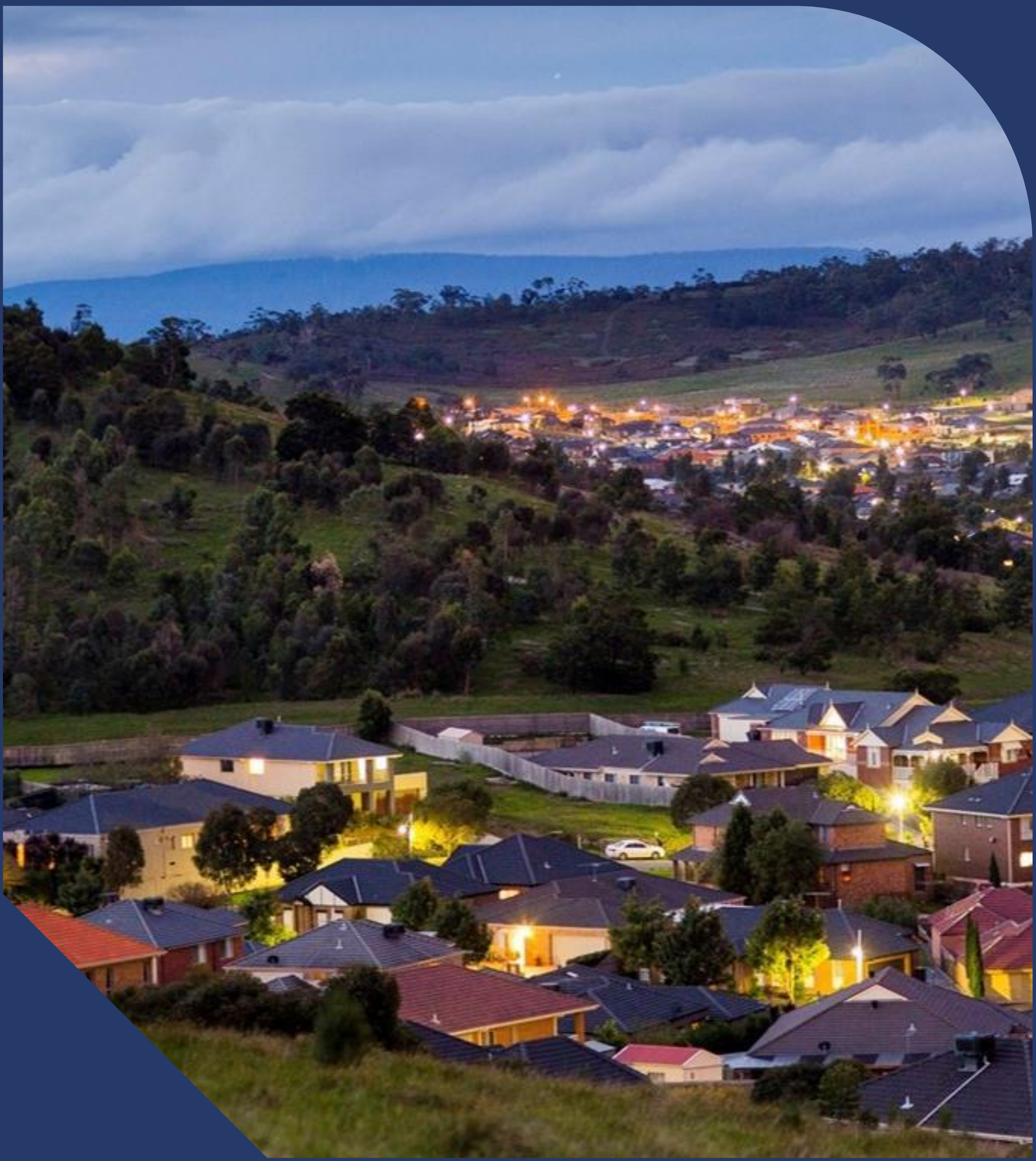
Communication Systems

AMS – Electricity Distribution Network



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Document number:	AMS 20-81
Issue number:	10
Status:	Approved
Approver:	Denis McCrohan
Date of approval:	<insert date published on ECM>

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1. Executive Summary

The AusNet electricity distribution network covers over 80,000km^2 in eastern Victoria and serves more than 800,000 customers. There are 101 locations (15 radio sites, 71 zone substations and 15 terminal stations) with distribution communications assets. The electrical distribution network employs communications systems primarily for protection signalling, Supervisory Control and Data Acquisition (SCADA), operational voice communications, and operational data communication.

The distribution communications network has grown significantly over the last 15 years as part of communications network expansion program into distribution sites. It is expected the communications network will continue to grow in the next five years to support the energy transition. Radio communication links and optical fibre cables are in relatively heathy condition, whereas asset replacements will be required for systems which use time division multiplexing (TDM) technology like Plesiochronous Digital Hierarchy (PDH) and Synchronous Digital Hierarchy (SDH).

The availability of communication assets is evaluated based on current utilisation, historical failure events, vendor support, and availability of spare parts. Lack of vendor support and shortage of spare parts for legacy systems has played an important role in assessing the level of risk to business continuity.

This Asset Management Strategy (AMS) outlines various communications related technologies, their condition and the strategies aimed at enhancing the reliability of the electricity distribution network and supporting Information Technology (IT) systems to efficiently deliver existing and future communication services.

The Communication Technologies used for the Metering network are excluded from this AMS document and can be found in AMS 21–04 Electricity Distribution Metering – Telecommunications Infrastructure.

1.1. New Assets

Time Division Multiplexing (TDM) systems and the third-party 3G/4G networks are classified legacy technologies and will be replaced by packet-based systems and 5G/6G systems respectively. In addition, as the third-party wireless network expands, the point-to-multipoint radio modems used for the internal radio network will be replaced by third-party network modems.

New or upgraded 66KV and 22KV overhead lines being built that include an aerial earth will be scoped with an Optical Ground Wire (OPGW) option.

1.2. Inspections and Monitoring

Update PGI 02-01-04 to be consistent with Risk-based analysis outcomes.

1.3. Maintenance Planning

Update PGI 02-01-04 to be consistent with Risk-based analysis outcomes. Decommissioned assets will be maintained in working condition as spares.

1.4. Renewals Planning

Asset renewals and replacement will be based on results of risk-based evaluation and analysis and in accordance with current standard.

2. Introduction

2.1. Purpose

The purpose of this document is to outline the inspection, maintenance, replacement and monitoring activities identified for life cycle management of communication systems in the AusNet Victorian electricity distribution network. This document intends to be used to inform asset management decisions and communicate the basis for the activities.

The document forms part of the Asset Management System suite of documents needed to satisfy compliance with relevant standards and regulatory requirements. The document demonstrates responsible asset management practices by outlining economically justified outcomes for the Communication systems in the AusNet Electricity Distribution Network

2.2. Scope

The following communication systems are included in this document:

- Communications Bearers: Optic Fibre cables (OFC) and Point-to-Point (PTP) radio systems
- Network Technologies: Tele-protection systems (TPS), Plesiochronous Digital Hierarchy (PDH), Synchronous Digital Hierarchy (SDH), Wave Division Multiplex (WDM), and Multiprotocol Label Switching (MPLS)
- Wireless Access Technologies: Fourth and Fifth Generation (4G/5G) and Point-to-Multipoint (PTMP) radio system
- Telephony Technologies: Operational Telephony Systems, Trunk Mobile Radio (TMR)

The following assets are covered in other AMS documents

- Buildings and air conditioners AMS 20-55
- Station Direct Current (DC) Power supplies (Batteries, chargers) AMS 20-80
- Communication towers AMS 20-64
- Business Telephone Systems, Public Carrier and Other Telephony, Network Management Systems (NMS) (Digital Submission)

2.3. Asset Management Objectives

The high-level asset management objectives are outlined in AMS 01-01 Asset Management System Overview and the Electricity Distribution Network Objectives are stated in AMS 20-01 Electricity Distribution Network Asset Management Strategy.

3. Abbreviations and definitions

TERM	DEFINITION
ACMA	Australian Communications and Media Authority
ADG	Asset Data Gathering
ADSS	All Dielectric Self Supporting
AEMO	Australian Energy Market Operator
AMI	Advance Metering Infrastructure
AMS	Asset Management Strategy
BMS	Building Management Systems
CEOT	Customer and Energy Operations Team
CWDM	Coarse Wave Division Multiplexing
DCS	Distributed Control Systems
DWDM	Dense Wave Division Multiplexing
EDAMS	Electricity Distribution Metering Asset Management Strategy
EMS	Energy Management Systems
HMI	Human Machine Interface
HV	High Voltage
ICS	Industrial Control Systems
ICT	Information Communication Technology
IED	Intelligent Electronic Device
IoC	Identifiers of Compromise
IPVPN	Internet Protocol Virtual Private Network
LTE	Long Term Evaluation
MPLS	Multi-Protocol Label Switching
NAC	Network Access Control
NBN	National Broadband Network
NOC	Network Operations Centre
ODN	Operational Data Network
OMN	Operational Management Network
OPGW	Optical Fibre in Ground Wire
OSS	Operational Support Systems
OTN	Operational Telephony Network
PCS	Process Control Systems
PDH	Plesiochronous Digital Hierarchy

POTS	Plain Old Telephone System
PSTN	Public Switching Telephony Network
PTMP	Point-to-Multipoint
PTP	Point-to-Point
QoS	Quality of Service
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SDH	Synchronous Digital Hierarchy
SIEM	Security Information and Event Management
SIS	Safety Instrumentation Systems
TDM	Time Division Multiplexing
TMR	Trunk Mobile Radio
TRIO	Point-to-multipoint RF wireless network
TS	Terminal Station
U/G	Under Ground
VLAN	Virtual Local Area Network
VoIP	Voice Over Internet Protocol
VPN	Virtual Private Network
VRLA	Valve Regulated Lead Acid
VSWR	Voltage Standing Wave Ratio
WDM	Wavelength Division Multiplexing
ZSS	Zone Substation

4. Asset Description

4.1. Function

The AusNet communications network enables the transfer of information between various electricity network operating systems, applications and devices. The information can be classified in one of the following categories: signalling, data, commands, and voice.

Protection devices use signalling to constantly exchange information over a communication channel. In the event of a network incident, messages are exchanged between the protection devices so that the appropriate devices operate to protect equipment and minimise the risk of injury.

Field devices, which include Remote Terminal Units (RTUs), line monitoring devices, control boxes and smart meters, send electricity network data to the Supervisory Control and Data Acquisition (SCADA) master or other master server and receive commands from the SCADA master to reconfigure the electricity network through communication channels.

The telephony system provides voice channels which enable operational teams to talk during periods of emergency or planned network maintenance work and allows customers to contact AusNet to report faults or emergencies.

Through communication systems, engineers and field teams can remotely access field devices and diagnose network failures or get access to network databases that are used to maintain the network and avoid multiple trips between the Zone Substation (ZSS) and depots or offices.

The communication network is divided into three main functions: communication transmission, communication transport, and communication network access. Communication transmission provides the physical interconnection between communicating sites, communication transport aggregates multiple messages and interfaces with the physical transmission systems. The network access function provides the interfaces for the clients (users) to connect to the communication network.

4.2. Population

4.2.1. Population Considerations

The population profile for communication systems includes information on the quantity, types, locations, and specifications of these assets within the electrical distribution network.

A comprehensive understanding of the population profile allows asset managers to:

- **Identify critical assets:** Determine which communication systems are essential for maintaining the integrity and reliability of the network. For example, a particular optic fibre cable serving a critical substation might be deemed essential and require more frequent inspections to ensure uninterrupted service.
- **Allocate resources efficiently:** Plan and allocate maintenance resources effectively by knowing the exact number and location of assets. For instance, knowing that a certain region has a high concentration of point-to-point radio systems can help in scheduling maintenance activities more efficiently.
- **Risk management:** Assess and manage risks associated with different assets. For example, if the population profile indicates that certain sections of the communication network are in flood-prone areas, additional protective measures can be implemented in those areas.
- **Optimise maintenance schedules:** Develop optimised maintenance schedules based on the distribution and condition of assets. For instance, communication bearers that form the backbone of the network might be scheduled for more frequent inspections and maintenance to prevent any potential failures.
- **Enhance reliability and safety:** Ensure that all components, including optic fibre cables and network technologies, meet the required standards for reliability and safety. For example, if the profile reveals that certain radio systems have outdated components that no longer meet safety standards, these can be prioritised for replacement.
- **Support strategic planning:** Inform long-term strategic planning and investment decisions. For instance, the population profile might show that the electricity network is expanding to areas previously not

developed would mean the communication systems may need upgrading to support the expanding network, guiding future investment in that region.

4.2.2. Geographic Impact Areas

The AusNet electrical distribution network covers a significant portion of Victoria, including Melbourne's northern and eastern suburbs, and extends across eastern and north-eastern Victoria. This region encompasses a diverse range of geographic locations, each with specific environmental impacts on communication systems. Understanding these impacts is essential for effective asset management within the AusNet electrical distribution network.

Notable examples include:

- **High Wind Areas:** High wind areas, particularly in elevated regions and open plains, can subject communication infrastructure to significant stress and fatigue. Wireless technologies, such as point-to-point radio systems and antennas, are particularly susceptible to wind-related issues. Example: The structural integrity of antennas and wireless base stations in the elevated regions of the Dandenong Ranges must be robust enough to withstand high wind speeds, ensuring they remain securely in place and do not fail under stress. High winds can cause misalignment of radio links, resulting in communication disruptions.
- **Corrosive Areas:** Coastal areas and industrial regions where salt and pollutants are prevalent can cause corrosion of metallic components in communication systems. Example: Regular maintenance and the use of corrosion-resistant materials are crucial to prolong the lifespan of these assets. Communication systems in coastal towns like Wonthaggi require regular inspections and maintenance to mitigate the effects of salt-induced corrosion on antennas, outdoor enclosures, and other exposed components.
- **Bushfire Areas:** Bushfire-prone areas, common in many parts of Victoria, pose a risk of fire damage to communication infrastructure. Example: Fire-resistant materials and strategic vegetation management around installations are essential for reducing this risk. In the bushfire-prone regions of the Yarra Valley, communication systems must be designed to withstand high temperatures, and installations must be cleared of nearby vegetation to prevent fire spread. Additionally, ensuring that communication equipment enclosures are fire-resistant can help protect the systems during bushfires.
- **Flood-Prone Areas:** Areas prone to flooding can impact the performance and integrity of underground communication systems. Example: Proper waterproofing and drainage systems are essential to protect these assets. In regions like Gippsland, where flooding is more frequent, underground communication cables and enclosures must be installed with robust waterproofing measures to prevent water ingress and subsequent failures. Elevated installations for above-ground equipment can also mitigate flood risks.
- **Seismic Zones:** Though less common, areas with potential seismic activity may require communication systems to be constructed with flexibility and resilience to absorb and dissipate seismic forces, reducing the risk of structural failure. Example: In areas near fault lines, communication systems may need to incorporate seismic-resistant features to ensure stability during earth tremors. This includes flexible mounting systems for antennas and shock-absorbing installations for sensitive electronic equipment.

4.2.3. Population by Type

4.2.3.1. Communications Bearers:

Optical Fibre Cables

- **Summary Explanation of Form and Function:** Optical fibre cables consist of thin strands of glass or plastic that transmit data as light signals. They can transmit high-speed, large bandwidth data over long distances with minimal signal loss.
- **Purpose within the Asset Class:** Optical fibre cables serve as the physical medium for data transmission within the communication network.
- **Purpose within the Network Design:** They ensure high-speed, high-capacity data transfer between substations and control centres, supporting critical applications such as SCADA, power system protection, and operational telephony.
- **Process Function:** They transmit light injected by the transmitter to the receiver at the remote end within a minimum acceptable loss

Point-to-Point Radio Systems

- **Summary Explanation of Form and Function:** Point-to-point radio systems use electromagnetic waves to establish direct communication links between two fixed locations
- **Purpose within the Asset Class:** These systems serve as the physical medium for data transmission within the communication network.
- **Purpose within the Network Design:** They ensure connectivity between remote sites and control centres, supporting the transmission of SCADA data, tele-protection signals, and other operational communications. They provide an alternative communication medium where laying physical cables is impractical or too costly or can be used as a redundant path
- **Process Function:** They transmit data using electromagnetic waves, requiring line-of-sight between the transmitter and receiver.

4.2.3.2. Network Technologies:

Operational Data Network (ODN)

- **Summary Explanation of Form and Function:** The ODN provides services that support power system protection, SCADA, and operational telephony traffic.
- **Purpose within the Asset Class:** This network serves as the transport and access network for client services
- **Purpose within the Network Design:** The network ensures deterministic or near deterministic delivery of information for operational purposes.
- **Process Function:** It multiplexes multiple data streams into a single channel at the transmitting end and demultiplexes them at the receiving end

Operational Management Network (OMN)

- **Summary Explanation of Form and Function:** The OMN uses packet-switched technology to provide remote management access to various power network devices.
- **Purpose within the Asset Class:** Serves as the access network for client services.
- **Purpose within the Network Design:** It supports the communication of management data, allowing for remote configuration, monitoring, and troubleshooting
- **Process Function:** It routes data packets across the network, ensuring secure transmission and reception.

Corporate Network

- **Summary Explanation of Form and Function:** The Corporate Network supports business operations, providing data connectivity for corporate applications and administrative tasks.
- **Purpose within the Asset Class:** It enables seamless communication and data exchange for non-operational business activities.
- **Purpose within the Network Design:** It provides the infrastructure for business applications, email, internet access, and other corporate services.
- **Process Function:** It connects various office locations and provides secure access to corporate resources and applications.

4.2.3.3. Wireless Access Technologies:

Base Stations

- **Summary Explanation of Form and Function:** Base stations are fixed communication points that facilitate wireless communication by connecting wireless devices to the communication network.

- **Purpose within the Asset Class:** They enable wireless communication for various operational applications.
- **Purpose within the Network Design:** They provide the infrastructure for wireless connectivity, ensuring reliable communication with remote devices and field teams.
- **Process Function:** They transmit and receive radio signals, converting them to and from digital data.

Point-to-Multipoint radio Modems

- **Summary Explanation of Form and Function:** Point-to-Multipoint (PTMP) radio modems provide the connectivity for telemetry and control capabilities of remote devices.
- **Purpose within the Asset Class:** They provide the interface for the clients to access the communication network.
- **Purpose within the Network Design:** They provide the communication link for pole-top devices or ZSS, ensuring real-time data transmission.
- **Process Function:** They transmit data wirelessly to and from pole-top devices to the PTMP base stations

Third Party Network Modems

- **Summary Explanation of Form and Function:** Third-party network modems provide connectivity of telemetry and control capabilities of remote devices
- **Purpose within the Asset Class:** They provide the interface for the clients to access the communication network.
- **Purpose within the Network Design:** They provide a flexible and cost-effective solution for wireless communication.
- **Process Function:** They connect to the third-party mobile network, transmitting and receiving data wirelessly.

4.2.3.4. Telephony Technologies:

PABX Systems

- **Summary Explanation of Form and Function:** Private Automatic Branch Exchange (PABX) systems are telephony systems that manage incoming and outgoing calls within a station or office.
- **Purpose within the Asset Class:** They facilitate internal and external voice communication for operational staff.
- **Purpose within the Network Design:** They provide reliable telephony services, connecting the CEOT to other controlling authorities and field teams.
- **Process Function:** They route and manage calls, ensuring clear and reliable voice communication.

4.2.4. Detailed Asset Type Description

4.2.4.1. Communications Bearers

Communication bearers provide the interconnectivity medium from one physical location to another. The bearers used in AusNet include optical fibre cables, point-to-point radio, and some third-party services such as Broadband Digital Subscriber Line (BDSL).

Optical fibre cables provide the best reliability, the greatest data throughput per dollar and has a comparatively long-life expectancy. Optical fibre is the preferred bearer but, if not economic and the terrain can support line-of-sight media, point-to-point radio links are deployed as bearer links. Third party services are used where neither optical fibre nor private radio is economic to employ.

4.2.4.2. Network Technologies

Network technologies enable communications services and applications to access the communications bearers. There are three networks classified as: Operational Data Network (ODN), Operational Management Network (OMN), and Corporate Network

Operational Data Network (ODN)

The ODN carries power system protection data, SCADA, and Operational telephony traffic for zone substations. Plesiochronous Digital Hierarchy (PDH) and tele-protection (TPS) provide interfaces to access the network, and Synchronous Digital Hierarchy (SDH) aggregates and acts as the transport network. Wavelength Division Multiplexing (WDM) equipment augments the transport network to either extend the geographical distance between the SDH nodes or address fibre capacity limitations. Multiprotocol Label Switching (MPLS) is being introduced at both the access and transport layers to TDM technologies.

Operational Management Network (OMN)

The OMN provides access for remote management of various power network devices and carries sensitive information about power network management settings. This network is based on packet switched technology consisting of switches and multiservice devices (including routers).

Corporate Network

The Corporate network provides services for offices and depots. The systems used in this network consist of switches, routers, and modems

4.2.4.3. Wireless Access Technology

Wireless communication services enable end devices to access the communication network. The wireless platforms predominantly provide communications services to SCADA and remote engineering access. This service is currently provided by the AusNet owned PTMP radio network and third-party wireless mobile network.

4.2.4.4. Telephony Technologies

AusNet relies on telephony for voice communication between operational staff to operate and maintain the electricity network. The operational telephone system is a combination of AusNet owned systems, and third-party provided services. The third-party networks include TMR and satellite handsets. In combination, the system provides reliable telephony capability to operational sites independent of public telephony systems.

The internal systems provide facilities to connect the CEOT to other controlling authorities and an interface to the public carrier networks. Satellite phones are used when other conventional methods are not available and the TMR system is used by field staff for voice communication in areas where the public telephone network is poor.

4.2.4.5. Supporting Infrastructure

Supporting infrastructure consists of assets that are auxiliary to communication systems, and do not actively carry or transport communications traffic themselves. These include towers, site buildings, fencing, security systems, power supplies, and air conditioners.

These asset classes are covered in other AMS documents

4.2.4.6. Operational Support Systems

Operational support systems are used as diagnostic and remote management software tools. These systems are vendor specific and may include element management systems for WDM, SDH, PDH and PTMP. An overarching software application [CIC] is used to view the various element managers.

4.2.4.7. Security Systems and Services

Various cyber security mechanisms are used to secure the communications network infrastructure to minimise the risk of potential cyber-attacks. The mechanisms used include securing and segmenting network traffic, traffic encryption, network monitoring, and authenticating, authorising and accounting for remote user access to critical systems.

The Cyber security is covered in other documents prepared by the Digital Division.

4.2.5. Population Profile

The AusNet electricity distribution network has communication assets at approximately 2,332 geographical locations (zone substations, Control Centres, data centres, administrative offices and Pole top locations) as shown in Table 1.

Table 1 Location of Communication Assets

Communication Asset Locations	Sites
Zone Substations	71
Radio Sites	20
Terminal Stations	15
Data Centers	2
Office/Depots	36
Pole Top Locations	2,984
Total Communication Sites	**3,128**

The list of assets for system types is provided in the tables below

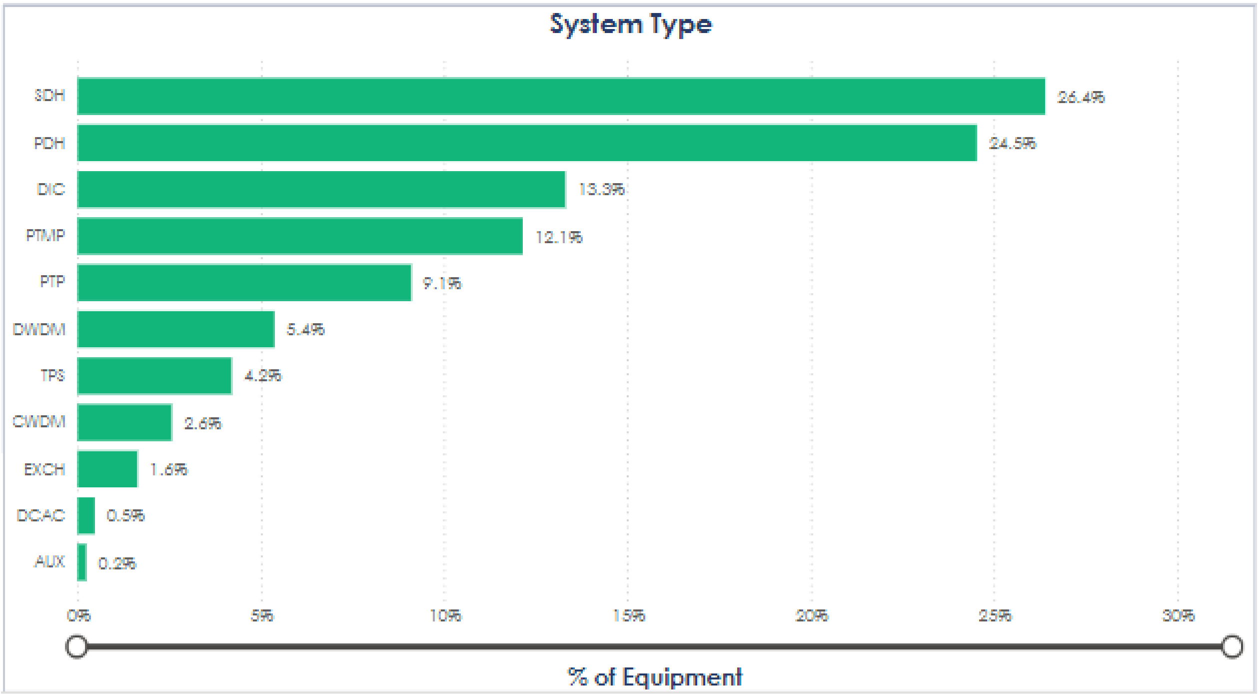

Figure 1: System Types

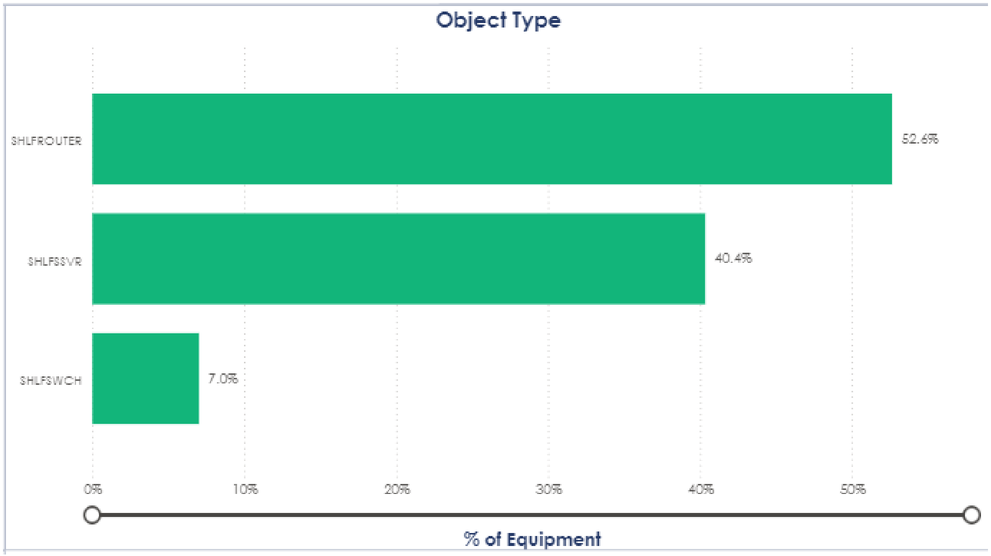

Figure 2: DIC Subsystems

Table 2: Optical Fibre and Antennas

Asset Type	Type/Make	Length/Quantity
Optical Fiber Cable	OPGW (3 routes)	100km
	ADSS (160 routes)	620km
	Underground	15km
Antennae		38

Table 3: Remote Modems

System	Total Quantity
PTMP radio Modems on Pole Tops	180
PTMP radio Modems at ZSS	9
Third Party network Modems	2014
TOTAL	2203

4.3. Age Profile

4.3.1. Age Considerations

Understanding the age profile of communication systems is essential for effective asset management and lifecycle planning. Knowing the age distribution of these assets helps in predicting their remaining useful life and planning maintenance, upgrades, or replacements accordingly.

- **Optical Fibre Cables:** The age profile of optical fibre cables can indicate potential issues related to fibre attenuation and connector degradation. Older cables may require more frequent inspections and condition assessments to ensure they continue to operate safely and efficiently.
- **Point-to-Point Radio Systems:** Over time, point-to-point radio systems can experience component wear and frequency drift. By analysing the age profile, asset managers can identify systems that are at higher risk of failure and prioritise them for maintenance or replacement.

- **Network Technologies:** The age profile of ODN systems can reveal areas where technology upgrades may be needed to maintain reliability and performance. PDH and SDH systems are classified legacy technologies and should be replaced
- **PTMP Base Stations:** The age profile of base stations can reveal potential issues with power supplies and antenna wear. Regular inspections based on age-related data ensure these systems remain functional.
- **PTMP Radio Modems:** Remote PTMP radio modems depend on the existence of the base station. As the base stations become obsolete, the modems may need to be replaced
- **Third-party Modems:** With the ongoing evolution of mobile network technologies, older modems may need replacement to support newer standards.
- **Antennas:** The age profile of antennas can indicate potential issues with wear and weathering. Regular maintenance based on age ensures they continue to operate effectively.
- **PABX Systems:** The age profile of PABX systems can reveal areas where technology upgrades are necessary to maintain telephony services.

Targeted Activities (Age)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Legacy TDM technologies to be replaced
02	

4.3.2. Age Profile

Figure 3 below shows the age distribution of communication assets, around 90% of the equipment are in the 11-20year band.

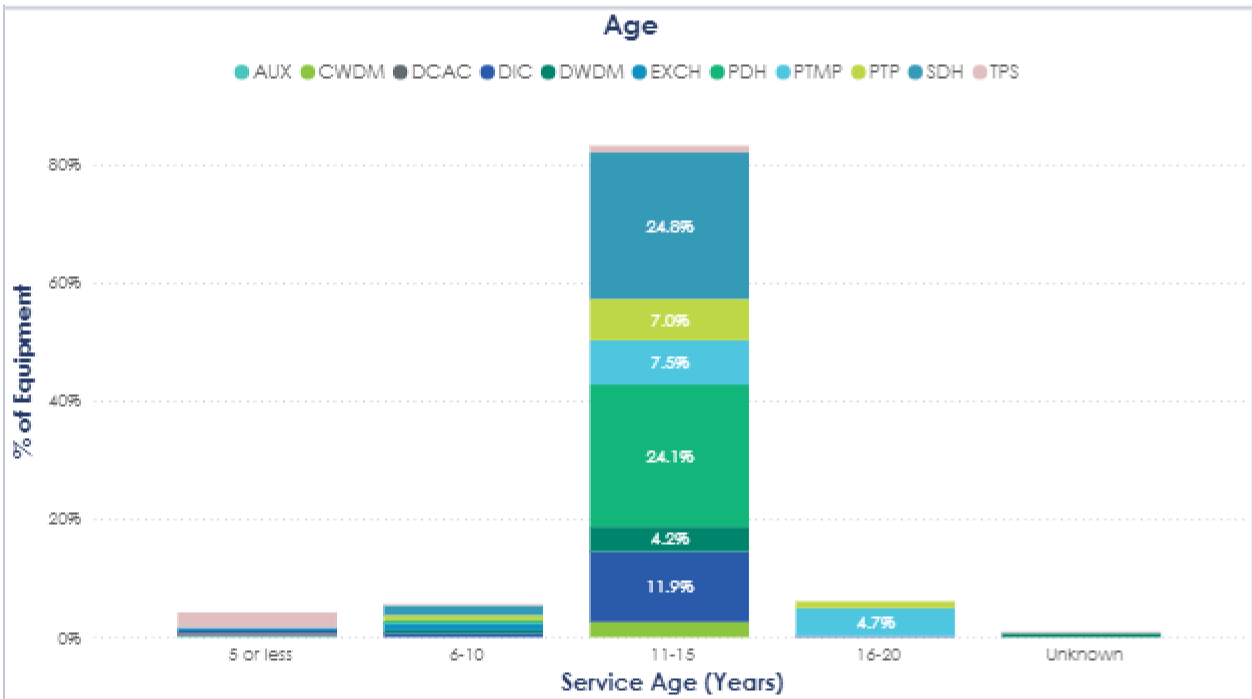

Figure 3: Age Profile of System Types

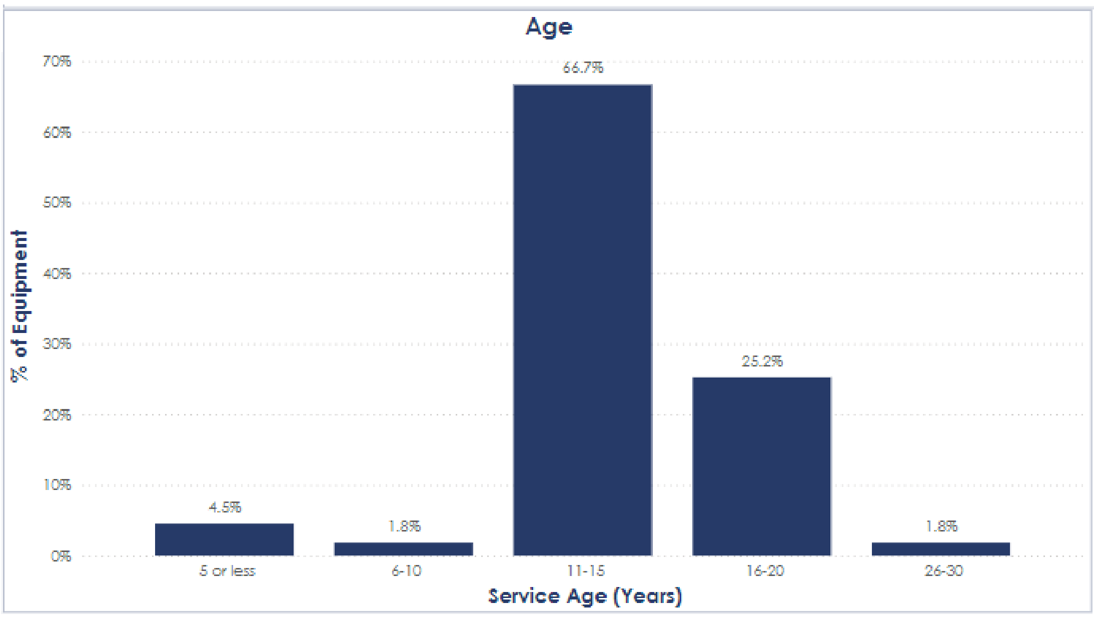

Figure 4: Age Profile of Optical Fibre

5. Asset Risk

AusNet maintains a risk management system designed in accordance with AS ISO 31000 Risk Management – Guidelines to ensure risks are effectively managed to provide greater certainty for the owners, employees, customers, suppliers, and the communities in which we operate.

The risk of each asset is calculated as the product of probably of failure (PoF) of the asset and the consequence of failure (CoF) of the asset. The risk is then extrapolated into the future as the PoF and CoF are forecast to change.

In the distribution network, AusNet aims to maintain risk. Risk mitigation activities required to achieve this over time include replacement, refurbishment and maintenance activities which are developed based on current risk and extrapolated risk.

The approach and detailed methodology of the risk assessment process are described in AMS -01-09. Section 5.1, 5.2 and 5.3 in the document describe the considerations and methodologies to determine PoF, Cof, and the risk mitigation measures that are unique to Communication assets.

5.1. Probability of Failure

There are four categories taken into consideration when determining the likelihood of a functional failure of an asset: asset service life, asset utilisation/duty factor, location, and the measured or observed physical condition of the asset. The four categories are assessed using machine learning or health scores to calculate the probability of failure or the remaining useful life of the asset.

The physical condition of an asset is the single most important category in predicting likelihood of failure. Using FMEA/FMECA techniques, dominant failure modes are identified, and this guides the determination of which measurements or observations are to be taken for monitoring the condition of the asset.

5.1.1. Failure Modes

5.1.1.1. Application of Failure Modes

Failure mode is the way in which an asset might fail. By identifying and analysing the various ways in which an asset can fail, including the mechanisms of failure, asset managers can better predict and mitigate the probability of failure. This understanding allows for a more accurate definition of maintenance tasks and measurements to be taken.

5.1.1.2. Failure Modes by Asset Class

Assessing failure modes and utilising the detailed information about each mode plays a crucial role in various aspects of Asset Management Planning. Some notable failure modes for communication systems are detailed below.

Optical Fibre Cables

- **Cable Breaks:** Most optical fibre cable runs are strung on electricity network poles and, where not practical, such as road crossings or major urban areas, the cables are run underground. The main cause of failure is cable breaks due to cars and trucks knocking down poles, pulling down cables that run across roads, or damage during excavations. Example: In urban areas, construction activities often lead to accidental cable cuts, disrupting communication services**.**
- **Jacket Degradation:** Over time, the protective sheathing of optical fibre cables can degrade due to environmental factors such as UV exposure and physical wear. Example: In coastal areas, salt exposure can lead to faster degradation of the cable sheath, necessitating more frequent inspections and replacements.
- **Signal Attenuation:** The signal strength can degrade over long distances, especially if the cables are damaged or poorly maintained. Example: Physical damage from construction work can lead to signal loss in urban areas.

Point-to-Point Radio Systems

- **Frequency Drift:** Over time, radio systems may experience drift in their operating frequencies due to component aging or environmental factors. Example: High temperatures can cause frequency drift, leading to communication disruptions.
- **Physical Damage:** Environmental factors such as high winds can physically damage antennas and other components. Example: A point-to-point radio system in an exposed area may suffer from misalignment due to wind, affecting signal quality.
- **Structural Damage:** Antennas and supporting structures can suffer from physical damage due to environmental factors such as high winds or corrosion. Example: An antenna in a coastal area may corrode faster, compromising its structural integrity. Antennas experience damage due to breaks emanating from mounting failures, excessive mechanical stress due to wind or snow, and corrosion.

Wireless Access Technologies

- **Interference:** Wireless communication systems are susceptible to interference from other electronic devices and environmental factors. Example: Increased urbanisation leading to higher electronic interference can affect the performance of third-party network modems.
- **Wear:** Subsystems such as antennas and transmitters can wear over time, reducing the efficiency of wireless communication. Example: Antennas in high wind areas may experience faster wear and require regular maintenance.

Telephony Technologies

- **Electronic Component Failure:** PABX systems and other telephony technologies rely on electronic components that can fail over time due to aging or environmental factors. Example: A PABX system exposed to high humidity may suffer from corrosion of electronic components.
- **Software Obsolescence:** Telephony systems may become outdated if software updates are not regularly applied, leading to compatibility issues and reduced functionality. Example: Outdated firmware in TMR units can lead to communication failures in emergency situations.

General Communication Systems Failure Mechanisms

- **Extreme Heat:** High temperatures can affect the performance and longevity of electronic components in communication systems.
- **Heavy Rain:** Prolonged exposure to rain can lead to moisture ingress, affecting the functionality of outdoor communication equipment.
- **Moisture:** Moisture can cause corrosion and electrical failures in various components of the communication network.
- **Rodents:** Rodents can damage cables and other infrastructure, leading to communication failures.

5.1.2. Probability of failure Assessments

Communication assets are evaluated using the health score methodology (Refer to AMS 01-09 for details). The results of the health score are analysed using a Weibull distribution to determine the shape and scale parameters for calculating probability of failure (PoF) and remaining life.

Factors considered in developing the health score include age, utilisation capacity, location, and observed physical condition of the assets through notifications.

5.1.3. Likelihood Profile

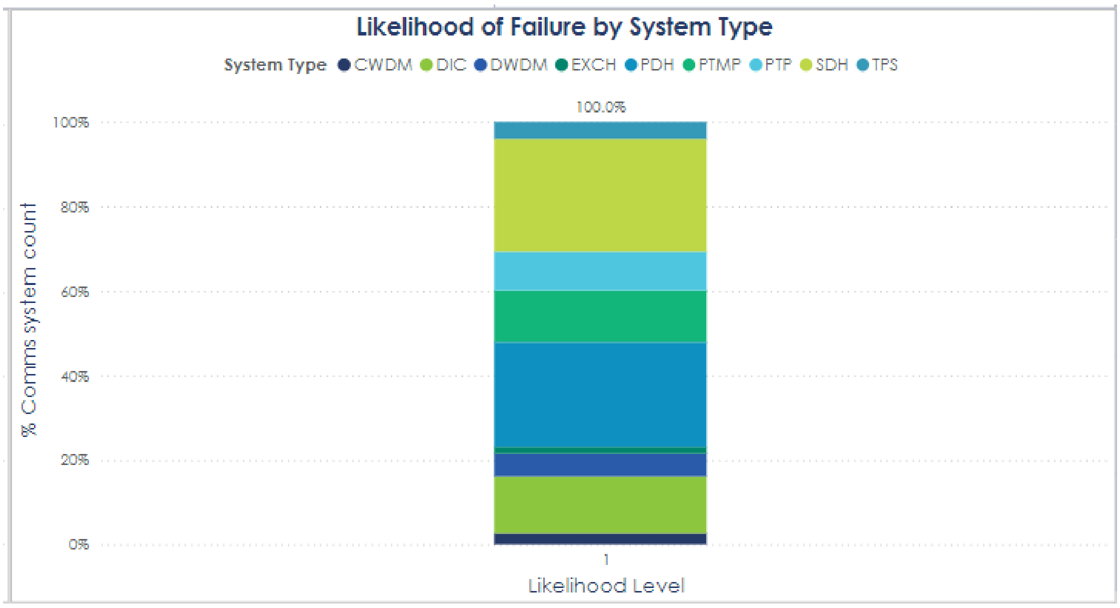

Figure 5: Relative Likelihood Profile

5.2. Consequence of Failure

All assets fulfil a function that enables delivery of electricity to customers. This means that failure of an asset has the potential of resulting in failure to supply customers with energy. There is also a possibility that the failed asset could injure an employee or member of the public or negatively affect the environment.

The cost resulting from this failure (cost of failure) is viewed through three lenses: safety, environment, and customer/reputation for all asset classes. Table 4 is a summary description for each lens.

Table 4: Consequence Lenses

Consequence Lenses	**Descriptions**
SAFETY	Failure of primary equipment and/or comms asset resulting in injury or death of an employee or member of the public
ENVIRONMENT	Bushfire damage or environmental waste resulting from comms system or subsystem failure
CUSTOMER AND REPUTATION	Loss of supply to customers
	Impact on energy market
	Breach of regulatory obligations

The Cost of failure associated with any of the consequence lenses is the product of the cost of consequence and likelihood of consequence. Refer to AMS 01-09 for methodology of calculating consequence of failure.

5.2.1. Safety

The Safety cost of failure incorporates all potential health and safety effects that could impact the public and employees. Whereas the likelihood of consequence for a communication system, on its own, resulting in a safety consequence is very low, failure of the communication system could increase in consequence of a primary asset failure causing a safety consequence.

The safety cost of consequence is related to the value of lost life, whereas the likelihood of consequence is calculated using the event tree methodology. Detailed event trees can be found in AMS 01-09-02.

5.2.2. Environmental

The Environmental cost of consequence covers consequences relating to bushfire, oil spills, SF6 discharge, and waste. Other than communication system failure resulting in waste, there is no direct environmental consequence. However, failure of communication system could result in a primary asset failure causing an environmental consequence.

The likelihood of consequence is calculated using the event tree methodology. Detailed event trees can be found in AMS 01-09-02.

5.2.3. Customer and Reputation

The Customer and Reputation cost of consequence arises from customers not being supplied with energy and the energy market not dispatching the cheapest generators.

The Customer cost of consequence is calculated using Value of Customer Reliability (VCR) and the duration of the outage. The likelihood of consequence is calculated using event tree methodology and detailed in AMS 01-09-02

5.2.4. Consequence Profile

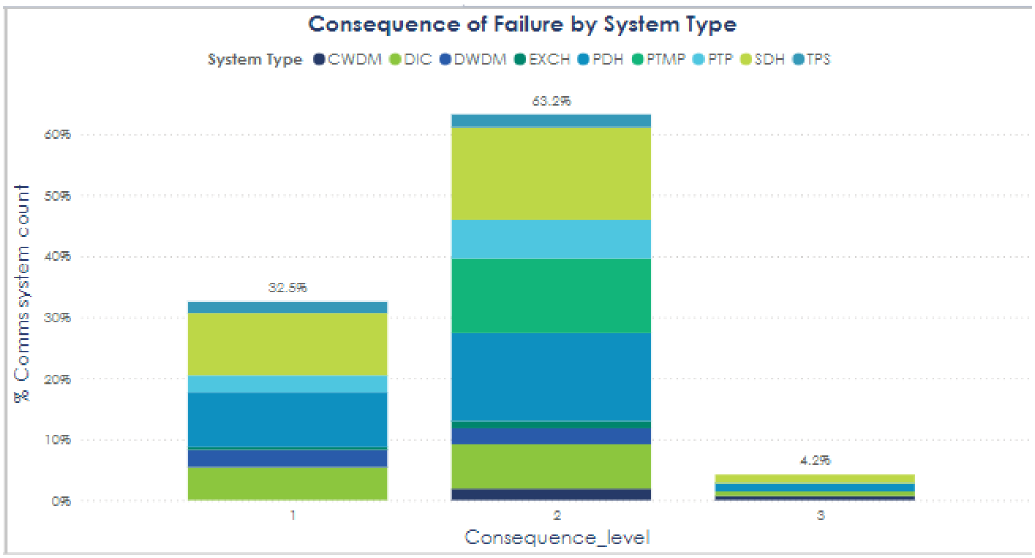

Figure 6: Relative System Types Consequence Profile

5.3. Risk Treatment

Risk mitigation activities, or treatments, are required to maintain risk by targeting reduction of PoF or CoF depending on the nature of the risk. Mitigation measures include asset replacement, asset refurbishment, inspections, testing or system redesign, and are achieved through capital projects or operational expenditure. Risk treatment options are described in figure 7 of AMS 01-09.

Capital replacement is a major component of asset risk management. The prerequisites for replacing an asset are:

- replacement of the asset will result in a material risk reduction
- risks can’t be feasibly managed through maintenance or refurbishment
- monetised risk exceeds the replacement cost meaning that it is economic to replace the asset

6. Performance

6.1. Condition Assessment

Currently communication assets do not have condition monitoring or a formal condition assessment process. The asset conditions are inferred from the number and type of notifications raised.

6.2. Performance Analysis

In the context of asset management for communication systems, assessing asset performance is a vital tool for effective lifecycle management. Performance information provides a comprehensive understanding of how these assets behave under various conditions, enabling asset managers to make informed decisions that enhance the reliability, safety, and efficiency of the electrical distribution network.

Performance data helps identify trends and patterns in asset behaviour, which are crucial for making strategic decisions regarding maintenance, upgrades, and replacements. Understanding how assets perform over time allows for proactive management, reducing the risk of unexpected failures. The assessment employed by AusNet involves analysing failure trends and any significant impacts resulting from failure, which provides valuable insights into the health and reliability of the assets.

6.3. Performance Profile

Figure 9 to figure 13 show the percentage of total number of ZA (Condition Based Maintenance) and ZK (Fault) notifications per communication system type and optical fibre per calendar year during the period 2015 – 2024.

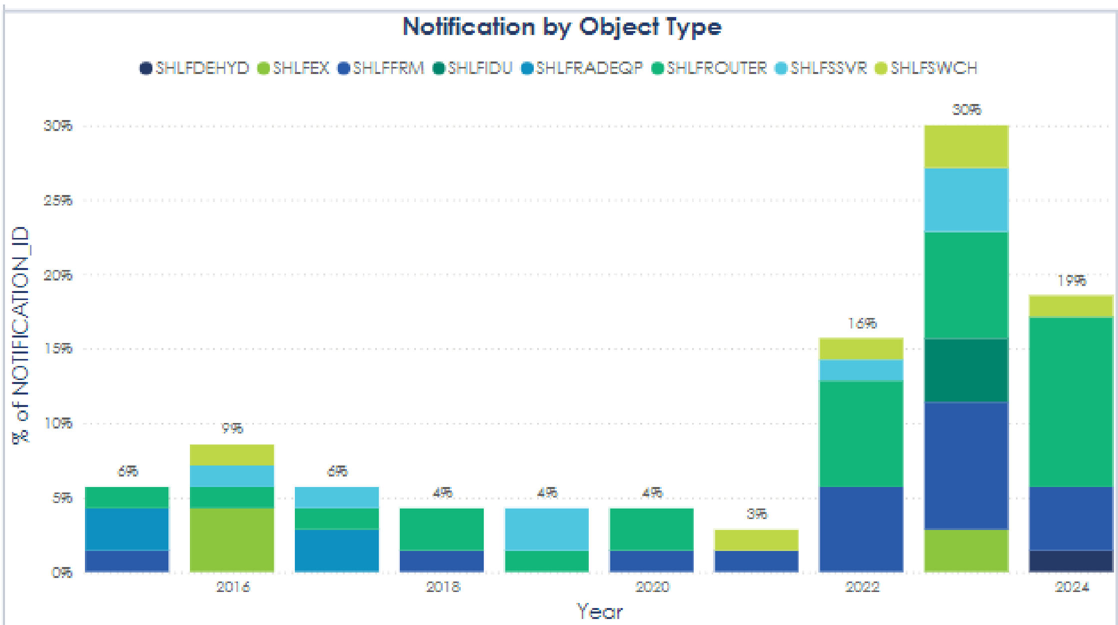

Figure 7: Notifications of System Types Since 2015

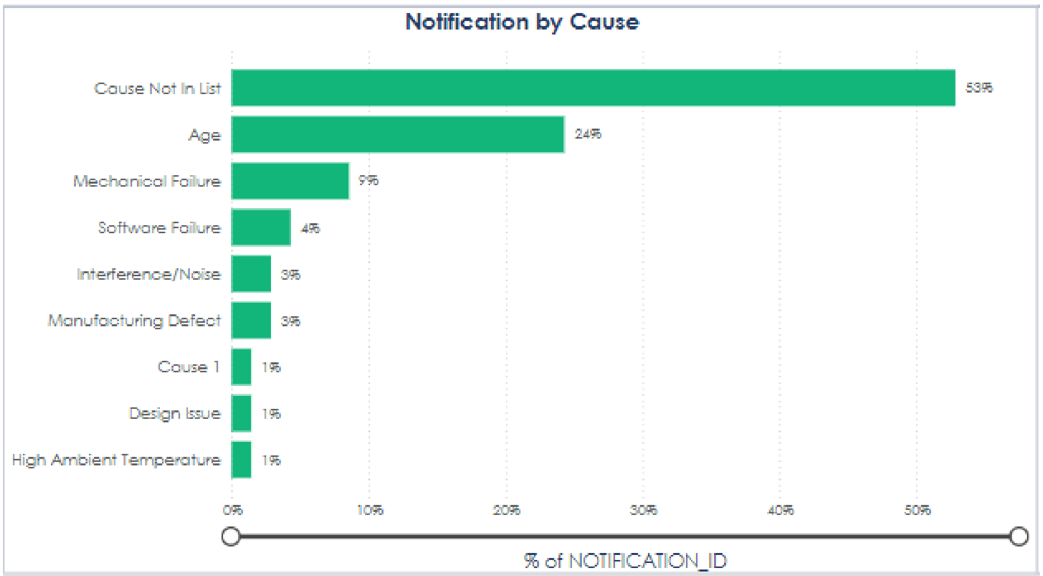

Figure 8: Recorded System Type Causes

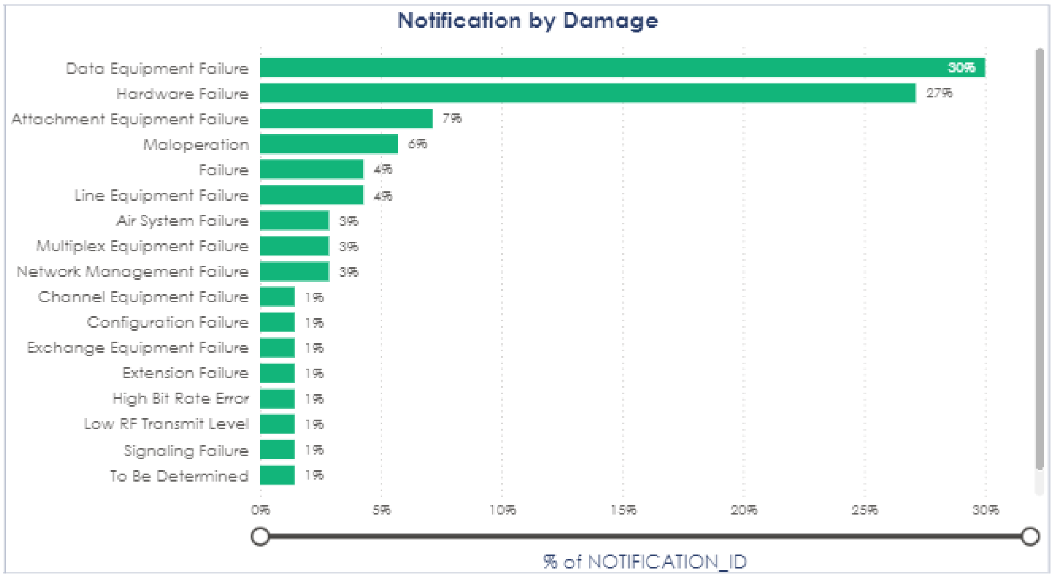

Figure 9: Recorded System Type Damage

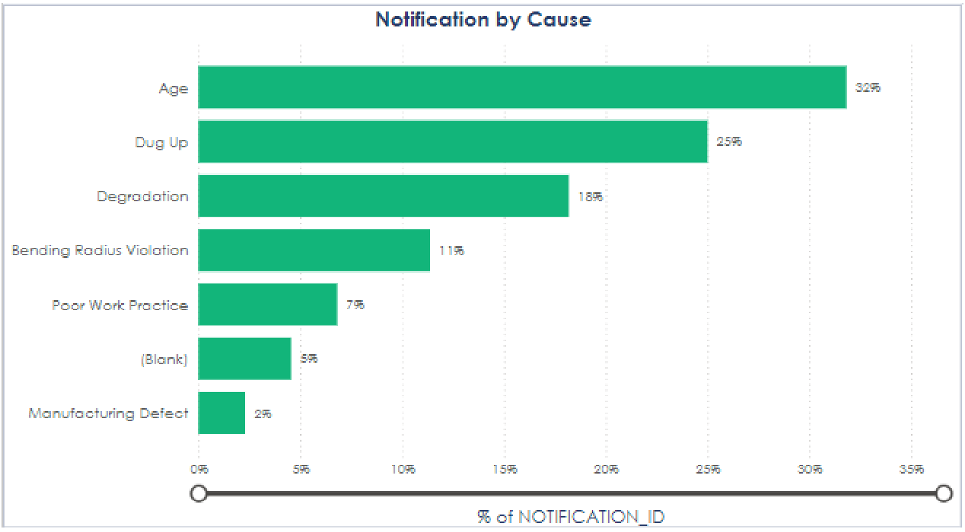

Figure 10: Optical Fibre Causes

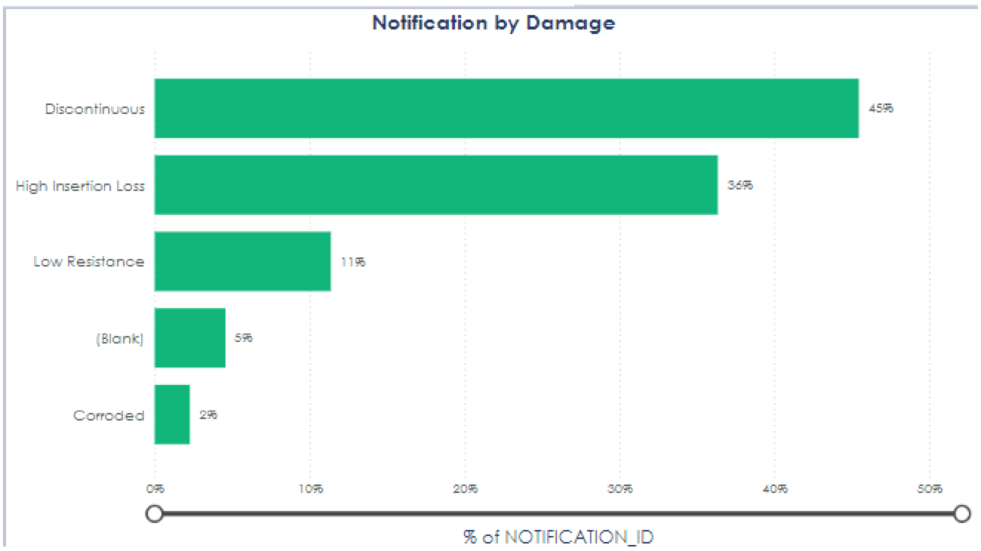

Figure 11: Optical Fibre Damage

7. Related Matters

7.1. Regulatory Framework

7.1.1. Compliance Factors

7.1.1.1. Regulatory and Legislative Reference

Effectively managing compliance obligations specific to legislation and policies is a core element of Asset Class Planning and supports the sustainable operation and management of Network Assets. Ensuring adherence to relevant laws, policies and codes helps prevent legal and regulatory breaches, which can lead to significant penalties, operational disruptions, and reputational damage.

7.1.1.2. Technical Standards and Procedures

Effectively managing compliance with technical standards and operational procedures is an important element of Asset Class Planning. Adhering to these standards ensures that the assets are designed, constructed, maintained, and operated in a manner that meets industry best practices, enhances safety, and ensures reliability. Compliance with technical standards helps decrease asset failures, reduces risks, and ensures interoperability within the electrical distribution network. For example, ensuring that all systems of various asset types are installed and maintained according to Australian Standards can reduce unplanned failure and operational faults, enhancing network reliability.

Targeted Activities (Compliance Factors)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Compliance with the relevant clauses and/or sections: National Electricity Rule (Clause 6.5.7)
02	Compliance with the relevant clauses and/or sections: Electricity Distribution Code (Section 3.3.1(b))
03	Compliance with the relevant clauses and/or sections: Electricity Safety Act (Section 98(a))

7.2. External Factors

7.2.1. Technical Factors

Understanding and managing the technical factors that can directly impact the lifecycle planning for Network Assets across all the AusNet Asset Classes is a core element of effective asset management. These factors encompass various design, engineering, and technical performance considerations that directly impact the ability to manage and maintain these assets efficiently. Ensuring that Network Assets meet specific technical performance standards is vital for maintaining the reliability and safety of the electrical distribution network. For example, selecting construction materials with appropriate durability and weather resistance is essential to prevent faults and ensure consistent performance under varying environmental conditions.

Targeted Activities (Technical Factors)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	**Legacy Systems**: The communications network is made up of devices from multiple vendors which are expected to exchange information seamlessly. A strategic objective of AusNet is to build efficient automated and integrated processes and systems to support a dynamic business model.
02	**Legacy Systems**: TDM is now considered a legacy technology, and the development of this technology is gradually diminishing. Systems are migrating to packet-based technologies

REF	DETAILS OF MATERIAL CONSIDERATIONS
03	**Legacy Systems**: Support and spare parts for legacy systems quickly become scarce and often requires a long-term financial commitment to a supplier to maintain stock of the required spare parts. This is not always economic, and the long delays experienced in obtaining support or spares introduces an increasing risk of affecting the availability of the communication network.
04	**Performance and Architecture**: The application of IEC 61850 is on the increase and changes need to be made in the ODN and OMN networks to support this capability
05	**Coverage**: The energy transition to renewable energy will require improved and expanding communication systems over the next 10 years
06	**Cyber Security**: Increasing threat of cyber-attacks. Ensure that issues are identified quickly, contained and recovered so that the damage or outage to the electricity network is minimised.
07	
08	

7.2.2. Environmental Factors

7.2.2.1. Environmental Management

Effectively managing obligations specific to environmental management is a core element of Asset Class Planning and supports the sustainable operation and management of Civil Infrastructure. Ensuring adherence to relevant environmental laws and standards helps prevent legal and regulatory breaches, which can lead to significant penalties, operational disruptions, and reputational damage.

Apart from radio systems which must adhere to the electromagnetic field requirements the other assets are not impacted by environmental requirements directly.

7.2.3. Stakeholder/ Social Factors

7.2.3.1. Social Factors

Understanding social factors is essential for the effective management of critical network infrastructure assets. Social factors, including community expectations, public safety, and environmental impacts, play a significant role in shaping asset management strategies. Ensuring that these social considerations are addressed helps build public trust, maintain social license to operate, and enhance the organisation's reputation. For instance, ensuring that maintenance activities for Civil Infrastructure do not disrupt local communities or pose safety risks is crucial for maintaining public support and compliance with social responsibilities.

Targeted Activities (Social Factors)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	**Towers/Poles**: Engage the community when planning to establish towers/poles within the community areas to mount antennas.
02	

7.2.3.2. Stakeholder Factors

Not applicable to this strategy

7.3. Internal Factors

7.3.1. Training and Competency Factors

Effective training and competency development is a core element of asset class. Ensuring that asset managers, engineers, operational staff, and field personnel possess the necessary skills and knowledge is crucial for maintaining the reliability, safety, and efficiency of the asset network. Competent staff can effectively perform inspections, maintenance, and repairs, preventing asset failures and minimising downtime. Continuous training helps in keeping up with technological advancements, regulatory changes, and best practices, thereby enhancing overall asset management performance.

Targeted Activities (Training and Competency Factors)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to provide internal staff as well as Ausnet partner in training, education and industry knowledge of IEC61850 standard and MPLS

7.3.2. Resource Management Factors

Not applicable to this strategy

7.3.3. Economic Factors

Not applicable to this strategy

7.3.4. Safety Factors

Not applicable to this strategy

7.4. Future Developments

7.4.1. Technology and Innovation Factors

Effectively managing the process of tracking future technology developments and innovations is a core element of asset class planning. Staying informed about technological advancements ensures that asset management practices remain up-to-date, efficient, and competitive. Innovations can lead to improved materials, better monitoring systems, and enhanced maintenance techniques that increase the reliability, safety, and longevity of critical infrastructure. For example, the rapid advancement of mobile telephone services 5G, 6G and the opportunities it brings for SMART networks

Targeted Activities (Technology and Innovation Factors)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	**Third-party Networks**: Introduction of SMART networks especially for generator connection
02	

7.4.2. Research and Development Factors

Not applicable to this strategy

8. Asset Strategies

8.1. New Assets

A strategic asset strategy for the introduction of new assets provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the aspects of asset upgrades or changes, detailing the conditions under which new assets may be introduced into the network. This is not a like-for-like replacement but rather a strategic change or upgrade to a different type of asset to enhance reliability, improve efficiency, and incorporate advanced technologies. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for integrating new assets into the AusNet network.

Targeted Activities (New Asset Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Replacement of TDM technology equipment with packet-based systems
02	Upgrade modems using third-party networks which operate on 3G/4G to 5G/6G
03	As third-party networks expand, replace TRIO modems with third-party network modems
04	Leverage 66KV and 22KV Line extensions and upgrades to extend optical fibre connectivity

8.2. Inspections and Monitoring

A strategic plan for inspections and monitoring provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the ideal framework and objectives for conducting inspections and monitoring activities, such as enhancing reliability, improving efficiency, and incorporating advanced technologies. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for establishing comprehensive inspection and monitoring protocols within the AusNet network.

Targeted Activities (Inspection and Monitoring Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Introduce Risk-based inspection intervals
02	Install monitoring equipment for communication systems within the risk appetite threshold
03	

8.3. Maintenance Planning

A strategic plan for maintenance provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the ideal framework and objectives for conducting maintenance activities, such as enhancing reliability, improving efficiency, and incorporating advanced technologies. It serves as a roadmap that guides the decision-making process for establishing comprehensive maintenance protocols within the AusNet network. This involves creating a structured approach to regular maintenance activities to ensure optimal performance and longevity.

Targeted Activities (Maintenance Planning)

REF	DETAILS OF MATERIAL CONSIDERATIONS

01	Prepare risk-based maintenance plans
02	Keep decommissioned equipment in working condition to be used as spares
03	

8.4. Renewals Planning

A strategic asset strategy for renewals and replacements provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the aspects of asset refurbishments or like-for-like replacements, detailing the conditions under which existing assets may be renewed or replaced within the network. This process ensures continued reliability and efficiency, manages obsolescence, and maintains adequate spares. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for renewing or replacing assets within the AusNet network.

Targeted Activities (Renewal Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	The refurbishment and renewals program to be developed based on asset risk and in accordance with current standard
02	
03	

8.5. Decommissioning

Not applicable to this strategy

9. Legislative References

NO.	TITLE	LINK
1	Electricity Safety Act 1998	https://content.legislation.vic.gov.au/sites/default/files/2024-06/98-25aa083-authorised.pdf
2	Electricity Distribution Code	https://www.esc.vic.gov.au/electricity-and-gas/codes-guidelines-and-policies/electricity-distribution-code-practice
3	National Electricity Rule	https://energy-rules.aemc.gov.au/ner/611

10. Resource References

NO.	TITLE	LINK
1	SDM	Station Design Manual
2	AMS 01-01	Asset Management System Overview
3	AMS 01-09	Asset Risk Assessment Overview
4	AMS 20-01	Electricity Distribution Network Asset Management Strategy
5	PGI 02-01-04	Summary of Maintenance Intervals – Distribution Plant Guidance and Information
7	AMS 01-09-02	Consequence Analysis - Addendum

11. Schedule of revisions

ISSUE	DATE	AUTHOR	DETAILS OF CHANGE	APPROVED BY
1		K. Tory	Initial Draft	
2	19/1/09	T. Ton	Updated Draft	
3	3/2/09	K. Tory	Updated Draft	
4	9/4/09	G. Lukies	Review and update	G. Towns
5	21/4/09	K. Tory, D. Rendell	Post review update	G. Towns
6	7/7/09	L. Biancucci	Added information on the implementation of new Comms technologies such as MPLS	G. Towns
7	24/11/09	N. Bapat	Editorial and other minor changes	G. Towns
8	18/11/09	D. Dhammanarachchi	Major Review and Update	T. Ton
9	15/8/19	A. Nainhabo, T. Ton	Review and Update	T. Ton
10	31/10/24	A. Nainhabo	New Template and Update	

AusNet

Level 31

2 Southbank Boulevard

Southbank VIC 3006

T +61 3 9695 6000

F +61 3 9695 6666

Locked Bag 14051 Melbourne City Mail Centre Melbourne VIC 8001

www.AusNetservices.com.au

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