Network Standard

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NW000-S0072 NS203 TELECOMMUNICATIONS NETWORK: MASTER POLICY DOCUMENT

ISSUE

This document is for issue to all Ausgrid and Accredited Service Providers' staff involved with the design, construction and/or support of Ausgrid's telecommunications network, 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Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document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 Network Standards road map
- ☐ Telecommunications Fundamental Principles
- ☐ Protection Signalling Policy
- ☐ Compliance Policy
- ☐ Telecommunications Maintenance Policy

Where to for more information?

Sections 1-2

Telecommunications Fundamental Principles

This section defines:

- ☐ Ausgrid's telecommunications principles, goals and values
- ☐ Telecommunications history
- ☐ Telecommunications future strategy

Where to for more information?

Section 5

Tools and Forms

Annexure A

Telecommunications Standards Road Map

This section defines:

- ☐ Telecommunications standards structure and hierarchy
- ☐ High level statements to guide planning, design, construction and support personnel to the standard or guide applicable to the work to be performed

Where to for more information?

Section 6

Tools and Forms

Annexure A

Signalling, Compliance and Maintenance Policies

These sections detail:

- ☐ Ausgrid's goals and objectives for protection signalling, compliance and maintenance
- ☐ Protection signalling build requirements
- ☐ Compliance responsibilities and auditing
- ☐ Maintenance responsibilities

Where to for more information?

Sections 7-9

Tools and Forms

Annexure A

Network Standard
NS203
Telecommunications Network: Master Policy Document

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1.0 PURPOSE

The purpose of this document is to define Ausgrid's telecommunications policy, and to provide guidance on the use of Ausgrid's telecommunications Network Standards (NS) and Network Engineering Guidelines (NEG). Its intended audience is Ausgrid staff, Accredited Service Providers and contractor's staff who are directly or indirectly involved in any or all life cycle stages of Ausgrid's telecommunications network, including from conceptual planning, through all stages to decommissioning and disposal.

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.

Note: At the time this standard is released, the hierarchy map of Figure 3 below will show some NS and NEG documents that are not released as yet, or are under review. These NS and NEG will be released as soon as is practicable. Where the information or direction within Ausgrid standards is conflicting, the most recent release shall apply.

This policy document affirms Ausgrid's commitment to telecommunications network integrity. Ausgrid intends to exceed the standards as set out in the National Electricity Rules (NER's) and all applicable Ausgrid, national and international rules, laws, legislation, standards and guidelines for telecommunications network supporting the electrical network.

It is the responsibility of all Ausgrid staff, contractors' alliance partners and related support mechanisms who are involved with Ausgrid's telecommunications network, to apply this policy and related telecommunications standards and guides at all times.

2.0 SCOPE

This standard is intended as a road map for telecommunications guides and standards, as well as to define Ausgrid's telecommunications policy. It does not cover standards, guides or policies related to electrical distribution, environmental, architectural, or any other engineering or network discipline, with the exception of aspects directly related to telecommunications infrastructure.

3.0 REFERENCES

Annexure A details a list of documents (standards, codes, acts, annexure, policies and procedures) related to NS203. The listing has been added as an annexure due to the large number of standards which NS203 (and related telecommunications standards) is based upon, and / or makes reference to.

4.0 DEFINITIONS

Refer to NS001 Glossary of Terms

5.0 FUNDAMENTAL PRINCIPLES OF AUSGRID TELECOMMUNICATIONS NETWORK

5.1 General

Ausgrid has a telecommunications network that has been constructed to carry SCADA, high voltage feeder protection circuits, and general telecommunications services. The critical nature of high voltage feeder protection sets the performance metrics of the network. The telecommunications network must be reliable and highly available to ensure Ausgrid meets its legal requirements as set out in the National Electricity Rules (NER's) for maintaining electrical grid stability.

The majority of Ausgrid's optical fibre backbone network carries critical high voltage feeder protection along with SCADA services, both of which are critical to the successful operation of the electrical network. In addition network traffic is allocated to Ausgrid's computing network, VOIP telephony, video channels in the Sydney CBD, and external telco companies.

It is recognised that Ausgrid's core business is the distribution of electricity; therefore the knowledge base and skills within the company also centre around electrical network. Telecommunications is a small percentage of Ausgrid's overall business even though the electrical network is becoming more and more reliant on telecommunications for control, protection, condition monitoring and support mechanisms. For these reasons, many of Ausgrid's telecommunications NS and NEG documents are structured to provide information about Ausgrid's telecommunications network as well as the minimum performance standards, installation and maintenance standards and guidelines.

This document does not independently provide rules and engineering guidelines for personnel involved with the planning, design, construct, commission, operation, maintenance, decommissioning, or disposal of Ausgrid's telecommunications network. Readers should refer to the Figure 3 hierarchy map within this document to assist with finding the telecommunications standards and engineering guideline documents relevant to the work that is to be performed. Should the reader be unable to find the information required within Ausgrid's telecommunications Network Engineering Guidelines and/or Network Standards, refer to Ausgrid's Manager responsible for Communications Engineering prior to performing any work on Ausgrid's telecommunications network.

5.2 Objectives, values and goals

The telecommunications objectives, values and goals set out in this document align with Ausgrid's company vision and values. Refer to Ausgrid's web site for further information relating to our safety Policy, Standards, Rules, Procedures and Guides.

AUSGRID TELECOMMUNICATIONS OBJECTIVES:

Safety: Applying Safety in Design principles

Integrity: Provision and maintenance of reliable, secure and available network

Commerciality: Adopting the most cost effective solution

Value: Engineering to produce a robust and durable network

AUSGRID TELECOMMUNICATIONS VALUES:

- Cause zero harm to people, property and the environment
- Foster a culture of respect for the telecommunications network as well as the personnel and support mechanisms involved in all aspects of the provision and maintenance of the network
- Compliance with all applicable Ausgrid, national and international standards, rules, laws, procedures, regulations and guides
- Leadership and accountability
- Effective risk management
- Ethical behaviour
- Future focus - collaboratively plan the optical network to cater for the needs of the electrical network as well as Ausgrid's business
- Innovation – aligning Ausgrid's infrastructure with telecommunications technological advances in the pursuit of meeting our Objectives (as above)

AUSGRID TELECOMMUNICATIONS GOALS:

- Compliance with the Ausgrid Be Safe system
- Secure, reliable and redundant optical paths for all Ausgrid ≥33kV substations (See Note)
- Secure and reliable duplicate and diverse optical paths for all Ausgrid 132kV feeders (See Note)
- Exceed the critical HV feeder protection requirements set out in the NER's for reliable continuance of electrical grid stability

Note: Provision of telecommunications redundancy is not always a requirement for the energisation of the related electrical asset, as determined by Ausgrid Protection Engineers and based on the requirements set out in the NER's. Where redundancy is neither required nor installed for electrical energisation, the provision of telecommunications redundancy remains a goal for optimising reliability.

5.3 History of telecommunications supporting electrical networks

Note: In this section the reference to "Ausgrid" covers the current Ausgrid geographical franchise area through its former company names including splits and mergers.

Copper pilot cables have been installed for the control and protection of electrical cables since the very beginning of electricity in NSW over 100 years ago. A small current was sent through the copper pilot cable proportional to the current through its related HV electrical cable. Monitoring the current through the pilot was indication of the HV feeder's status. SCADA (Supervisory Control And Data Acquisition) was also transmitted through the copper pilot cables.

Power Line Carrier (PLC) was implemented by TransGrid for feeder protection reasons. This saved the installation and maintenance of a separate copper pilot cable for each feeder. Frequency based signalling was transmitted through the power line to indicate the status of the HV feeder. Ausgrid inherited some of the 132kV substations from TransGrid with PLC still in use.

VHF was implemented for voice communications between vehicles, as well as for SCADA. SCADA was later transitioned to UHF. Ausgrid's use of UHF radio has grown relative to the availability and cost of various technologies, its related equipment and the licensing requirements. Authorities have changed the frequency availability over the years, to which Ausgrid has had to realign each time for compliance. Some substations still contain the remnants of radio equipment that is no longer used.

Microwave radio systems were deployed by Ausgrid initially for communication between depots and offices at a time when the alternative of leasing services through Telstra network proved far too expensive. SCADA was later transferred from standard UHF radio links to the backbone microwave system, as the microwave platform could support all of Ausgrid's communication needs.

Figure 1 – Microwave tower

Ausgrid began installing optical fibre within the earth conductor of overhead transmission power lines, before a network strategy was formed for its use. Known as Optical Pilot Ground Wire (OPGW), the cost of adding the fibre cores to the earth conductor was insignificant to an electrical project. Not long after the first OPGW cables were installed, the Platform of Integrated Network Communications (PINC) project was given the task of building an optical fibre network for the transmission of MultiProtocol Label Switching (MPLS) services. MPLS is primarily used by Ausgrid to transmit SCADA information to the Network Operations Centre or Operational Technology Centre (NOC/TOC) for control and monitoring of the electrical network.

With Ausgrid developing an established optical fibre network along with telecommunications technological advances, the possibility of using the new optical fibre network for HV feeder protection became apparent. Teleprotection services began transferring off schemes provided by copper pilot cables and microwave links, and onto the optical fibre network. HV feeder protection became the primary driver behind optical fibre link installation. To Ausgrid, the optical fibre network represents a much more cost effective telecommunications investment due to the fact that it can transmit and receive all of Ausgrid's telecommunications needs faster, in higher volumes, and with much less life cycle cost by comparison to copper pilots. The optical fibre network has a long life span and is also more reliable by comparison to microwave and UHF radio which suffer signal fade or loss from environmental factors such as rain, dust clouds and smoke. Optical fibre is also not susceptible to degradation from water ingress as are copper pilot cables.

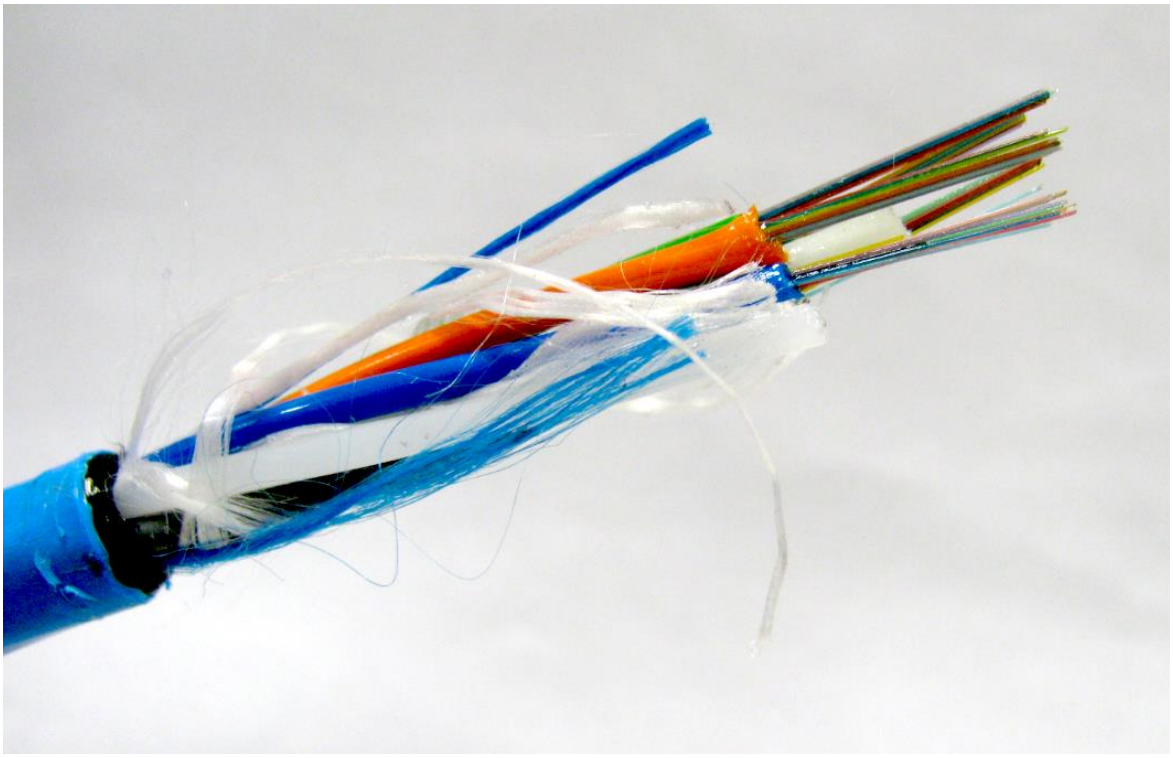

Figure 2 – Underground optical fibre cable

Microwave and UHF systems are still used in Ausgrid due to the fact that building optical fibre links to some of the more remote sites has proven cost prohibitive when weighting the cost versus benefit. Many of these substations do not require primary teleprotection for their HV feeders according to the NERs. In these cases, Ausgrid may accept the occasional loss of signal due to environmental factors. The microwave backbone system has been upgraded for additional bandwidth, hence the carriage of more services.

More recently, the demand on the optical fibre network has increased markedly. In some areas, fibre core capacity was depleted and so multiplex devices were deployed to increase network capacity, thereby enabling more services to transmit through existing telecommunications infrastructure. Multiplex devices allow a larger amount of services to transmit through a single pair of optical fibre cores. The need to forecast demand on the communications network was recognised and so the Optical Fibre Area Plans were developed based on protection requirements predicted to fulfil the electrical area plans and other developments over time.

5.4 Ausgrid telecommunications future strategy

The history in Clause 5.3 above highlights the extent to which Ausgrid's Telecommunications medium has changed over time. Ausgrid's optical fibre network was initially installed for the transmission of MPLS between Ausgrid sites, and as such its installation was designed for that level of reliability. More recently the demand placed upon Ausgrid's optical fibre network has shown rapid growth; therefore the value to the company provided by the optical fibre network is also increasing. More control and protection services are migrating onto the optical fibre network and a wider variety of applications are choosing the fibre network for service transmission.

As demand on the fibre network increases, Ausgrid's risk tolerance reduces; therefore it has become more important for the optical fibre network to be engineered with optimal security and reliability. Optical fibre cables installed more recently have been designed to protection fibre grade with security and reliability optimised, however pre-existing optical infrastructure may require some alterations for end-to-end reliable transmission of the many services now utilising this platform. The requirement for upgrading pre-existing network will be detailed in project related Telecommunications Brief documents provided by Telecommunications Area Planners, and the

network must be provisioned compliant to Ausgrid's telecommunications network standards and guidelines referred to in Figure 3 below, prior to commissioning the new service. Some examples of upgrades include, but are not limited to: raising the height of pre-existing optical cable attachments on poles to reduce the risk of damage from vehicular or construction activity, and padlocking pre-existing pits for security to reduce the likelihood of vandalism and unauthorised access.

Technological advances are accelerating for telecommunications infrastructure. It is expected that the optical fibre transmission medium will not change before end-of life for our current fibre cable assets.

In terms of network architecture, Ausgrid intend to make opportunistic use of optical fibre provided by HV feeder works in the form of OPGW (Optical Pilot Ground Wire) installed over an aerial HV feeder, or by installation of a protection fibre conduit alongside a new underground HV feeder. The connection of these optical fibre cables must be compliant to the Telecommunications Area Plan as determined by the Senior Engineer Responsible for Telecommunications Area Planning. In general, the telecommunications planning intent is to connect Ausgrid sites in ring form, with each site on the ring benefitting in reliability by having at least one redundant telecommunications path. On occasion, additional optical fibre cable and equipment will need to be installed to complete or create new links between sites for control and protection reliability reasons.

Ausgrid intend to utilise multiplex devices where new services cannot connect through existing links due to fibre core capacity constraints, and where the cost and benefit of building new optical fibre links outweighs the cost of multiplexing in consideration of optical demand forecasts. Multiplexing of protection signals is used widely where sufficient direct fibre paths are not available.

Ausgrid services are intended to transition off the following mediums and onto Ausgrid owned and maintained optical fibre network at the time when fibre links become available and when it is reasonably practicable to do so:

- Copper pilot
- PLC
- UHF
- Microwave
- Ausgrid services through 3rd party network

Note: In this section the reference to "Ausgrid" covers the current Ausgrid geographical franchise.

6.0 TELECOMMUNICATIONS STANDARDS AND GUIDELINES ROAD MAP

6.1 General

Figure 3 below maps Ausgrid's telecommunications standards and guidelines to assist users with finding the information relevant to the work to be performed. The subsections to this section provide a general overview of Ausgrid's telecommunications standards and guidelines; however they do not negate the need for readers to review the related NS or NEG documents for compliance.

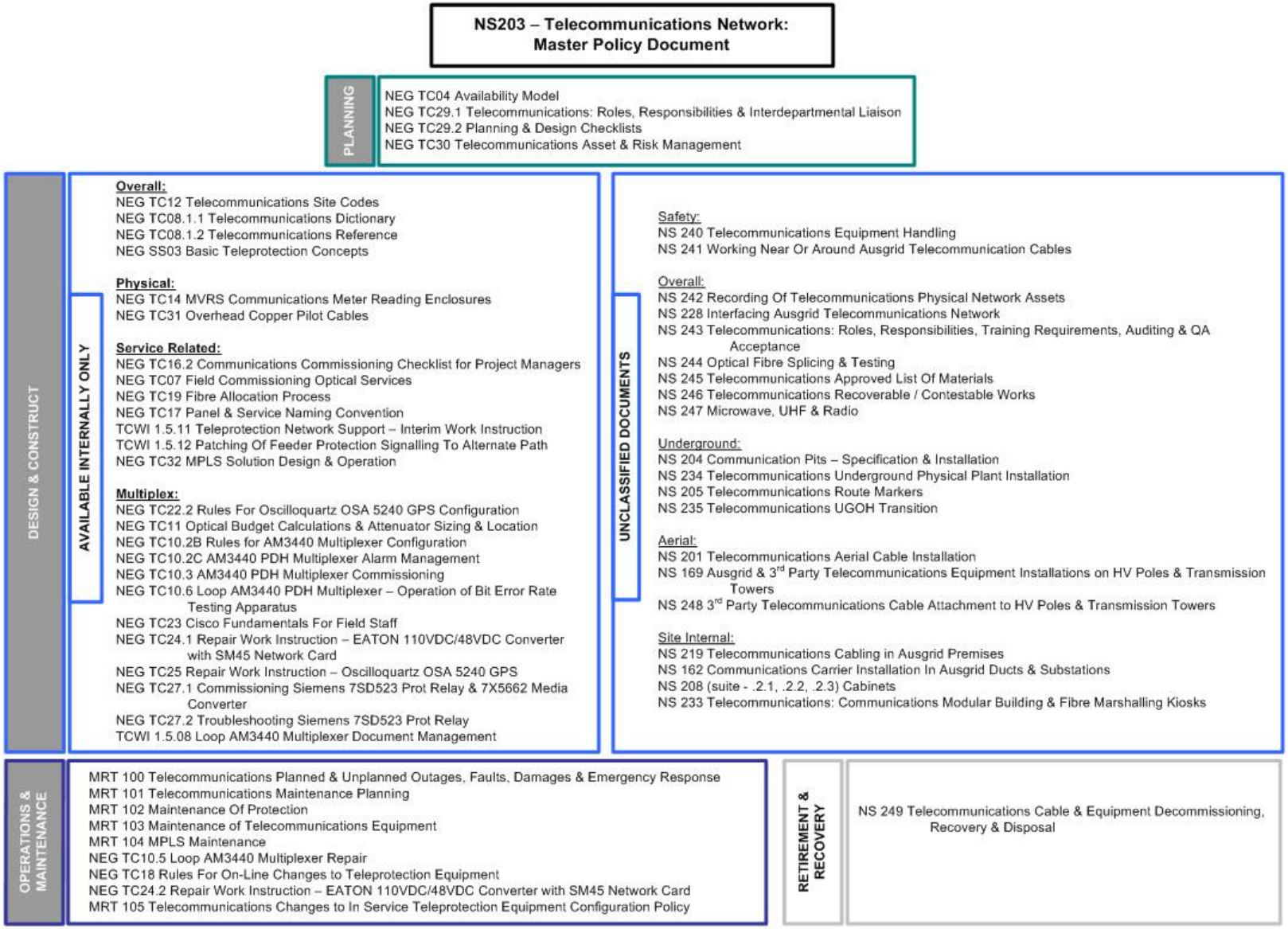

Figure 3 – Hierarchy map – telecommunications standards and guidelines

6.2 Planning

Refer Figure 3 above for the NS and NEG documents related to this section.

Ausgrid's optical fibre network is built with the primary intent of transmitting Ausgrid's telecommunications services. Some 3rd party services utilise Ausgrid's optical fibre network, however, Ausgrid's current business direction does not encourage the promotion of optical fibre leases to external parties.

Figure 4 below shows Ausgrid's electricity distribution area.

Figure 4 – Map of Ausgrid's electricity distribution area

Ausgrid have optical fibre network infrastructure stretching across a majority of the distribution area in a ring topology. Several areas are yet to connect in ring form. Some of these areas are geographically sparse and present costly installation challenges. The Area Planning intent is to link

all significant Ausgrid sites in ring form to create a chain network, thereby improving the overall network reliability. Ausgrid Planners also have a responsibility of engineering for the most available network.

An electrical project may trigger alterations to the communications network at more than one site, and may include new optical fibre network construction requirements to facilitate the redundancy and reliability required for supporting the electrical network. These requirements shall be specified by the Ausgrid Telecommunications Planning Group and communicated in the form of a Telecommunications Brief.

Risk management of the Ausgrid optical fibre network assets has always been at the forefront of planning and design initiatives. Reasons for this include, but are not limited to:

- Ausgrid has a legal requirement to provide feeder protection that complies with the National Electricity Rules for maintaining the ongoing stability of the electrical grid.
- Ausgrid has an expansive control network that requires access at key management points.
- Ausgrid has a diverse workforce that requires access to critical and non-critical IT systems.
- Ausgrid is deploying more intelligent electronic devices across the network in an effort to gain greater awareness of asset performance.

The Ausgrid Telecommunications Planning Group release Telecommunications Briefs with associated plans to project managers for direction on the design and construction of the physical telecommunications network necessary to fulfil the project's needs. Ausgrid's Teleprotection Design Team delivers plans and information on how to connect services and activate them through the physical network.

All planning efforts for Ausgrid's Telecommunications network must be performed in a collaborative manner due to the fact that the electrical network and telecommunications network are interrelated and often interdependent. For this reason, management of all stages of an electrical project from concept through to commissioning, must liaise with and have input from Ausgrid's Telecommunications Group to ensure that the telecommunications needed to support the electrical network are funded as part of the electrical project, as well as built and commissioned in time for the related electrical commissioning.

6.3 Design and construct

Refer Figure 3 for the NS and NEG documents related to this section.

6.3.1 Overall

The planning, design and construction of Ausgrid's telecommunications network must predominantly be performed in a consultative, cross-functional manner due to the fact that the electrical and telecommunications networks are interrelated and often interdependent. Telecommunications Area Planners must work with Electrical System Planners, Protection Engineers and other users of Ausgrid's optical fibre network in order to forecast fibre demand, manage capacity and engineer efficiencies into the network.

Project Managers have the responsibility of managing the network build in compliance with the direction given by the Telecommunications team in the form of the Telecommunications Brief documents, drawings and related information. Project Managers also have the responsibility for ensuring audits are completed and documented to Ausgrid's satisfaction prior to acceptance of the network alteration. Audit checklists are associated to each Network Standard. Design, construction and maintenance crews have the responsibility of consulting the Telecommunications Area Planners where the Telecommunications Brief direction given cannot be followed for unforeseen reasons.

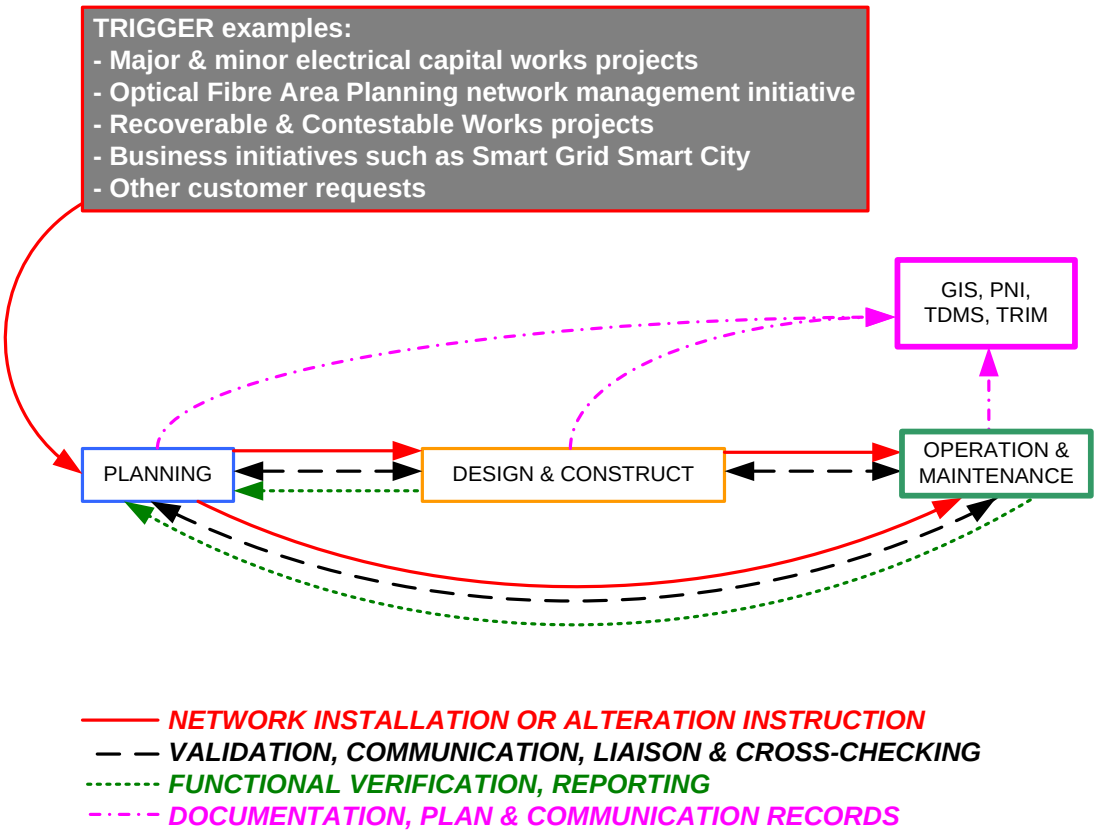

Figure 5 – Telecommunications work stream communication requirements

As Ausgrid is primarily an electrical business, NEG TC08.1.1 Telecommunications Dictionary is published on Ausgrid's Balin website to explain common Telecommunications terms.

Ausgrid's PNI (Physical Network Inventory) system records Ausgrid's physical fibre cable geographic location, cable data and core usage. Optical fibre cable information is uploaded from Ausgrid's GIS system after 'As Built' plans and related information are received from the field. Reservations, alterations and new connections of optical services are restricted to certain approved PNI users who must follow the applicable procedures available on Ausgrid's Balin web site. For further information, refer to NEG TC19 Fibre Allocation Process.

Procedures must be followed with regards to third party optical fibre transmission requests to ensure that agreements are formally and contractually approved, fibre core capacity and / or transmission capacity is managed, and correct demarcation is achieved between Ausgrid's backbone network and that of the third party customer. Refer Ausgrid's Telecommunications Area Planning team for further information.

6.3.2 Physical - overall

Work on Ausgrid's physical telecommunications network must only be performed by appropriately licensed, qualified and approved personnel.

The current Ausgrid standard is for the use of 60F SMOF cable for the backbone network, unless otherwise directed by the Senior Engineer responsible for Optical Fibre Area Planning. Larger fibre core counts such as 144F or 312F may be used for bridge crossings, tunnels, rail crossings waterway crossings or other installations where access and space is restricted and where multiple 60F cables coalesce either presently, or in the foreseeable future.

Figure 6 – 312F UGFO cable (20mm diameter)

Data network in office environments and campus fibre cabling is to be planned and structured with connection and physical cabling records kept up to date for the life of the asset. Refer Ausgrid's Telecommunications Area Planning Team for further information.

Ausgrid's communications pits must have the appropriate symbol and a unique identifying number allocated and recorded in GIS (Geographic Information System). The identifying number must be applied to a plate and the plate physically attached to the pit as per the standard for electrical pits defined in NS148 Overhead Line and Street Lighting Supports, Pits, Pillars and Ancillary Assets Numbering.

Splices and coils of optical fibre cables must be stored safely, to minimise potential risks to the fibre network (i.e: vandalism, degradation, accidental damage) and using approved housings or hardware. The testing of optical fibre cables must be performed as soon as the link is completed and prior to submission for acceptance as part of Ausgrid's network. Signal loss must be less than 0.03dB per core splice. UGFO cable type is not UV stabilised, therefore for pole or tower mounted splices at UGOH transitions and for riser attachments to buildings and structures, the UGFO cable must be enclosed in sub ducting for the entire exposed area up to and including entry of the enclosure.

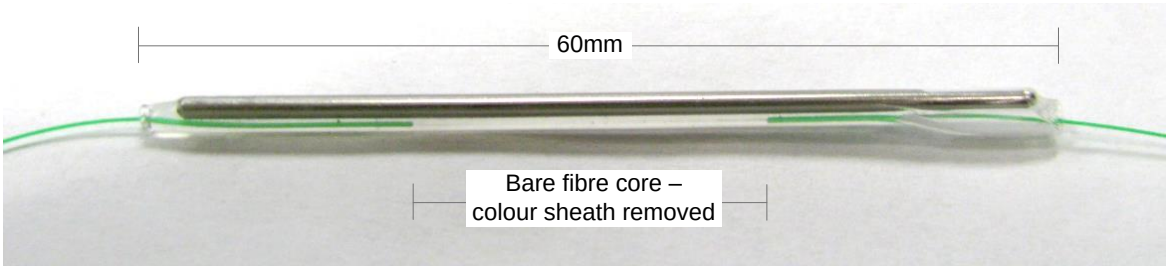

Figure 7 – Single optical fibre core - fusion spliced

After completion of fibre installation works, each fibre core shall be tested with an OTDR for length and transmission anomalies as well as attenuation. Terminated fibres are also to be tested with power meter / light source. Test results are to be recorded and submitted to Ausgrid for records storage. Test results are also to be submitted to Ausgrid as part of the acceptance process.

Recoverable and Contestable works projects must not degrade the Ausgrid optical fibre backbone network performance, security, reliability or availability in the relocation or replacement of Ausgrid telecommunication assets. Recoverable and Contestable works projects must be performed to current standards regardless of the state of the pre-existing infrastructure. Project Managers must consult Ausgrid Telecommunications Area Planners from the conceptual stage of the project onwards to enable the Area Planners time to perform a best cost solution assessment.

Where 3rd party services have been approved to travel through Ausgrid's optical fibre network, a clear demarcation must be established between the 3rd party network and Ausgrid's backbone network. Existing interfaces of this type that have not been established with demarcation splice points must be rearranged to comply at the earliest possible convenience. Demarcation requirements are to be determined by the Telecommunications Area Planning Team. Third party cabling must not terminate directly in an Ausgrid substation, building, or any other Ausgrid backbone network access point. Interfaces between Ausgrid backbone network and the network of other electricity distributors such as Essential Energy and Endeavour Energy must also interconnect by way of clear demarcation points.

Ausgrid microwave towers may support other 3rd party telecommunications equipment if the structure is designed to support the load, if the 3rd party equipment has no impact on Ausgrid telecommunications equipment including accessibility, and provided all approvals and contractual agreements are in place. In this case, the tower may have shared use, however the Ausgrid telecommunications shelter at the base is for Ausgrid's exclusive use.

6.3.3 Service related

Ausgrid's Telecommunications Planners hold the register of 4 alpha site codes representing each substation or site with telecommunications network connection. NEG TC17 Panel and Service Naming Convention is the naming convention for Ausgrid's telecommunications network elements and services for application through all records as well as for physical labelling of apparatus. The 4 alpha site codes are used for telecommunications records purposes and form part of many identifiers including but not limited to: service connection designations, site names, points of interconnect with 3rd parties, and campus fibre links.

Project Managers must follow Ausgrid's NEG TC16.2 Communications Commissioning Checklist for the commissioning of optical fibre network and services associated with the electrical project. Separately, NEG TC07 Field Commissioning Optical Services communicates more technical commissioning aspects for field personnel.

Control and protection services transmitting via microwave radio shall only utilise licensed frequencies. Ausgrid antenna towers and masts must be purpose built and certified by a qualified structural engineer.

HV feeder protection for sites with optical fibre interconnectivity may require either no optical protection, single path optical protection or duplicate and diverse optical protection schemes. Where optical protection is required, the necessity for stand-by paths shall be determined by control and protection engineers. If stand-by paths are required for active protection schemes, the stand-by fibre cores shall be reserved, but only patched through and put in use as needs.

No new 3rd party services or alterations to existing 3rd party services may proceed unless clear demarcation points are established between Ausgrid's backbone network and the network owned by the 3rd party. All 3rd party service installations or alterations must be planned and approved by Ausgrid's Telecommunications Area Planning Team.

Ausgrid also utilise other carrier infrastructure for the transmission of Ausgrid services. Where this is the case, careful coordination is required between Ausgrid and the utility providing the transmission medium for instances where network alterations are necessary.

6.3.4 Multiplex

Rules and instructions for the design, installation, commissioning, rearrangement and maintenance of Ausgrid's multiplex devices, related equipment and services are available on Ausgrid's Balin web site. In general, multiplex networks are commissioned where core utilisation limits new service provisioning. The Telecommunications Area Planning Team design strategic logical multiplex rings across the network which are to commission on an 'as needs' basis in time for the new services requiring provision.

Where duplicate and diverse schemes are required for HV feeder protection, the A and B multiplex rings are designed with no commonality between the two. Multiplex rings are planned and designed with no more than 6 nodes on each ring to minimise complexity of the system, and for

simplifying maintenance work on the ring. Rings are planned and designed with multiple link points to other rings where possible.

6.3.5 MPLS

MPLS is the platform utilised by Ausgrid for the transmission of SCADA, IT, and other business essential data. Duplicate and diverse optical paths are Ausgrid's goal for MPLS service interconnectivity between Ausgrid significant sites, however diversity is not essential in some cases. Diverse MPLS links must be provisioned in all cases where diverse telecommunications paths exist.

Substation SCADA telemetry is Ausgrid's method for reducing SAIDI through the ability for remote substation control. The transmission of SCADA services over MPLS optimise reliability & security for the substation.

MPLS devices are progressively being installed in FOX cabinets to provide the most secure location. The procedures used to manage and maintain these devices will continue to be refined so the MPLS WAN is able to be used for critical services including protection.

Like all telecommunications equipment, the MPLS hardware must be kept in line with current technology and availability of equipment. It is an Area Planning initiative to plan the strategic placement of core node sites such that the in-feed of local edge nodes does not consume excess optical cores.

6.3.6 WiMAX

Ausgrid's WiMAX towers have been installed as part of the Smart Grid Smart City initiative. The WiMAX towers were built to transmit information back to the OTC via microwave links and / or optical fibre links. At the time this document was released, Ausgrid had ceased the roll-out of WiMAX infrastructure.

6.3.7 Microwave and UHF

Ausgrid's Microwave and UHF radio network is utilised to connect remote sites into Ausgrid's telecommunications network where the provision of more reliable optical fibre links are cost prohibitive. Microwave and UHF radio services both suffer from signal fade through environmental factors including, but not limited to: rain, smoke, birds and dust. Diverse microwave links or the provision of a Telstra 3G back-up may reduce the impact of signal losses. Microwave provides more bandwidth than that of the UHF radio network; therefore UHF provisioned sites connecting new systems such as IEC61850 SCADA will need to upgrade the UHF to another transmission medium such as optical fibre or microwave. In all cases, the Area Planning initiative is to either supplement, or replace UHF and microwave links with more reliable optical fibre connections to Ausgrid significant sites.

6.3.8 Copper pilot

Ausgrid's business decision is to replace the aerial and underground copper pilot network with new optical fibre connections over time. No new copper pilot links will be built for Ausgrid. Existing copper pilot links may need to be re-routed or diverted for situations including, but not limited to: recoverable and contestable works projects, decommissioning of an Ausgrid substation, aerial safety clearance issues. In all cases, the cost of works required to decommission the pilot cable must be assessed against the cost to re-route. Alterations and recovery of Ausgrid copper pilots are performed by Ausgrid.

6.3.9 Distributed temperature sensing

Distributed Temperature Sensing (DTS) fibre cables are being deployed across Ausgrid for the temperature monitoring of underground feeders. The data gathered by the DTS fibres allows Ausgrid to monitor the feeder status, and more accurately apply ratings. DTS fibres are planned with the HV feeder build. At substations, the DTS fibres are to be housed such that equipment may be patched to the DTS for monitoring as needs. Due to the large number of DTS fibres entering some substations, a structured fibre architecture has been established by the Telecommunications Area Planning Team in order to reduce installation costs, and make more efficient use of void and

panel space. It is the Telecommunications Area Planners role to holistically forecast optical fibre network needs at each substation including, but not limited to DTS.

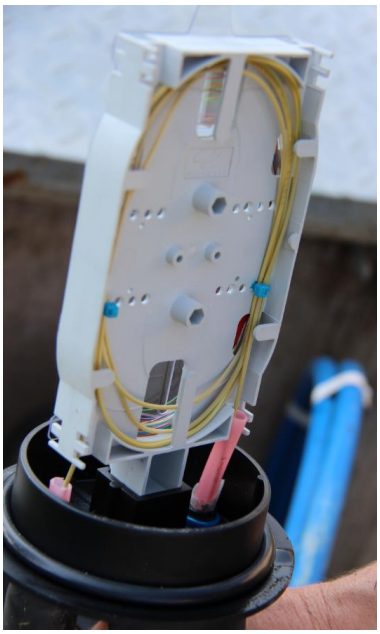

Figure 8 – DTS splice open

6.3.10 Safety and the environment

This standard does not independently cover safety aspects related to telecommunications work. Each Network Standard & Network Engineering Guide shall cover safety relative to the work it is standardising.

In general, the installation, operation, alteration and subsequent maintenance, retirement and disposal of Ausgrid's telecommunications network shall not cause harm to people, property or the environment, and shall comply with all applicable Ausgrid, national and international industry safety and environmental standards, guides, laws, rules, regulations and procedures. Refer to Ausgrid's web site http://www.ausgrid.com.au/ for NS174 Environmental Procedures and applicable Ausgrid safety policies, standards, rules, procedures and guides.

6.3.11 Underground installation and pits

Refer Ausgrid drawing 212393 available on Ausgrid's TDMS for standard pit and conduit construction layouts.

6.3.11.1 Pits

Ausgrid telecommunications pits must be minimum class C rated pre-cast concrete No.8 type defence pits with substation type padlocks fitted to the lids at the time of pit installation. Telecommunications pits installed within a substation yard surrounded by a locked security fence are exempt from the requirement to be fitted with a substation type padlock. Protection communications conduits must enter the end walls of the pits (not the side walls). Telecommunications pits must be installed in road reserve land or land that is not trafficable (i.e: avoid installations in roads, formed driveways, parking lots and access roads). Exception to this rule is for the Sydney CBD where telecommunications pits may be installed in road ways if road reserve land is congested with other utility infrastructure. In these cases, telecommunications pits must be fitted with a class D lid. The class D rating is to be achieved by installing a standard J8 locked pit below surface level, then placing a riser collar and class D lid over the top made flush with the road surface. Class D lids and collars must not restrict the working of the underlying locked pit lids.

Pits where Ausgrid protection fibre conduits will not enter may utilise smaller standard No.5 pits or a similar pit shell with a class B non-locking lid. The DTS (Distributed Temperature Sensing) cables may utilise these pits, however design generally optimises efficiency by housing DTS cables and protection fibre cables in the one No.8 defence type locked pit. Refer NS204 Communication Pits – Specification and Installation for further information.

Figure 9 – Telecommunications pit (padlock removed)

6.3.11.2 Underground installation

The requirement for installation of protection fibre conduits alongside HV cables and conduits is determined by the Telecommunications Area Planning team. Project Managers and Designers of HV feeder construction projects must liaise with the Telecommunications Area Planning team at the concept stage to determine the telecommunication conduit requirements. Protection fibre conduits are not required alongside LV conduits.

Protection fibre conduits must not enter electrical pits. The exception to this rule is for the Sydney CBD in locations where road reserve land is congested and telecommunication pits are not able to be situated. In this case, the protection fibre conduits must be concrete encased at the base of the electrical pit.

Orange 63mm OD HD conduit is to be used for protection fibre cable installation purposes with bends no less than 1200mm radius. Ausgrid optical fibre cable must not be direct buried. Conduits must be installed as per the design. It is the designer's responsibility to perform haul ability assessments on each conduit between telecommunication pits for the haul of standard Ausgrid 60F UGFO cable (Underground Fibre Optic), unless advised otherwise by the Telecommunications Area Planning team. Apply no more than 300m between pits and no more than 180degrees total bend between pits unless otherwise proven to pass by haul ability calculations. Haul ability calculation results must be stored with the design for 7 years or the life of the asset (whichever is last).

Protection fibre conduits installed by under bore methods must utilise a conduit of the same or larger inner diameter as that of the 63mm OD conduit, and transition between conduit sizes must

be either by fitted and sealed transition couplings, or by the installation of a locked J8 concrete pit. For UGOH transitions, 50mm OD HD conduit may be used. A J8 pit must be installed within 40m of the base of the pole for protection fibre UGOH transitions.

Protection fibre conduits entering pits, basements, vaults, cable chase, voids and other enclosed areas must be fitted with bell mouths at the entry point. Telecommunications conduits entering basements must be plug sealed until ready for use. Protection fibre conduits must form a continuous network with all joins glued for air seal and free of burrs to allow for the installation of rope through the conduit via high pressure air blowing technique. Conduits must be proven and left roped for acceptance.

Protection fibre conduit installations by trenching techniques must reinstate the route so as to leave no lasting obvious visible scar or depression in the land and reinstatement must match the surrounds. As optical fibre cable is not traceable, frequency based omnidisk route markers set to the telecommunications frequency must be installed above the conduit as per NS205 Telecommunications Route Markers.

Conduit riser attachments must be mechanically protected for all UGOH transitions (Underground to Overhead) as per NS235 Telecommunications Underground to Overhead (UGOH) Transition. Conduit riser pipes attached to buildings and structures must also be mechanically protected.

Ausgrid telecommunications conduits may be installed in a shared trench agreement with other utilities, however 3rd party network assets must not travel through Ausgrid telecommunications pits. Ausgrid telecommunications conduits must not travel through 3rd party access pits.

For all Ausgrid underground optical fibre conduit and cable installations and alterations, the design and construction must minimise the likely risk of damage to the cable at all stages of the installation including but not limited to effects from vandalism, damage from debris entering pits and conduits, environmental factors and other utility installation works potentially damaging Ausgrid assets. If the risk to Ausgrid's assets during or resulting from the installation is high, then the design and / or construction crews must consult the Senior Engineer responsible for Telecommunications Area Planning for guidance.

Refer to NS234 Telecommunications Underground Physical Plant Installation for further direction.

6.3.12 Aerial installation

For all Ausgrid aerial optical fibre cable installation, the design and construction must minimise the likely risk of damage to the cable at all stages of the installation including but not limited to effects from vandalism, bush fire, degradation from tracking, flora and fauna, environmental factors, as well as proximity to people and fixed or mobile structures. If the risk to Ausgrid's assets during or resulting from the installation is high, then the design and / or construction crews must consult the Senior Engineer responsible for Telecommunications Area Planning for guidance.

Figure 10 – Examples of Ausgrid aerial cable, splice and UGOH installations

6.3.12.1 ADSS

Ausgrid ADSS (All Dielectric Self Supporting) aerial optical fibre cable installation must be installed to comply with the manufacturer's specification and guidelines. Ausgrid ADSS cable must be designed and installed to span entirely above or below other existing or currently proposed conductive wires and/or telecommunications cables mid span, at pole attachment points and UGOH transitions. ADSS cable must not be designed or constructed to rest against or rub against cables or structures mid-span in wind conditions ranging from still to high wind and considering maximum and minimum sag from environmental conditions reasonably expected for the area. Electrical aerial cable installation projects must not be designed or constructed to rest against or rub against pre-existing Ausgrid ADSS cable/s for all reasonably expected environmental conditions for the area, and considering the maximum and minimum sag conditions of the conductors.

It is the designer's responsibility to ensure that the ADSS is designed to span through the minimal electric field zone for the conductive cable arrangement and current considering maximum and minimum sag conditions, thereby minimising the likelihood of cable deterioration caused by dry band arcing from tracking over time. Refer to the manufacturer's specification for electric field tolerances relevant to the chosen ADSS cable. If anti-tracking ADSS cables are recommended for a given route, refer to the Senior Engineer responsible for Telecommunications Area Planning for guidance before proceeding with the design. Approved clearances to ground and other specifications for ADSS are available in NS201 Telecommunications Aerial Cable Installation.

Ausgrid telecommunications installations must only use approved hardware and equipment suitable for the task. It is the designer's responsibility to assess the pole stability and suitability for ADSS attachment. Pole stability assessment information must be kept with the design for the life of the asset. If more than one pole en route is assessed as structurally unsuitable for ADSS attachment, refer to the Senior Engineer responsible for Telecommunications Area Planning for possible alternatives.

If construction machinery is planned to operate directly under Ausgrid ADSS cabling, the ADSS cable must be temporarily raised over the lowest conductor as a minimum, and the conductor below must have high visibility flags temporarily attached as appropriate over the construction site

for the duration of construction works. When the construction works are complete, the ADSS cabling must be returned to pole attachment and span positions compliant to NS201 Telecommunications Aerial Cable Installation.

Figure 11 – Examples of Ausgrid optical cables - UGFO (blue) and ADSS (black)

6.3.12.2 OPGW

OPGW must be installed as per NS135 Specification for the Construction of Overhead Sub-Transmission Lines and associated standard construction drawings. Splices and coils of optical fibre must be installed as per NS201.

6.3.12.3 3rd party cabling

The installation of 3rd party Telecommunications cables and equipment to Ausgrid poles and towers must comply with all current agreements between Ausgrid and the 3rd party including the approved and allocated aerial easement through which the 3rd party telecommunications cable may span. Third party telecommunications equipment attachment agreements must also take into consideration asset access agreements. The installation of 3rd party telecommunications cables and equipment must not conflict with Ausgrid protection fibre cable and equipment installations both existing and proposed for the future. For this reason, 3rd party telecommunications cable and equipment attachment requests must be reviewed by the Telecommunications Area Planning group prior to construction.

The installation of 3rd party telecommunications cable and equipment must not cause harm or increase the risk profile for the adjacent Ausgrid telecommunications protection fibre cable and equipment or Ausgrid's electrical assets. The 3rd party telecommunications cable and equipment must be labelled at each pole so as to clearly differentiate between Ausgrid network assets and the 3rd party network assets. Refer NS232 National Broadband Network Assets on Ausgrid Poles.

6.3.13 Site internal

6.3.13.1 Cabling

Protection fibre cable installation and alteration inside buildings must be routed as per direction given by the Telecommunications Area Planning group. Protection fibre cable/s may need to be routed with diversity from other fibre cable/s up to and including the fibre termination panels within the building, for the NER compliant carriage of critical HV feeder protection services.

Protection fibre cables must be enclosed in sub ducting through buildings from the point of entry to the building, basement, cable chase or void, and up to the optical fibre termination panel. Some buildings, bridge voids and tunnels owned by other utilities or authorities may impose specific requirements on the colour or type of sub ducting used. Sub ducting must be labelled with the designated fibre cable number at all enclosed area entry and exit points including but not limited to: a basement, a room, a cable chase / trench, a tunnel, a riser shaft, a void, a pit, a vault, areas separated by fire stopping, a cabinet / panel. Sub ducting must also be labelled with adhesive warning tape as per NS205 Telecommunications Route Markers at no greater than 5m intervals.

Protection fibre cables must be supported on cable tray / ladder from the immediate point of entry to an enclosed room or basement. Supports must cater for bend radius control of the telecommunications cable attached to or travelling along it. Cable chases may support the sub ducted optical fibre cable by saddling the sub duct to the wall of the trench, however all bends must be supported including at junction points in the trench lines. The fibre cables may travel along the floor of a sub-floor void (or 'computer floor') so long as they are not installed beneath common void entry points, beneath cabinets or beneath equipment storage points.

Protection fibre cables and conduits must enter the side wall of a cable chase, not through the floor. Refer to NS219 Telecommunications Cabling in Ausgrid Premises for further information.

DTS and other internal telecommunications cabling travelling through buildings must be sub ducted and labelled with the designated fibre cable identifier. DTS fibre cables shall be labelled with "DTS" along with the related feeder designation.

Telecommunications cables that are brought into a building and not terminated shall have spare cable length coiled and stored safely in an area that does not restrict access or egress to staff, equipment or other cabling installations. Spare cable length for protection fibre cables shall be coiled and safely stored on purpose built overhead horizontal coil storage trays, or in sub-floor void area where coils are not at risk of damage from access lid and equipment falling, and where coils do not restrict the access and egress of staff, equipment and other cabling.

Telecommunications carrier installations inside Ausgrid ducts and buildings must comply with NS162 Communications Carrier Installations in Ausgrid Ducts and Substations.

Pre-existing protection fibre cables at a substation shall be diversified according to the Telecommunications Area Plans when new or altered control and/or protection schemes deem diversity necessary, or at the time when optical fibre cabling is to be rearranged or relocated in a substation. Plans showing the re-routing of protection fibre cables shall be provided by the Telecommunications Area Planning team.

6.3.13.2 Patching

Insertion loss at patch points must be less than .35dB. Patch cords must be ordered to the appropriate length such that excess cord length is minimised in the panel/s. Patch cords may run between panels housed in the one room. For interconnection with panels in a different room, ruggedized patch cords or tie cables must be used. Dedicated cable tray must support patch cords between panels. Patch cords must be labelled as per NS208.2.2 Telecommunications Substation Communication Cabinet Interconnectivity Design Work Instruction and NEG-TC17 Panel and Service Naming Conventions.

6.3.13.3 Structured fibre cabling architecture

A structured optical fibre cabling architecture may be designed by the Telecommunications Area Planning team where one or more of the following conditions apply to an Ausgrid substation site:

- more than 2 DTS fibre cables enter a substation
- 61850 cabling is to be installed
- CCTV security camera installations
- more than one control building requires telecommunications at the site
- a CMB shelter is required separate to the main control building for telecommunication panel housing space
- multi storey substations requiring telecommunications to more than one level
- WiMAX and / or microwave communications tower installation within or nearby to the substation property
- other control and monitoring functions additional to the standard MPLS and SCADA systems are being trialled and / or deployed

Where one or more of the above points apply, design must consult the Telecommunications Area Planning team to assess the site's suitability for a structured physical fibre cabling architecture considering a holistic forecast of demand. Structured fibre cabling systems are designed to enhance the flexibility of telecommunications at the site and provide the most cost efficient cabling solution. Structured fibre cabling architecture also rationalises the space required through conduits, voids, riser shafts, cable chase etc.

For the most cost effective solution, Area Planning may design fibre collection panels at strategic points where may optical cables coalesce. Back bone cables link the collection panels through to the main termination panels within substation. Collection panels are known as FDA (Fibre Distribution Ancillary) when they are placed within a substation premises.

Figure 12 – FDA – Fibre distribution ancillary panel

6.3.13.4 Housings, panels and terminations

Optical fibre cable terminations inside substations and Ausgrid premises must comply with the NS208 suite of documents. Ausgrid's Telecommunications team may specify additional panels to those stipulated within the NS208 documents, due to factors including but not limited to the number of fibre cables entering the site, the number of interconnections required between panels at the site, diversity requirements, the necessity for structured fibre cabling architecture, or other factors.

Where a substation does not have enough space to house panels in order to comply with the NS208 suite of documents, a CMB (Communications Modular Building) may need to be installed at the site. Ausgrid CMB shelters can house a full suite of communications panels and equipment as per the NS208 suite of documents. Planning for cost efficient interconnections from the CMB panels to the control and / or protection equipment in the substation control building will be required. CMB type shelters shall only be installed to Ausgrid substations and premises.

TransGrid sites which have more than 2 Ausgrid owned optical fibre cables entering must have a FMK (Fibre Marshalling Kiosk) sited nearby or on TransGrid land for the marshalling of Ausgrid optical fibre cables. This requirement is based on agreement between Ausgrid and TransGrid. The FMK shelter in this case also forms a demarcation point between Ausgrid and TransGrid owned telecommunications network. FMK shelters are of the same construction as the CMB shelters mentioned above, however FMK shelters have different security and electrical requirements.

Ausgrid's Telecommunications Area Planning Team shall specify the requirement for CMB and FMK shelters in all instances.

6.3.14 Materials, quality assurance and strategic spares

Materials and equipment shall be new and of a quality at least equal to that stated in Ausgrid's Network Standards, Guidelines or Technical Specifications. Refer to NS245 Telecommunications Approved List of Materials.

All work shall be carried out by suitably qualified and licensed persons having experience or being supervised by someone with experience in the particular types of work to be executed. Refer to NS243 Telecommunications: Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance standard regarding task specific minimum training requirements. Ausgrid may conduct random audits on telecommunications network installations at any time.

Materials for telecommunications network application must be sourced from Ausgrid stores, unless the stores do not have the required item/s in stock. Where no detailed specifications have been provided for the supply of materials or manufactured articles, the chosen materials and manufactured articles shall be of the most suitable grade in quality and workmanship obtainable in the market from firms of established good reputation or, if not ordinarily carried in stock, shall conform to the best accepted standard of the relevant trade for articles of the kind required with due consideration of the use to which these are to be put, and the specified design life. The Senior Engineer responsible for Telecommunications Area Planning shall be notified in all instances where required items are not available from Ausgrid stores.

Ausgrid requires a minimum base line of strategic spares to be held at various depots and storage facilities to only be used in the event of emergency restoration works with stocks replenished as soon as is practicable after each emergency restoration event. Telecommunications equipment spares returned to stores must be recorded in Ausgrid's SAP system. Partial or full cable drums returned to stores must be recorded in SAP.

6.4 Operations and maintenance

Refer to section 9 below for Ausgrid's Telecommunications Maintenance Policy.

6.4.1 Outages and notifications

Planned outages on Ausgrid's optical fibre network must be managed and compliant to the outage limits applicable to the services carried by the link at the time of effect. Planned teleprotection service outage time limits vary according to the related HV feeder as per the NERs. Field staff must request outage windows for each service that is to be affected by the work to be performed. For leased services, Ausgrid shall notify the primary lessee of the service for outages, however if the primary lessee has on-sold use of the Ausgrid telecommunications path, then it is the responsibility of the primary lessee for notifying their sub-lessee/s of the outage.

Work near optical fibre cables also requires OTC notification for monitoring 'at risk' network during the course of the works. Staff must notify the OTC of proposed works near the Ausgrid optical fibre network a minimum of 10 working days in advance of the proposed start work date, at the time work begins, and also at the completion of work. This notification requirement includes work being carried out by external parties including designated underground asset information provider requests.

All planned and unplanned outages which alter Ausgrid's telecommunications network must follow the GIS as built reporting process once services are restored. Data including plans showing cable,

splice and coil locations must be sent for the update of Ausgrid's GIS as soon as is reasonably practicable. Damage reports must be sent to the Senior Engineer responsible for Telecommunications Area Planning for analysis. Refer to MRT100 Telecommunications Planned and Unplanned Outages – Damage and Emergency Response available on Ausgrid's Balin web site.

6.4.2 Damage and emergency response

Damage and emergency response service restoration must be performed by personnel suitably qualified and licensed for the task. Staff arriving on the scene of a broken optical fibre cable must make the area safe as first priority and tape the ends of any broken optical fibre cables to ensure the optical lasers do not cause damage to the retinas of staff or the public. Temporary restorations that do not comply with Ausgrid's NS and NEG documents must be replaced with permanent compliant infrastructure as soon as is reasonably practicable. AEMO (Australian Energy Market Operator) may request the shutdown of HV feeders when a telecommunications link is damaged causing the loss of critical feeder protection circuits.

6.4.3 Tree trimming

Vegetation must be trimmed clear of Ausgrid aerial telecommunications cables as stated in ISSC 3 Guide to Tree Planting and Maintaining Safety Clearances Near Power Lines for up to and including 1000V bare LV and service lines.

6.5 Retirement and recovery

Planning, design and construction for the retirement and recovery of Ausgrid's telecommunications network must be performed safely and minimising any impact on the environment.

Ausgrid's Telecommunications Area Planners must provide instruction for all retirement and recovery projects involving Ausgrid's telecommunications network. Assessment is required for re-routing the existing and planned services transmitting through the infrastructure proposed for retirement. Temporary, staged and / or permanent re-routing of services may necessitate works including, but not limited to diversion of: copper pilot cable, optical fibre cable and / or radio connections.

Ausgrid's copper pilot cables set for decommissioning must be proven de-energised, isolated, cut and capped. Decommissioned optical fibre cabling must be recovered in all instances unless otherwise stipulated by Ausgrid's Telecommunications Area Planning team.

Pit, pole, tower, cabinet (external), pillar, building and concrete pad recovery must reinstate the land after removal. Aerial infrastructure and riser recoveries must remove all associated pole and / or riser fittings and equipment from the structure.

All telecommunications cable, equipment and housings are to be returned to stores where there is a potential for re-use. Returned cable and equipment must be recorded in Ausgrid's SAP system so that items may be reallocated to future projects. For safety reasons, cut optical fibre cables must have the cable ends taped up before disposal or before placing into storage for re-use.

6.6 Training and support

Work on Ausgrid's telecommunications network must only be performed by suitably licensed, qualified and approved personnel. Refer to NS243 Telecommunications: Roles, Responsibilities, Training Requirements, Auditing and QA Acceptance available on Ausgrid's Balin web site and internet site regarding training requirements for work on Ausgrid's telecommunications infrastructure.

7.0 PROTECTION SIGNALLING POLICY

7.1 General

In all cases protection signalling paths are planned, designed and provisioned based on requirements determined by Ausgrid's Control and Protection Engineers as detailed in their Engineering Brief documents.

The variety of services utilising Ausgrid's telecommunications platform today are diverse. Each type of service has its own signalling priority ranking. Due to the fact that protection signalling is essential to maintaining the electricity grid's stability, the protection signalling is therefore regarded as highest priority. For all link programming activities, splicing, damage and emergency response service restorations, patching and related works, the protection signalling continuity, security and reliability takes priority over all other services being transmitted.

The key objectives of Ausgrid's protection signalling policy are:

- Provide secure, reliable and available services compliant to the NER's
- Provision protection schemes with redundancy complying with the requirements set by Ausgrid's Control and Protection Engineers as a minimum
- Provision primary protection services with 24hr condition monitoring
- Retain capacity for roll-over of critical services under damage or fault conditions
- Roll protection services over onto more secure fibre links when they become available
- Holistically monitor the performance of the protection signalling platform
- Seek out and implement opportunities for improving protection signalling performance

The table below describes the hierarchy for protection links, with each type of protection link in the network to be classified according to one of the categories shown.

Table 1 – Protection link category definitions

Category	Description and Long Term Outage per Year as per Availability Model	Availability
1	All 132 kV protection schemes requiring unit, permissive or blocking communications, and all 66 kV protection schemes with possible network outage implication extending into the transmission network. National Electricity Rules (NER) apply. **Note:** Communications is required for these protection links by default; in some cases stability studies may prove that communications are not required and the NER, where applicable, can be met by other means. 5 MINUTES PER YEAR OUTAGE	99.999%
2	High speed line protection at less than 132 kV for electrical transmission links that have no possible network outage implication extending into the transmission network. The NER do not apply. Protection for most 66 kV and all 33 kV lines are in this category. 1500 MINUTES PER YEAR OUTAGE (25 hrs)	99.715%
3	Power system protection communications for distribution networks. No more than 3 days per year expected outage time.	99.178%

Table 1 is based on the use of the NEG TC04 Bearer Availability Model availability model, which was developed using historical and generally expected risks along fibre routes. Although it is a requirement to apply the model, it does not relieve the designer of the responsibility for assessing each route and identifying any atypical risks to telecommunication links that may fall outside the model.

Each category in Table 1 above is indicated in Figure 13 below. The selection of maximum allowable average outage per year is based on a judgement of what is required balanced against the cost of providing that level of performance. In all instances, Communications Engineering plan network in accordance with the requirements set by Ausgrid's Control and Protection Engineers. In some exceptional circumstances, exemption to the NER requirements may be sought.

"NER Zone" in the following diagram refers to a Zone substation subject to the NER. The rules specify clearing times, levels of redundancy and restoration times. Not all Zone substations are subject to the NER.

'Availability' in this document refers to the availability of a protection scheme as a whole, not just the communications link.

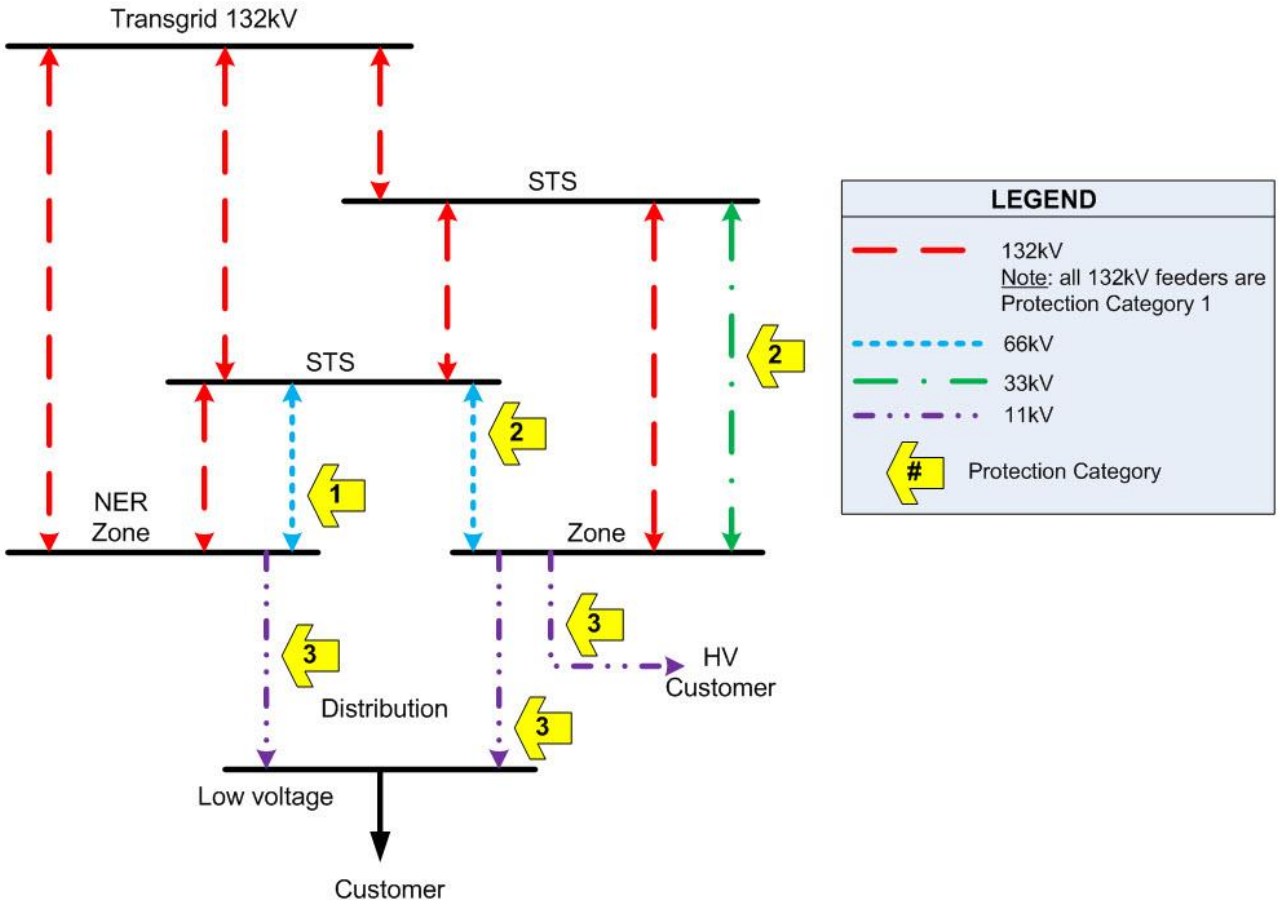

Figure 13 – Protection hierarchy

7.2 Availability

Protection Scheme availability is addressed in NEG TC04 Bearer Availability Model and NEG TC04 APPENDIX A: Availability Model spreadsheet. The availability model shall be used to verify that the protection link meets the requirements of Table 1.

7.3 Diversity

Diverse and redundant N-1 optical paths are the preferred condition when planning and designing for new HV feeder protection signalling. Diversity in this case refers not only to the physical cable paths end-to-end, but also extends to the panels, cable terminations, switches, multiplexers and all devices through which the signal transmits, or upon which signalling transmission relies. Diversity includes the requirement for devices to be of different manufacturer supply for each scheme to ensure common mode failure cannot cause simultaneous dual protection path outages. Signals must be programmed to travel through paths which are entirely independent of each other to be regarded as diverse.

N-1 telecommunications paths may not be a legal requirement (based on the NERs) for commissioning a new protection scheme, however the N-1 condition remains Ausgrid's goal for telecommunications supporting ≥33kV feeders and substations.

It is the designers' responsibility to design according to Ausgrid's diversity direction in compliance with this standard and all applicable Network Standards and guides appropriate to the task, and to accurately document and plan physical infrastructure paths. It is the constructors' responsibility to install infrastructure according to the design, and to consult Ausgrid where variations to the design potentially compromise diversity.

Protection schemes are planned and designed to use the path of least risk, which is in most cases also the shortest path between substations. For risk reduction reasons, the choice of paths for protection signalling must also account for spreading the risk over each diverse path. All 'A' protection signals for a ring must not group together and travel along the one route and vice versa for the 'B' signals. The risk is reduced and maintainability of the network is enhanced when the A & B signals are shared between diverse paths.

7.4 Minimum number of diverse paths

The establishment of fully redundant protection will require a minimum number of physically diverse paths for two, three and four ended schemes.

In the following diagrams "A" and "B" refer to protection scheme A and protection scheme B.

From the diagrams below it can be seen that the minimum solution will require:

- 2 diverse paths for a 2 ended scheme.
- 4 diverse paths for a 3 ended scheme.
- 6 diverse paths for a 4 ended scheme.

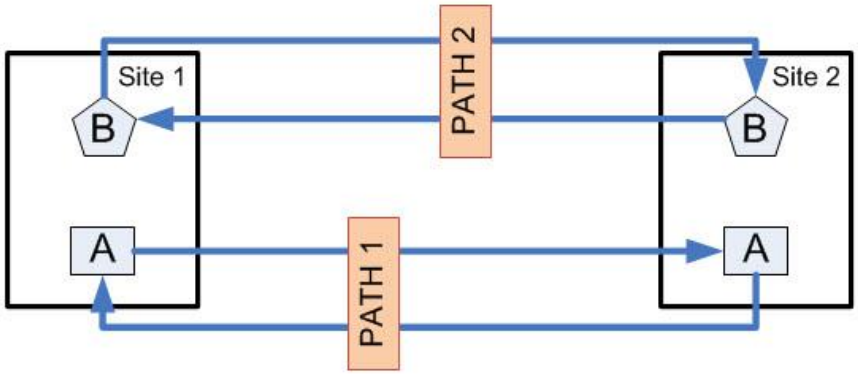

Figure 14 – Duplicated 2-element folded ring topology

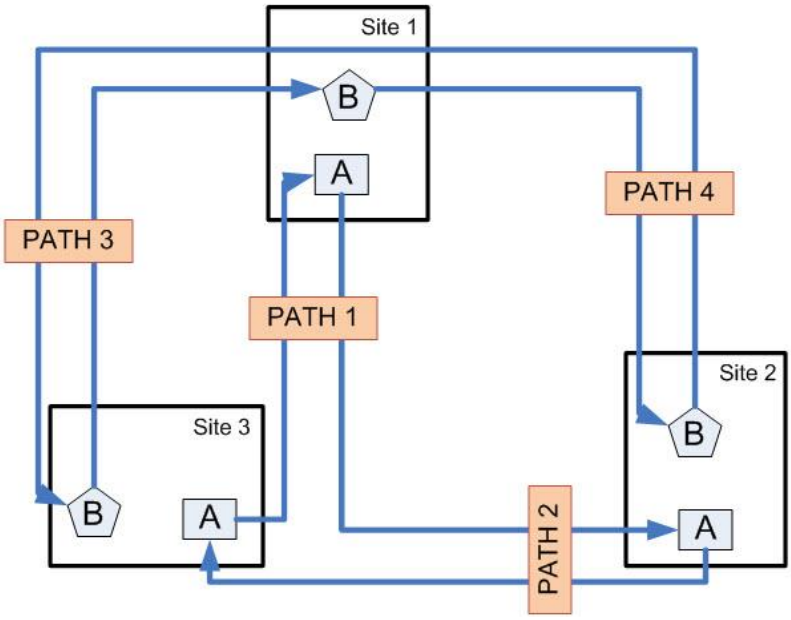

Figure 15 – Duplicated 3-element folded ring topology

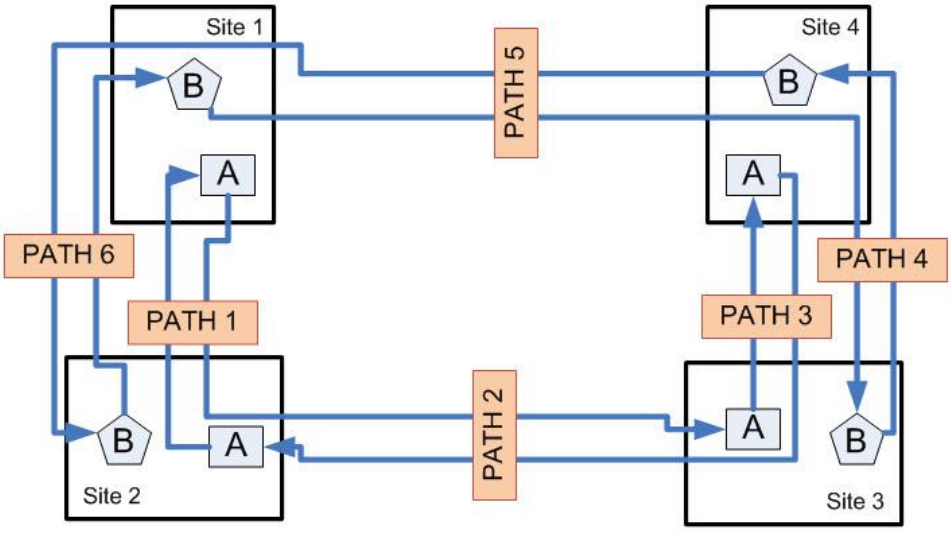

Figure 16 – Duplicated 4-element folded ring topology

7.5 Propagation delay and repeatability of delays

When calculating the overall delay the designer must include the delay of every network element in the path. The designer will be required to confirm that the calculated propagation delay will be within requirements, particularly as the telecommunications network expands and more elements are introduced.

The design of the communications system shall be such that the latency for protection services is deterministic and repeatable, to within the requirements of the protection scheme, but in the absence of other information, with a variance of no more than 1.5ms.

End to end delay for Category 1 and Category 2 protection links shall be less than 20ms.

7.6 Preference in fibre options

Notwithstanding the need to meet the availability model requirements, the table in Table 2 below indicates the preferred method of optical fibre construction for the purpose of network integrity. Area Planners and Designers may also refer to NEG TC30 Telecommunications Asset and Risk Management for risk calculation matrices that will guide users to assign the appropriate network solution in proportion with the value of the asset to Ausgrid's business.

Table 2 – Preferred method of optical fibre construction

Preference	Urban and Cleared Rural Areas	Rural and Bush Areas (see Note below)
1	Underground protected by conductors	Underground protected by conductors
2	OPGW	Underground unprotected or OPGW
3	ADSS	ADSS
4	Underground unprotected	

Note: "Rural and Bush Areas" refers to locations where there is uncleared native bush or planted vegetation posing a fire risk. Cleared open rural land does not pose this level of risk.

7.7 Category 1 – options

Table 3 – Category 1 options

A Path	B Path
Optic fibre cable, installed based on priority in table above. OR If the above options are considered impractical or too expensive the following are acceptable: * Microwave radio * Leased TransGrid protection fibre * Leased TransGrid protection communications channel, if fibre is not available Copper pilots are NOT permitted.	Any option for A path is acceptable. If the primary link is optic fibre cable then it is acceptable to use: * Leased TransGrid fibre or protection channel * Leased PowerTel fibre on Ausgrid OPGW If the above options are impractical or too expensive the following are, although not desirable, acceptable: * Microwave radio, but not with a primary link also on radio If the above options are considered impractical or too expensive the following are acceptable, with the explicit approval from the manager responsible for design of communications systems for power system protection: * Leased dark fibre from a licensed carrier * Use of copper pilot

Category 1 additional notes:

- Redundancy with geographical diversity is mandatory.
- The use of copper pilots is never permitted for both A and B protection schemes without the approval of the manager responsible for design of communications systems for power system protection.
- ADSS on street lighting poles and low voltage poles shall not be used for primary or redundant protection circuits without the approval from the manager responsible for design of communications systems for power system protection.

7.8 Category 2 – options

Table 4 – Category 2 options

A Path	B Path
Category 1 links are the preferred method of interconnectivity. If this is considered impractical or too expensive the following is acceptable: * Microwave radio * Leased TransGrid protection 64Kbit channel Exception can be sought from the manager responsible for design of communications systems for power system protection (which will require site specific studies).	Same as for A path.

Category 2 additional notes:

- Redundancy with geographical diversity is optional but desirable.
- The use of copper pilots is never permitted for both A and B protection schemes without the approval of the manager responsible for design of communications systems for power system protection.
- ADSS on street lighting poles shall not be used for primary or redundant protection circuits without the approval from the manager responsible for design of communications systems for power system protection.

7.9 Category 3 – options

Category 3 links shall be designed in a similar manner to Category 2 links with the following major exceptions:

- Redundancy is provided only when there is a particular reason to do so and is cost feasible.

7.10 Protection over microwave

Protection circuits over radio bearers shall only be on microwave systems using licensed frequencies.

7.11 Special cases

In the event that the above options do not provide an appropriate solution, alternatives can be approved by the manager responsible for Communications Engineering. Such alternative may be the provision of a third communications path.

7.12 Use of 3rd party optical fibre

The following requirements shall be fulfilled in order to convey Category 1 and 2 protection signals over third party fibres:

- Confirmation shall be obtained that Ausgrid or the lessor has full control of the asset for the route, including the splice enclosures along the way, and
- Any leases arranged with a lessor for use in power system protection communications shall be obtained and used solely and specifically for that purpose. The approval of the Communications Engineering Manager shall be obtained prior to proceeding with design or implementation of any Category 1 circuit carried on a leased asset which is not a dark fibre, and
- Category 1 and Category 2 circuits shall only be carried on PowerTel or telecommunications carrier assets when such circuits are carried on dark fibre leased for power system protection purposes, and
- A lease period to suit shall be defined, generally minimum 20 years, made up of 4 lots of 5 year leases with automatic options to renew (thereby allowing Ausgrid to exit the lease should alternative paths become available), and

- Ausgrid retains first right of refusal to purchase the asset in the event that the asset is sold, and
- An Ausgrid interest in the asset shall be registered so that if a third party intends to purchase the asset or any of its components, the Ausgrid interest will be an inseparable part of the asset, and
- Ausgrid shall retain the right to pass on its interest in the agreement to affiliated corporate entities or successors.

In all instances, the use of Ausgrid assets is preferred over the choice to use third party assets.

One of the duplicated schemes associated with Category 1 protection shall be on Ausgrid owned assets. Exceptions to this will require the explicit approval from the Communications Engineering Manager.

7.13 Condition monitoring

Ausgrid's primary protection schemes are provisioned with 24hr condition monitoring with alarming systems to indicate connectivity failures and signal loss.

7.14 Sheath capacity

Each optical fibre cable link between substations must retain a minimum of four (4) spare cores available end-to-end that may be used for roll-over of services in the event of a damage or fault, or for the establishment of new multiplex schemes where cores are depleted. These cores must not be faulty.

7.15 Physical diversity arrangements

The following details the minimum physical separation required for cables carrying category 1 protection circuits.

7.15.1 External to Ausgrid controlled property

Optical fibre shall exit the substation on different sides of the building in different directions (with opposite directions being the most desirable).

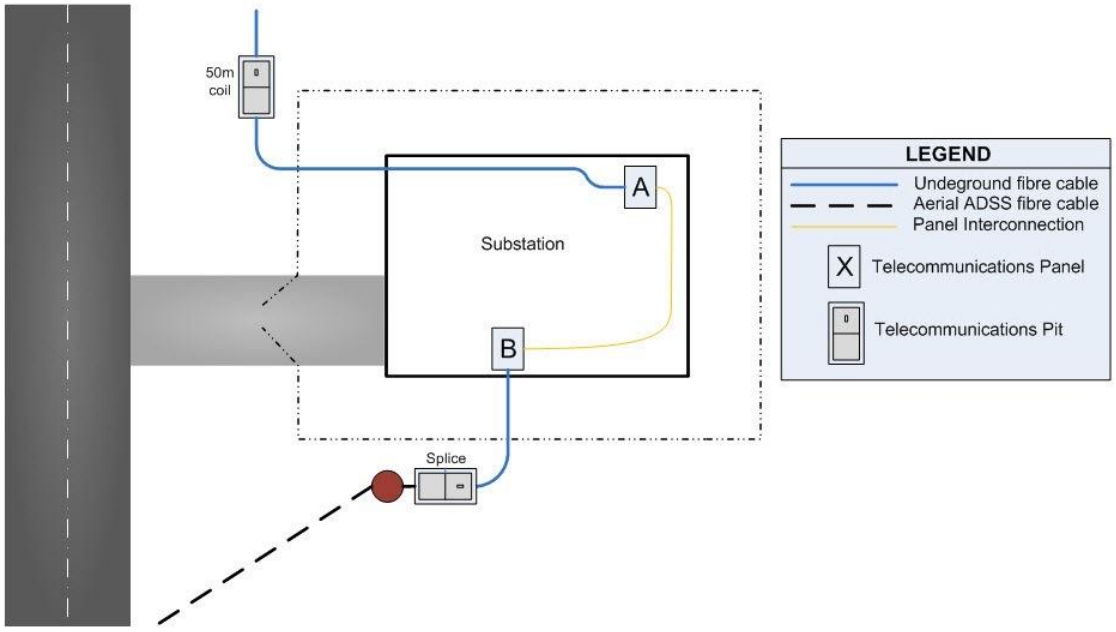

Figure 17 – Diversity example 1

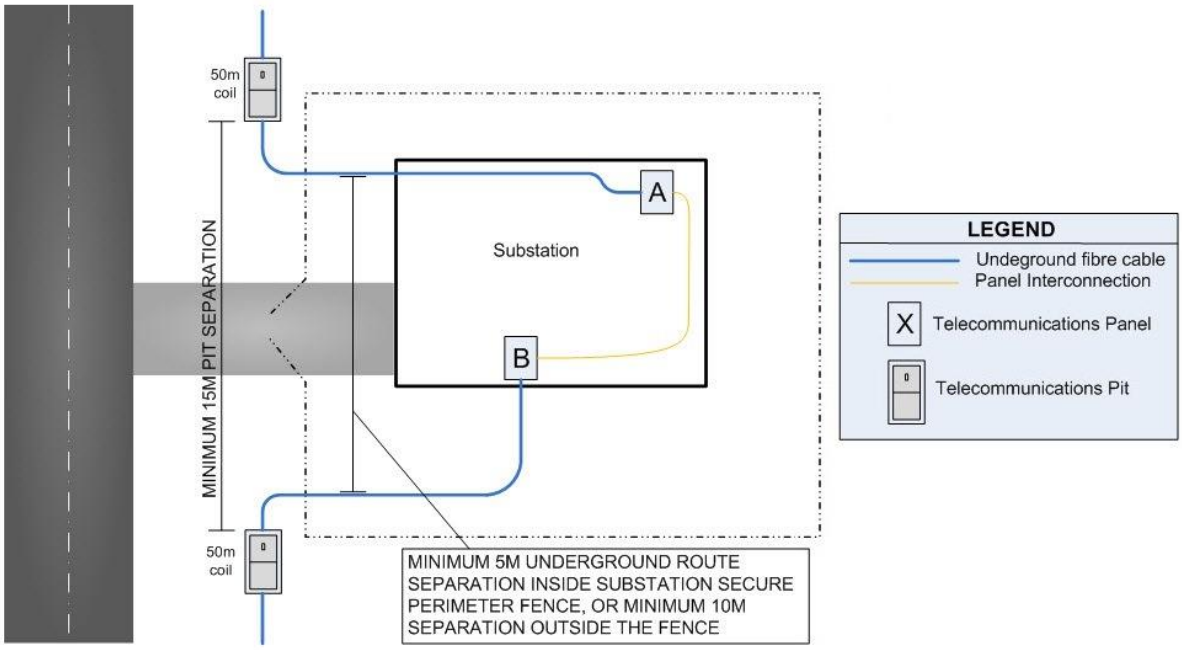

Figure 18 – Diversity example 2

A minimum of 15 metres segregation shall be maintained between pits when both cables are leaving a substation underground on the same side of the building. It is allowable for the underground conduit to only have a separation of 5 metres within Ausgrid property, 10 metres external to Ausgrid property.

A minimum of 10 metres segregation shall be maintained when leaving a substation with one cable underground and one cable aerial.

A minimum of 20 metres segregation shall be maintained when both cables leave a substation by aerial route and when the cables do not cross the same lane of vehicular traffic within 200 metres. Minimum ground clearances as per NS 201 Telecommunications Aerial Cable Installation must be met.

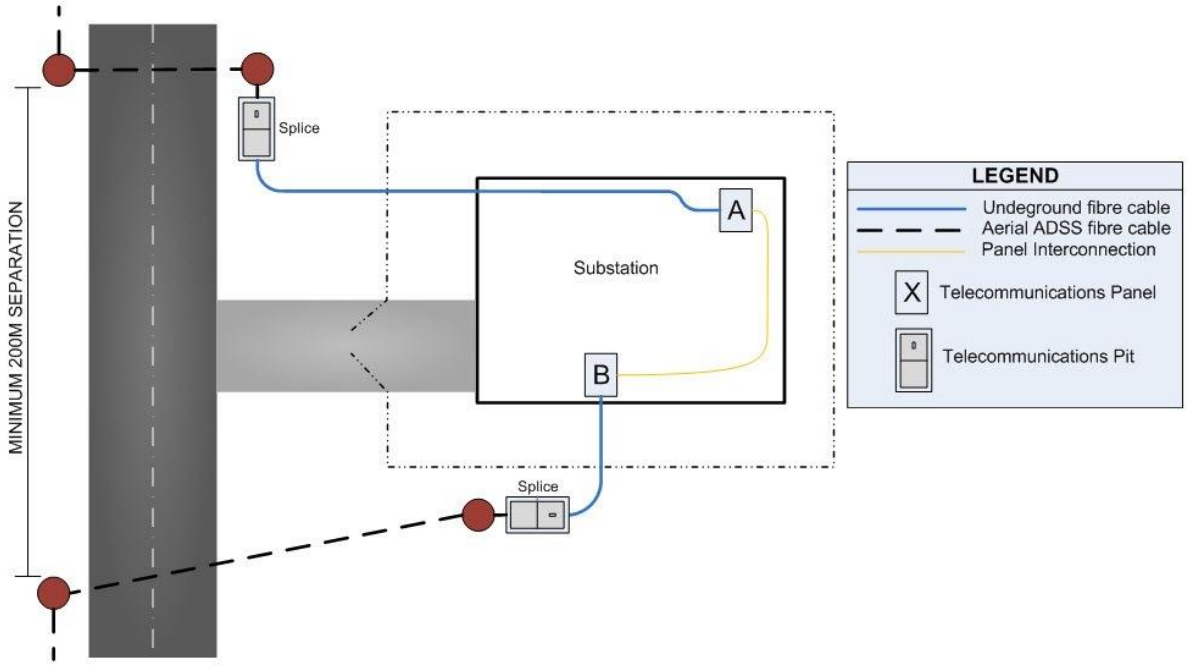

Figure 19 – Diversity example 3

A minimum of 200 metres segregation shall be maintained when using ADSS for both lead in cables and they cross the same lanes of vehicular traffic. This distance can be reduced to 100 metres if both ADSS road crossings are above mains conductors.

7.15.2 Within Ausgrid controlled property

A minimum underground separation of 5 metres shall be maintained (an exception to the 5 metres may be made when cables are installed in troughs or below ground ducts in conjunction with power cables but each cable must be in separate troughs).

A minimum above ground yard separation of 10 metres segregation shall be maintained. A minimum in building separation of 5 metres shall be maintained, or where such separation is not practical, cables shall run on opposite sides of the room. Alternately, a 2 hour fire rated wall between cables is considered optimum separation.

Diversity within the room housing communications equipment shall be on the basis of best efforts, within the bounds of practicality.

Deviations for the above segregation requirements shall only be implemented following approval from the Communications Engineering Manager.

Route design shall demonstrate and document consideration and minimisation of risks with the potential to cause common mode failure (eg. having two ADSS fibre runs requiring diversity are crossing the same main road which makes them susceptible to being damaged by the same high load travelling down the road).

7.15.3 Backbone cable bypass

For reasons including but not limited to risk minimisation, security or signal loss, Telecommunications Area Planners may not route the entire backbone cable in and out of a substation which has no diversity requirements. Where this is the case, the substation lead-in cable shall be spliced in 3-way arrangement to the backbone, and Ausgrid shall design the 3-way splice core arrangement.

If the site requires redundancy, and diverting the backbone cable places the backbone at higher risk of damage, two diverse lead-in cables shall be used to connect to the substation via separate 3-way splices to the backbone.

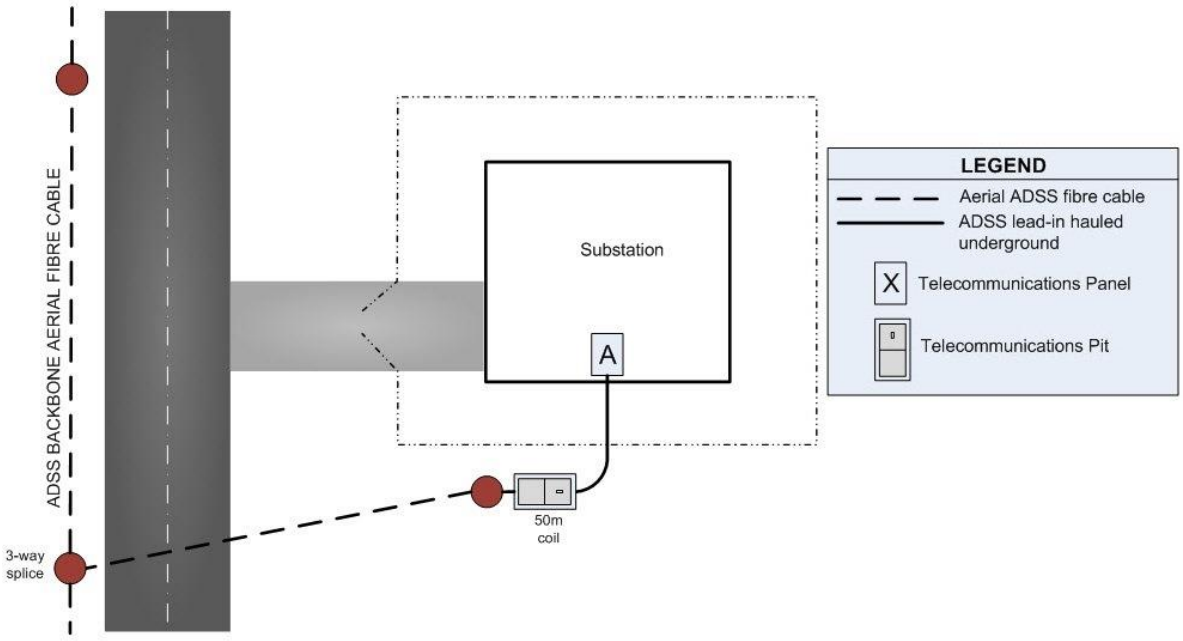

Figure 20 – 3-way splice and lead-in to substation

7.15.4 Internal to the substation building

Sites with more than one optical fibre network link entering shall have in building fibre cable paths designed with as much diversity as is reasonably practicable to the site irrespective of protection diversity requirements. Sites with set diversity requirements shall have in building fibre cable paths designed with as much diversity as is reasonably practicable including in consideration of fire zones.

The above requirements also incorporate fibre termination panel placement. It is preferred that Fibre Optical Patch Panels (FOP) are placed at either end of a control room containing electrical equipment and associated fibre routes planned such that a fire on one side of the building is least likely to damage both optical lead-ins and terminations.

7.15.5 Protection signalling records

Ausgrid maintain records databases for storage of plans and documents related to protection signalling. Keeping the protection signalling databases and plans current is essential to the reliability of the system, in particular in the event of damage and emergency service restoration.

It is the responsibility of all personnel involved with installation or alteration of telecommunications infrastructure and signal transmission, to perform all works necessary to update Ausgrid's plans and records at the earliest possible convenience and no greater than 1 week from completion of works.

8.0 COMPLIANCE POLICY

8.1 General

All personnel working on Ausgrid's telecommunications network must be covered by current public liability, professional indemnity and workcover insurances, as well as applicable licences, accreditations, contractor registrations and ABN, and safety compliances as applicable to the work they are performing.

Ausgrid's Telecommunications Network Standards detail requirements based on engineering for the most cost effective, reliable, secure, durable, available, robust, and predictable network solutions, that are best practice outcomes for Ausgrid's business needs. Compliance with Network Standards therefore provides optimal asset value.

The key objectives of Ausgrid's telecommunications compliance policy are:

- Provide concise checklists with each Network Standard document to be used as a guide for designers and constructors to self-assess for compliance
- Maintain the currency of Network Standards and their interrelationships with other standards, guides and drawings
- Provide a Network Standard to define the roles and responsibilities of key stakeholders involved in any or all aspects of the telecommunications infrastructure's lifecycle, in particular with regard to compliance
- Facilitate a compliance auditing process whereby acceptance of network installations or alterations is based on the audit of checklists associated with each Network Standard applicable to the works performed
- Monitor compliance audits to ensure they are performed and documented on a regular basis
- Seek out and implement opportunities for improvement of the compliance process

8.2 Responsibilities

It is the responsibility of all persons engaged in the planning, design, construction, alteration, support, maintenance, operation, retirement and recovery of Ausgrid's telecommunication network through any or all life cycle stages to comply with Ausgrid's Network Standards (NS) and Network Engineering Guides (NEG) at all times.

All designs must comply with Ausgrid's Be Safe 12 Design.

8.3 Auditing

Design and construction for the Ausgrid Telecommunications network must comply with the Telecommunications Area Plans, Telecommunications Brief documents, Ausgrid's NS and NEG documents, drawings and other reference materials provided by Ausgrid. For all telecommunications network installation or alteration initiatives, Network Standard compliance checklists must be completed and submitted for review to the Ausgrid's representative nominated on each checklist, in order to apply for approval and acceptance of the asset and / or function.

It is recommended that Network Standard checklists are used to self-assess for compliance prior to submission of the asset or function for acceptance.

Compliance measures must be applied by Ausgrid in a consistent manner, and Ausgrid has the right to audit for compliance at any time. The requirements of Ausgrid's auditor's may include, but not be limited to:

- review of checklists applicable to the project
- inspection of the physical installation
- review of project plans and associated documentation
- review of test records
- review the currency of training records for the personnel listed as performing work on or related to Ausgrid's telecommunications infrastructure
- review of Safe Work Method Statements (SWMS) and associated safety checks used for each aspect of the provisioning

Audits shall form the basis upon which Ausgrid assesses the network installation or alteration for acceptance. Ausgrid reserves the right to refuse acceptance of telecommunications work performed that is not compliant with Ausgrid standards and all applicable national and international standards, rules, laws, procedures, regulations and guides.

At the time of writing this document, the checklists associated with some telecommunications standards had not yet been released to Balin and Ausgrid's internet site.

At all stages of a project's progress, the project managers as well as design and construct crews must verify that Ausgrid's planned and or designed direction is being adhered and the overall functional intent is being achieved. Ausgrid reserves the right to decline telecommunications assets installed or amended to comply with an out dated standard, as well as for reasons including but not limited to the following:

- installations which do not comply with the planned network instruction provided by Ausgrid
- installations which do not function as per Ausgrid's specified intent including, but not limited to: blocked or deformed conduits, or conduits with bends additional to those in the design, or equipment that is inoperable or not fit for the intended purpose, or fractured and faulty fibre cable cores
- installations which do not comply with Ausgrid's NS and NEG documents
- installations for which Network Standards checklists are incomplete, or not submitted
- use of unapproved or substandard materials for Ausgrid's telecommunications network

- installations which put Ausgrid's network and / or the safety of people, property and the environment at risk at any stage up to and including the construction completion, or which could reasonably be proven to have been caused by the construction works

8.4 Variation

Where compliance to Ausgrid standards and approved materials cannot be adhered, Ausgrid must be consulted for approval of each variation to standards and materials as per NS181 Approval of Materials and Equipment and Network Standard Variations.

Checklists associated with each Network Standard shall be used to highlight non-compliances, and shall be submitted as part of the process of requesting variation. Variation works must not proceed until Ausgrid's written approval for the variation has been given. The only exception to this rule is in the event of emergency restoration works, where temporary variations to materials and Network Standards may proceed so long as the works do not create or cause;

- safety hazards,
- environmental risks,
- or risk damage to property.

Refer to MRT100 Telecommunications Planned and Unplanned Outages, Faults, Damages and Emergency Response.

8.5 Records

Compliance with standards must be documented on plans and in engineering, design and construction documents. Each document stating compliance must be stored with the project for 7 years or the life of the asset (whichever is last).

Due to the direct association between operability of Ausgrid's telecommunications assets and Ausgrid's business operations, as well as the distribution of electricity, it is imperative that records related to Ausgrid's telecommunications infrastructure and signalling transmission are kept current at all times. It is the responsibility of all persons involved with installation, alteration or support for Ausgrid's telecommunications network to ensure their work is reflected accurately in Ausgrid's records at the earliest possible convenience and no more than 1 week from completing works.

9.0 TELECOMMUNICATIONS MAINTENANCE POLICY

9.1 General

Maintainability is inherent in the planning, design, and conceptual phases, and is the probability that an item shall be returned to service in a defined period of time given perfect support. Effective maintenance facilitates consistent reliable operation of the telecommunications platform thereby optimising the value of the asset to Ausgrid.

The key objectives of Ausgrid's telecommunications maintenance policy are:

- Retain inherent equipment reliability levels
- Stop equipment from failing or causing failures
- Collect information for trend analysis to spotlight network improvement opportunities
- Return degraded or failed equipment to a serviceable standard
- Holistically monitor the maintenance system's performance

Ausgrid's telecommunications assets must be maintained as per the manufacturers specifications and recommendations, unless deemed otherwise required in Ausgrid's NS or NEG documents, or where stipulated by Ausgrid's Communications Engineering Team. Maintenance of Ausgrid's telecommunications assets must only be performed by suitably qualified, licensed and approved personnel.

9.2 Responsibilities

The role of assessing maintenance requirements for Ausgrid's telecommunications network elements is to be performed by Ausgrid using a risk based analysis method. Refer to NEG TC30 Telecommunications Asset and Risk Management standard on Ausgrid's Balin site.

9.3 Monitoring

Ausgrid provision condition monitoring schemes for network elements and / or links that are critical to the business.

9.4 Scheduling maintenance

As a minimum Ausgrid schedule periodic maintenance activities in accordance with manufacturer recommendations.

9.5 Tests and trend analysis

Ausgrid's telecommunications infrastructure is fairly new, however it has now accumulated enough history to enable more targeted reliability trend analysis. Particular units that form part of Ausgrid's telecommunications network therefor may require a programme of work created specifically for replacement of all like units due to factors including but not limited to reliability.

Each time tests are performed for a telecommunications element, the results should be compared to the previous test/s for that element as well as other elements performing the same function, or other elements on the same transmission path (ie: cores in the same cable sheath) to assess the presence of and rate of degradation, or mortality rate. The impact of degradation on the system as a whole should be risk assessed using Ausgrid's NEG TC30 Telecommunications Asset and Risk Management guide. Degradation must be scheduled to be rectified before it affects service transmission. After rectification works are performed, tests must prove the element has been brought back to within allowable service transmission limits.

Area Planners performing maintenance trend analysis must option study the cost of maintenance works versus the cost of replacement works. If it is more cost effective to replace an element rather than perform regular periodic maintenance, and where a new element can provide the same or better performance with the same or better maintainability, then replacement works should be scheduled. Assessment of cost effectiveness for replacement versus ongoing maintenance costs may be considered over a financial year, a regulatory period, or over the remaining expected life of the asset.

To assist effective trend analysis, faults, damages and near misses on telecommunications infrastructure must be reported in every instance. Refer to Ausgrid's MRT100 Planned and Unplanned Outages, Faults, Damages and Emergency Response standard. This includes but is not limited to reporting risks associated with Ausgrid's microwave, FMK (Fibre Marshalling Kiosk), CMB (Communications Modular Building), FDH (Fibre Distribution Hub) and pilot junction boxes.

9.6 Escalation

Major or long duration outages to telecommunications infrastructure require Ausgrid to perform an ICAM investigation (Incident Cause Analysis Method).

10.0 RECORDKEEPING

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

Table 5 – Recordkeeping

Type of Record	Storage Location	Retention Period*
Approved copy of the network standard	Document Repository Network sub process Standard – Company	Unlimited
Draft Copies of the network standard during amendment/creation	Work Folder for Network Standards (Trim ref. 2014/21250/29)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	Records management system Work Folder for Network Standards (Trim ref. 2014/21250/29)	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 – References

A1 Network Standards and Engineering Guidelines available on Ausgrid's Balin site

It is the reader's responsibility to obtain the most recent amendment of all Ausgrid, national and international standards, policies, rules, regulations and guidelines. Ausgrid reserves the right to decline telecommunications assets installed or amended to comply with an out-dated standard.

The Telecommunications Network Engineering Guidelines and Network Standards related to this document are listed and described within the body of this document.

All work on or related to Ausgrid's telecommunications network shall conform to all relevant legislation, standards, codes of practice, rules, policies, guides, regulations and network standards including but not limited to those listed in Figure 3 above as well as in the following sections.

A2 Acts and regulations

- Electricity Supply (General) Regulation 2014
- Electricity Supply (Safety and Network Management) Regulation 2014
- Environmental Planning and Assessment Regulation 2000
- Environmental Planning and Assessment Act (1979)
- Electricity Market Operations Rules (NSW)
- National Environment Protection Council Act 1994
- Work Health and Safety Act 2011
- Work Health and Safety Regulation 2017

A3 Tools and Documents

Some of the following may also be available through internet sites including Ausgrid's web site - http://www.ausgrid.com.au/.

- Bellcore Standard - Isolated Ground Planes: Definition and Application
- Building (ETSI TC-EE 02002)
- CCITT K.27 - Bonding Configurations and Earthing Inside a Telecommunication
- Code of Practice Contestable Works (Department of Water and Energy)
- Code of Practice (Electricity) Service and Installation Rules (DEUS)
- Code of Practice for Electricity Transmission and Distribution Asset Management (Electricity Association of NSW)
- Code of Practice Installation Safety Management (Electricity Association of NSW)
- Duct pull (cable pulling tension calculator)
- ETSI 300 019 - Equipment Engineering – Environmental Conditions and Environmental Tests for Telecommunications Equipment
- ETSI ETS 300 329 - Radio Equipment and Systems (RES): Electromagnetic Compatibility (EMC) for Digital Enhanced Cordless Telecommunications (DECT) Equipment
- ETSI 300 342 Radio Equipment and Systems (res) – ElectroMagnetic Compatibility (EMC)
- Model Agreement for Local Councils and Utility / Service Providers
- MOU – Ausgrid, RTA (now RMS), and Dept of Transport
- NSW Maritime - Crossings Code Dec 2011 (Crossings of NSW Navigable Waters: Electricity Industry Code)
- NSW Maritime - Protocol for Incident Reporting and Analysis – for crossings of NSW Navigable Waters
- NSW Maritime - Protocol for Exchange of GIS Data
- NSW RFS Bush Fire Prone Land Mapping Guideline
- Relocation of Ausgrid Assets on to RMS proposed Public Roads (pending release of ES9A and ES12)
- RMS Guide – Traffic Control at Worksites

- Road Occupancy Licence Conditions of Approval - Sydney East, Sydney North, Sydney South – Homebush, Sydney South – Oatley
- Seek Consent Under Section 138 of the Roads Act
- Shared Trench Utility Agreement

A3 Networks NSW Technical Specifications

- Electrical Conduit, Conduit Fittings, Cable Protection Covers and Marker Tape

A4 Ausgrid Documents

The following list excludes those referenced in Figure 3 above. Some of the following may also be available through internet sites including Ausgrid's internet site - http://www.ausgrid.com.au/.

- Asbestos Safety Management Plan
- Be Safe 12 Design
- Bushfire Risk Management Plan
- Company Form (Governance) - Network Document Endorsement and Approval
- Company Procedure (Governance) - Network Document Endorsement and Approval
- Company Procedure (Network) - Production / Review of Network Standards
- Customer Installation Safety Plan
- D292 - Installation Instruction – Straight Through Joint – Four Core Nylon Translay Pilot Cables
- D294 - Installation Instruction – Transition Joint for Nylon Translay Pilot Cable to PILC Balanced Voltage Pilot Cable
- D11/88008 - Network Management Plan
- DG01 - Details the types of broadband communications cables and equipment that are located on Ausgrid's poles
- DG13 - Amendments to TS5130 – Gas Detector – Gas Tech Models
- DG14 - Underground Distribution Substations and Confined Spaces
- DG27 - Ausgrid Substation Risk Mitigation Asbestos Management Program
- DG33 - Hot Work During Total Fire Bans
- DG36 - Invisible Danger: WARNING on the Use of Microscopes, Magnifiers and Inspection Scopes on Optical Fibres
- DG37 - Use of Fall Arrest Systems for Vault and Basement Distribution Substation Entry
- DG42 - Bushfire Prevention
- DG45 - Hot Work Near Service Stations
- DG49 - Fire Risk
- DG53 - Dräger MiniWarn Gas DetectorDG24 - Use of Lubricants with Stainless Steel Nuts and Bolts
- DG85 - Interim Safety Procedures for Working on Overhead Cables Attached to Commercial Buildings
- DG118 - Identification of Termite Affected Poles
- DG119 - High Voltage Live Line Work Safety Alert – EWP Lanyards and Harnesses
- DG122 - Interim Safety Procedures for Working at Heights on Communication Structures and Equipment (under production)
- DG123 - Interim Height Safety Procedures for Working on Zone and Sub-transmission Substation Structures and Equipment (under production)
- DG126 - Water Use in the Workplace
- DG127 - Crystalline Silica Dust in the Workplace
- DG128 - Termite Baiting on Timber Power Poles
- DG141 - Work Near Overhead Power Lines and Use of Cable Covers
- DG146A - Guideline for Helicopter Use- Construction Work
- DG148 - Close Approach Tree Trimming Techniques and Training
- DG150 - Disposal of Damaged or Out-of-Date Height Safety Equipment
- DG154 - Procedure for Breaking into or Stripping Away Concrete Encased Conduits
- DG155A - Cutting Inspection Windows in Underground Conduits
- DG191 - Use and Care of LV Gloves

- DG194A - Extension Ladder Grip Device
- DG209 - Retro-fitting NGK Strap Winches
- DG212 - Retro-fitting Lug-All brand Strap Winches
- DG221 - Hoses for Hand Operated Hydraulic Power Tools (Interim Advice)
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- EMSO-309 - Emergency Procedures for “Wires Down” and Reporting Low Service Lines
- ES4 - Service Provider Authorisation - Connection Policy – Connection Charges - 2014
- ES8 - Capital Contributions Guidelines
- Live Line Manual – High Voltage (and Supplementary Manual)
- Live Line Planning Check sheet
- MRPA005 - Establishment / Re-Establishment of Access Tracks
- MRPA015 - Lightning Masts in Zone and Transmission Substations – Identification, Inspection and Maintenance Requirements
- MRPA047 - Damage to Substation Buildings Associated with Network Incidents
- MRPA061 - Requirements for Equipment Trials on Ausgrid’s Network
- MRPA073 - Bushfire Risk Identification
- MRT100 Telecommunications Planned and Unplanned Outages, Faults, Damages and Emergency Response
- NE211 - Earth Resistivity Modelling
- NEG-EP01 - Guidance Notes for Maintenance, Low Impact and Emergency Access to Existing Facilities within the Railway Corridor
- NEG EP02 - Guidance Notes for Construction of New Facilities within the Railway Corridor
- NEG EP04 - Process for Acquisition of Easements in Capital Projects
- NEG EP05 - Entry to Private Property
- NEG EP06 - NRP0002 Procedure for Negotiating Mines Access
- NEG EP07 - Network Access and Security – Locks and Keys
- NEG EP11 - Management of Easement Encroachment Enquiries
- NEG NPR03 - Design and Engineering Project Brief – Cover Sheet and Instructions
- NEG NPR04 - Drawing Title Convention – WiMAX Project – Telecommunications
- NEG OH01 - Undergrounding Telecommunications Cables in Conjunction with Distribution Mains
- NEG OH06 - Load Alterations to Reinforced Poles
- NEG OH12 - Removing or Relocating Third Party Telecommunications Assets Attached to Condemned Poles
- NEG OH13 - Guide to Dealing with Requests to Underground Parts of an Overhead Sub-transmission Line
- NEG OH14 - Guide to the Assessment of Waterway Crossing Risks
- NEG OH22 - Assessment of Concrete Poles and Piles
- NEG SD04 - Information on separation between distribution earthing systems and telecommunications plant – supplementary to NS116 (Design Standards for Distribution Earthing)
- NEG SE05 - Safety Equipment – Care, Use and Inspection
- NEG SE10 - Traffic Management
- NEG SE12 - Safety Procedures for Working at Height
- NEG SE13 - Earthing Safety Compliance in Major Substations (under construction)
- NEG SE14 - Aerial Operations (under construction)
- NEG SM04 - Specification for Design and Construction of Major Substations
- NEG SM04.7 - Selection of Substation Batteries
- NEG SM04.29 - Specification for Design and Construction of Major Substations – Intertrip Batteries
- NEG SM04.30 - Maintenance of Intertrip Batteries
- NEG SM07 - Active Fire System for Substations
- NEG TC04 Bearer Availability Model
- NEG TC07 Field Commissioning Optical Services
- NEG TC08.1.1 Telecommunications Dictionary
- NEG TC16.2 Communications Commissioning Checklist
- NEG TC17 Panel and Service Naming Convention

- NEG TC19 Fibre Allocation Process
- NEG UG03 - Mains Underground – guideline to management of work in close proximity to underground power cables
- NS100 - Field Recording of Network Assets
- NS102 - Working on or near Poles with Telecommunication Transmitters
- NS104 - Specification for Electrical Network Project Design Plans
- NS128 - Pole Installation and Removal
- NS130 - Laying of Underground Cables Up to and including 11kV
- NS135 - Construction of 33kV, 66kV and 132kV Overhead Mains
- NS143 - Easements, Leases and Rights of Way
- NS146 - Inspection Procedure for Working on Poles
- NS148 - Overhead Line Support, Street Light Column, Pit and Pillar Labelling
- NS156 - Working Near or Around Underground Cables
- NS158 - Labelling of Mains and Apparatus
- NS159 - Installation of Cables or Conduits using Trenchless Techniques
- NS161 - Specification for Testing of Underground Cables
- NS162 - Installation in Ausgrid Ducts and Substations
- NS165 - Safety Requirements for Non-Electrical Work In and Around Live Substations
- NS166 –Routine Overhead Line Inspection
- NS167 - Positioning of Poles and Lighting Columns
- NS168 - Design and Construction of 33kV, 66kV and 132kV Underground Cables
- NS171 - Fire Stopping in Substations
- NS172 - Design Requirements for Cable Pits, Vaults and Bays
- NS174 - Environmental Procedures
- NS174C - Environmental Handbook for Construction and Maintenance
- NS178 - Secondary System Requirements for Major Substations
- NS181 - Approval of Materials and Equipment and Network Standard Variations
- NS185 - Major Substation Building Design Standard
- NS186 - Major Substations Civil Works Design Standard
- NS187 - Passive Fire Mitigation Design of Major Substations
- NS191 - Batteries and Battery Chargers in Major Substations
- NS194 - Embedded generation
- NS200 - Major Substations Ventilation Design Standard
- NS201 – All Dielectric Self Supporting Fibre Optic Cabling for Installation on Distribution Assets.
- NS205 - Telecommunications Route Markers
- NS208.2.2 - Telecommunications Substations Communication Cabinet Interconnectivity Design Work Instruction
- NS210 - Documentation and Reference Guide for Major Substations
- NS211 - Working With Asbestos
- NS212 - Integrated Support Requirements for Ausgrid Network Assets
- NS214 - Guide to HV Live Work Design Principles
- NS219 - Telecommunications - Telephone Allocation and Isolation
- NS220 - Overhead Design Manual
- NS222 - Major Substation Earthing Design
- NS232 - National Broadband Network Assets on Ausgrid Poles
- NS234 - Telecommunications Underground Physical Plant Installation
- NS235 - Telecommunications - Underground to Overhead (UGOH) Transition
- NS236 - Installation of Electronic Perimeter Security at Major Substations
- NS243 - Telecommunications: Roles, Responsibilities, Training Requirements, Auditing and Quality Assuarance Acceptance
- NSEC007 - Submitting Connect and Reconnect and System Alteration Orders
- Planning for Live Line Work – Protection Requirements
- Public Electrical Safety Awareness Plan
- Public Lighting Management Plan
- Tree Safety Management Plan
- TS620 - Overhead Line Work

- TS650 - Safety Equipment – Care, Use and Inspection
- TS655 - Height Safety (DRAFT)
- TS680 - Overhead Earthing and Short-Circuiting Equipment
- TS1180 - Mains Underground Cable Jointing – Control, Telephone and Pilot Cables
- TS1222 - Mains Underground – Control and Protection Straight Through Joints
- TS1612 - Overhead Line Inspection
- TS3211 - Substation Batteries – Maintenance
- TS5125 - Plant and Tools – Pipe and Cable Locators
- TS5130 - Gas Detector – Austech Models

A5 Interim Network Standard Advices (NSA)

Network Standards Advice are interim policy and technical requirements that relate to Network Standard documents. Ausgrid may release NSA documents pending formal release of a revised Network Standard document. It is the responsibility of all Network Standard readers to review the current NSA listing for any amendments to associated Network Standard documents.

The most current NSA listing is available on Ausgrid's Balin site and also Ausgrid's internet sites.

A6 Australian Standards and documents

- AS 1049 - Telecommunication cables – insulation, sheath and jacket
- AS 1324.2-1996 Air filters for use in general ventilation and airconditioning - Methods of test
- AS 1154 - Insulator and conductor fittings for overhead power lines
- AS 1170 - Structural design actions
- AS 1289.0-2014 - Method of testing soils for engineering purposes – Definitions and general requirements
- AS 1345 - Identification of the contents of pipes, conduits and ducts
- AS/NZS 1530.3 - Methods for fire tests on building materials, components and structures-Simultaneous determination of ignitability, flame propagation, heat release and smoke release
- AS 1657 - Fixed platforms, walkways, stairways and ladders – design, construction and installation
- AS/NZS 1715 - Selection, use and maintenance of respiratory protective equipment
- AS 1720 - Timber structures
- AS 1742 - Manual of uniform traffic control devices
- AS 2124 - General conditions of contract
- AS/NZS 2211 - Safety of laser products
- AS 2444 - Portable fire extinguishers and fire blankets – selection and location
- AS 2700 - Colour standards for general purpose
- AS 2834 - Computer accommodation
- AS/NZS 3000 - Electrical installations (known as the Australian/New Zealand Wiring Rules)
- AS/NZS 3500 - Plumbing and drainage
- AS/NZS CISPR 22:2002 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
- AS 3600 - Concrete structures
- AS 3610 - Formwork for concrete
- AS 3798 - Guidelines on earthworks for commercial and residential developments
- AS/NZS 3835.1-2006 - Earth potential rise – protection of telecommunications network users, personnel and plant – code of practice
- AS/NZS 3835.2-2006 - Earth potential rise – protection of telecommunications network users, personnel and plant – application guide
- AS 3996-2006 - Access covers and grates
- AS 4000-1997 - General conditions of contract for construction contracts
- AS 4122-2010 - General conditions of contract for consultants
- AS 4145.1 - Locksets and hardware for doors and windows - Glossary of terms and rating system
- AS 4198-1994 - Precast concrete access chambers for sewerage applications
- AS/NZS 4275 - Methods of testing underground marking tape

- AS 4282 - Control of the obtrusive effects of outdoor lighting
- AS 4300 - General conditions of contract for design and construct
- AS 4373 - Pruning of amenity trees
- AS/NZS 4676 - Structural design requirements for utility services poles
- AS 4902-2000 - General conditions of contract for design and construct
- AS 4910-2002 - General conditions of contract for the supply of equipment with installation
- AS 4912-2002 - General conditions for periodic supply of goods
- AS 4915-2002 - Project management – general conditions
- AS 4919-2003 - General conditions of contract for the provision of asset maintenance and services (Superintendent's version)
- AS 4920-2003 - General conditions of contract for the provision of asset maintenance and services (Principal's version)
- AS 60870.2.1-1998 - Telecontrol equipment and systems - operating conditions - power supply and electromagnetic compatibility
- AS/CA S008:2010 - Requirements for customer cabling products
- AS/CA S009:2013 - Installation requirements for customer cabling (Wiring Rules)
- AS 61010.1-2003 - Safety requirements for electrical equipment for measurement, control and laboratory use - General requirements (IEC 61010-1:2001, MOD)
- AS/NZS 1477 - PVC pipes and fittings for pressure applications
- AS/NZS 1768 - Lightning protection
- AS/NZS 1891.4 - Industrial fall-arrest systems and devices - selection, use and maintenance
- AS/NZS 2032 - Installation of PVC pipe systems
- AS/NZS 2053 - Conduits and fittings for electrical installations
- AS/NZS 2648.1 - Underground marking tape - Non-detectable tape
- AS 2865-2009 - Confined spaces
- AS/NZS 3015 -Electrical installations – extra-low voltage d.c power supplies and service earthing within public telecommunications networks
- AS/NZS 3080 - Information Technology - Generic cabling for customer premises (ISO/IEC 11801:2011, MOD)
- AS/NZS 3084:2003 – Telecommunications installations -telecommunications pathways and spaces for commercial buildings (ISO/IEC 18010:2002, MOD)
- AS/NZS 3085.1 - Telecommunications installations - administration of communications cabling systems - basic requirements
- AS/NZS 4117 - Surge protective devices for telecommunication applications
- AS/NZS 4129-2008 - Fittings for polyethylene (PE) pipes for pressure applications
- AS/NZS 4130-2003 – Polyethylene (PE) pipes for pressure applications
- AS 4586 - Slip resistance classification of new pedestrian surface materials
- AS/NZS 4911-2003 - General conditions of contract for the supply of equipment without installation
- AS/NZS/ISO 9001 - Quality management systems - Requirements
- AS/NZS ISO 14001: 2004 - Environmental management systems – Requirements with guidance for use
- AS/NZS ISO 14000 Set:2005 - Environmental management standards set
- AS/NZS ISO/IEC 27001:2006 Information technology - Security techniques - Information security management systems - Requirements
- AS/NZS/ISO 31000 - Risk management – principles and guidelines
- AS/NZS IEC 61935.1:2012 Specification for the testing of balanced and coaxial information technology cabling-Installed balanced cabling as specified in ISO/IEC 11801 and related standards (IEC 61935-1, Ed.3.0 (2009) MOD)
- AS/NZS 60950.1-2011 - Information technology equipment - Safety - General requirements (IEC 60950-1-Ed. 2.0 (2005), MOD)
- AS 60529-2004 - Degrees of protection provided by enclosures (IP code)
- AS/NZS IEC 60825 - Safety of Laser Products (series)
- AS/NZS 1660 - Test methods for electric cables, cords and conductors
- AS/NZS 3008 - Electrical installations – selection of cables
- AS 4702-2000 (R2013) - Polymeric cable protection covers
- AS/NZS 5000 - Electric cables – polymeric insulated

- AS/NZS ISO/IEC 24702 - Telecommunications installations – generic cabling – industrial premises
- AS/NZS 60065:2012 - Audio, video and similar electronic apparatus – safety requirements (IEC 60065, Ed.7.2 (2011) MOD)
- AS/NZS 61000 - Electromagnetic compatibility (EMC) (series)
- AS/NZS ISO/IEC 14763.2 - Telecommunications installations – Implementation and operation of customer premises cabling – planning and installation
- AS/NZS ISO/IEC 14763.3 - Telecommunications installations – Implementation and operation of customer premises cabling – testing of optical fibre cabling (ISO/IEC 14763-3:2011, MOD)
- AS/ANZ ISO 9000 - Quality management systems – fundamentals and vocabulary
- AUS-SPEC 1151 - Road openings and restoration
- AUS-SPEC 1152 - Road openings and restoration (utilities)
- BCA – Building Code of Australia
- ENA C(b)1-2006 - Guidelines for design and maintenance of overhead distribution and transmission lines
- ENA Doc 001-2008 - National Electricity Network Safety Code
- ENA Doc 005-2006 - Joint use of power poles-Model agreement
- ENA Doc 008-2006 - National guidelines on electrical safety for emergency service personnel
- ENA Doc 011-2006 - Pole supply and performance specification
- ENA Doc 012-2006 - Cross-arm supply and performance specification
- ENA Doc 015-2006 - National guidelines for prevention of unauthorised access to electricity infrastructure
- ENA Doc 016-2006 - Guideline for the Management of Risks When Working Alone
- ENA Doc 019-2014 - Land Management Guidelines
- ENA EG1-2006 - Substation Earthing Guide
- ENA NENS 03-2006 - National guidelines for safe access to electrical and mechanical apparatus
- ENA NENS 04-2006 - National guidelines for safe approach distances to electrical and mechanical apparatus
- ENA NENS 05-2006 - National Fall Protection Guidelines for the Electricity Industry
- ENA NENS 08-2006 - National Guidelines for Aerial Surveillance of Overhead Electricity Networks
- ENA NENS 09-2006 - National Guidelines for the Selection, Use and Maintenance of Personal Protective Equipment for Electrical Hazards
- ENA NENS 10-2005 - National Guidelines for Contractor Occupational Health and Safety Management
- G591-2006 Communications Alliance - Telecommunications in Road Reserves – Operational Guidelines for Installations
- HB 101 (CJC 5) - Coordination of power and telecommunications – Low Frequency Induction (LFI): Code of practice for the mitigation of hazardous voltages induced into telecommunications lines
- HB231 - Information Security – Risk Management Guidelines
- HB240 - Guidelines for Managing Risk in Outsourcing
- ISO/IEC 11801:2002 - Information Technology – Generic Cabling for customer premises
- ISSC 3 – Guide to Tree Planting and Maintaining Safety Clearances Near Power Lines.
- ISSC 14 – Guide to Electrical Workers' Safety Equipment
- ISSC 29 - Guideline for Pre-Climbing and Climbing Assessment of Poles
- ISSC 32 - Guide for Network Operators to Provide Information to the Construction Industry for Working Near Overhead Power Lines
- ISSC 34 - Guide for Height Safety within the NSW Electricity Industry
- NER - National Electricity Rules
- Service and Installation Rules for NSW August 2012
- Street Opening Conference - Guide to Codes and Practices for Street Opening
- WHS - Confined Spaces: Code of Practice
- WHS - Electrical Hazard Awareness for Operators of High Machinery
- WHS - Elevating Work Platforms – National Certificate of Competency
- WHS - Excavation: Code of Practice
- WHS - Hazardous Manual Tasks: Code of Practice

- WHS - How to Manage Work Health and Safety Risks: Code of Practice
- WHS - Managing the Risk of Falls at Workplaces: Code of Practice
- WHS - Managing the Work Environment and Facilities
- WHS - Manual Handling Resource
- WHS - Moving Plant on Construction Sites: Code of Practice
- WHS - Moving Plant on Construction Sites: Safety Guide
- WHS - Safe Working at Heights: Guide
- WHS - Work Health and Safety Consultation, Coordination and Cooperation
- WHS - Work Near Overhead Power Lines: Code of Practice
- WHS - Work Near Underground Assets: Guide
- Work Cover documentation, rules and codes of practice

Note: The department of Resources Energy and Tourism has commissioned Standards Australia to initiate the delivery of a Smart Grid Standards Roadmap. Ausgrid's employment of Smart Grid technology had ceased at the time this standard was written.

A7 International Standards

- TIA-598-D (July 2014) - Colour Coding for Fibre Optical Fibre Cables Coding
- BS EN 713:1995 - Plastics Piping Systems – Mechanical Joints Between Fittings and Polyolefin Pressure Pipes – Test method for leaktightness under internal pressure of assemblies subjected to bending (also known as I.S. EN 713:1994, and DIN EN 713 (1994-03), and UNE EN 713:1994)
- I.S. EN 41003:2008 - Particular Safety Requirements for Equipment to be Connected to Telecommunication Networks and / or a Cable Distribution System
- I.S. EN 50173-1:2001 - Information Technology – Generic Cabling Systems (series)
- I.S. EN 50178:1998 - Electronic Equipment For Use in Power Installations
- EN/IEC 60794 - Optical Fibre Cables – Generic Specification
- EN/IEC 61969 - Mechanical Structures for Electronic Equipment – Outdoor Enclosures
- I.S. EN 50102 - Degrees of Protection Provided By Enclosures For Electrical Equipment Against External Mechanical Impacts (ik Code)
- IEC 60134 Ed. 1.0: - Rating Systems for Electronic Tubes and Valves and Analogous Semiconductor Devices
- IEC 60255-1 Ed. 1.0: - Measuring Relays and Protection Equipment (series)
- IEC 60297 --3-100 Ed, 1.0: Mechanical Structures for Electronic Equipment – Dimensions of Mechanical Structures of the 482,6 mm (19in) series (series)
- IEC60331-1 Ed. 1.0: - Tests for Electric Cables Under Fire Conditions – Circuit Integrity (series)
- IEC60332-1-1 Ed. 1.0: - - Tests on Electric and Optical Fibre Cables Under Fire Conditions (series)
- IEC60529 Ed. 2.2: Degrees of protection provided by enclosures (IP code)
- IEC60754-1 Ed. 3.0: - Tests of Gases Evolved During Combustion of Materials From Cables (series)
- IEC60793-1-1 Ed. 3.0: Optical Fibres - Part 1-1: Measurement Methods and Test Procedures – General and guidance
- IEC61034-1 Ed. 3.1 - Measurement of Smoke Density of Cables Burning Under Defined Conditions (series)
- IEC 61280-1-1 Ed. 2.0: - Fibre Optic Communication Subsystem Basic Test Procedures (series)
- IEC/TR 61282-10 Ed. 1.0: - Fibre Optic Communication System Design Guides (series)
- IEC 61284 Ed. 2.0 - Overhead Lines – Requirements and Tests for Fittings
- IEC 61300-1 Ed. 3.0: - Fibre Optic Interconnecting Devices and Passive Components – Basic Test and Measurement Procedures (series)
- IEC 61326-1 Ed. 2.0: - Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements (series)
- IEC 61850 -3 Ed. 1.0 (Bilingual 2002) - Communication networks and systems in substations - general requirements
- EN/IEC 61969-1 Ed. 2.0: Mechanical Structures for Electronic Equipment – Outdoor Enclosures (series)

- IEC/TR 62263 Ed. 1.0 Live working – Guidelines for the installation and maintenance of optical fibre cables on overhead power lines
- IEC 62305-1 Ed. 2.0: - Protection Against Lightning
- IEC/TS 62610-1 Ed. 1.0: - Mechanical Structures for Electronic Equipment – Thermal Management for Cabinets in Accordance with IEC 60297 and IEC 60917 (series)
- IEC 62843 Ed. 1.0: - Standard for N Times 64 Kilobit Per Second Optical Fibre Interfaces Between Teleprotection and Multiplexer Equipment (formerly IEEE C37.94-2002)
- IEEE 524 - Guide to the Installation of Overhead Transmission Line Conductors
- IEEE 8802-3-201412 – International Standard for Ethernet
- IEEE1138 - Testing and Performance for Optical Ground Wire (OPGW) for Use on Electric Utility Power Lines
- IEEE SA 1222 - Standard for Testing and Performance for All-Dielectric Self-Supporting (ADSS) Fibre Optic Cable for Use on Electric Utility Power Lines
- ISO 3008 - Fire Resistance Tests – Door and Shutter Assemblies
- ITU-T G.651 - Characteristics of a 50/125 µm Multimode Graded Index Optical Fibre Cable
- ITU-T G.652 - Characteristics of a Single Mode Optical Fibre and Cable
- ITU-T G.653 - Characteristics of a Dispersion-Shifted Single-Mode Optical Fibre and Cable
- ITU-T G.654 - Characteristics of a Cut-Off Shifted Single-Mode Optical Fibre Cable
- ITU-T G.655 - Characteristics of a Non-Zero Dispersion Shifted Single-Mode Optical Fibre Cable
- ITU-T G.656 - Characteristics of a Fibre and Cable with Non-Zero Dispersion for Wideband Optical Transport
- ITU G.703 - Physical / Electrical Characteristics of Hierarchical Digital Interfaces
- ITU G.704 - Synchronous Frame Structures used at 1544, 6312, 2048, 8448 and 44 736 Kbit/s Hierarchical Levels
- SR OHSAS 18001:2007 - Occupational Health and Safety Management Systems - Requirements
- TIA/EIA-606-A - Administration Standard for the Telecommunication Infrastructure of Commercial Buildings

A8 Useful web sites

- AGL - http://www.agl.com.au/
- Ausgrid - http://www.ausgrid.com.au./
- Australian Bureau of Statistics - http://www.abs.gov.au/
- Australian Conservation Foundation - http://www.acfonline.org.au/
- Australian Heritage Council - http://www.environment.gov.au/heritage/ahc/index.html
- Australian Resuscitation Council - http://www.resus.org.au/
- Australian Standards online - http://balin/Techpub/useful/Australian%20Standards%20Online.htm
- Energy Networks Association (ENA) homepage - http://www.ena.asn.au/
- Department of Urban Affairs and Planning - http://www.planning.nsw.gov.au/
- Department of Natural Resources - http://www.environment.nsw.gov.au/dnr/
- Environmental Protection Authority - http://www.epa.nsw.gov.au/
- Environmental Legislation site - http://www.austlii.edu.au/databases.html
- Environment Australia Online - http://www.erin.gov.au/
- ENA (Energy Networks Association) EMF site - http://www.ena.asn.au/?page_id=7111
- Heritage Council - http://www.heritage.nsw.gov.au/
- Landcare Australia - http://www.landcareonline.com/National Environment Protection Council - http://www.nepc.gov.au/
- National Parks and Wildlife Service - http://www.npws.nsw.gov.au/
- Nature Conservation Council - http://www.nccnsw.org.au/
- NSW Government – Trade and Investment – Energy - http://www.industry.nsw.gov.au/energy
- NSW Government – Department of Water and Energy - http://www.water.nsw.gov.au/Department-of-Water-and-Energy/dwe/default.aspx
- NSW Land and Environment Court - http://www.lawlink.nsw.gov.au/lec

- NSW Local Government Directory - http://www.dlg.nsw.gov.au/dlg/dlghome/dlg_LocalGovDirectory.asp?index=1
- Polywater Pull Planner - Hauling Calculator - http://www.polywater.com/pullplan.html
- Roads and Maritime Services – NSW (formerly RTA) - http://www.rta.nsw.gov.au/
- Safe work Australia - http://safeworkaustralia.gov.au/
- SAI Global – Standards, Handbooks and Publications - http://www.saiglobal.com/search-publications/
- SDS Database - http://dc1wp11957:8000/chemalert
- SDS Database user guide - http://balin/Techpub/MSDS/User%20Manual.pdf
- Standards Australia - http://www.standards.com.au/
- State Forests of NSW - http://www.forest.nsw.gov.au/Street Openings Conference - http://www.streetsopening.com.au/
- Sydney Water - http://www.sydneywater.com.au/
- TransGrid - http://www.transgrid.com.au/
- Weather Bureau - http://www.bom.gov.au/
- Work Cover - http://www.workcover.nsw.gov.au/