cross-arm. The communications cable fittings on the communication cross-arm must be isolated from earth potential. The earthed catenary wire shall be insulated with a minimum 0.6/1kV insulated UV stabilised cover extending 2 metres either side of the pole. Typical covers would be Raychem, 3M zippered or clip-on line covers.

The communication cable catenary wire shall not be connected to the substation earth at a pole substation.

No junction or termination boxes are permitted on a substation pole, only through connections are accepted.

15.0 PRE-COMMISSIONING CHECK

Once substation testing is complete, the Accredited Service Provider shall carry out a pre-commissioning check and a report confirming:

- The required tests have been completed and passed the minimum criteria as per NS230 Testing of Distribution Substations.
- The substation is completed to the relevant drawings and is ready for service.
- All operational and asset numbers are correctly in place.
- Pole mounted 'Danger High Voltage' signs are correctly in place.
- The substation cannot be climbed by unauthorised persons.
- All work has been performed in a tradesperson like manner and is fit for purpose.
- The HV drop-out fuse and LV fuse size complies with the Design Information.
- The transformer tap position is set correctly.
- All asset details have been recorded as detailed in NS100 Field Recording of Network Assets and NS104 Specification for Electrical Network Project Design Plans.

16.0 INSPECTION

Ausgrid reserves the right to inspect, at any time, the work being carried out by the Accredited Service Provider, their employees and sub-contractors.

A pre-commissioning inspection may be carried out by the Ausgrid Compliance Officer following the completion of the substation. The inspection will make sure of conformity to the Design Information, all associated Network Standards and the relevant design drawings.

Any major defects which can be shown to be associated with the Accredited Service Provider's shall be rectified before commissioning tests are commenced. A non-conformance notice shall be issued for all major defects.

Any minor defects that can be shown to be associated with the Accredited Service Provider's work will not preclude the commissioning of the substation. A non-conformance notice shall be issued for all minor defects. Minor defects shall be rectified within 10 days of the non-conformance notice.

Major and minor defects are defined in Section 4 – Definitions of this Network Standard.

The Accredited Service Provider shall attend the network inspection to rectify any major defects detected during the inspection.

17.0 COMMISSIONING

Ausgrid shall carry out the commissioning tests of the pole mounted substation as outlined below.

The Accredited Service Provider, working under an 'Access Permit', shall connect the substation HV and LV mains to the network.

Note: If an external Accredited Service Provider is not able to undertake the connection work, arrangements should be made for Ausgrid to carry out the work at the Accredited Service Provider's cost.

The Accredited Service Provider shall arrange for an Access Permit by submitting a Disconnection and Reconnection Order.

The Accredited Service Provider shall attend the commissioning to witness the phasing tests and correct any incorrect phasing.

The commissioning tests shall include but not be limited to:

- Closing the HV drop-out line fuses and listen for any unusual noise within the transformer.
- Identifying the LV neutral.
- Carrying out a voltage test from the line side of the LV fuses to include: a-b, b-c, c-a, a-n, b-n, c-n. The voltage readings should be the same (approx. 433V phase-phase and 250V phase to earth).
- Phasing out the LV to a known source of supply. The phase rotation should be checked when there are no paralleling points. If the substation is not in LV parallel, then the LV fuses will have to be closed and the LV phased out at all possible paralleling points.
- Documenting the results of the above commissioning tests and submitting the results to the Compliance Officer.

18.0 ACCEPTANCE

The pole mounted substation shall be accepted at a time following the commissioning of the substation and Practical Completion. The date of commissioning the substation shall initiate the start of the warranty period as per Customer Connection Contract (NECF) and related documents.

19.0 RECORDKEEPING

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

Table 5 – 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 system Work Folder for Network Standards (HPRM ref. 2014/21250/347)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	Records management system Work Folder for Network Standards (HPRM ref. 2014/21250/347)	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.

20.0 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 Network Standards. 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.

Annexure A – List of Drawings

Annexure A provides the List of Drawings relevant to this Network Standard. The drawings listed are the relevant drawings at the time of publishing this standard. These drawings are subject to change without notice. It is the responsibility of the Contestable Projects Coordinator to obtain the correct and latest versions of the drawings for supply to the Accredited Service Provider.

Table A1 11kV/415 volt, 25 – 400kVA, 3-phase, Pole mounted substation

Drawing	Equipment
228821	11kV 3-phase 0-400kVA Timber Pole Mounted Substation, General Arrangement
228822	Combined and Segregated Earthing Connection Details
228823	HV, LV and Communications Cross arm Details
228824	LV Transformer and LV ABC Connections
228825	11kV Overhead Supply Connection Options
228826	Street Lighting Detail
228827	LV Open Wire Connections
508726	Timber Pole Footing Arrangement
566101	Distribution Substation Pole Mounting Brackets Details

Table A2 11/22kV / 500-250 volt, 16 – 63kVA, single phase, Pole mounted substation

Drawing	Equipment
228831	11/22kV Single Phase 0-63kVA Timber Pole Mounted Substation, General Arrangement
228832	Combined and Segregated Earthing Connection Details
228833	HV, LV and Communications Cross arm Details
228834	LV Transformer and LV ABC Connections
228835	11kV Overhead Supply Connection Options
228836	Street Lighting Detail
228837	LV Open Wire Connections
508726	Timber Pole Footing Arrangement

Table A3 All pole substations

Drawing	Equipment
164578	Maximum Demand Indicator – Enclosure and Prewired Unit
566345	Cross arm Details for 11kV and LV
566374	Insulation Cover for Transformer Mounting Bracket

Annexure B – Master Option List (11/22kV Substations)

B1 Using master option list

1. Starting at selection 1 (general arrangement details) select one of the options a, b, c, or d and note the drawing required for the option selected.
2. Next using selection 2 (pole detail) again select one of the options a-e noting the drawing required for the option selected.
3. Continue the above for selections 3 through to 15.
4. If a selection is not required, eg street light, skip that option.
5. At the end (15), the list of drawings noted are the drawings required to construct the substation to the options selected.

The selected options also identify the substation construction record. The following is an example:

1A/2A/3B/4B/6A/7A/8A/9A/10A/11A/12A/13A/14B/15A.

This record is required to be included in the substation formal report.

Table B1 0–400 kVA 3-phase Pole Mounted Substation Master Option List

	Selection	A	B	C	D	E	Notes
	HV line construction details	11kV					See NS126
1	General Arrangement details	11kV 0 – 400kVA Dwg. 228821					
2	Pole details	11kV 0 – 400kVA Dwg. 228821					
3	HV fuse arm details	11kV Fuse Base - for Dropout Type Fuse <8kA Dwg. 228823	11kV Fuse Base - for Dropout Type Fuse 8-11.2kA Dwg. 228823				
4	LV fuse arm details	25 - <200kVA single circuit ABC Dwg. 228823	200-400kVA dual circuit ABC Dwg. 228823				
5	LV Overhead to underground (UGOH)	Low voltage Dwg. 228821					Refer Sect 11 of this Network Standard
6	Transformer mounting detail	Strap hung 25 – 400kVA Dwg. 228821					All transformers are strap hung
7	HV cable detail – HV dropper and HV arresters	11kV Dwg. 228821					
8	LV cabling detail – Transformer to LV fuses	25 –100kVA Dwg. 228824	>100 –400kVA Dwg. 228824				
9	Earthing details	Combined system Dwg. 228822	Segregated system Dwg. 228822				See NS116
10	Maximum Demand Indicator details	3 phase sub MDI Dwg. 228824					
11	Street light details	3 phase sub Dwg. 228826					See NS119
12	Miscellaneous equipment	Dwg. 228821					Safety sign, Sub No LV ID, Asset No.
13	Communications cable / Operating arm	3 phase sub Dwg. 228821 Dwg. 228823					
14	HV mains connection detail	End termination Dwg. 228825	Parallel Groove Clamps Dwg. 228825	Hot line clamps Dwg. 228825	CCT Dwg. 228825	Intermediate Support Crossarm Dwg. 228823	
15	LV mains connection detail	LV ABC Dwg. 228824	LV cross-arm support for LV ABC end termination Dwg. 228823	LV Open Wire Dwg. 228827			See NS125 for selection criteria

Table B2 0–63 kVA 1-phase Pole Mounted Substation Master Option List

	Selection	A	B	C	D	E	NOTES
	HV line construction details						See NS126
1	General Arrangement details	11/22kV 0 - 63kVA Dwg. 228831					
2	Pole details	11/22kV 0 – 63kVA Dwg. 228831					
3	HV fuse arm details	11kV Fuse Base - for Dropout Type Fuse <8kA Dwg. 228833	11kV Fuse Base - for Dropout Type Fuse 8-11.2kA Dwg. 228833	22kV Fuse Base - for Dropout Type Fuse ≤10kA Dwg. 228833			
4	LV fuse arm details	0 – 63kVA LV single customer Dwg. 228833	0– 63kVA LV single ABC Dwg. 228833	0- 63kVA LV dual ABC Dwg. 228833			
5	LV Overhead to underground (UGOH)	Dwg. 228831					
6	Transformer mounting detail	Pole mounted Dwg. 228831					
7	HV dropper and HV surge diverter details	11kV Dwg. 228831	22kV Dwg. 228831				
8	LV cabling detail Transformer / LV fuse	0 – 25kVA Dwg. 228834	40 - 63kVA Dwg. 228834				
9	Earthing details	Combined system Dwg. 228832	Segregated system Dwg. 228832				Also see NS116
10	Maximum demand indicator details	1 phase sub MDI Dwg. 228834					Where required. Determined by planning
11	Street light details	Dwg. 228836					See NS119
12	Miscellaneous	Dwg. 228831					Safety sign, Sub No, LV ID, Asset No
13	Communications cable arm	1 phase sub Dwg. 228831 Dwg. 228833					If required for communications cable
14	HV mains connection detail	End termination Dwg. 228835	Parallel Groove Clamps Dwg. 228835	Hot line clamps Dwg. 228835	CCT Dwg. 228835	Intermediate Support Crossarm Dwg 228823	
15	LV mains connection detail	ABC Dwg 228834	Open Wire Dwg 228837				See NS125 for selection criteria