Network Standard

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NW000-S0074 **NS234 TELECOMMUNICATIONS UNDERGROUND PHYSICAL PLANT INSTALLATION**

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design and installation of telecommunications underground physical plant, 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Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.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

Scope and Risks Addressed

This standard is limited to scope identified below and provides controls for associated risks as listed below:

- ☐ Telecommunications buried conduit asset installation and alteration outside of Ausgrid substation premises which are not co-located with HV feeders in a shared trench (for telecommunications in shared trench with Ausgrid electrical assets, refer to NS168 and NS130)
- ☐ Telecommunications cable haul installations, alterations or recovery through conduits which may be in shared trench and/or stand-alone arrangement
- ☐ Installation of Ausgrid telecommunications assets in or on voids, vaults, bridges and tunnels
- ☐ Labelling of telecommunications buried assets in pits and voids
- ☐ Testing, Inspection and Documentation related to the above points

Where to for more information?

Sections 2

Planning, Design and Installation

This section defines:

- ☐ The approved cable and conduit installation for Ausgrid underground telecommunications assets
- ☐ Labelling underground assets in Ausgrid pits and voids
- ☐ Ausgrid fibre cable drum stock requirements
- ☐ Telecommunications cable types for underground haul
- ☐ Shared trench arrangements – with Ausgrid HV assets
- ☐ Shared trench arrangements - with other utility assets
- ☐ Third party interfaces with Ausgrid underground infrastructure

Where to for more information?

Section 5

Tools and Forms

Annexure A

Testing, Inspection and Documentation

This section defines:

- ☐ When to test conduit and cable and the requirements for testing
- ☐ Documentation required to prove successful installation

Where to for more information?

Section 6

Tools and Forms

Annexure A

Route Alteration and Recovery

These sections define:

- ☐ Requirements for altering underground telecommunications routes
- ☐ Requirements for recovery of underground telecommunications routes

Where to for more information?

Sections 7-8

Tools and Forms

Annexure A

NS234
Telecommunications Underground Physical Plant Installation

CONTENTS

1.0 PURPOSE

Network Standard NS234 specifies the requirements for the installation of Ausgrid's telecommunications conduit as well as for the haul of telecommunications cable through underground conduit in Ausgrid's supply area.

All local instructions must be made to comply with this standard and its related NS and NEG documents as referred to and available on Ausgrid's Balin and internet sites.

It is the responsibility of all Ausgrid staff and contractors who are directly or indirectly involved with Ausgrid's telecommunications network, to apply this standard and related standards and guides at all times.

If any of the requirements in this document are ambiguous, the Proponent may refer to Ausgrid for clarification. Ausgrid's interpretation shall then apply as though it was included in the standard, and is final and binding.

2.0 SCOPE

This standard defines Ausgrid telecommunications underground infrastructure installation requirements. The majority of Ausgrid telecommunications infrastructure works are for optical fibre cable installation. This standard therefore covers installation of underground conduit and cabling for Ausgrid's protection fibre cable network, as well as for DTS temperature sensing application.

This standard does not include telecommunications assets within the following boundary points:

- the security boundary fence line of Ausgrid's electrical substations for substations with yards;
- the building entry point for substations with no yard and;
- the security boundary fence line of Ausgrid's depots and offices.

Telecommunications asset installation and alteration works within the above boundaries shall comply with NS266 Telecommunications Cabling in Ausgrid Premises.

This standard does not include telecommunications pit installations or underground installations which are co-located with a HV feeder in shared trench arrangement. For these specifications, the reader should refer to NS204.2.1 Communications Pits – Specifications and Installation Guidelines, as well as NS130 Specification for Laying Underground Cables up to and including 11kV and NS168 Specification for the Design and Construction of 33kV, 66kV and 132kV Underground Cables.

The general excavation and reinstatement requirements as well as the associated documentation, safety and environmental aspects of underground asset installation detailed in NS130 and NS168 shall be applied to telecommunications stand alone conduit installation and alteration works.

In relation to conduit, this standard shall only cover details specific to stand alone telecommunications conduit installation and alteration which are considered atypical or separate to underground HV feeder installation works. In relation to cable, this standard shall cover details specific to the haul of all optical fibre cables outside of Ausgrid premises, regardless of whether the haul be through conduit in shared trench or stand alone arrangement. Refer to section 4 below for clarification of the term 'stand alone'.

Distributed Temperature Sensing (DTS) fibre cores and tubes that are built into the HV feeder cable sheath are not included in this standard. Refer to Ausgrid Mains Design Manager, NS130 and NS168 regarding composite conductor and DTS cables. Break-out of composite DTS and conductor cables to take the DTS away from the feeder for calibration, termination or other purposes may be performed as per this specification and/or NS266 Telecommunications Cabling in Ausgrid Premises where appropriate for the cable and/or conduit installation beyond the break-out

joint. The Proponent should refer to Ausgrid's Communications Engineering Planning Manager where clarification of DTS requirements is required.

This standard does not cover the installation, alteration, or recovery of copper pilot cables. Copper pilot cable works shall only be performed by Ausgrid in compliance with direction given by the Communications Engineering Planning Manager.

3.0 REFERENCES

3.1 General

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

3.2 Ausgrid documents

- Be Safe 12;
- Company Form (Governance) - Network Technical Document Endorsement and Approval;
- Company Procedure (Governance) - Network Technical Document Endorsement and Approval;
- Company Procedure (Network) – Network Standards Compliance;
- Company Procedure (Network) - Production / Review of Engineering Technical Documents within Document repository
- DG14 Underground Distribution Substations and Confined Spaces;
- DG37 Use of Fall Arrest Systems for Vault and Basement Distribution Substation Entry;
- Electrical Safety Rules;
- Electricity Network Safety Management System Manual;
- MRPA-005 Establishment / Re-establishment of Access Tracks;
- NEG-EP07 Network Access and Security – Locks and Keys;
- NEG OH14 Guide to the Assessment of Waterway Crossings Risks
- NEG-SE10 Traffic Management;
- NEG-UG03 Mains Underground – Guideline to Management of Work in Close Proximity to Underground Power Cables;
- NS100 Field Recording of Network Assets;
- NS130 Laying Underground Cables up to and Including 11kV;
- NS143 Easements, Leases and Rights of Way;
- NS156 Working Near or Around Underground Cables;
- NS159 Installation of cables and conduits using trenchless techniques
- NS165 Safety Requirements for Non-Electrical Work In and Around Live Substations;
- NS168 Specification for the Design and Construction of 33kV, 66kV and 132kV Underground Cables;
- NS171 Fire Stopping in Substations;
- NS174 Environmental Procedures;
- NS181 Approval of Materials and Equipment and Network Standard Variations;
- NS204.2.1 Communication Pits – Specifications and Installation Guidelines;
- NS205 Fibre Optic Cabling Installation – Cable markers, Placement and Numbering;
- NS212 Integrated Support Requirements for Ausgrid Network Assets;
- NS235 Telecommunications UGOH Transition;
- NS241 Working Near Or Around Ausgrid Telecommunication Cables;
- NS243 Telecommunications: Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance;
- NS245 Telecommunications Approved List of Materials;
- NS266 Telecommunications Cabling in Ausgrid Premises;

3.3 Other standards and documents

- AS1012 Methods of Testing Concrete;

- AS1141 Methods for Sampling and Testing Aggregates;
- AS1289.0-2000 Method of Testing Soils for Engineering Purposes – General Requirements and List of Methods;
- AS1289.5.1.1 Soil Compaction and Density Tests – Determination of the Dry Density / Moisture Content Relation of a soil using Standard Compactive Effort;
- AS1289.5.2.1 Soil Compaction and Density Tests – Determination of the Dry Density / Moisture Content Relation of a soil using Modified Compactive Effort;
- AS1289.5.6.1 Soil Compaction and Density Tests – Compaction Control Test – Density Index Method for Cohesion less Material;
- AS1345 Identification of the Contents of Pipes, Conduits and Ducts;
- AS1379 The Specification and Supply of Concrete;
- AS1742 Manual of Uniform Traffic Control Devices;
- AS/NZS 2032 Installation of PVC Pipe Systems;
- AS2053.5 Rigid Plain Conduits and Fittings of Insulating Material;
- AS2124-1992 General Conditions of Contract;
- AS/NZS 2648.1 Underground Marking Tape;
- AS2700 Colour Standards for General Purpose;
- AS2758.1 Aggregates and Rock for Engineering Purposes – Concrete Aggregates;
- AS/NZS 2865 Safe Working in a Confined Space;
- AS/NZS 3085.1 Telecommunications Installations – Administration of Communications Cabling Systems – Basic Requirements;
- AS3610 Formwork for Concrete;
- AS3798 Guidelines on Earthworks for Commercial and Residential Developments;
- AS3996-2006 Access Covers and Grates;
- AS4000-1997 General Conditions of Contract for Construction Contracts Issued Under Standing Order Deed;
- AS/NZS 4129-2008 Fittings for Polyethylene Pipes for Pressure Applications;
- AS/NZS 4130-2003 Polyethylene Pipes for Pressure Applications;
- AS4275 Methods of Testing Underground Marking Tape;
- AS/NZS 4586 Slip Resistance Classification of New Pedestrian Surface Materials;
- AS4671 Steel Reinforcing Materials;
- AS/NZS4702 Polymeric Cable Protection Covers;
- AS4902-2000 General Conditions of Contract for Design and Construct;
- AS4910-2002 General Conditions of Contract for the Supply of Equipment with Installation;
- AS6947 Crossing of Waterways by Electrical Infrastructure
- AS/NZS ISO/IEC 14763.3 Telecommunications Installations – Acceptance Testing for Optical Fibre Cabling;
- Communications Alliance – Telecommunications in Road Reserves – Operational Guidelines for Installations;
- EA NSW Code of Practice Installation Safety Management;
- EA NSW-1999 NSW Service and Installation Rules;
- EA NSW-2004-ISSC 28 Guideline for Enclosed Spaces – NSW Energy Networks March 2004;
- EA NSW-ISSC20-2001 Guidelines for the Management of Electricity Easements;
- ESAA C(b)2-1989 Guide to the Installation of Cables Underground;
- Electrical Conduit, Conduit Fittings, Cable Protection Covers and Marker Tape;
- ENA 1984 Earth Potential Rise EPR Code;
- ENA D(b)37 Register of Plant Used for Underground Cable Installation;
- ENA Doc 001-2008 National Electricity Network Safety Code;
- ENA HB 101 (CJC 5) Guide for Low Frequency Induction;
- ENA NENS 10-2005 National Guidelines for Contractor Occupational Health and Safety Management;
- IEC 60793 Optical Fibres – Measurement Methods and Test Procedures;
- IEC 50102 Degrees of Protection Provided by Enclosures for Electrical Equipment Against External Mechanical Impacts;
- Model Agreement for Local Councils and Utility / Service Providers;
- MOU – Ausgrid, RMS and Department of Transport;
- NAT-SPEC – AUS-SPEC 1152 Road Openings and Restoration (Utilities);

- RMS – Guide – Traffic Control at Worksites;
- RMS – Protocol for Exchange of GIS data;
- RMS – Road Occupancy Licence Conditions of Approval – Sydney East, Sydney North, Sydney South – Homebush, Sydney South – Oatley;
- SAA-HB102-1997 Coordination of Power and Telecommunications – Low Frequency Induction (LFI);
- Shared Trench Utility Agreement;
- WHS – Confined Spaces: Code of Practice;
- WHS – Code of Practice: Excavation;
- WHS – Excavation: Code of Practice;
- WHS – Hazardous Manual Tasks: Code of Practice;
- WHS – Manual Handling Resource and;
- WHS – Work Near Underground Assets – Guide.

3.4 Acts and regulations

- Electricity Supply (General) Regulation 2014 (NSW);
- Electricity Supply (Safety and Network Management) Regulation 2014;
- Environmental Planning and Assessment Act 1979;
- Environmental Planning and Assessment Regulation 2000;
- Protection of the Environment Operations Act 1997;
- Roads Act – Seek Consent Under Section 138 of the Roads Act and;
- Work Health and Safety Act 2011 and Regulation 2017.

4.0 DEFINITIONS

Refer to NS001 for Glossary of Terms.

5.0 PLANNING, DESIGN AND INSTALLATION

5.1 General

The Communications Engineering Planning Manager is responsible for planning the optical fibre network, and producing documentation including but not limited to Telecommunications Brief instructions and plans to communicate build requirements. All design and construction activity for telecommunications works must be compliant with direction given by the Communications Engineering Planning Manager and Ausgrid standards including, but not limited to, this standard.

All Ausgrid telecommunications conduit and cable installations and alterations are to be designed and constructed in compliance with this standard and the associated Ausgrid standards and guides. Cable routes must be inspected and tested for compliance with this standard prior to services commissioning through the installation, and prior to asset acceptance. Refer to NS243 Telecommunications Roles, Responsibilities, Training Requirements, Auditing and Quality Assurance Acceptance regarding asset acceptance.

Ausgrid telecommunications conduits must be primed, glue joined and sealed to form a continuous haul route free of burrs and obstructions between pits and/or voids. Ausgrid underground protection optical fibre cables must be housed in conduit or pits for the entire underground route end to end. Ausgrid protection optical fibre cables must not be direct buried.

The designer is responsible for consulting the Communications Engineering Planning Manager where clarification of this standard or variation from the standard is necessary, prior to progressing the design through to construction issue. The constructor is responsible for consulting the designer where clarification or variation from this standard and/or the design is necessary at any time throughout the construction stage.

The Proponent is responsible for compliance with:

- Ausgrid's Be Safe system;
- Ausgrid's Safety in Design procedures;
- Ausgrid Electrical Safety Rules;
- Work Health and Safety Act 2011 and associated Regulation and;
- NS174 and all relevant laws, rules, regulations and guides for environmental impact assessment.

The Proponent is responsible for assessing and recommending mitigation of risks associated with asbestos in the work place in accordance with NS211 Working with Asbestos Products and all relevant laws, rules, regulations and guides.

Refer to NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering regarding the installation, testing and recording of markers for buried telecommunications assets associated with underground telecommunications infrastructure installation and/or alteration.

The Proponent shall comply with the guidelines relevant to the protection of trees found in AUS-SPEC 1152.

Design documentation must be sent to Ausgrid for review prior to construction release. The design shall not be released for construction until Ausgrid is satisfied that its needs for the telecommunications infrastructure installation or alteration are met.

It is the "Proponent's" responsibility to restore all damage to Ausgrid pre-existing infrastructure that is caused, by or results from, their installation works at no cost to Ausgrid.

5.2 Locating existing services

The Proponent is responsible for documenting all efforts undertaken to locate existing underground services in the vicinity of, or that may be affected by, the proposed works before excavation begins. It is expected that in the course of performing all reasonable efforts, the Proponent will contact the designated underground asset information provider and obtains current underground services plans.

Refer to NS156 Working Near or Around Underground Cables and NS241 Working Near or Around Ausgrid Telecommunication Cables with regards to the safety aspects and notification requirements of working in close proximity to underground cables.

Existing Ausgrid telecommunications conduits that are located, exposed and found to be non-compliant with the minimum depth of cover stated in this standard, must be reported to Ausgrid's Communications Engineering Planning Manager. An assessment on the risk will be undertaken to determine if any remediation works are warranted.

5.3 Excavation and reinstatement

Excavation and reinstatement work shall be carried out with minimal disturbance to the surrounding environment and in accordance with the responsibilities detailed in section 5 of this standard.

All excavations must be performed in accordance with the Certified Design and any other engineering and design drawings approved by Ausgrid.

Due diligence must be exercised to minimise the impact caused by excavation and reinstatement works including to the visual amenity of the area. This includes, but is not limited to, soil compaction and surface reinstatement to match the surrounds and prevent subsidence.

The Proponent shall design and construct telecommunications underground installation works which, throughout the project, do not create or cause security risks to Ausgrid infrastructure and/or safety hazards for the particular scope of works falling within the "Proponent's" responsibility.

In established areas, the removal of pavement layers, surface and sub-surface materials requires maximum care to safeguard existing underground services and other structures within and around the work site against damage.

The design and excavation for underground telecommunications works within substation sites must comply with NS 165 Safety requirements for Non-Electrical Work in and around Live Substations.

The Proponent is responsible for locating all existing services that may be affected by the proposed works before any excavations take place. This includes the designated underground asset information provider The following sections of NS130 are applicable to this standard with regards to excavation and reinstatement:

- NS130 section 5 regarding AUS-SPEC 1152 (Managed by NATSPEC) for road opening and restoration and;
- NS130 sections 6 – 8 and sections 16 - 18 regarding excavation and reinstatement requirements for instances where compliance with this standard deems retrofit of route markers above existing telecommunications buried assets is required.

Standard NS130, NS168 and NS159 are to be read in conjunction with this standard for telecommunications asset installations co-located with HV underground assets.

5.4 Community consultation

Community consultation must be performed by the Proponent in accordance with Ausgrid's Community Engagement Policy. The Proponent is responsible for attaining agreement for access and easements prior to commencing works.

Aesthetic impact from underground telecommunications installation or alteration works is to be minimised.

5.5 Geographic and environmental considerations

The Proponent is responsible for assessing, studying, and selecting the option with the lowest acceptable risk and the most cost efficient telecommunications route which complies with Ausgrid's standards. Geographic and environmental considerations that may alter the underground installation route option choice include, but are not limited to existing or future:

- fences or barriers;
- structures or buildings;
- road and rail works;
- Ausgrid or other utility underground installation or alteration works;
- natural rock or landscaping;
- drainage;
- natural or man-made water bodies;
- steep terrain or cliffs;
- human, livestock and/or farm plantation activity;
- mine effects including but not limited to excavation or subsidence;
- requirements or restrictions of the local community, heritage, aboriginal, national parks or other authorities with interest in the land;
- water table;
- erosion;
- polluted soil including but not limited to acid sulphate soils;
- housing or industrial estate developments;
- sand dune movement and;
- potential for landslides.

5.6 Access and easements

The Proponent is responsible for attaining agreement for access and easements prior to commencing works.

Refer to NEG-EP07 regarding locks in series for easements.

5.7 Approved conduits

Ausgrid has approved a rationalised range of Un-plasticized Poly Vinyl Chloride (UPVC) orange conduits for underground telecommunications cabling as a minimum standard. Refer to NS245 Telecommunications Approved List of Materials for the list of conduits, bends, bell mouths, couplings and associated materials approved for Ausgrid's telecommunications installations.

The default conduit for Ausgrid's protection fibre network is 63mm OD HD orange conduit (55mm ID). The 63mm OD HD orange conduit type shall be used in all instances for protection fibre infrastructure installations unless otherwise specified by Ausgrid, or unless an under bore requires a larger diameter conduit.

Telecommunications conduit bends are preferred to be by natural sweeping bend of the conduit length, however 1200mm and 900mm radius sweeping bends are approved for street routes if haul ability assessment passes. Telecommunications UGOH transitions where the underground route distance to pit is no more than 40m may use 600mm radius bends.

In some instances Ausgrid may utilise spare orange HV feeder conduits for the haul of protection fibre cables for sections where the following conditions are <u>all</u> applicable:

- there is no existing 63mm conduit;
- it is cost efficient to utilise the spare conduit line;
- Ausgrid's Communications Engineering Planning Manager has written approval to use the HV feeder conduit from the appropriate Ausgrid Section Manager, and
- other than conduit size and duty (i.e. LD / HD), the conduit proposed to be used is compliant, or will be made compliant, with all applicable Ausgrid telecommunications standards including, but not limited to this standard.

Note: The use of pre-existing HV conduits may necessitate additional works to ensure the protection fibre cable haul route is mechanically protected or segregated from the HV assets at either end and at intermediate pits of the HV feeder conduit route.

White telecommunications conduits must not be used for Ausgrid telecommunications cabling. White telecommunications conduits are only to be used for carrier network installations such as Telstra and Optus.

The approved conduit for DTS infrastructure installation is either 32mm or 50mm OD HD orange conduit. Ausgrid shall determine which conduit is to be used for each installation.

5.8 Depth, alignment and spacing

Ausgrid telecommunications conduits are to be installed at no less than 900mm depth of cover for the entire route unless they are installed directly alongside a HV cable or conduit. Within Ausgrid substation security fenced areas, the minimum telecommunications conduit depth of cover may be reduced to 500mm depth of cover, however assessment is required regarding earth grid impact, as well as for the presence of other underground assets.

Ausgrid telecommunications conduits installed alongside HV assets must comply with the depth of cover, alignment and spacing requirements of NS130 and/or NS168.

Stand alone telecommunications conduits which cannot be installed at 900mm depth of cover due to the presence of existing underground infrastructure or other reasons, must not proceed until the Proponent has received written approval from Ausgrid's Communications Engineering Planning Manager, including specific instructions for risk mitigation from the reduced depth of cover. Risk mitigation measures for reduced depth of cover may include, but are not limited to, concrete encasement, cover plates or altering the conduit path.

In instances where ground levels have been altered resulting in reduced cover, the matter is to be referred to the Communications Engineering Planning Manager for assessment of what remedial action may be required.

Ausgrid telecommunication conduits shall be aligned in accordance with easement approvals for power networks. Refer to NS204.2.1 Communications Pits: Specifications and Installation Guidelines regarding pit alignment.

There is no requirement for space between Ausgrid protection fibre conduit and other underground infrastructure. For reliability reasons, it is preferred that Ausgrid protection fibre conduits are installed directly alongside the HV cable and/or conduit. The requirement for diversity between each protection fibre conduit line is determined by Ausgrid's Communications Engineering Planning Manager in accordance with NS203 Telecommunications Network: Master Policy Document. Refer to clause 7.3 of this document.

DTS cables and conduits are to be installed as close as possible to the related HV feeder cable/s and/or conduit such that the DTS installation does not interfere with the thermal rating of the conductor, and such that the DTS is best able to rate the temperature of the electrical asset along the route. Open trench installations must have the backfill completely surround all of the conduits including gaps between conduits for the most reliable DTS temperature readings along the route.

5.9 Coupling and sealing of conduits

All conduit couplings must be primed and then glued using PVC solvent cement on both surfaces to be joined. Conduit joints must be sufficiently sealed to prevent the ingress of water and foreign material to the conduit line.

Transitions in conduit sizes shall be by installation of communications pits. Conduit reducers shall not be used for telecommunications conduit internal diameter changes. Coupling of conduits must only join conduits with matching internal diameter.

Conduit joins must be glue sealed and free of obstructions, burrs and internal ridges such that the cable haul has a continuous smooth internal surface that will not cut or abrade the cable sheath if the haul is performed in accordance with the approved design haul ability study.

5.10 Route design

It is the “Proponent’s” responsibility to design routes to achieve Ausgrid’s functional intent in compliance with this standard and all other applicable Ausgrid standards and guides. To design the most cost efficient route/s, the designer must perform a haul ability study to assess the suitability of each route for hauling the intended cable. The main influencing factors for telecommunications route design are:

- Fulfilling Ausgrid’s documented functional intent including but not limited to provisioning specific requirements for cable type, pit, coil and splice points;
- Compliance with Ausgrid standards;
- Minimising the number of pits and splices;
- Minimising the number of conduit bends;
- Safety – Safety In Design;
- Security;
- Cost efficiency;
- Haul ability assessment (see below);
- Cable drum lengths (including for the use of spare cable stores as per section 5.23 below);
- Traffic, pedestrian and access timing issues including, but not limited to rail crossing installations;
- Bridges, voids, tunnels, UGOH’s and other route installation method change points;
- Community consultation requirements;
- Bridge and void authorities and other asset owner’s requirements and;
- Geography and the environment (as per clause 5.5 above).

The designer performing haul ability calculation must account for factors including, but not limited to:

- Co-efficient of friction;
- Manufacturer’s maximum allowable hauling tension for the nominated cable type;
- Conduit type;
- Conduit bends and the radius of bends;
- Inclines;
- Pit, vault or void locations;
- Presence of other assets within the conduit;
- Physical characteristics of the cable/s to be hauled including but not limited to cable dimensions and cable weight;
- Route length between hauling pits and;
- Lubricants, or duct liners.

Hauling calculation software may be recommended by Ausgrid, the cable manufacturer, or the manufacturer of cable pulling lubricants.

Ausgrid protection fibre cable routes must be no more than 300m long with no more than a cumulative total bending radius of 180° between pits. Distances greater than 300m or a total bending radius greater than 180° between pits, requires Secondary Systems approval. This approval is to be sort prior to the final approved design and implementation of work. In undertaking the assessment for routes greater than 300m or a total bending radius greater than 180° between pits, hauling calculations must account for the haul of standard UGFO cable as per Ausgrid's current period contract for protection fibre. If the Manager Secondary Systems or representative designates an alternate cable type for installation, the associated hauling calculations are to use the material specific standards in determining the haul distance and total bending radius.

Hauling calculations must be stored with the project documentation for 7 years or the life of the asset (whichever comes last).

The Proponent shall avoid designing or installing telecommunications conduits to enter electrical pits. Locating a telecommunications pit alongside or nearby electrical pits often proves to be the most cost efficient option considering other route design influences including, but not limited to, optical fibre cable haul ability. At these points, the telecommunications conduits stray away from the HV feeder trench to enter the telecommunications pit, therefore bypassing the electrical pit. Refer to NS204.2.1 Communications Pits: Specifications and Installation Guidelines for further information on telecommunications pits including requirements for Sydney CBD where it may be unavoidable to enter electrical pits. Refer also to standard construction drawings 212393 and 212386.

Route designs joining to or utilising pre-existing telecommunications conduit routes or conduit sections must ensure the routes are compliant with this standard, or can be altered to be compliant with this standard and all other appropriate Ausgrid standards and guides prior to hauling new Ausgrid cable through.

Pre-existing telecommunications route sections which cannot be made compliant with this standard and all other applicable Ausgrid standards and guides must not be used for Ausgrid telecommunications cable haul unless written approval to do so has been granted by the Communications Engineering Planning Manager. In these cases, the Communications Engineering Planning Manager may specify particular requirements for risk reduction reasons, which must be adhered prior to new Ausgrid telecommunications cable haul.

Refer to section 5.21.2 below regarding the use of pre-occupied telecommunications conduits.

Routes for Ausgrid protection fibre cables are to be designed such that the protection fibre cable only travels through securely locked pits, conduits and voids which are exclusively for Ausgrid access and use. Exception to this rule must be approved in writing by the Communications Engineering Planning Manager prior to design approval.

The Proponent shall consult the asset owner, as well as perform and document risk assessment, on the potential smoke and fire propagation hazards in fire conditions for all instances where Ausgrid telecommunications assets are proposed to travel through large enclosed spaces including, but not limited to, bridge voids and tunnels. Changing Ausgrid's fibre cable sheath type to LS0H (also known as "LSZH") and/or changing conduit type to metallic or halogen free conduits are options for reducing risk, and/or for compliance with the asset authority's requirements. Refer to NS171 Fire Stopping in Substations regarding risk mitigation options, materials and applications.

It is the "Proponent's" responsibility to account for Safety In Design for each project and document present or potential atypical hazards for the project scope falling within the designer's responsibility, and communicate this information in a designer safety report issued with construction documentation. Refer to NS243 Telecommunications Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance.

5.11 Route diversity

The Proponent is responsible for designing routes that are compliant with Ausgrid's direction for protection fibre diversity. Ausgrid's Communications Engineering Planning Manager shall specify which protection fibre routes are to be diverse from each other for the project. Some projects may have multiple diversity requirements. Refer to NS203 Telecommunications Network: Master Policy Document regarding diversity.

5.12 Co-location with HV feeders

The majority of Ausgrid's telecommunications conduits are installed in shared trench arrangement with HV assets which are installed in accordance with standards NS130 and NS168. From the originating point where the telecommunications conduit begins to stray away from the HV asset route, it is then regarded as "stand alone" and is to be performed in accordance with this standard (NS234).

Telecommunications conduits may stray away from HV asset routes for reasons including, but not limited to:

- Entering Ausgrid locked pits for haul or splicing purposes;
- Entering substation cable chases;
- Entering buildings;
- UGOH transition (refer NS235 Telecommunications UGOH Transition);
- Diversity and;
- Avoiding electrical pit entry.

It is preferred that telecommunications conduit installations in shared trench with HV feeders position the telecommunications conduit directly beside the HV conduit and/or cable on the property side of the trench where it is easiest for the telecommunications conduits to stray away to telecommunications pits for hauling, splicing and coil storage purposes. It is important to place the telecommunications conduit/s directly beside HV cables and/or conduits to protect the telecommunications assets from potential damage caused by subsequent excavation or civil works activity. Refer to TDMS drawings 212393 and 212386 which are standard construction drawings.

All HV feeder projects including but not limited to capital works, recoverable and contestable works for voltages ≥33kV which are installing or altering the route of underground power cable and/or conduit assets shall install one telecommunications protection fibre conduit alongside each HV feeder and within the same trench in all instances. The Communications Engineering Planning Manager shall advise in writing if more than one telecommunications conduit is required with a particular HV feeder.

All HV feeder projects including, but not limited to, capital works, recoverable and contestable works for voltages <33kV which are installing or altering the route of underground power cable and/or conduit assets where any of the following conditions apply, shall install one telecommunications protection fibre conduit alongside the HV feeder asset and within the same trench for each trench or under bore:

- For railway crossings and;
- For waterways crossings.

All HV feeder projects including but not limited to capital works, recoverable and contestable works for voltages <33kV which are installing or altering the route of underground power cable and/or conduit assets where any of the following conditions apply, shall consult the Communications Engineering Planning Manager for protection fibre conduit requirement advice prior to progressing the design through to construction issue. The conduit requirement direction given by the Communications Engineering Planning Manager shall be applied to the project and the Proponent shall design and construct the telecommunications assets in accordance with this standard:

- For continuous sections of ≥ 2km;

- For any sections linking to or extending from existing telecommunications conduit section/s and;
- For full or partial sections falling within, passing through or crossing over the shaded "Strategic Comm's Corridors" layer shown in Ausgrid's web GIS available via the following link: http://webgis.energy.com.au/kml/area.php#filename|Strategic_Comms_Corridors_v2_Contestable.kml

All telecommunications underground asset installations shall be designed and installed in compliance with Ausgrid's direction and all applicable Ausgrid standards including, but not limited to this standard (NS234), NS130 and NS168.

5.13 Co-location with LV cables

It is not often that telecommunications conduits will be determined a requirement for co-location with LV (<1kV) cables in shared trench arrangement. Approved designs with this requirement, shall be performed in compliance with this standard using the same parameters as for telecommunications co-location with HV assets.

5.14 Open trench installation

In most cases Ausgrid underground stand alone telecommunications protection fibre infrastructure installations shall be for the installation of one 63mm OD protection fibre conduit. The Communications Engineering Planning Manager shall determine if more than one protection fibre conduit is required in a particular trench or trench section, or if an alternate size conduit is required. This information shall be communicated in the form of a Telecommunications Brief.

The trench size required depends on the number of conduits to be installed, the size of conduits to be installed, the location of the trench, and if the installation is to be co-located with other utility conduits.

It is preferred by road authorities and Ausgrid that road crossings (and crossings of other authorities' allocations) by trench installation methods, is at 90° to:

1) the property alignment;

2) the authorities' allocation and;

3) the road.

5.15 Trenchless techniques

Trenchless techniques may be used to reduce impact on surface infrastructure such as for installations under road, path, driveway, drains, parking lot surfaces and other utility infrastructure. Trenchless techniques are essential for crossing under rail lines. Trenchless techniques are also used for tree preservation reasons as this method is less invasive on tree roots by comparison to open trench techniques. In all of the above mentioned cases, the Proponent shall consult the utility or authority of interest to the asset and negotiate a reasonably practicable and mutually agreeable installation solution.

Transition in telecommunications conduit size either side of an installation by trenchless techniques shall be by installation of telecommunication pits. Conduit reducers shall not be used to join conduits of different internal dimensions for Ausgrid's buried telecommunications infrastructure unless written approval to do so is given by the Communications Engineering Planning Manager.

In all cases, new telecommunications conduit installations shall be proven as per clause 6.1 below.

5.16 Pits

The Proponent must design and construct Ausgrid telecommunications pits to comply with NS204.2.1 Communications Pits: Specifications and Installation Guidelines.

Telecommunications conduits shall enter voids, cable chase, basements and other enclosed areas through the side wall of the void. Conduits must enter the end wall (smaller dimension wall) of telecommunications pits. Telecommunications pits are used where conduits change in internal diameter, for hauling and splicing purposes, and for the storage of fibre cable coils.

Telecommunications conduits shall not enter electrical pits unless the presence of other infrastructure prevents the telecommunications conduit from either bypassing the electrical pit or straying away to a telecommunications pit.

Telecommunications conduits may enter electrical pits if by option study, it can be proven to be more cost effective and more risk averse for the telecommunications conduit to travel through the electrical pit. The Sydney CBD area is more likely to encounter instances where it is more risk averse and cost efficient for the telecommunications conduit to travel through the electrical pit. In all cases, telecommunications conduits proposed to travel through Ausgrid electrical pits must not be designed or constructed unless written approval to do so has been given by the Communications Engineering Planning Manager.

Refer to NS204.2.1 Communications Pits: Specifications and Installation Guidelines regarding requirements for mechanically protecting telecommunications conduits and cables travelling through electrical pits.

5.17 Void, vault, bridge and tunnel attachment

The Proponent is responsible for liaising with asset owners and/or authorities for Ausgrid's telecommunications infrastructure that is required to travel through voids, vaults, bridges, tunnels and other spaces owned or governed by an authority outside of Ausgrid. The asset authorities' requirements for the installation shall be negotiated through to mutual agreement, documented and factored into the design and construction.

The Proponent is to minimise the up-front and ongoing costs to Ausgrid as well as the inherent potential risks to infrastructure and maintenance personnel by installing Ausgrid telecommunications infrastructure through the external authority's structure, or by attachment to the external authority's structure.

The Proponent shall refer to Ausgrid's Communications Engineering Planning Manager for guidance or clarification on matters that cause conflict between Ausgrid's standards and the requirements of the asset authority, and/or where potential risks to Ausgrid's infrastructure or personnel are not able to be sufficiently reduced or eliminated.

Potential risks that may be inherent by occupying or attachment to bridge, tunnel, void, vault and other external authority's structures include but are not limited to:

- Fire hazard from Ausgrid's assets or other combustible or flammable materials, equipment, gasses, fumes and/or fluids that are present or have reasonable potential for ingress to the site;
- Smoke damage hazard from Ausgrid's assets or other materials at the site that are not halogen free;
- Asphyxiation and other health effects from production or ingress of noxious gasses, smoke or fumes to the site;
- Water ingress – tidal, stormwater or other potential flooding;
- Congestion – spaces with insufficient access and egress space and/or associated infrastructure i.e. ladders, steps and railings;
- Dust – of particular risk to optical splicing activities, however also includes the inhalation risk to workers from airborne asbestos fibres and other dust particles;

- Electrocution - electrical hazard potential;
- Noise hazards from nearby machinery, industrial, traffic, construction or other works;
- Insufficient lighting;
- Falls - Slippery surfaces and trip hazards or no allowance for fall arrest systems;
- Flora and fauna – overgrown entry and exit points or infestations of vermin, snakes, bees, wasps, ants, spiders or other pests;
- Crush – damaged or structurally unsound void construction and/or the potential for other infrastructure to fall on workers and/or Ausgrid assets;
- Vibration – potential effects on Ausgrid infrastructure from bridge and void assets that are designed for movement and vibration;
- Chemical hazard – potential for chemical leaks to impact workers, equipment, structures and/or cables;
- Mechanical – risk of damage from other utility installation or alteration works where their assets are sharing the same void space and;
- Vandalism – potential for vandalism in the area such as; lit cigarette butts and syringes dropped into voids, fires lit in bridge void utility chambers, intentional cable cuts and cable theft.

Sydney CBD has several large tunnel utility chambers through which Ausgrid telecommunications assets travel. Co-location of these spaces by Ausgrid and other authority assets introduces the additional risk of damage from works performed by other utilities in the shared void space. Refer to NS241 Working Near or Around Telecommunications Physical Network Assets.

Labelling Ausgrid assets through void, vault, bridge and tunnel structures shall comply with NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering.

Ausgrid protection optical fibre cable shall be installed through continuous rigid or flexible conduit through all void, vault, bridge and tunnel spaces to protect the cable from crush, kink, or impact.

The requirement for mechanical protection of Ausgrid telecommunications assets through void, vault, bridge and tunnel structures that are not owned by Ausgrid shall be specified in Ausgrid's telecommunications brief. Mechanical protection methods may include, but are not limited to concrete encasement, the use of metal conduit, or the use of cover guards applied over the top of cables and conduits.

It is the "Proponent's" responsibility to assess the potential maximum force or load that could be applied to Ausgrid's infrastructure under conditions expected for the site, and therefore design and construct mechanical protection that exceeds the potential maximum load, without introducing other risks to Ausgrid or other authority infrastructure.

The Proponent must design and construct Ausgrid infrastructure paths such that they do not entwine other authority infrastructure. The Proponent shall design and construct Ausgrid infrastructure paths such that the number of times Ausgrid's infrastructure crosses the path of other authority infrastructure is minimised.

5.18 Waterways crossings

It is not often that Ausgrid standalone telecommunications infrastructure installation will necessitate conduit or submarine fibre cable installation for the crossing of navigable waterways. In most

instances, these crossings will be by co-location of telecommunications assets with HV conductor installation, in which case the risk assessment for crossing the waterway is performed in accordance with Ausgrid's electrical infrastructure design standards.

For the rare instance where Ausgrid telecommunications brief specifies installation of buried conduit or submarine cable waterway crossing, the associated risks shall be assessed and managed by Ausgrid in accordance with AS6947 Crossing of Waterways by Electrical Infrastructure and also Ausgrid's NEG OH14 Guide to the Assessment of Waterway Crossings Risks.

5.19 Approaching substations

Telecommunications routes approaching Ausgrid substations in which the fibre link will terminate, shall have a min. 50m coil of protection fibre cable left in a locked telecommunications pit located within 50m of the substation secure yard or premises, for each fibre cable haul. If a pit cannot be located within 50m of the substation secure yard or premises, then an alternative is to install the pit and fibre cable coil inside the substation yard in a safe area that does not impose access restrictions to the pit or to other assets. Fibre links entering and terminating within Sydney CBD substations which have direct basement entry, must leave a minimum 50m fibre cable coil positioned in accordance with NS266.

The Proponent shall also refer to NS266 Telecommunications Cables in Ausgrid Premises regarding installation of underground conduits within substation yards in consideration of earth grid structures and other buried assets, and also for the transition from underground installation to building exterior riser conduits.

Fibre cables travelling through substations in which the fibre link will not terminate including, but not limited to distribution substations, do not need to leave any coil in the substation unless directed otherwise by the Communications Engineering Planning Manager.

5.20 UGOH

The Proponent shall refer to NS235 regarding telecommunications Underground to Overhead transitions (UGOH).

5.21 Hauling telecommunications cable

5.21.1 General

It is the "Proponent's" responsibility to plan, design and execute fibre cable hauls in accordance with the cable manufacturer's hauling recommendations, Ausgrid standards and the direction provided in Ausgrid's telecommunications brief document. Refer to section 5.10 above regarding route design factors.

The installation of hauling rope and Ausgrid telecommunications cable to a conduit must assess the following cable and conduit conditions prior to haul commencement:

- Debris, fluids or foreign objects in the conduit and/or pits;
- Damage to the rope and/or cable prior to haul;
- Cable type, conduits and associated materials are compliant with the design and; [1]
- Presence of other assets in the conduit and/or pits. [2]

Notes:

1. If any aspect of the design cannot be adhered, or if design direction is unclear or ambiguous for telecommunications infrastructure installation or alteration works, then the Proponent must refer back to the designer for guidance;

2. If the presence of other assets in Ausgrid conduits and/or pits was not accounted for at the design stage and noted on plans, then the installer must notify the designer, as route re-design may be required in order for the installation to be compliant with this standard.

The Proponent should plan long fibre cable hauls to originate from intermediate pit locations and haul in both directions to reduce the number of splices required. The haul-out / haul-in method for fibre cable installation must only be executed in accordance with the cable manufacturer's recommendations for repeat haul of the nominated cable type and cable length, factoring in the haul conditions as per the above points and clause 5.10.

The Proponent is responsible for performing haul calculations at the design stage for each fibre cable haul or telecommunications conduit route design. If a particular cable type has not been specified by Ausgrid for hauling into the route (i.e.: the design scope covers conduit only), then the Proponent shall calculate haul assessments based on Ausgrid standard 60F UGFO cable. Routes found to fail haul assessment shall be redesigned until a pass solution results. Haul calculations must be submitted to Ausgrid with the project design documentation. Haul calculations shall also be included in the design documentation that is submitted for construction issue.

Lubricants used for fibre cable hauls shall not degrade the cable, conduit or inner duct liners.

During and upon completion of the haul, the fibre cable shall be inspected for damage. Any cable length found to have damage* shall be discarded, and additional length hauled in to replace the damaged cable length.

* "Damage" (mentioned above) to fibre cable is further defined as including, but not limited to:

- the haul exceeding the cable manufacturers recommended maximum hauling tension at any time;
- scratching or deformity to more than 20% of the sheath in a 1m section;
- penetration depth by scratch, spike or melt of 20% or more into the external most sheath layer;
- kinking, bending, crushing or twisting of the fibre cable exceeding the cable manufacturers defined tolerances for the nominated cable type and;
- any installation causing or resulting in one or more mid-section cracked or broken fibre cores.

If cutting-off damaged cable length results in insufficient cable length coiled in each pit for splicing purposes, then the damaged cable shall be removed, and a new length shall be hauled in. If the second fibre cable hauls results in the same cable damage, then the Proponent should assess the cause of damage and perform rectification works to reduce the likelihood of damage recurrence. This process is to repeat until a successful undamaged cable haul results. If the conduit hauling issues cannot be resolved with minimal rectification works such as flush-out, or minimal excavation and repair, then the Proponent should refer to Ausgrid's Communications Engineering Planning Manager for advice on alternatives.

The Proponent must document the manufacturer's recommended maximum pulling tension for the intended haul cable on all construction issue plans for the project. For asset acceptance, the Proponent must submit hauling tension logs to Ausgrid to certify that the manufacturer's maximum pulling tensions were not exceeded for each fibre cable hauled.

Hauling new cable through pre-existing unused conduit sections requires route suitability assessment. The Proponent may request the conduits to be mandrelled and proven prior to inclusion of the conduit section in the design. Excavation work performed to locate conduit sections for mandrel must place a frequency based marker device (set to the telecommunications frequency) over the conduit end prior to reinstatement if a marker device was not present at the time of excavation. Marker installation is to apply whether the conduit section will be used or not and the device coordinate locations must be reported to Ausgrid in accordance with NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering.

All sections of conduit planned for the haul of Ausgrid cable are to be made locatable in accordance with NS205 prior to the haul of fibre cable (if they are not already NS205 compliant).

It is the "Proponent's" responsibility to design and install fibre cables maintaining bend radius control at all times such that cable bends are always greater in radius than the cable manufacturers minimum radius for either at load or no load conditions.

5.21.2 Hauling new cable into an occupied conduit

Hauling new cable through pre-existing occupied conduits must only be performed by the use of duct liners such as Maxcell Milliken Inner Duct product. The installation must result in one spare inner duct sheath left for future installation or upgrade works, therefore two sheath duct liners are the minimum for each conduit run. The Proponent must refer to Ausgrid's Communications Engineering Planning Manager to check if two inner duct sheaths will be sufficient for the forecast use of the conduit run for these instances.

The use of the last remaining spare inner duct sheath in a conduit is reserved exclusively for Ausgrid fibre cable haul only. Ausgrid's use of the last available spare inner duct sheath must be for a fibre cable with core count to match the total cores present within the conduit plus 60 as a minimum. Refer to Ausgrid's Communications Engineering Planning Manager for advice on the fibre cable type and forecast core count requirements in all instances where the last remaining inner duct sheath is proposed for use.

No more than 3 individual cables shall be hauled into a 63mm ID telecommunications conduit. The fourth cable hauled must be for Ausgrid cable sheathing a core count to match the total cores through the conduit plus 60 as a minimum, and this fourth cable haul must replace the 3 pre-existing cables. Services must be spliced at either end to cut-over onto the new cable, and the 3 pre-existing cables must be hauled-out of the conduit. On haul-out of the 3 pre-existing cables, an inner duct liner with minimum 2 sheaths must be hauled-in to the conduit.

The conditions in this section are to apply for all Ausgrid owned telecommunications 63mm ID conduits regardless of the ownership of each cable.

5.22 Hauling ADSS cable type

Underground hauling of ADSS cable type is only approved for a maximum of 300m distance unless otherwise approved by the Communications Engineering Planning Manager. This requirement allows for ADSS UGOH transitions and site lead-ins. New sections of underground fibre cable installation must use UGFO fibre cable type which is specifically engineered for underground installation purposes.

5.23 Fibre cable drum stock

Ausgrid has spare telecommunications cable drum stock in stores. Ausgrid's preference is for the Proponent to deplete spare fibre cable drum stock supplies prior to the order of new drum stock, however this action should not adversely impact project cost efficiency. The status of Ausgrid fibre cable drum stock is recorded in SAP. The Proponent must check that the spare fibre cable drum stock is appropriate for the installation proposed, and complies with Ausgrid's current standards.

Spare fibre cable drum stock shall not be used if it has ≤50% of the original manufacturers designed life span remaining. Drum stock found to exceed the 50% age limit shall be reported to Ausgrid's Somersby stores centre.

Note: Some fibre cable drums are designated as strategic spares only to be used for damage and emergency response situations. Drum stock reserved for emergencies must not be used for capital works, contestable and recoverable works, or for maintenance projects which are not deemed 'emergency response'. Refer to SAP to clarify the status of each fibre cable drum. If any or all of the drum stock does not appear in Ausgrid's SAP system, the Proponent should refer to Ausgrid's Communications Engineering Planning Manager for clarification.

The Proponent is responsible for:

- planning and designing to fully utilise the entire length of each fibre cable drum where cost efficiency is not adversely affected;
- executing fibre cable hauls in accordance with the designed efficient use of cable stock and;
- minimising the number of fibre cable drums or lengths returned to Ausgrid for storage.

If the Proponent chooses spare fibre cable drum stock from Ausgrid stores, then it is the "Proponent's" responsibility to inspect and assess the cable and drum for damage or degradation.

If damage or degradation is found, then the Proponent should not install the cable, and instead contact Ausgrid stores for advice on return or disposal requirements.

Return of left-over fibre cable stores shall be reported to Ausgrid's Somersby stores, and delivered to Ausgrid in accordance with the direction given by Ausgrid stores. Fibre cable stock of 200m or more length shall be delivered to Ausgrid on the drum. Lengths between 200m and 100m shall be figure '8' coiled and taped or zip-tied either side of the coil to hold the coil together. Coils must be greater in diameter than the manufacturers minimum bend radius for no load conditions. Lengths of 100m or less are to be disposed of in accordance with manufacturer's instructions. In all instances, the ends of fibre cable lengths shall be completely wrapped and covered with adhesive tape or heat shrink caps to prevent injury to personnel involved with handling the cable. Refer to the cable manufacturers SDS sheets.

5.24 Splice and coil points

For protection fibre cable hauls, 40m (minimum) UGFO fibre cable coils are to be left in a pit every 1km route distance averaged over the entire underground route and also at UGOH transition points where the splice is planned to be placed in the pit.

For UGOH transitions where the splice is planned to be pole mounted, the minimum UGFO cable length to be left in the pit ready for haul up to the splice point is:

Minimum length = <the route length from the pit to the pole splice point> **+**

<length from the splice point to ground> **+** <10 metres>.

Refer to NS235 Telecommunications Underground to Overhead Transition standard.

At splice points, 20m (minimum) fibre cable coil shall be left coiled in the pit for each fibre cable to be entering the splice enclosure.

Refer to section 5.19 regarding the requirement for 50m coil on approach to substations.

5.25 UGOH transitions

OPGW must be spliced to UGFO on the pole for UGOH transitions, as OPGW is not permitted by Ausgrid to come to ground for earthing reasons. Ausgrid prefer ADSS UGOH transitions to splice to UGFO in the locked communications pit.

It is important to note that UGOH transition hauls require different training and authorisations to that of underground cable hauling, specifically from a safety aspect. It is the "Proponent's" responsibility to check that all personnel engaged to complete installation works on the "Proponent's" behalf and within the scope of their project are appropriately trained and authorised to perform the task. Refer to NS243 Telecommunications Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance.

UGFO cable hauls at UGOH transition points must be entirely enclosed in conduit up to the splice closure entry gland such that no part of the UGFO cable is exposed to direct sunlight. Refer to NS235 Telecommunications UGOH Transition.

5.26 Cable types

Standard UGFO cable type shall be used for all Ausgrid underground fibre cable hauls unless there is a documented specific reason to opt for a different cable type.

Rodent resistant underground fibre cable is to be installed in areas where there is a documented history of vermin damaging Ausgrid cable assets or similar utility infrastructure no greater than 10 years prior to the date of design commencement. Sydney CBD is recognised as a region prone to cable damage perpetrated by vermin.

All underground fibre cable hauls shall utilise underground fibre cable type unless clause 5.21.2 applies. The Proponent is responsible for designing and constructing UGFO cable routes such that

the UGFO cable is enclosed and out of sunlight for the entire route as UGFO cable type is not UV stabilised.

Refer to clause 5.10 regarding the use of LS0H (also known as LSZH) cable type for large enclosed spaces, bridge and tunnel voids.

5.27 Recoverable and contestable works

Telecommunications Recoverable / Contestable Works must be carried out in accordance with Ausgrid's requirements. If telecommunications conduit installation is a requirement, then the conduit/s shall be installed in compliance with this standard (NS234). Refer to section 7 below regarding underground route alteration.

5.28 Shared trench arrangements

Ausgrid infrastructure installed in shared trench arrangement with other utility infrastructure must be installed in compliance with this standard and all other Ausgrid standards applicable to the project including, but not limited to: NS205, NS204, NS235, NS243, NS245 and NS203.

The Ausgrid conduit route is to be made locatable in accordance with NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering prior to the haul of fibre cable through Ausgrid's conduit regardless of the presence of route location facilities installed for the other utility/utilities.

Ausgrid telecommunications infrastructure in shared trench arrangement must not travel through other utility pits or voids. Equally, other utility infrastructure must not travel through Ausgrid telecommunications pits.

Refer to sections 5.12 and 5.13 above regarding co-location of Ausgrid telecommunications assets with Ausgrid power infrastructure.

5.29 DTS

Ausgrid's current business initiative is to deploy DTS cabling with each underground HV feeder cable installation. The cable characteristics and installation methods for DTS vary between manufacturers. There are several different DTS cable types deployed by Ausgrid. The DTS installation instruction in this standard is for DTS cables and/or conduits which are physically separate to the HV feeder cable and conduit. These DTS cables may be hard shell blown fibre tube construction which may be direct buried, while others require conduit installation and cable haul. Ausgrid shall specify the DTS cable type for installation with the conductive cable, and the installation shall be compliant with this standard as well as Ausgrid's engineering direction.

DTS splices, hauling points, and calibration coils may share pit space with the protection fibre cable pits. Refer to NS204.2.1 Communications Pits: Specifications and Installation Guidelines.

DTS cables installed within the sheath of the HV conductor cable shall be spliced and enclosed in accordance with manufacturer recommendations.

5.30 Route markers

All pre-existing and new conduits planned for the haul of Ausgrid optical fibre cables must be made locatable in accordance with NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering prior to the haul of Ausgrid telecommunications cable.

5.31 Copper pilot

Ausgrid copper pilot cables must only be installed or altered by Ausgrid. The Proponent must refer to Ausgrid's Communications Engineering Planning Manager for instances where Ausgrid's copper pilot infrastructure may be impacted by the proposed project works.

5.32 Third party pit and pipe

Amongst other services, Ausgrid protection fibre cable carries circuitry integral to maintaining the electrical grid's stability, therefore it is also integral that control of access to Ausgrid's telecommunications assets including conduit, cable and pits, is limited to authorised Ausgrid personnel. For these reasons clear and secure demarcation between Ausgrid and third party infrastructure must be established and maintained at all times such that the third party is not able to access Ausgrid's backbone network or infrastructure.

Ausgrid's Communications Engineering Manager is responsible for assessing and approving demarcation at infrastructure junction points, as well as for coordinating the agreements between utilities in these cases. Third party applications for access to Ausgrid network and/or infrastructure must be referred to the Communications Engineering Manager for assessment.

In all instances, third party telecommunications conduits shall be sealed with a removable conduit seal where they enter Ausgrid infrastructure, or at points of demarcation. Expandable foam must not be used to seal conduits.

Ausgrid shall not utilise third party pit and conduit for the haul of Ausgrid protection fibre cables unless written approval to do so has been received from the Communications Engineering Manager. If approval has been received, then the third party asset must be recorded in Ausgrid GIS and PNI systems including access points for the entire route occupied by Ausgrid assets and demarcation points.

5.33 Labelling assets

5.33.1 Conduit

This section applies to all conduits entering Ausgrid pits and voids only.

All Ausgrid telecommunications new conduit assets entering pits and voids shall have the conduits identified by permanent marking on the wall nearest the conduit entry point for each pit or void entry regardless of whether cable is planned to haul into the conduit or not. Conduit marking shall identify the conduit independent of all other conduits on the wall face where the conduit size matches GIS and/or Ausgrid plans, but does not uniquely identify the asset on the wall face.

Telecommunications pits designed and/or installed prior to the publish of this standard which are not compliant with this section, do not require pre-existing conduits to be identified accordingly until the time of new fibre cable haul into the conduit. At such time as a new fibre cable haul is to take place, any and/or all pre-existing conduits identified shall be recorded on the pit wall in compliance with this section, noting that it is not necessary to identify all pre-existing conduits on a given wall face at that time.

The following figure and identification example is based on TDMS drawing 212393 sheet 14, Section 1, and assumes that vertical on the plan is north.

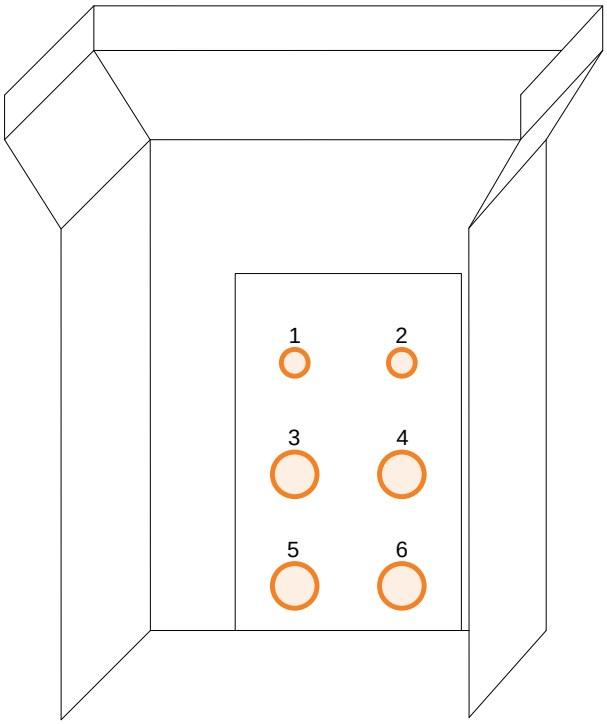

Figure 1 – Diagram: internal telecommunications conduit entries to an Ausgrid Size 8 telecommunications pit

Standing within the telecommunications pit as shown above and looking out towards cross section 1 of TDMS drawing 212393 Sheet 14 would identify the above conduit positions as such:

Table 1 – Wall marking

Conduit position on wall	Permanent wall marking
1	“North FDR DTS”
2	“South FDR DTS”
3	“North FDR side PF”
4	“North FDR bottom PF”
5	“South FDR side PF”
6	“South FDR bottom PF”

Note: PF = Protection Fibre

If the conduits were aligned in the same arrangement for the opposite pit wall to the above scenario, then the installer must be careful to note that the positions would be mirror imaged (i.e. 1, 3 and 5 would swap with 2, 4 and 6) as the conduits on the opposite pit wall will be identified looking out the opposite direction.

The conduit identification method above is preferred over identifying conduits by the feeder numbers with which they share trench, as occasionally feeder designations change either for sections of the feeder, or for the whole feeder route.

If Ausgrid's Communications Engineering Planning Manager approves of other carrier and/or utility conduits entering Ausgrid pits and/or voids, then their conduits must be labelled with permanent marker on the wall face with the name of the conduit owner.

If Ausgrid's Communications Engineering Planning Manager approves of Ausgrid conduits entering other authority or utility pits and/or voids, then the Planning Manager shall provide direction on the specific installation requirements as agreed between Ausgrid and the relevant authority or utility.

Conduit positions as indicated in this section must also be reflected accurately on 'as built' plans returned to Ausgrid for storage, and/or for audit purposes.

5.33.2 Cable

This section applies to all cables entering Ausgrid pits and voids only.

Ausgrid telecommunications cables shall be labelled at all Ausgrid enclosed area entry and/or exit points which are larger than a standard size 8 pit. This includes but is not limited to; manholes, splices, basements, cable chase, vaults, cavities, void sections separated by fire stopping, buildings and rooms.

Within J8 telecommunications pits, coils of fibre cable with no splice entry shall have a label attached to the middle of the length in the pit at the highest point of the stored coil and placed so as it is easily viewable on pit opening. Cables travelling straight through the telecommunications pit with no loop left shall not have a label attached to the fibre cable in the pit. Coils of fibre cable that enter splices within the pit shall have a label attached at the base of the splice for each fibre cable entering the splice including tie cables between several splices within the same pit.

It is the "Proponent's" responsibility to request fibre cable designations from Ausgrid if none are provided with project documentation. Designations can be provided by the Communications Engineering Planning Manager.

Protection fibre cable labels shall have the fibre cable designation written on the labels.

Example: "FOU123456" (see figure 2 below)

Tie cables between several splices in the one pit, or between splices in adjacent pits shall have the above type of cable designation marking plus the word "tie cable".

DTS cable labels shall have <DTS> <FDR> <feeder number> written on the labels

Example: "DTS FDR 71X"

Other utility and/or carrier cables shall have the name of the asset owner written on the labels.

Example: "Optus"

The following figure is an example of an approved cable marker attached to Ausgrid standard UGFO cable.

Figure 2 – Telecommunications cable label example

Note: "FOU123456" is a fictional fibre cable designation. The Proponent must request Ausgrid to supply the correct fibre cable designation for each fibre cable link which is to be installed or altered.

Refer to NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering regarding frequency based marker devices, adhesive labels and marker tapes that apply to trench and bore situations, basements, bridge and tunnel voids and other large void installations.

If Ausgrid's Communications Engineering Planning Manager approves of Ausgrid cables entering other authority or utility pits and/or voids, then the Planning Manager shall provide direction on the specific installation requirements as agreed between Ausgrid and the relevant authority or utility.

Route alterations to pre-existing optical fibre cables must appropriately update and/or change the labelling of the optical fibre cable for the entire route affected by the change.

6.0 TESTING, INSPECTION AND DOCUMENTATION

6.1 General

All Ausgrid telecommunications infrastructure installed must be tested and proven to fulfil Ausgrid's functional intent for successful asset acceptance. The Proponent is responsible for providing documentation to Ausgrid proving that the asset meets Ausgrid's standards as well as Engineering direction.

Refer to NS243 Telecommunications Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance and also the check lists in Annexure A of this document.

6.2 Proving conduits

After installation and route reinstatement works are complete, telecommunications conduits must have rod, rope and mandrel performed to prove the conduit run. The mandrel for each conduit must be no more than 12mm less than the internal diameter of the conduit. Ausgrid's may request to be present and witness the mandrel of conduits..

New telecommunications conduits linking between pits and/or Ausgrid building voids must be left with a hauling rope ready for cable installation. The hauling rope shall have a length no less than 5m coiled tightly and attached to the wall of each pit or void such that the rope and coil does not entwine other infrastructure or cables and such that the coil does not impede access nor restrict door or pit lid operation. The rope must not be tied to any cable or splices.

New telecommunications sections that do not link between pits and/or Ausgrid building voids are not required to be left roped, but must be end capped for future use with a frequency based marker device installed over the end cap in accordance with NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering.

6.3 Proving optical integrity

Underground optical fibre cable hauls must have Optical time domain reflectometer (OTDR) tests performed in both directions to prove optical integrity of the installation. The Proponent is responsible for performing and documenting OTDR tests for all new sections of underground fibre cable installed regardless of whether the section will connect through to a site or not. Upon successful completion, OTDR test results must be returned to Ausgrid's GIS team for upload to the PNI system. A copy of OTDR test results are also to be submitted to Ausgrid's as part of requesting asset acceptance.

Cables with any optical cores fractured, broken, or in any way damaged will not be accepted by Ausgrid. Manufacturer tests prove 100% optical fibre core performance at the factory, and the same core performance quality is expected by Ausgrid at the completion of cable installation.

6.4 Inspection by Ausgrid

Ausgrid's may request inspection of telecommunications underground infrastructure works at any stage through the project. Refer to NS243 Telecommunications Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance.

6.5 Provision of 'As Built' documentation

The Proponent is responsible for providing detailed records of works carried out on Ausgrid's network in the form of 'as built' drawings in accordance with this standard and the requirements of NS100 Field Recording of Network Assets, NS104 Specification for Electrical Network Project Design Plans.

As well as the requirements detailed in the standards mentioned above, Ausgrid underground telecommunications 'as built' plans must document information appropriate to the project including but not limited to:

- Depth of cover over any conduit or cable installation including detailing the points where cover changes;

- Conduit bedding or encasement, type of backfill, constitution of encasement and depth of layers where appropriate;
- Conduit alignment or location relative to property boundaries and other structures;
- The presence of other utility infrastructure for shared trench sections and the points at which one or more of a nominated utilities' infrastructure leaves the shared trench;
- The route location method chosen and implemented (refer to NS205 Fibre Optic Cabling Installation – Cable Markers, Placement and Numbering);
- Location coordinates for marker devices or trace wire;
- Cable type, conduit type and duct liner types (where applicable);
- Trench cross sections when more than one conduit is in the trench;
- Pit types and locations;
- Total route length between pits and/or between end caps and/or between building void entry points and/or between UGOH points (Note: routes linking to pits are measured from pit centre to pit centre);
- Whether the asset/s are all Ausgrid owned i.e. Ausgrid cable within third party conduits or the presence of other third party cabling within Ausgrid conduits. Note: Plans shall also note who owns each of the cable assets within Ausgrid conduits, and the cable type and size if able to be determined;
- The radius of each bend for conduit bends;
- Mechanical protection details if Ausgrid protection fibre has no other option but to travel through electrical pits i.e. concrete encasement or by installation of G.I pipe through the void;
- The designers name and date of design;
- The installers name and date of installation and;
- The name of the person responsible for rod, rope and mandrel of the conduit and date it was performed.

"As Built" documentation must be returned to Ausgrid no more than 1 week after completion of works.

6.6 Asset acceptance request

Ausgrid has the right to refuse payment of invoices for assets which are not compliant with Ausgrid standards and/or installations which do not perform in accordance with Ausgrid's documented functional intent. Refer to NS243 Telecommunications Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance.

7.0 UNDERGROUND ROUTE ALTERATION

Re-routing existing underground telecommunications infrastructure must be performed in compliance with this standard and all other applicable Ausgrid standards. This requirement applies whether the existing infrastructure complied with Ausgrid standards or not.

All re-routing of existing Ausgrid underground telecommunications infrastructure shall be performed in accordance with directions from Ausgrid's Communications Engineering Planning Manager. The Planning Manager will assess each re-route section proposal and document applicable diversity requirements and other route requirements including but not limited to cable size to meet forecast demand, specific splicing and pit location requirements and the effect of changed optical loss created by altering optical distance and/or adding splices to a fibre link. The Proponent is responsible for applying the requirements documented by the Communications Engineering Planning Manager to the project.

After route alteration works are complete, and the fibre cable/s have been spliced through the new route, the optical fibre in the old route may be recovered and either returned to Ausgrid for future use, or discarded. Ausgrid's Communications Engineering Planning Manager shall advise if there are any specific reasons or directions for retaining the old conduit route and/or cable.

Refer to NS266 Telecommunications Cables in Ausgrid Premises regarding re-routing existing underground infrastructure within Ausgrid premises.

8.0 ROUTE RECOVERY

Decommissioning and recovery of existing routes must be performed in accordance with direction from the Communications Engineering Planning Manager. Ausgrid's Communications Engineering Planning Manager shall advise if there are any specific reasons or directions for retaining the old conduit route and/or cable.

9.0 TOOLS AND MATERIALS

Tools used for telecommunications underground infrastructure installation or alteration shall be selected to facilitate compliance with Ausgrid's telecommunications conduit, cable and equipment manufacturer recommendations, Ausgrid standards, and to achieve Ausgrid's documented functional intent.

Refer NS245 Telecommunications Approved List of Materials.

10.0 RECORDKEEPING

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

Table 2 – 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	Work Folder for Network Standards (Trim ref. 2014/21250/135)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	Records management system Work Folder for Network Standards (Trim ref. 2014/21250/135)	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.

11.0 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.

12.0 DOCUMENT CONTROL

Content Coordinator : Control & Protection Engineering Manager

Distribution Coordinator : Manager Asset Standards

Annexure A – Sample Compliance Checklist

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. Where non-compliance is the result of specific site conditions or design decisions this needs to be identified in the “variations to standard materials and/or Network standards” section of the forms. Should additional information be available to document non-compliance decisions, these can be attached to the checklist forms. The checklist and any attached explanatory notes should be saved in the project document repository.

1.0 DESIGN CHECK SHEET

NS234 Telecommunications Underground Physical Plant

Check sheet completed by: _____ **Signature:** _____ **Date:** _____

Submitted for approval by: _____ **To:** _____ **Date:** _____

Project reference:

_____

For asset compliance and acceptance, the design and construction check sheets must be completed and submitted for each project installing or amending infrastructure for which the NS234 standard applies. NS234 covers Ausgrid telecommunications "stand alone" conduit and cable installation, which is not laid or installed directly alongside an Ausgrid electrical asset. This check sheet does not negate the responsibility for the Proponent to review the full NS234 standard for compliance.

Design check list	Clause Ref	✓/✗ or N/A
1. Design compliance with Ausgrid Electrical Safety Rules as well as WHS Act 2011 and associated Regulation	5	
2. Design compliance with NUS174 and all relevant laws, rules, regulations and guides for environmental impact assessment	5	
3. Design assesses and recommends mitigation of risks associated with asbestos in the work place in accordance with Ausgrid's NUS211 Working With Asbestos Products and all relevant laws, rules, regulations and guides	5	
4. Installation is designed to utilize approved easement corridors, or land which is approved through standard development agreement or land access agreement process	5.3, 5.5, 5.7	
5. The installation is designed to minimize aesthetic impact, in accordance with community consultation	5.3	
6. Design specifies reinstatement to minimize scar and prevent subsidence	5.2	
7. The designed route and installation methods are chosen to minimize the likelihood of erosion caused by the installation	5.4	
8. Designed works do not cause or create security risks for Ausgrid assets, or safety hazards	5.2, 5.9	
9. Haul ability assessment is performed by design to pass based on standard 60F underground (UGFO) cable type or other cable as specified by Ausgrid, to be hauled through the proposed conduit	5.9, 5.20	
10. Design documentation and plans specify the allowable maximum hauling tension	5.20	
11. Design specifies the end-to-end enclosure of all cables which are not UV stabilized, such that no part of the cable is exposed to sunlight	5.20.5, 5.21	
12. Route designs include specifying cable hauls to maximize full drum use and minimize the number of splices required	5.9, 5.20.3	

Check sheet continues over page .....

13. Design plan and detail the most cost efficient number and location of pits en route and share pit space with DTS (Distributed Temperature Sensing cables) where applicable	5.9, 5.24	
14. Design allows for no more than 180° total bend radius between pits and no more than 300m distance between pits unless documented hauling calculations prove otherwise passes	5.9	
15. Design specifies protection fibre routes have 63mm OD orange conduit for the entire project unless under bore requires a larger internal diameter	5.6	
16. Conduits are designed to enter pits, voids and other enclosures through the wall of the void	5.15	
17. Design specifies a pit installation where conduits change in internal diameter	5.8, 5.15	
18. Conduits enter the end wall of the J8 telecommunications pit (smaller dimension wall), not the side wall (larger dimension wall)	5.15	
19. Design minimizes the number of conduit bends between pits or voids	5.9	
20. Design specifies conduit installation at 900mm depth of cover or more, unless installed directly alongside a HV cable or conduit, or unless within Ausgrid premises security fence line	5.7	
21. Design specifies the use of rodent resistant cable in areas where there is a documented history (≤10 years) of vermin damaging Ausgrid cable assets or other utility cable	5.21	
22. Designs specify routes in accordance with the diversity requirements documented by Ausgrid for the project	5.10	
23. Design plans routes, hauls and splice points to minimize wastage of the left over cable drum stock or minimize the need for storage of partially used drums. Existing spare stores of cable are to be utilized where appropriate	5.20.3	
24. Protection fibre cables are designed to utilize secure conduit, locked pits and voids which are for the exclusive use of Ausgrid	5.9, 5.26	
25. Designs avoid protection fibre cable and conduit entering and travelling through electrical pits and voids	5.9, 5.15	
26. Designs that cannot avoid protection fibre cable and conduit entering electrical pits and voids have mechanical protection for the cable through the entire void space	5.9, 5.15, 5.16	
27. Protection fibre cable is designed such that it is only installed through securely locked pit infrastructure fitted with Ausgrid substation type padlocks as per NS204	5.9, 5.27	
28. Designs account for route locatability according to NS205	5.25	
29. Designs account for pit alignment and installation according to NS204.2.1	5.15	
30. Designers proposing telecommunications cable installation through large voids have performed and documented risk assessment regarding smoke and fire propagation	5.9, 5.16	

Check sheet continues over page .....

31. Designs specify Ausgrid approved materials	9	
32. Specific Ausgrid directions for pits, routes or materials are incorporated into the design	5.9, 6, 6.5, 9	
33. Design specifies that for each protection fibre route, a pit is installed either within 50m of the substation it approaches, or inside the locked substation security fence line	5.18	
34. Design consults Ausgrid for assessment of the dB loss impact to a link for designs adding splices and/or altering optical distance for a route requiring replacement or relocation of existing fibre cable	7	
35. Designs for new protection optical circuit connections assess the existing fibre route/s through which the circuit will travel to ensure compliance with NS234 and all other relevant standards. Where non-compliances are found, corrective works must be designed as part of the project connecting the new optical circuit	5	
36. Designs select UGFO cable type to haul underground. The maximum underground haul designed for ADSS cable type at UGOH transitions is 300m to reach a pit for splicing to underground cable type (UGFO), or for lead-in to a site. (was prev 100m)	5.20.2, 5.21	
37. Design documentation is sent to Ausgrid for review and approval prior to construction release	5	
38. Haul ability assessment/s are provided to Ausgrid for storage with the design for the life of the asset	5.9, 5.20	
39. Design plans to leave min. 40m fibre cable coils every 1km averaged over the entire haul and at every UGOH transition. A min. 50m fibre cable coil is left in the nearest pit on approach to a substation	5.20.4, 5.20.5, 5.18	
40. Design documentation details all of the above compliances	Annx. A	

Check sheet continues over page .....

All check list items marked '*' above shall be referenced and submitted for approval in the below variation table along with supporting documentation, prior to design release.

Design variations to standard materials and/or Network Standards	Signature
Cross reference to check sheet and explanation of non-conformance	Name:_____ Title:_____ Signature:_____ Date:_____
Cross reference to check sheet and explanation of non-conformance	Name:_____ Title:_____ Signature:_____ Date:_____
Cross reference to check sheet and explanation of non-conformance	Name:_____ Title:_____ Signature:_____ Date:_____

Design variations to NS234 must be submitted to Ausgrid's Senior Engineer responsible for Telecommunications Area Planning for approval and signature prior to construction release.

Design check sheet verified and approved by:_____

Signature:_____ Date:_____

1.0 CONSTRUCTION CHECK SHEET

NS234 Telecommunications Underground Physical Plant

Check sheet completed by: _____ **Signature:** _____ **Date:** _____

Submitted for approval by: _____ **To:** _____ **Date:** _____

Project reference:

_____

For asset compliance and acceptance, the construction check sheet must be completed and submitted for each project installing or amending infrastructure for which the NS234 standard applies. NS234 covers Ausgrid telecommunications "stand alone" conduit and cable installation, which is not laid or installed directly alongside an Ausgrid electrical asset. This check sheet does not negate the responsibility for the Proponent to review the full NS234 standard for compliance.

Construction check list	Clause Ref	✓/✗ or N/A
1. Construction compliance with WHS Act 2011 and associated Regulation as well as Ausgrid Electrical Safety Rules	5	
2. Construction compliance with NUS174 and all relevant laws, rules, regulations and guides for environmental impact assessment	5	
3. Construction assesses and mitigates risks associated with asbestos in the work place in accordance with Ausgrid's NUS211 Working With Asbestos Products and all relevant laws, rules, regulations and guides	5	
4. Construction complies with AUS-SPEC 1152 Road Openings and Restoration (Utilities)	5.2	
5. Construction is performed in approved easement corridors, or land which is approved through standard development agreement or land access agreement process	5.3, 5.5, 5.7	
6. The installation and reinstatement minimizes aesthetic impact, in accordance with community consultation	5.3	
7. Construction reinstates routes to minimize scar and prevent subsidence	5.2	
8. The route, machinery movements and installation methods used by construction crews minimize the likelihood of erosion caused by the installation	5.4	
9. The installation does not at any stage cause or create security risks for Ausgrid assets or safety hazards	5.2, 5.9	
10. Cables are hauled according to the design. The hauling tension was monitored throughout the installation process, and the manufacturer's maximum hauling tension was not exceeded at any time.	5.20	
11. Cables which are not UV stabilized are enclosed and out of direct sunlight for the entire route	5.20.5, 5.21	
12. Drum use is optimized as per the design and therefore the number of splices required was minimized	5.9, 5.20.3	

Check sheet continues over page …..

13. Spare fibre drum stock is returned to Ausgrid	5.20.3	
14. No extra pits, conduit bends or deviations from the design were required or installed	5.9, 5.20	
15. DTS cable shares pit space with the protection fibre cable as per the design	5.24	
16. 63mm OD orange conduit was installed for the entire project unless under bore conduit required a larger internal diameter	5.6	
17. A pit was installed where conduits changed internal diameter	5.8, 5.15	
18. Conduits enter pits, voids and other enclosures through the side wall of the void	5.15	
19. Conduit joins were glue sealed and no internal ridges or obstructions were formed	5.8	
20. Conduits enter the end wall of the J8 telecommunications pit (smaller dimension wall), not the side wall (larger dimension wall)	5.15	
21. The number of conduit bends between pits or voids was minimized and/or as per the design	5.9	
22. Conduit was installed at 900mm depth of cover or more, unless installed directly alongside a HV cable or conduit, or unless within Ausgrid premises security fence line	5.7	
23. Rodent resistant cable was used in areas where there is a documented history (≤10 years) of vermin damaging Ausgrid cable assets or other utility cable	5.21	
24. Conduit and cable installation routes comply with Ausgrid's direction for diversity	5.10	
25. Protection fibre cables are installed through conduit, pits and voids which are made secure and fitted with locks prior to the haul, and are utilizing conduit paths which are exclusively for Ausgrid use	5.9, 5.27	
26. Conduits for protection fibre avoid entering and travelling through electrical pits and voids	5.9, 5.15	
27. Conduits for protection fibre that cannot avoid entering electrical pits and voids, have mechanical protection for the cable through the entire void space	5.9, 5.15, 5.16	
28. Protection fibre cable is only installed through securely locked pit infrastructure fitted with Ausgrid substation type padlocks as per NS204	5.9, 5.27	
29. Protection fibre routes are made locatable according to NS205	5.25	
30. Pits are aligned and located in accordance with NS204.2.1	5.15	
31. Materials that are procured for installation in voids do not produce noxious fumes in fire conditions	5.9, 5.16	

Check sheet continues over page .....

32. Cables are labeled with the fibre designation at all enclosed area entry and/or exit points. This includes but is not limited to; pits, splices, basements, cable chase, vaults, cavities, void sections separated by fire stopping, buildings, rooms. Ausgrid shall provide fibre designation numbers.	5.28	
33. Only Ausgrid approved materials are utilized	9	
34. For each protection fibre route approaching a substation in which it will terminate, a pit is installed either within 50m of the substation it approaches, or within the substation locked security fence line	5.18	
35. Construction selects standard 60F UGFO cable type to haul underground. The maximum underground haul for ADSS cable type at UGOH transitions did not exceed 300m to reach a pit for splicing to underground cable type (UGFO), or for lead-in to a site. (was prev 100m)	5.20.2, 5.21	
36. Construction leaves min. 40m fibre cable coils every 1km averaged over the entire haul and at every UGOH transition. A min. 50m fibre cable coil is left in the nearest pit on approach to a substation	5.20.4, 5.20.5, 5.18	
37. Hauling tension records from the cable installation are documented and provided to Ausgrid for storage with the asset records for the life of the asset	5.20	
38. Telecommunications infrastructure "as built' documentation is in compliance with NUS100 and NS104 and includes location coordinates for the route which are sent to Ausgrid at the earliest possible convenience and no more than one week from construction completion, whereby acceptance of the 'as built' infrastructure will be assessed by Ausgrid	6.4	

Check sheet continues over page .....

All check list items marked '*' above shall be referenced and submitted for approval in the below variation table along with supporting documentation, prior to construction commencement.

Construction variations to standard materials and/or Network Standards	Signature
Cross reference to check sheet and explanation of non-conformance	Name:_____ Title:_____ Signature:_____ Date:_____
Cross reference to check sheet and explanation of non-conformance	Name:_____ Title:_____ Signature:_____ Date:_____
Cross reference to check sheet and explanation of non-conformance	Name:_____ Title:_____ Signature:_____ Date:_____

Construct variations to NS234 must be submitted to Ausgrid's Senior Engineer responsible for Telecommunications Area Planning for approval and signature prior to construction commencement.

Construction check sheet verified and approved by:_____

Signature:_____ Date:_____