

## Network Standard

### NETWORK

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NW000-S0042

NS110 DESIGN AND CONSTRUCTION STANDARD FOR URDS



## ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design of URD reticulation systems 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](http://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Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.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 NS212 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.

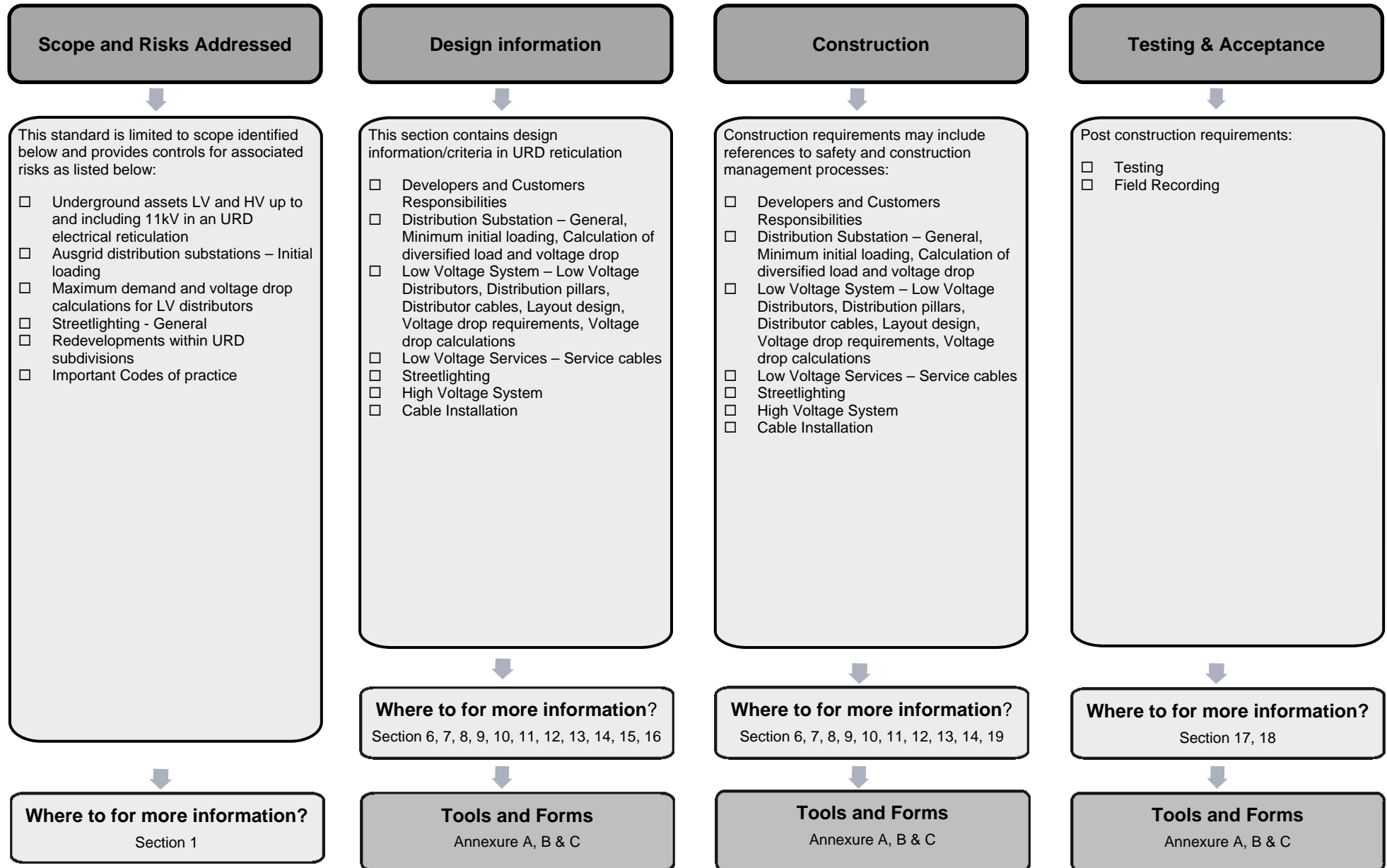
## KEYPOINTS

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, Supersedes – document details (for example, "Supersedes Document Type (Category) Document No. Amendment No.").

# KEY POINTS OF THIS STANDARD



# Network Standard NS110 Design and Construction Standard for URDs

## Contents

1.0	PURPOSE .....	6
2.0	SCOPE .....	6
3.0	REFERENCES .....	6
3.1	General .....	6
3.2	Ausgrid documents .....	6
3.3	Other standards and documents.....	7
3.4	Acts and regulations.....	7
4.0	DEFINITIONS .....	7
5.0	ASBESTOS.....	9
6.0	GENERAL.....	9
7.0	RESPONSIBILITIES.....	10
8.0	DESIGN INFORMATION.....	10
9.0	DISTRIBUTION SUBSTATIONS .....	11
9.1	General .....	11
9.2	Maximum initial loading.....	11
9.3	Calculation of diversified load and voltage drop .....	11
10.0	LOW VOLTAGE SYSTEM.....	12
10.1	General .....	12
10.2	Low voltage distributors .....	12
10.3	Distribution pillars.....	13
10.3.1	Link pillars .....	13
10.3.2	Solid pillars .....	13
10.3.3	Service pillars .....	14
10.3.4	Network service pillars .....	14
10.3.5	Switch pillars .....	14
10.4	Distributor cables .....	14
10.5	Layout design.....	15
10.5.1	Paralleling and switching requirements: .....	15
10.6	Voltage drop requirements.....	15
10.7	Voltage drop calculation for the low voltage distributor .....	16
11.0	LOW VOLTAGE SERVICES .....	16
11.1	General .....	16
11.2	Service cables.....	17
12.0	STREET LIGHTING.....	17
12.1	General .....	17
13.0	HIGH VOLTAGE SYSTEM .....	18
14.0	CABLE INSTALLATION.....	18
14.1	General .....	18

14.2 Cable joints and terminations..... 18

15.0 REDEVELOPMENTS WITHIN URD SUBDIVISIONS..... 18

16.0 SERVICES TO PUBLIC FACILITIES ..... 18

17.0 TESTING ..... 19

18.0 FIELD RECORDING..... 19

19.0 STORES AND MATERIALS ..... 19

20.0 RECORDKEEPING ..... 19

21.0 AUTHORITIES AND RESPONSIBILITIES..... 20

22.0 DOCUMENT CONTROL..... 20

ANNEXURE A1 – TYPICAL ARRANGEMENTS OF LOW VOLTAGE SYSTEM ..... 21

ANNEXURE A2 - LINK PILLAR CONNECTION DIAGRAMS..... 24

ANNEXURE B – SAMPLE LOAD AND VOLTAGE DROP CALCULATIONS..... 26

ANNEXURE C – SAMPLE COMPLIANCE CHECKLIST ..... 28

## 1.0 PURPOSE

Ausgrid is responsible for the management and operation of its electricity supply network. This network which supplies the most populous area in Australia, is a major infrastructure investment. The network is required to operate economically and reliably under all weather and other environmental conditions.

As part of its formal asset management approach Ausgrid's aim is to provide a series of cost effective, modular designs for use in developing the distribution network. These designs must satisfy a range of functions far wider than basic electrical performance and economy. These functional requirements include meeting all statutory obligations, operating effectively under adverse conditions and utilising readily available components, which have demonstrated reliability.

This Network Standard lays down the electrical design and construction standards for all underground reticulation of residential subdivisions in Ausgrid's supply area, the ownership of which will ultimately be vested in Ausgrid.

## 2.0 SCOPE

This document details the design and construction standards for URD Subdivisions across the Ausgrid franchise area. Low Voltage System, High Voltage System and Street lighting requirements are explained.

Responsibilities of Developer and Customer are specified.

The Client shall refer to NS130 Specification for Laying Underground Cables up to and Including 11 kV with regards to cables. The general excavation and reinstatement requirements as well as the associated documentation, safety and environmental aspects of underground asset installation detailed in NS130 shall be applied to URD cable installation work.

## 3.0 REFERENCES

### 3.1 General

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

### 3.2 Ausgrid documents

- 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
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- ES1 Premises Connection Requirements
- NS100 Field Recording of Network Assets
- NS104 Specification for Electrical Network Project Design Plans
- NS117 Design and Construction Standards for Kiosk Type Substations
- NS119 Street Lighting Design and Construction
- NS122 Pole Mounted Substation Construction
- NS124 Specification for Overhead Connections up to 400 Amps
- NS127 Specification for Low Voltage Cable Joints and Terminations
- NS129 11kV Joints and Terminations – Paper Insulated Lead Covered Cables
- NS130 Specification for Laying Underground Cables up to and including 11kV
- NS141 Site Selection and Site Preparation Standards for Kiosk Type Substations
- NS143 Easements, Leases and Rights of Way

- NS156 Working Near or Around Underground Cables
- NS161 Specification for Testing of Underground Cables
- NS177 11kV Joints (including Transition Joints) & Terminations – Polymeric Insulated Cables
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS211 Working with Asbestos Products
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS261 Requirement for Design Compliance Framework for Network Standards
- Policy for ASP/1 Premises Connections
- Public Electrical Safety Awareness Plan
- Public Lighting Management Plan
- Tree Safety Management Plan

### 3.3 Other standards and documents

- AS/NZS 3000:2007 Electrical Installations (Known as the Australian/New Zealand Wiring Rules)
- ENA Doc 001-2008 National Electricity Network Safety Code
- Service and Installation Rules of New South Wales

### 3.4 Acts and regulations

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

## 4.0 DEFINITIONS

<b>Accredited Service Provider (ASP)</b>	An individual or entity accredited by the NSW Government Trade & Investment in accordance with the Electricity Supply (Safety and Network Management) Regulation 2014 (NSW).
<b>Business Management System (BMS)</b>	An Ausgrid internal integrated policy and procedure framework that contains the approved version of documents.
<b>Customer Designer</b>	A customer is an individual or an entity who is an end-user of electricity. An Ausgrid employee, contractor to Ausgrid or ASP/3 who is duly qualified to produce design plans.
<b>Design Information</b>	Information provided by Ausgrid to enable Designers to prepare electricity reticulation design of the proposed development. Provision of Design Information is accordance with Ausgrid's Policy for ASP/1 Premises Connections and Connection Policy – Connection Charges.
<b>Developer</b>	A developer is an individual or an entity which has responsibility for arranging the supply of electricity to the development in accordance with Ausgrid's policies. A developer could be a commercial developer, or customer.
<b>Direct-buried cables</b>	Cables installed underground whose outer surface is in direct contact with the general mass of the earth, not installed in conduits, cable chases and the like.
<b>Distribution side</b>	The side of the street on which low voltage distributor cables are installed. (Applies only to single sided schemes).
<b>Document control</b>	Ausgrid employees who work with printed copies of document must check the BMS regularly to monitor version control. Documents are considered "UNCONTROLLED IF PRINTED", as indicated in the footer.
<b>Link pillar</b>	A pillar incorporating links which serves as a switching point using removable links.
<b>Lot boundary</b>	The dividing boundary line between adjoining lots.

<b>Low voltage distributor</b>	An electricity line rated at 1000V ac which originates at the low voltage end of a distribution substation and serves to convey electrical energy to end users via their service mains. Low voltage distributors are usually laid in public roadways and through easements on private land.
<b>Network Standard</b>	A document, including Network Planning Standards, that describes the Company's minimum requirements for planning, design, construction, maintenance, technical specification, environmental, property and metering activities on the distribution and transmission network. These documents are stored in the Network Category of the BMS repository.
<b>Network service pillar</b>	A pillar owned by Ausgrid and providing a service connection point remote from the distributor cables. Supply to service pillars is provided using 4-core service cables. Consumer pillars constitute the point of attachment/supply for the customer.
<b>Pillar</b>	An enclosure consisting of a base and a cover, housing cable terminations and forming part of the low voltage distribution network. Types of pillars include link pillars, solid pillars, and service pillars. All pillars have provisions for the connection of services.
<b>Remote side</b>	The non-distributor side of the street.
<b>Review date</b>	The review date displayed in the header of the document is the future date for review of a document. The default period is three years from the date of approval however a review may be mandated at any time where a need is identified. Potential needs for a review include changes in legislation, organisational changes, restructures, occurrence of an incident or changes in technology or work practice and/or identification of efficiency improvements.
<b>Service conduit stub</b>	A short length of service conduit installed between the service enclosures and each of the adjoining lots within the subdivision.
<b>Service enclosure</b>	An enclosure providing a point of connection of service mains to the low voltage network. A service enclosure can be either a pillar or a pillar-standard. Note: Pillar-standards are no longer a design/construction option. Reference to them is only included in this Network Standard as connection may still be required to be made to them where they currently exist in Ausgrid's network.
<b>Service mains</b>	The electricity cable connecting the Consumer's first point of supply to Ausgrid's service enclosure located in a public footway.
<b>Service pillar</b>	A pillar located on private property and providing a service connection point remote from the distributor cables. Supply to service pillars is provided using 4-core service cables 16mm <sup>2</sup> at the minimum. Note: Service pillars are owned by customers and not by Ausgrid in accordance with Clause 10.3.3 of this Standard.
<b>Solid pillar</b>	A pillar where the distributor cables are solidly connected using either bolted lugs or mechanical connectors. Isolation of the distributor cables requires removal of the connection bolts under load-free conditions.
<b>Street alignment</b>	The boundary line between the dedicated roadway and the adjoining subdivision lots. This is also known as the building line.
<b>Street Lighting Customer</b>	<p>The person (eg Local Council) responsible for providing street lighting, controlling the standard of lighting and responsible for the applicable Street Lighting charges.</p> <p>For dedicated roadways, the Street Lighting Customer is the local Council or RMS (Roads and Maritime Service). For Community Land Title developments under the Community Land Development Act 1989 the Street Lighting Customer is the Community Association.</p>



## 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 2011 (NSW) and confirm in writing that all products supplied to Ausgrid contain no Asbestos related materials. Refer to NS211 Working with Asbestos Products.

## 6.0 GENERAL

Electricity reticulation systems in new residential subdivisions must be installed underground in accordance with the requirements of this Network Standard and all other design and construction standards referenced in this document. These systems are commonly known as Underground Residential Distribution (URD) systems.

Detailed design of URD systems depends on street layouts, street lighting requirements and other local factors. The design parameters and approved electrical equipment specified in this Network Standard provide for minimum acceptable system performance over the life of the designed installation. Any deviations from this Standard must be submitted to Ausgrid for consideration in accordance with NS181 Approval of Materials and Equipment and Network Standard Variations and must not be implemented prior to obtaining approval.

Where new residential developments take place in overhead reticulated areas, Ausgrid will determine the extent of undergrounding of existing overhead mains which may be necessary. Dedicated roadway sites for future substations and cable easements for future use may also be required as part of these developments.

Street lighting reticulation design forms part of the low voltage system design in URD subdivisions and must conform to the requirements of both the Street Lighting Customer and Ausgrid as set out in Network Standard NS119 Street Lighting Design and Construction as applicable. Approval of the Street Lighting Customer for the applicable street lighting charges must be obtained before construction work commences.

All future rail crossings (overhead or underground) should allow for all poles or the ends of ductlines to be located off rail property wherever possible. In particular:

- Poles should be located in the road either side of a rail crossing, provided Rail's technical requirements on maximum span lengths etc permit this.
- Ducts should be run the full width of the rail corridor, finishing just outside the rail property boundary. Note that this does not necessarily require a bore across the entire width of rail land, only that the ductline protecting any cables should continue the entire width of the crossing, so that the need to enter rail land for works is minimised.

Where new works on existing crossings permit, advantage should be taken of the opportunity to extend ductlines or relocate poles where this is appropriate. Any such projects should be referred to Ausgrid for a decision on what work should be included in these cases.

This network standard, NS110 Design and Construction Standard for URDs applies to residential subdivisions in the supply area of Ausgrid. Low voltage and street light reticulation in Community Title developments other than on dedicated public roads shall be owned and maintained by the owners of the development and does not form part of Ausgrid's network assets.

## 7.0 RESPONSIBILITIES

The developer is responsible for the design, supply of materials and construction of electricity reticulation systems in new residential subdivisions, including the provision of service mains to some of the properties in the subdivisions, as detailed in this Standard and in Policy for ASP/1 Premises Connections.

It is the responsibility of the developer to ensure that only accredited service providers are engaged on the design and construction of electricity reticulation systems.

The developer is also responsible for providing local authorities with copies of the proposed electrical network project design construction plans at least 40 days before work is to commence, and must comply with any special requirements of these authorities.

Where undergrounding occurs in areas that are already reticulated with overhead construction, it is the responsibility of the developer to liaise with all the affected customers and come to satisfactory arrangements to ensure that the existing service connections continue to be supplied after the introduction of the new underground system. Any development that has outstanding disputes will not be energised.

The customer (end user) is responsible for supplying and installing the portion of service mains from the street alignment (where the service mains are terminated by the developer) to the point of supply in accordance with the Service and Installation Rules of NSW and Ausgrid's Electrical Standards. In cases where a service enclosure is installed adjacent to the property, the customer is responsible for supplying and installing the service mains to terminate at the enclosure.

Developer's responsibilities are further outlined in Ausgrid's Policy for ASP/1 Premises Connections.

## 8.0 DESIGN INFORMATION

Ausgrid will supply the Design Information relating to the Development in accordance with Ausgrid's Policy for ASP/1 Premises Connections.

Electrical design and construction works on Ausgrid's low voltage and high voltage distribution systems must be carried out in accordance with Ausgrid's Network Standards, which include but are not limited to the following:

- NS100 Field Recording of Network Assets
- NS104 Specification for Electrical Network Project Design Plans
- NS117 Design and Construction Standards for Kiosk Type Substations
- NS122 Pole Mounted Substation Construction
- NS124 Specification for Overhead Connections up to 400 Amps
- NS127 Specification for Low Voltage Cable Joints and Terminations
- NS129 11 kV Joints and Terminations – Paper Insulated Lead Covered Cables
- NS130 Specification for Laying Underground Cables up to and including 11 kV
- NS141 Site Selection and Site Preparation Standards for Kiosk Type Substations
- NS143 Easements, Leases and Rights of Way
- NS161 Specification for Testing of Underground Cables
- NS177 11kV Joints (Including Transition Joints) & Terminations – Polymeric Insulated Cables
- NS181 Approval of Materials and Equipment and Network Standard Variations

## 9.0 DISTRIBUTION SUBSTATIONS

### 9.1 General

Only kiosk-type substations are used by Ausgrid for electricity reticulation in URD subdivisions. Reference should be made to the following Network Standards for site selection and construction of Kiosks:

- NS117 Design and Construction Standards for Kiosk Type Substations
- NS141 Site Selection and Site Preparation Standards for Kiosk Type Substations.

The need for substations in new residential subdivisions depends on the load requirements of the subdivision and the available spare capacity of the existing network. As part of the Design Information provided to the Designer (ASP/3), Ausgrid may specify, where applicable:

- Any proposed developments which may affect the electricity reticulation system in the subdivision under consideration, or
- Any additional load requirements or spare capacity to be designed for.

Substations shall be sited close to the load centre to fully utilise the substation capacity. The electrical network designer shall also consider any requirements to feed future extensions to the subdivision.

Substation location must consider DA approved building setbacks and building envelopes such that future dwellings meet the substation fire segregation requirements of NS141. Where required, formal restrictions over land may be considered to ensure compliance.

### 9.2 Maximum initial loading

The number of customers that can be supplied from a substation primarily depends on the specified Maximum Demand of these customers. It also depends upon the subdivision layout and voltage drop limitations. The Maximum Demand per dwelling varies from subdivision to subdivision and will be provided by Ausgrid to the Designer (ASP/3) as part of the Design Information.

As far as practical, the load to be connected to a substation must be balanced across the distributors of the substation, unless specified otherwise. Ausgrid may not certify a design if it believes that the design does not result in an optimum layout or it results in the use of additional and unnecessary substations or service enclosures.

### 9.3 Calculation of diversified load and voltage drop

The After Diversity Maximum Demand (ADMD) of a low voltage distributor is a function of the number of dwellings connected to the distributor and the allocated Maximum Demand for each dwelling.

The following formulae should be used in estimating the maximum demand and voltage drop of a distributor.

N = Number of customers

**Formula for maximum demand for distributor loading:**

$$MD = 8 * ADMD + 0.72 * ADMD * N + 0.95 * ADMD * \sqrt{N} \quad \text{kVA}$$

**Formula for maximum demand for voltage drop**

$$MD_v = 12 * ADMD + 0.97 * ADMD * N + 1.3 * ADMD * \sqrt{N} \quad \text{kVA}$$

$$\text{Phase Current} = \frac{\text{MaxDemand} * 1000}{3 * V_{start}}$$

$V_{\text{start}}$  is the voltage at the start of the distributor segment where voltage drop is to be calculated.

$$\text{Voltage Drop} = \frac{(V / A / km) * \text{Length} * \text{Phase Current}}{1000}$$

Where (V/A/km) is voltage drop constant of the cable is accordance with Table B2 of Annexure B.

**Note:** The After Diversity Maximum Demand appropriate for a subdivision will be specified by Ausgrid.

Sample load and voltage drop calculations are given in Annexure B.

## 10.0 LOW VOLTAGE SYSTEM

### 10.1 General

Detailed design of low voltage networks in new subdivisions depends on the street layouts, street lighting requirements and other local factors. However, all designs must use the types of cables, pillars and other electrical equipment specified in this and other referenced Standards.

The standard design concept for low voltage systems adopted by Ausgrid is the fully looped arrangement, having as its main components distribution pillars, and four-core distributor cables. Cables are looped into and out of distribution pillars. All service enclosures are usually installed adjacent to lot boundaries and centred 400 mm from the street alignment. Some typical arrangements used in Ausgrid network area are given in Annexure A1.

Approved decorative street lighting furniture may be used in the street lighting design in accordance with NS119 Street Lighting Design and Construction.

Decorative street lighting furniture and conventional base, street lighting standards are not utilised for the connection of low voltage services.

Low voltage distributor cables are normally direct-buried and looped into pillars, to allow for above-ground low voltage service and street lighting connections and switching requirements. Low voltage cables may be laid in the same trench as high voltage cables in URD subdivisions.

Services to both sides of the roadway are provided from these pillars. Service mains are direct-buried in the footway and are normally installed in conduits across the roadway to allow surfacing of the carriageway at an early stage in the subdivision construction.

Services up to 200 amperes in rating may be connected to these pillars using standard service termination blocks. Services exceeding 200 amperes and up to 400 amperes, such as high-density housing or shopping complexes in a large URD area, must be supplied from distribution pillars by connecting the service mains directly onto either the bifurcated or trifurcated connectors or, with Ausgrid approval, as the third cable connected to double link pillars. Where this arrangement is not suitable Ausgrid must be consulted for an alternative arrangement. Services larger than 400 amperes will be either directly supplied from the nearest substation, or if network capacity is insufficient, determined solely at the discretion of the Ausgrid officer, a kiosk substation may need to be constructed on site.

**Note:** Fully ducted systems are not allowed in URD subdivisions because of the de-rating effects on cables.

### 10.2 Low voltage distributors

The designed maximum diversified load on any distributor must not exceed 75 per cent of the distributor's nominal rating (unless specifically approved by Ausgrid) to provide a reasonable margin for load growth and paralleling requirements. Distributors are nominally rated at 400 amps.

## 10.3 Distribution pillars

Two types of distribution pillars are approved for use on Ausgrid's system; they are link pillars and solid pillars. Construction details for the two types of pillars are given in NS127 Specification for Low Voltage Cable Joints and Terminations.

### 10.3.1 Link pillars

The first pillar from a substation on each distributor should be a link pillar to allow for isolation of the distributor. (See Annexure A2, Link Pillar Connection Diagrams).

#### 10.3.1.1 Single link pillars

Single link pillars have a single link per phase to allow for paralleling and isolation. The fully encapsulated single link pillar allows for connecting up to a maximum of three 100 ampere 3-phase services or one 200 ampere 3-phase service to each side of the link. No more than two distributor cables can be terminated onto a fully encapsulated single link pillar.

Unless otherwise approved by Ausgrid, the designed number of services to be initially connected to a fully encapsulated single link pillar must not exceed four 100 ampere 3-phase services. This is to provide capacity for connecting a further two 100 ampere 3-phase services at a later date.

Single phase street light supplies can be doubled up with one of the initial four services (i.e. four 100 ampere 3-phase services + one single phase street light service). Three phase street light supplies shall be regarded as a separate service and connected independent of other services.

The old style link pillars allow for connecting up to two 100 ampere 3-phase services or one 200 ampere 3-phase service to each side of the link. No more than two distributor cables can be terminated onto the old style, single link panel.

#### 10.3.1.2 Double link pillars

Encapsulated double link pillars provide a three-way connection with links installed between the centre distributor cable and the two side distributor cables. These pillars can accommodate four 100 ampere 3-phase services or one 200 ampere 3-phase service to the centre distributor.

Unless otherwise approved by Ausgrid, the designed number of services to be initially connected to a fully encapsulated double link pillar must not exceed three 100 ampere 3-phase services. This is to provide capacity for connecting a further one 100 ampere 3-phase services at a later date.

Single phase street light supplies can be doubled up with one of the initial services (i.e. three 100 ampere 3-phase services + one single phase street light service). Three phase street light supplies shall be regarded as a separate service and connected independent of other services.

A minimum of one service must be connected when the pillar is being constructed as this will leave sufficient room in the pillar base for three conduit stubs for future services.

If installed in a new development where no services (including three phase street light circuits) are initially required, a maximum of three services may be taken from a double link pillar.

### 10.3.2 Solid pillars

Solid pillars utilise bolted mechanical connectors incorporating shear-bolt technology, commonly referred to as biform and tri-form connectors. Unlike link pillars, solid pillars do not allow for electrical isolation of terminated distributor cables except by removal of the connecting bolts under load-free conditions.

Solid pillar designs provide for two-way and three-way terminations. Three way terminations are used for tee connections (such as supply to cul-de-sacs), some road crossings and for terminating service mains larger than 200 amperes in rating. Note: The design of the mechanical connectors means that only LV 240 AL4 XQ Z/SAC service cables can be used for services larger than 200A that are connected to such pillars.

### 10.3.2.1 Two-way solid pillars

Two types of solid pillars are approved for use in Ausgrid's network, as shown in NS127 Specification for Low Voltage Cable Joints and Terminations as pillars LV1-33 and CMPBL2EA. The maximum number of services allowed for each type is as follows.

**Table 1 - Two-way solid pillars**

Pillar arrangement as per NS127	Designed number of services to be initially connected (unless otherwise approved)	Maximum number of services possible
LV1-33	Six	Ten 100amp 3 phase services or two 200amp 3 phase services.
CMPBL2EA	Four	Six 100 amp 3 phase services or two 200 amp 3 phase services

### 10.3.2.2 Three-way solid pillars

Two types of three-way solid pillars are approved for use in Ausgrid's network as shown in NS127 Specification for Low Voltage Cable Joints and Terminations as LV 1-34 and CMPBL3EA.

**Table 2 - Three-way solid pillars**

Pillar arrangement as per NS127	Designed number of services to be initially connected (unless otherwise approved)	Maximum number of services possible
LV1-34	Four	Five 100amp 3 phase services or one 200amp 3 phase service.
CMPBL3EA	Four	Five 100 amp 3 phase services or one 200 amp 3 phase service.

### 10.3.3 Service pillars

Service pillars are generally used for connecting multiple customers to a common set of 3-phase service mains. This usually occurs where residential blocks do not have a street frontage, as in battle-axe block developments.

Service pillars are also used for connecting consumer mains to a service cable remote from a distribution/network pillar.

The supply and installation of service pillars is the responsibility of the customer/developer.

### 10.3.4 Network service pillars

These are service pillars owned by Ausgrid and located on the opposite side of the road from the distribution pillars. They are used for connecting multiple services other than for battle-axe blocks (refer to sketches in Annexure A1 for examples). A maximum of three services can be connected to a network service pillar.

### 10.3.5 Switch pillars

Switch pillars are optionally installed at locations where they will be operated as normally open points in the LV network. The maximum of two three phase services are allowed in the switch pillar. Switch pillars are applicable only in Hunter region.

## 10.4 Distributor cables

The following standard low voltage cable is approved by Ausgrid for reticulation in URD subdivisions as described below:

- 240 mm<sup>2</sup> 4-core sector shaped solid aluminium conductors, cross-linked, polyethylene-insulated, PVC-sheathed cable to all details of AS/NZS 4026 Electric cables - For underground residential distribution systems.

**Table 3 - Cable ratings**

Cross-sectional area (mm <sup>2</sup> )	Cable Type	Rating (amps)* Direct laid
240	LV 240 AL4 XQ Z/SAC	440

\*Summer cyclic rating based on soil resistivity of 1.2 Km/W with no other cables in the same trench. For different environmental conditions and cable configurations, reference must be made to Ausgrid for applicable cable ratings

**Note:** In some parts of the Newcastle-Hunter regions the current is limited to 350A which is set by the thermal limit of the low voltage fuse units.

The three active cable cores shall be coloured red, white (or uncoloured) and blue. The neutral core shall be coloured black.

## 10.5 Layout design

In addition to any requirements stated elsewhere in this Standard, the following design criteria must be satisfied:

### 10.5.1 Paralleling and switching requirements:

- The number of services designed to be connected to any solid section of a distributor (i.e. not switchable by the use of Paralleling links) must not exceed 15. Any section of a distributor containing solid pillars is classified as a solid section.
- The first service enclosure from the distribution substation on every low voltage distributor must have links to allow for isolating the distributor from the source of supply.
- Service enclosures at the extremities of a low voltage distributor must have links installed to allow for paralleling with adjacent distribution centres.
- Alternate supply must be provided to distributor sections serving more than 15 customers unless specifically agreed in writing by Ausgrid.
- Alternate supply to LV distributors must be provided from adjacent distribution centres where practicable. Each distributor should have a minimum of 2 alternate points of supply (or 3 in cases where economically practical) unless approved by Ausgrid.
- Every opportunity must be taken to establish loop feeds where loop roadways exist (i.e. interconnection between distributors from the same distribution centre or between different branches of the same distributor). Extension of distributors beyond that necessary to provide a Paralleling path will not normally be required unless specified otherwise by Ausgrid.

## 10.6 Voltage drop requirements

The designed maximum voltage drop in a low voltage distributor must not exceed 9 volts at the extremities when the distributor is loaded to 75% of its nominal rating.

**Note:** Service mains are not regarded as part of the distributor.

The maximum voltage drop in the combination of distributor and service mains when the distributor is loaded to 75% of its nominal rating must not exceed 11.4 volts.

The voltage drop in the service mains, determined in accordance with Service and Installation Rules of NSW.

## 10.7 Voltage drop calculation for the low voltage distributor

Voltage should be calculated using the formulae given in Clause 9.3.

A sample voltage drop calculation is given in Annexure B.

## 11.0 LOW VOLTAGE SERVICES

### 11.1 General

The developer is responsible for providing separate service mains to all lots not adjoining service enclosures within the subdivision, including lots on the remote side of the street.

For lots on the remote side of the street, a 50mm<sup>2</sup> service cable may be laid across the street and terminated at a network service pillar located in accordance with clause 10.3.4. These service enclosures can connect up to a maximum of three customers.

For each lot remote from a service enclosure or network service pillar, the developer may:

1. install the conduit and service cable, leave it in customer property (located within 1m inside the lot boundary), or
2. install only the conduit and draw wire, leave it in customer property (located within 1m inside the lot boundary) from the nearest available service enclosure.

Service pillars serving a single customer or battle-axe block developments must be installed inside the property boundary, and constitute the point of Supply for the customer. These service pillars are owned by the customer and not by Ausgrid.

Service enclosures or network service pillars adjoining residential lots must have conduit stubs installed as detailed in NS127 Specification for Low Voltage Cable Joints and Terminations to allow easy installation of service mains by consumers at a later stage. Service mains to these lots will only be installed as each customer requires supply. The customer will pull the service mains directly into the service enclosure or network service pillar. Connection is then made in the service enclosure or network service pillar. All service cables originating from a service enclosure other than to connect to a network service pillar must be shorted, sealed to prevent entry of moisture, and labelled at both ends. (Refer NS130 Specification for Laying Underground Cables up to and including 11kV). The label must be durable, and must show the lot number of the corresponding property.

Multiple battle-axe blocks sharing a common access driveway and similar blocks without a street frontage will normally be supplied by common service mains terminating in a common service enclosure at the street end of the driveway. Each customer must then install separate consumers mains from the common service enclosure to their meter board. A spare conduit must be laid across the common access driveway to the battle-axe blocks in Ausgrid's allocation to allow the service termination enclosure to be positioned at either side of the driveway.

**Note:** It is recommended that the developer/customer lay conduits for battle-axe blocks (complying with the requirements of Ausgrid's Electrical Standards (ES documents)) as shown in the sample arrangements in Annexure A1, before the common access driveway is concreted. This allows the installation of consumers mains at a later stage without disturbing the driveway.

Service cable roadway crossings must be made in conduits. Conduits must comply with the requirements for roadway crossings specified in Section 14. Conduits must be laid as close to being perpendicular to the carriageway as practicable, and should terminate at the road-side edge of Ausgrid's cable allocation. Refer to Network Standard NS130 Specification for Laying Underground Cables up to and including 11kV for the cable allocation that applies in the relevant area. Minor deviations to align with offset lot boundaries on opposite sides of the road are permitted.



When street light services are supplied from a service enclosure in the Newcastle and Hunter Region the service shall be connected via 3-way street lighting terminal block (stock code 177501) on both the active and neutral, together with an inline fuse (stock code 177552) located in the pillar.

## 11.2 Service cables

Service cables must be 4-core copper conductors (except for single domestic premises, duplexes and builder's services where a two-wire single-phase service is permissible provided the service cable does not require a direct buried joint), cross-linked polyethylene insulated, PVC-sheathed, manufactured to AS/NZS 4026 Electric cables - For underground residential distribution systems or AS/NZS 5000.1 – Electric cables – polymeric insulated. The minimum conductor size must not be less than 16 mm<sup>2</sup>.

Service cable specifications are as follows:

- 100A service - 16 mm<sup>2</sup> or 25 mm<sup>2</sup>, circular, stranded, copper conductor, single core or four core.
- 200A service - 50 mm<sup>2</sup> or 70 mm<sup>2</sup>, circular, stranded, copper conductor, single core or four core. Note: 70mm<sup>2</sup> must be of compacted conductor.
- >200A service - 185 mm<sup>2</sup>, circular, stranded, copper conductor, single core and 240 mm<sup>2</sup>, 90 degree sector shaped, solid, aluminium conductor, multicore.

Any intermediate service ratings (based on the assessed demand of the installation) must use the next largest service rating/cable available. The 50mm<sup>2</sup> cable may also be used for a 100 Amp service to satisfy voltage drop requirements.

For common service mains supplying multiple premises (e.g. battle-axe blocks) a 50 mm<sup>2</sup> cable may be used for supplying up to six 100 amp services.

## 12.0 STREET LIGHTING

### 12.1 General

Street Lighting equipment to be installed in a URD subdivision will be determined from the requirements of the Street Lighting Customer (the roads authority for existing streets or new streets proposed to be dedicated). Generally, streetlights will be placed on the boundary between lots unless otherwise agreed by Ausgrid.

The Lighting requirements should be determined at an early stage of negotiations between the Designer (ASP/3) and the Street Lighting Customer. Design parameters, which need to be identified, include the standard of lighting to be provided and any preferences for lamp types and sizes, luminaire types and standards, and any other requirements for street lighting furniture.

Approval of the Street Lighting Customer to accept annual charges for the street lighting must be obtained before construction work commences.

Street Lighting design for schemes which will be handed over to Ausgrid as part of the contestable works, must conform to the following Network Standard:

- NS119 Street Lighting Design and Construction. All lighting designs for schemes to be handed over to Ausgrid must be referred to Ausgrid for approval. The submission must include a schedule of all street lighting furniture and associated hardware proposed to be used.

Lighting in Community Title developments, or schemes which do not comply with the relevant Network Standards specified above, shall be private installations, and must comply with the requirements of AS3000 and the Service and Installation Rules of NSW.

## 13.0 HIGH VOLTAGE SYSTEM

Where required, a high voltage supply shall be provided as part of the URD Project. This HV supply may supply one or more substations in the current Project and or it may be required to supply future stages of this or other developments. Provision of HV system will be in accordance with Ausgrid's Connection Policy – Connection Charges.

Details of HV requirements for projects will be provided as part of the Design Information.

## 14.0 CABLE INSTALLATION

### 14.1 General

All LV cables under roadways must be installed in conduits with 1 spare conduit. All LV cables in footway must be direct buried to achieve the desired rating, and 1 spare conduit to be installed in all footway locations so that access under future driveways etc. is guaranteed.

The Designer (ASP/3) will provide details of the location, number and size of all conduits required on the design drawings.

Where a subdivision development involves only one half of a roadway construction and road crossing conduits are required, conduits shall be installed across the full width of the roadway.

Details of the conduit sizes and types approved for use in URD subdivisions, and installation requirements are given in NS130 Specification for Laying Underground Cables up to and including 11kV.

### 14.2 Cable joints and terminations

Cable joints and terminations should conform to the following Network Standards as applicable:

- NS100 Field Recording of Network Assets
- NS127 Specification for Low Voltage Joints and Terminations
- NS129 11kV Joints and Terminations – Paper Insulated Lead Covered Cables
- NS130 Specification for Laying Underground cables up to and including 11kV
- NS156 Working Near or Around Underground Cables
- NS161 Specification for Testing of Underground Cables
- NS177 11kV Joints (including Transition Joints) & Terminations – Polymeric Insulated Cables

## 15.0 REDEVELOPMENTS WITHIN URD SUBDIVISIONS

If redevelopments such as dual occupancies, battle-axe blocks etc. occur within an existing URD subdivision, the requirements for connecting the new services to the low voltage network will be determined by Ausgrid on a case by case basis.

The new services will be subject to capital contributions in accordance with Ausgrid's Connection Policy – Connection Charges.

## 16.0 SERVICES TO PUBLIC FACILITIES

Services to facilities in public places such as telephone cabinets, public conveniences, bus shelters, traffic lights etc. must be installed in accordance with the Service and Installations Rules of NSW.

Civil Works

All civil works required for cable laying and terminations within a subdivision must be carried out in accordance with NS130 Specification for Laying Underground Cables up to and including 11kV.

## 17.0 TESTING

Throughout the construction and installation of the URD Project and at its completion, the Accredited Service Provider (ASP/1) shall carry out tests as necessary to prove the project meets the requirements of this Standard. 'Tests' include all inspections, checks, measurements and tests necessary to prove the Project's compliance.

Relevant tests are outlined in the following Network Standards:

- NS117 Design and Construction Standards for Kiosk Type Substations
- NS161 Specification for Testing of Underground Cables.

## 18.0 FIELD RECORDING

All network assets shall be recorded in accordance with the Network Standard NS100 Field Recording of Network Assets.

## 19.0 STORES AND MATERIALS

Unless prior written approval is received from Ausgrid, all materials used must be new and approved in accordance with Ausgrid's Network Standard NS181 Approval of Materials and Equipment and Network Standard Variations.

Materials may be purchased directly from Ausgrid unless provided by Ausgrid as part of a contract.

To purchase materials from Ausgrid, the purchaser must contact the Manager – Customer Service - Logistics on telephone number (02) 9394 6001. All materials will be made available to be picked up from:

Somersby Warehouse  
Lot 11 Kangoo Road (Cnr Wella Way)  
Somersby NSW 2250

Refer also to Clause 7.7 in Ausgrid's document Policy for ASP/1 Premises Connections.

## 20.0 RECORDKEEPING

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

**Table 4 – Recordkeeping**

Type of Record	Storage Location	Retention Period*
Approved copy of the network standard	BMS Network sub process Standard – Company	Unlimited
Draft Copies of the network standard during amendment/creation	TRIM Work Folder for Network Standards (Trim ref. 2014/21250/80)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	TRIM Work Folder for Network Standards (Trim ref. 2014/21250/80)	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

## 21.0 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.

## 22.0 DOCUMENT CONTROL

**Content Coordinator** : Transmission & Distribution Mains Engineering Manager

**Distribution Coordinator** : Engineering Information and Services Manager

## Annexure A1 – Typical arrangements of low voltage system

### Distributor on one side of the street Pillars every third lot boundary

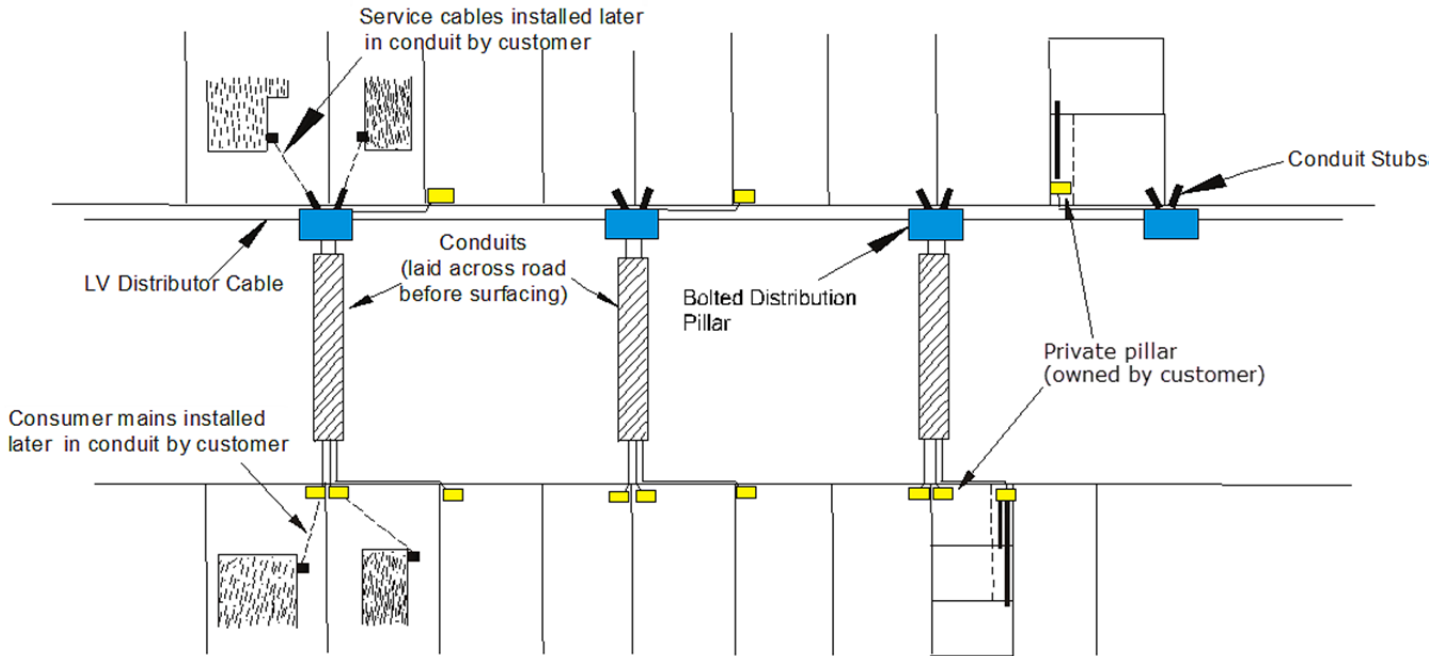


Figure A1.1: Distributor on one side of the street. Pillars every third lot boundary.

### Distributor on one side of the street Pillars every other lot boundary - Service pillars across the roads - Option 1

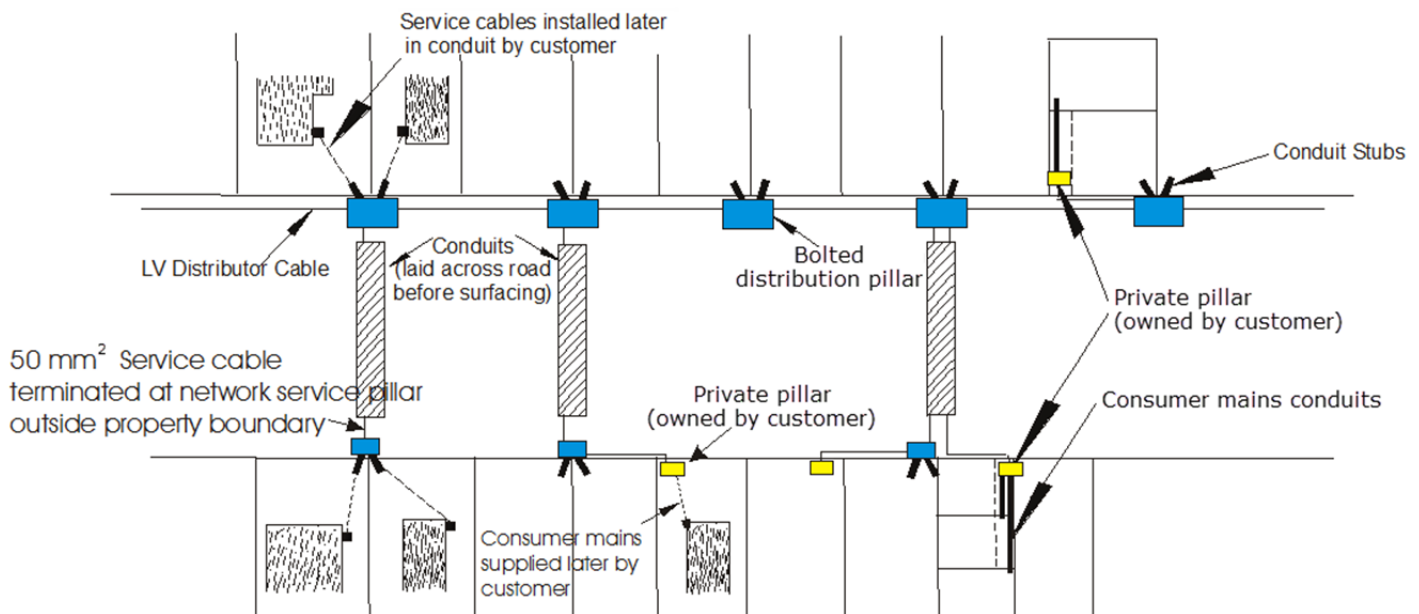


Figure A1.2: Distributor on one side of the street. Pillars every other lot boundary – service pillars across the roads – Option 1

## Distributor on one side of the street Pillars every other lot boundary - Service pillars across the roads - Option 2

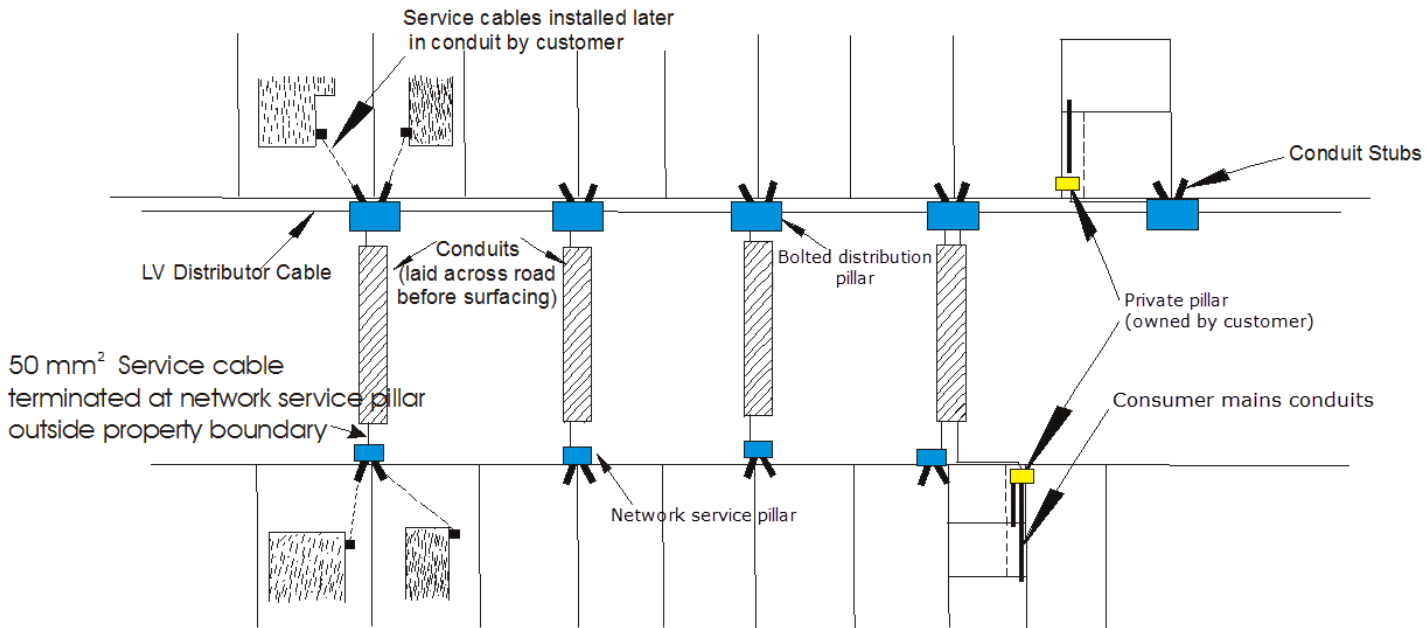


Figure A1.3: Distributor on one side of the street. Pillars across the roads – Option 2

## Distributors on both side of the street Pillar every third lot boundary

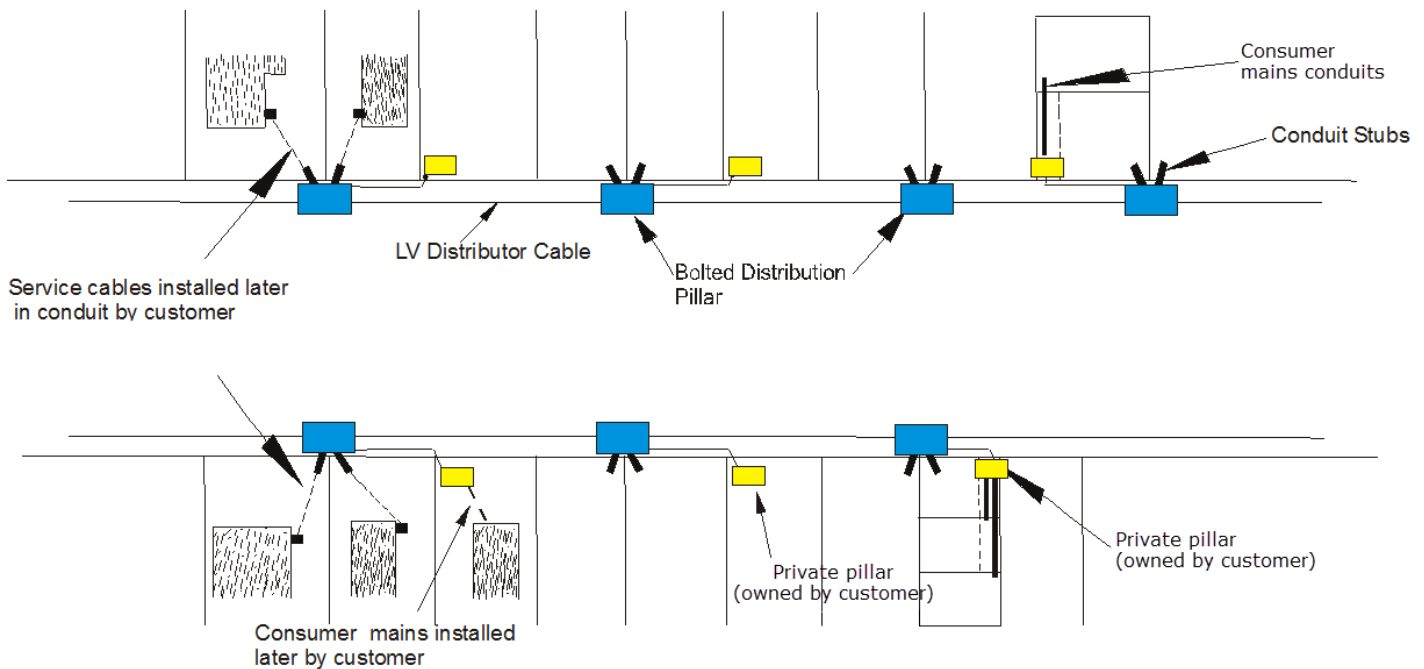
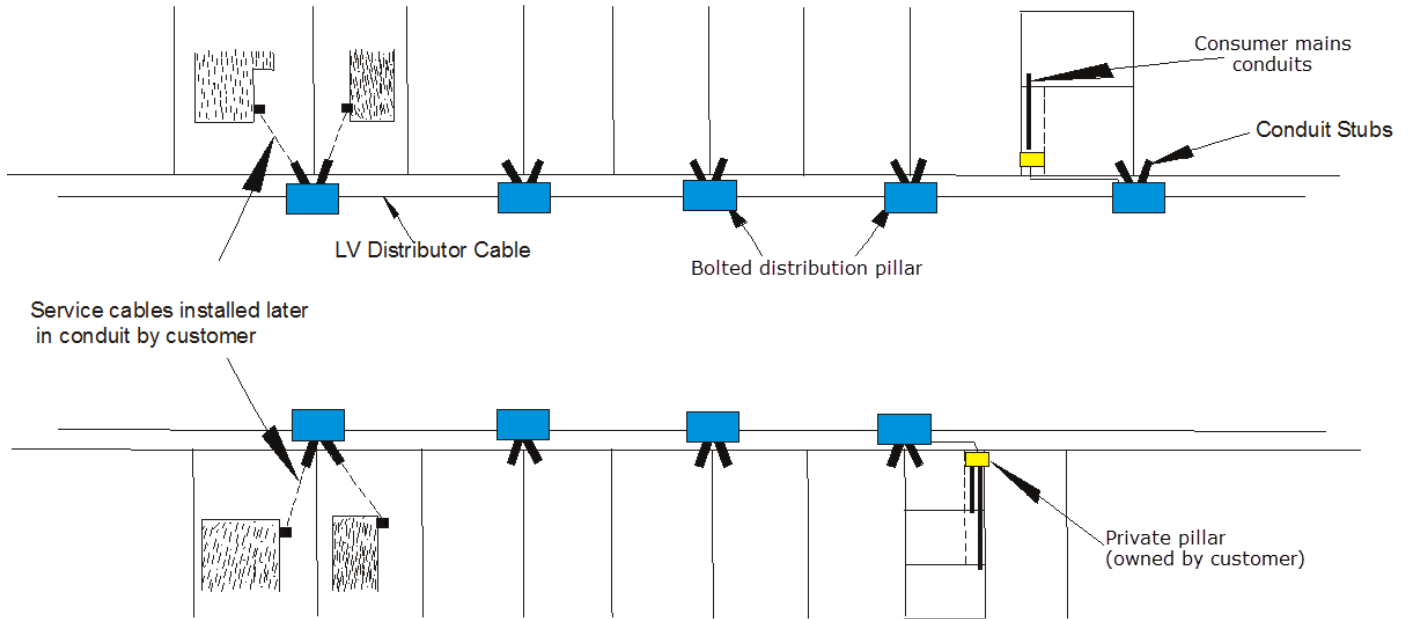


Figure A1.4: Distributors on both side of the street. Pillar every third lot boundary.

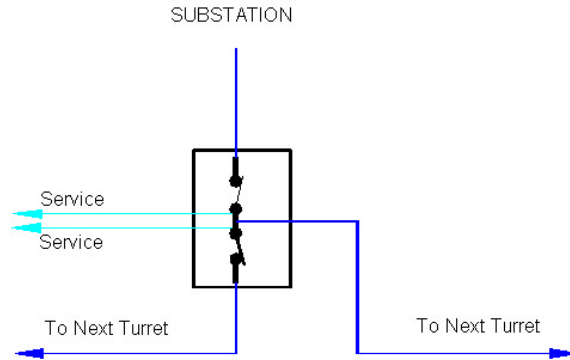
## Distributors on both sides of the street Pillar every other boundary



**Figure A1.5: Distributors on both sides of the street. Pillar every other boundary.**

## Annexure A2 - Link pillar connection diagrams

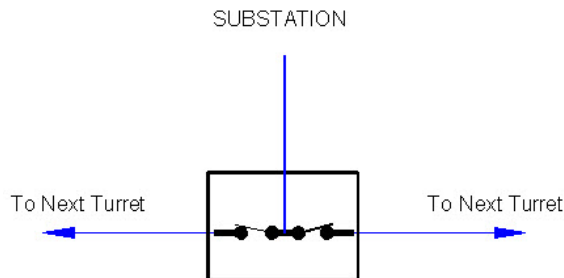
### Double link pillars



Used where distributor is required to supply two directions AND service connections are required

### Option 1

Figure A2.6: Ideal for low voltage networks where one leg is to a radial feed.



Used where distributor is required to supply two directions AND there is no foreseeable need for service connections

### Option 2

Figure A2.7: Ideal for low voltage networks where both legs are connected to Ring feed low voltage.

Figures A2.6 and A2.7: Currently used preferred options



Single link pillars

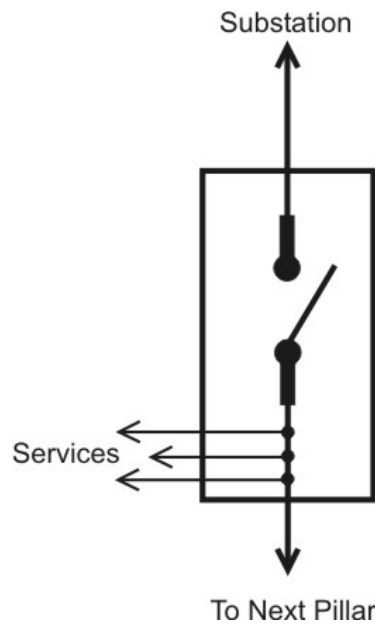


Figure A2.8: Currently used configuration

## Annexure B – Sample load and voltage drop calculations

Calculate the diversified Maximum Demand for the low voltage distributor shown below, and the voltage drop at the extremities of the distributor. The After Diversity Maximum Demand of the subdivision is 5 kVA and the distributor cable size is 240mm<sup>2</sup>. Length of each section of the distributor cable is 35m.

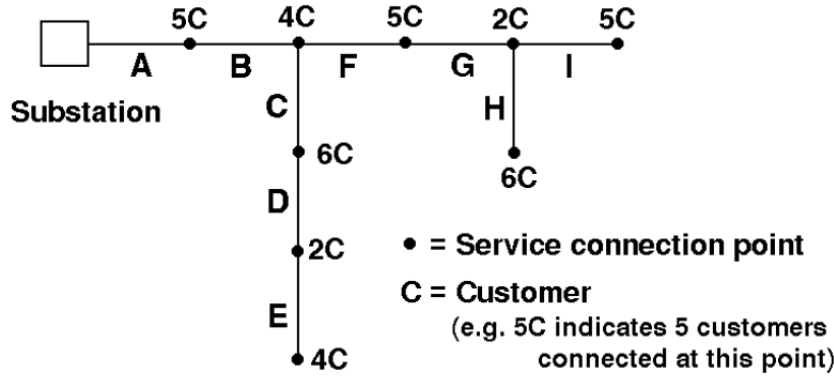


Figure B1: Sample load and voltage drop calculations

### Distributor Load

Total number of customers connected to section A is 39.

$$\begin{aligned}
 MD &= 8 * ADMD + 0.72 * ADMD * N + 0.95 * ADMD * \text{SQRT}(N) \\
 &= 210 \text{ kVA}
 \end{aligned}$$

$$\begin{aligned}
 \text{Phase Current} &= \frac{MD * 1000}{3 * V_{start}} \\
 &= 292 \text{ amps}
 \end{aligned}$$

### Voltage Drop Calculations (example shown for section A)

Voltage at the start of the Distributor 240V (at the Substation, beginning of section A)

Voltage drop constants (V/A/km) should be obtained from Table B2.

$$\begin{aligned}
 MD_v &= 12 * ADMD + 0.97 * ADMD * N + 1.3 * ADMD * \text{SQRT}(N) \\
 &= 289.74 \text{ kVA}
 \end{aligned}$$

$$\begin{aligned}
 \text{Phase current} &= \frac{MaxDemand * 1000}{3 * V_{start}} \\
 &= 402.42 \text{ amps}
 \end{aligned}$$

$$\begin{aligned}
 \text{Voltage drop (in section A)} &= \frac{(V / A / km) * Length * PhaseCurrent}{1000} \\
 &= 2.46 \text{ Volts}
 \end{aligned}$$

Note: Voltage drop constant used was 0.175 for 415 240A14 XQ Z/SAC cable

**Table B1: Calculations result**

Section	Length	No. of Customers supplied through section	Maximum Demand (12*ADMD +0.97*ADMD*N +1.3*ADMD*SQ RT(N))	Vstart	Phase Current (MD*1000/(3 *Vstart))	Voltage drop (V/A/Km)*length*Phase Current/1000	Voltage drop at the extremities	Percentage Voltage drop
A	35	39	289.74	240.00	402.42	2.46		
B	35	34	262.80	237.54	368.79	2.26		
C	35	12	140.72	235.28	199.36	1.22		
D	35	6	105.02	234.06	149.57	0.92		
E	35	4	92.40	233.14	132.11	0.81	7.67	3.18
F	35	18	174.88	235.28	247.76	1.52		
G	35	13	146.49	233.76	208.88	1.28		
H	35	6	105.02	232.48	150.58	0.92	8.44	3.52
I	35	5	98.78	232.48	141.64	0.87	8.39	3.50

**Table B2: Voltage drop constants for distributor and streetlighting cables**

Underground Cable	Voltage Drop Constants for Balanced Loading over Three Phases (mV/amp-metre)	
	*Phase / Earth	Phase / Phase
415 16 CU4 XQ Z	1.472	2.550
415 240 AL4 XQ Z / SAC	0.175	0.303

\* Note 1. Use this column for calculation of the designed maximum voltage drop in a low voltage distributor. The designed maximum voltage drop must not exceed 9 volts phase-to-earth at the extremities, when the distributor is loaded to 75 % of its nominal rating.

Note 2. For single-phase distributors, the voltage drop calculated from the phase-to-earth constants in the middle column of the above table must be doubled.

The resulting calculated voltage drop must not exceed 9 volts phase-to-earth at the extremities, when the distributor is loaded to 75 % of its nominal rating.

**Table B3: Voltage drop constant for single phase loads**

Underground Cable	Voltage Drop Constants for Single-Phase Loads (with Unparalleled Cable Cores) mV/amp-metre
415 16 CU4 XQ Z	2.945

## Annexure C – Sample compliance checklist



### Network Standard Checklist Form

#### NS110 Design and Construction Standard for URDs

Project Identification:	
Prepared by: <Name & Position Title>	Date:

This checklist is for internal Ausgrid use only and does not apply to ASPs or contractors who have specific compliance requirements in relation to Contestable project works. The checklist is unique for each network standard and is available within BALIN and the BMS as a separate form that can be amended as required, completed and saved in TRIM with the other project documentation.

This section is used to identify compliance checks that when applied to the work associated with this Network Standard will satisfy an audit process to establish that the requirements of the standard have been followed. It is expected that applicable items would normally be checked as Comply (Yes) as non-compliance is generally not tolerated.

Where non-compliance is the result of specific site conditions or design decisions this needs to be identified in the notes section of the form for each non-compliance and approval sought from an appropriately authorised Ausgrid manager responsible for design approval per NS261 Compliance Framework for Network Standards.

Should additional information be available to document non-compliance decisions, these can be attached to the checklist form. The checklist and any attached explanatory notes should be saved in the project document repository.

Item	Description	Refer Clause	Completed/ Actioned
	<b>Scope</b>		
	Underground assets LV, Street lighting and HV up to and including 11kV in an URD electrical reticulation		
	Maximum demand and Voltage drop calculations for LV distributors		
	Redevelopments within URD subdivisions		
	<b>Design Information</b>		
1	All products supplied to Ausgrid are free from Asbestos related material	5	Yes/No/NA
2	Electrical reticulation system in new residential subdivisions are underground	6	Yes/No/NA
3	NS181 procedure is followed for any deviations from this Network Standard	6	Yes/No/NA
4	Street lighting reticulation design meets Street lighting Customer and NS 119 requirements	6	Yes/No/NA
5	The developer supplied local authorities with copies of the construction plans at least 40 days before work is to commence	7	Yes/No/NA
6	Maximum initial loading for substation is carried out	9.2	Yes/No/NA
7	Diversified load and voltage drop calculation completed	9.3	Yes/No/NA
8	Designed maximum diversified load on any distributor is $\leq$ 75% of the distributor's nominal rating	10.2	Yes/No/NA
9	Distributor cables are selected according to this standard	10.4	Yes/No/NA
10	The first service enclosure from the distribution substation on every low voltage distributor has links to allow for isolating the distributor from the source of supply	10.5	Yes/No/NA

Item	Description	Refer Clause	Completed/ Actioned
11	Service enclosures at the extremities of a low voltage distributor has links installed to allow for paralleling with adjacent distribution centres	10.5	Yes/No/NA
12	Loop feeds are established where loop roadways exist	10.5	Yes/No/NA
<b>Construction</b>			
13	Approval of the Street lighting charges is obtained from the Customer before construction work commences	6	Yes/No/NA
14	Ducts are run in the full width of the rail corridor	6	Yes/No/NA
15	Poles are located on either side of a rail crossing	6	Yes/No/NA
16	Kiosk-type substation installation is carried out according to NS 117 and NS 141	9.1	Yes/No/NA
17	Distribution pillars are constructed according to NS 127	10.3	
<b>Testing &amp; Acceptance</b>			
18	Testing is carried out in accordance with NS 117 and NS 161	17	Yes/No/NA
19	All network assets are recorded in accordance with NS 100	18	Yes/No/NA

Notes:

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