AusNet

Electricity Safety Management Scheme

Electricity Distribution Network

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6.1	08/12/2023	Five year review & submission to ESV General update of asset volumes, data and Figures. Sec 2.1 included SAPS & BESS. Sec 3.1 New ownership structure. Sec 8.2 Revised enterprise risk system has two risk levels – 'key' & 'operational'. Mt Baw Baw islanded assets removed. Appendices of detailed operational risks removed.	H. Ho	P. Bryant

Disclaimer

This document has been prepared to inform stakeholders on the management of the safety of AusNet's electricity distribution network, in accordance with the requirements of the Electricity Safety (Management) Regulations and the Electricity Safety Act of Victoria.

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Responsibility

Management, Control and Safe Operation	**Electricity Safety Management Scheme Preparation and Submission**
The Chief Executive Officer, AusNet, is responsible for the management, control and safe operation of the electricity distribution network.	The General Manager, Asset Management, is responsible for the preparation and submission of this Electricity Safety Management Scheme for the electricity distribution network.
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Abbreviations

Term	Definition
AAC	All Aluminium Conductor
ABC	Aerial Bundled Cable
ABS	Air Break Switch
ACM	Asbestos Containing Material
ACMA	Australian Communication and Media Authority
ACR	Automatic Circuit Recloser
ACSR	Aluminium Conductor Steel Reinforced
ADSL	Asymmetric Digital Subscriber Line
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AFAP	As Far As Practicable
AIM	Asset Inspection Manual
ALARP	As Low As Reasonably Practicable
AMC	Asset Management Committee
AMI	Advanced Metering Infrastructure
AMP	Asset Management Plan
AMS	Asset Management Strategy
ARMC	Audit and Risk Management Committee
AS	Australian Standard
ASX	Australian Stock Exchange
AWB	Availability Workbench
BA	Boric Acid (fuse)
BDSL	Broadband Digital Subscriber Line
BESS	Battery Energy Storage System
BMI	Bushfire Mitigation Index
BMP	Bushfire Mitigation Plan
CB	Circuit Breaker
CERA	Capacitor Bank Station at Erica
CEO	Chief Executive Officer
CEOT	Customer Energy and Operations Team
CFA	Country Fire Authority
CIGRE	International Council on Large Electric Systems
CM	Corrective Maintenance
CMEN	Common Multiple Earthed Neutral
CMT	Crisis Management Team
COM	Constructability, Operability and Maintainability
CPG	Capital Portfolio Governance, previously Portfolio Management & Review (PM&R)
CT	Current Transformer
CVT	Capacitive Voltage Transformer
DE	Direct Earthed
DF	Disproportionality Factor
DFA	Distribution Feeder Automation
DFD	Distribution Feeder Device
DOMS	Distribution Outage Management System

Term	Definition
DTPLI	(Victorian) Department of Transport, Planning and Local Infrastructure
EA	Energy Australia
ECM	Enterprise Content Management
EDC	Electricity Distribution Code
EDO	Expulsion Drop Out
EDPR	Electricity Distribution Price Review
EHV	Extra High Voltage
ELT	Executive Leadership Team
EMT	Emergency Management Team
ENA	Energy Networks Association
ES&C	Electricity Supply and Construction
ESAA	Electricity Supply Association of Australia
ESC	Essential Services Commission
ESI	Electricity Supply Industry
ESMS	Electricity Safety Management Scheme
ESV	Energy Safe Victoria
FFDI	Forest Fire Danger Index
FLCM	Fire Loss Consequence Model
FMECA	Failure Mode, Effects and Criticality Analysis
FIRI	Fire Ignition Risk Indicator
FSA	Formal Safety Assessment
FSD	Fuse Switch Disconnector
FT	Fault Tamer (fuse)
GFN	Ground Fault Neutraliser
GIS	Gas Insulated Switchgear
GRC	Group Risk Committee
GSL	Guaranteed Service Level
HBRA	Hazardous Bushfire Risk Area
HEI	Human Error Incident
HSEQ	Health, Safety, Environment and Quality
HV	High Voltage
HV ABC	High Voltage Aerial Bundled Cable
IEC	Electro-technical Commission
IED	Intelligent Electronic Device
IEEE	Institute of Electrical and Electronic Engineers
IMEN	Individual Multiple Earthed Neutral
IMS	Issue Management System
IRU	Ignition Risk Unit
ISDN	Integrated Services Digital Network
ISO	International Organisation of Standardisation
ISRAT	Infrastructure Security Risk Assessment Tool
IUC	Insulated Unscreened Conductor
JSA	Job Safety Assessment
KMS	Kilmore South Zone Substation
KPI	Key Performance Indicator
kV	kilo-volts (1,000 volts)
kVA	kilo-volt-amperes (1,000 volt-amperes)

Term	Definition
kW	kilo-watts (1,000 watts)
LBRA	Low Bushfire Risk Area
LDMS HV ABC	Light Duty Metallic High Voltage Aerial Bundled Cable
LED	Light Emitting Diode
LEI	Licensed Electrical Inspector
LPG	Liquid Petroleum Gas
LST	Local Strike Team
LTI	Lost Time Injury
LV	Low Voltage
LVABC	Low Voltage Aerial Bundled Cable
LYS	Loy Yang South
MEC	Major Electrical Company
MEN	Multiple Earthed Neutral
MFB	Metropolitan Fire Brigade
MHO	Morwell Hernes-Oak
MTI	Medical Treatment Injury
MV	Medium Voltage
MVT	Magnetic Voltage Transformer
MW	mega-watts (1,000 kilo-watts)
MWE	Morwell East
MWN	Morwell North
MWTS	Morwell Terminal Station
MWW	Morwell West
NEC	Neutral Earthing Compensator
NED	Neutral Earthing Device
NEM	National Energy Market
NER	National Electricity Rules OR Neutral Earthing Resistor
NMS HV ABC	Non-Metallic Screened High Voltage Aerial Bundled Cable
NPIT	Network Performance Investigation Team
NSMC	Network Safety Management Committee
NSR	Network Safety Report
NST	Neutral Service Testing
OCR	Oil Circuit Recloser
OHS	Occupational Health and Safety
OLTC	On-load Tap Changer
PBST	Powerline Bushfire Safety Taskforce
PDH	Plesiochronous Digital Hierarchy
PF	Powder Filled (fuse)
PIR	Post Implementation Review
PM	Preventative Maintenance
PM&R	Portfolio Management and Review, renamed Capital Portfolio Governance (CPG)
POEL	Private Overhead Electric Line
PV	Photo Voltaic
RAB	Regulated Asset Base
RAS	Risk Appetite Statement
RCE	Risk Control Effectiveness
RCM	Reliability Centred Maintenance

Term	Definition
REFCL	Rapid Earth Fault Current Limiting
RIFR	Recordable Injury Frequency Rate
RIRT	Regional Incident Response Team
RMU	Ring Main Unit
RTO	Registered Training Organisation
RTU	Remote Terminal Unit
SAP	Enterprise Asset Management System
SAPS	Stand-alone Power System
SC	Station Controller
SCADA	Supervisory Control and Data Acquisition
SCS	Spacer Cable Systems
SCX-ST	Singapore Stock Exchange
SDH	Synchronous Digital Hierarchy
SDM	Station Design Manual
SECV	State Electricity Commission of Victoria
SFAIRP	So Far As Is Reasonably Practicable
SIR	Service and Installation Rules
SPIRACS	Strategic Plan for Integrated Response and Contingency System
STPIS	Service Target Performance Incentive Scheme
SVC	Static VAr Compensator
SWER	Single Wire Earth Return
TMR	Trunk Mobile Radio
URD	Underground Residential Distribution
USAIDI	Unplanned System Average Interruption Duration Index
VAr	volt-ampere reactive (unit of reactive power)
VBRC	Victorian Bushfires Royal Commission
VCR	Value of Customer Reliability
VESI	Victorian Electricity Supply Industry
VIF	Victoria in Future
VMP	Vegetation Management Plan
VRR	Voltage Regulating Relay
VT	Voltage Transformer
WACC	Weighted Average Cost of Capital
WARL	Weighted Average Remaining Life
WYK	Woori Yallock Zone Substation
XLPE	Cross-linked polyethylene
YHO	Yallourn Open Cut
YN	Yallourn North
YPS	Yallourn Power Station

1. Purpose and Objectives

This document describes AusNet's Electrical Safety Management Scheme (ESMS) for its electricity distribution network. The ESMS is an integration of enterprise wide policies, procedures, systems and standards that comply with the requirements of Division 2 of the *Electricity Safety Act 1998* and subordinate regulations for an ESMS.

It explains how AusNet protects:

- the public and persons working on or near the network;
- property and network assets;
- the community from bushfires ignited by the electricity network; and
- the community from safety aspects arising from the loss of electricity supply.

The purpose of the ESMS is to describe the assets forming AusNet's electricity distribution supply network, their location and the associated planning, design, construction, commissioning, operation, augmentation, inspection, testing, maintenance, refurbishment, replacement and decommissioning processes necessary to **ensure the safety of consumers, the public, AusNet's staff and contractors**.

Specifically, this document provides information and references to AusNet's:

- Organisational Structure;
- Scope of Operations;
- Operating Environment;
- Safety Management Policy and Systems;
- Risk Management Policy and Systems;
- Asset Management Strategies and Plans;
- Access Authority System;
- Competence and Training;
- Emergency Preparedness;
- Incident Recording, Investigation and Review;
- Key Performance Indicators;
- Monitoring, Audit and Review;
- Record Management;
- Reporting of Incidents; and
- Technical Standards.

The objectives are to prepare an ESMS that:

- Informs stakeholders of the context, operating environment and challenges AusNet faces in managing network operations and risk;
- Informs stakeholders on the nature of risks AusNet faces and the precautionary controls that may eliminate or mitigate these risks as far as practicable;
- Presents a reasoned safety argument that explains how distribution network safety risks are identified, monitored and minimised as far as practicable;
- Outlines the approach and management systems that manage network safety risks in compliance with the Electricity Safety Act 1998, subordinate regulations and the Australian Standard for Electricity Network Safety Management Systems (AS 5577:2013); and

- Gains ESV's acceptance

1.1 Intended Audience and Principal Benefits

This document is intended to be primarily a "living plan" that AusNet has developed to:

- Illustrate how risk is identified and minimised as far as practicable; and
- Demonstrate to relevant stakeholders AusNet's understanding of the factors that influence network risks and the controls that are applied to eliminate or mitigate these risks

The intended audience is AusNet stakeholders including management, employees, contractors, and ESV.

The principal benefits of the ESMS are that:

- It informs and educates stakeholders by providing a clear articulation of AusNet's proposed approach to managing network safety; and
- It explains the operation of AusNet's ESMS, key risks and the framework and approach to the management of network safety risks.

It is anticipated that different stakeholders will use the ESMS in ways which reflect their level of responsibility for and understanding of the electricity distribution network and the way it is managed. For example, contractors will have a good understanding of the aspects of the network that are of relevance to them such as how AusNet manages resourcing, training and competency, and auditing to ensure compliance with network safety requirements.

1.2 Commitment to the ESMS

Commitment to compliance with the ESMS is core to AusNet's Health, Safety, Environment and Quality (HSEQ) Policy (refer Appendix A) and Asset Management Policy (refer Appendix B).

AusNet consider compliance provides the most effective and systematic approach toward the identification and management of hazards associated with the network.

2. Scope

This ESMS relates to the safe acquisition, design, construction, commissioning, operation, maintenance and decommissioning of AusNet's electricity distribution network, which includes the application of temporary generation facilities for network support, emergency and planned interruptions.

The scope is consistent with the requirements of the *Electricity Safety (Management) Regulations 2019 and* AS 5577 – 2013.

AusNet (formerly TXU) established the ESMS for its electricity distribution network in 2000 and was formally gazetted by the Governor in Council in 2003.

2.1 Assets

The scope of this ESMS covers the *applicable assets*[1] forming AusNet's electricity distribution *supply network*[2] in Victoria, including:

- 66kV sub transmission power lines, power cables and associated easements and access tracks;
- Zone substations, switching stations and line voltage regulating stations including electrical plant, buildings, civil infrastructure and earthing;
- Medium Voltage (MV) distribution power lines, power cables and associated switching and disconnecting facilities;
- MV Distribution substations;
- Low Voltage (LV) distribution power lines, power cables and associated switching and disconnecting facilities;
- LV service cables connecting installations to the electricity distribution supply network;
- Battery Energy Storage Systems (BESS)
- Standalone Power Systems (SAPS)
- Distribution assets in Eastern Victoria (Bendoc), supplied by NSW, that were owned and operated by Essential Energy prior to 2012 under the Victorian Franchise Agreement;
- A small number of distribution assets (approx. 19 poles)_ connected to AusNet's network but located beyond Murray River highwater mark in NSW (Biggara S/L P55-70 & Indi Bridge S/L, Hume Generator 66kV connection – 2 poles);
- Public Lighting installations;
- Protection, control and metering equipment associated with the assets listed above;
- System Control and Data Acquisition (SCADA) equipment and communications equipment interconnecting network assets and the Customer Energy and Operating Team (CEOT); and
- Facilities within the CEOT to operate the electricity distribution supply network.

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[1] Electricity Safety (Management) Regulations 2009: **applicable asset** means (a) a supply network owned or operated by an MEC

[2] Electricity Safety Act 1998: **supply network** means a network consisting of electric lines, substations, circuits and any other thing required for the purposes of the transmission, distribution or supply of electricity

2.2 Functions

The ESMS covers the following management functions:

- Planning of extensions to the network and reinforcement of existing assets;
- Design, construction and acquisition of network assets;
- Commissioning and energisation of assets;
- Connection of customer installations and generators;
- Operation of the network;
- Inspection and testing of network assets;
- Maintenance, repair, refurbishment and replacement of network assets;
- Decommissioning, removal and disposal of network assets;
- Monitoring and audit of network performance including reliability, quality of supply, health and safety, environment, regulatory compliance and security; and
- Managing network safety including safety policy, technical standards, asset management strategies and plans, access authority system, emergency preparedness, monitoring audit and review, key performance indicators, incident recording investigation and review, competence and training, record management and reporting of incidents, checking and corrective actions, management review and continuous improvement.

2.3 Exclusions

This ESMS excludes:

- AusNet's electricity transmission and gas networks;
- Assets owned by Generators; and
- Assets owned by Consumers.

It also excludes AusNet's corporate processes and associated information technology systems such as business communication, human resources and financial management systems. It does not include corporate offices or general business equipment such as computers and motor vehicles.

3. About AusNet

The AusNet group is a large diversified energy infrastructure business operating a diversified portfolio of both electricity and gas assets throughout Victoria, helping to meet the energy needs of more than 1.3 million residential and business customers. It is based in Melbourne, Australia and employs about 1,900 people.

More information about AusNet can be found at: www.ausnetservices.com.au.

3.1 Ownership and Structure

AusNet is privately owned by Australian Energy Holdings No 4 Pty Ltd ACN 654 673 793, a company controlled by Brookfield Managed Investors, which comprises the following entities:

(a) Brookfield Asset Management inc., a publicly listed global diversified fund manager, headquartered in Toronto, Canada (NYSE:BAM and TSX:BAM.A) (BAM);

(b) Brookfield Infrastructure Partners LP, a publicly listed limited partnership and infrastructure investor, headquartered in Hamilton, Bermuda and managed by BAM (BIP); and

(c) Brookfield Super-Core infrastructure Partners, an open-ended global diversified infrastructure fund comprising the following entities: BSIP LP, BSIP TE, BSIP NUS and BSIP ER (together, BSIP).

Prior to the acquisition of AusNet by Australian Energy Holdings No 4, which completed on 16 February 2022, AusNet was listed on the Australian Stock Exchange (ASX).

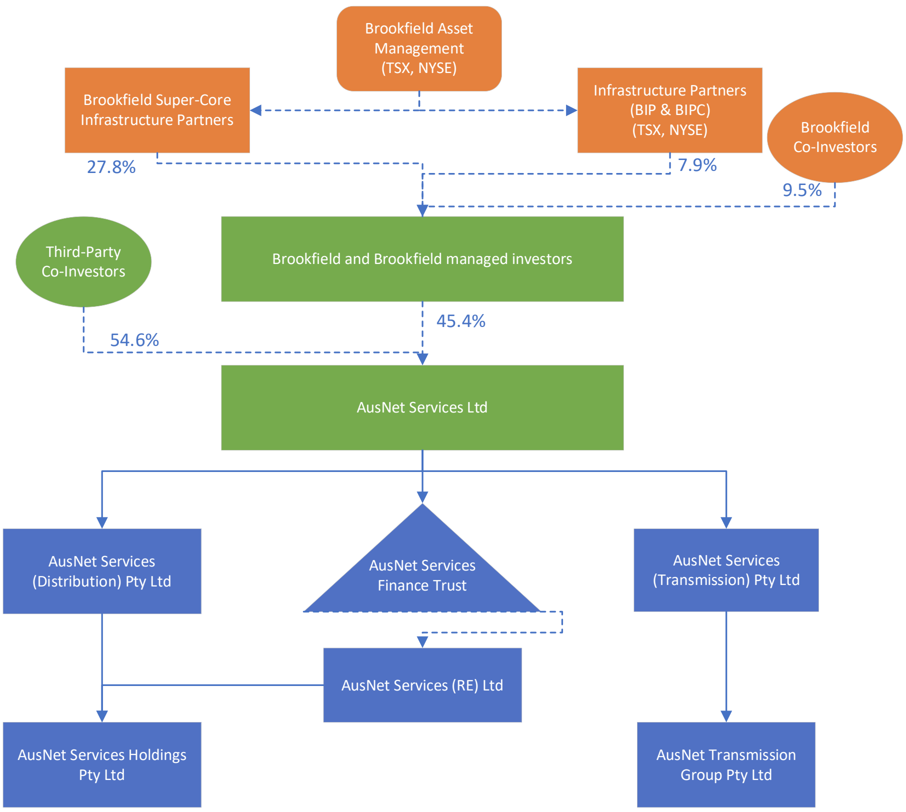

Figure 1 AusNet Ownership and Corporate Structure

AusNet holds a licence, issued by the Essential Services Commission in 1994, which authorises the distribution of electricity to customers in eastern Victoria. The electricity distribution supply network, sites and facilities are defined in Schedule 2 of the AusNet Pty Ltd Electricity Distribution Licence, as amended by the Essential Services Commission on 14 January 2005.

The legal entity title for the electricity distribution network is "AusNet Electricity Services Pty Ltd", with an ABN of 91 064 651 118.

Figure 2 illustrates the general location of the electricity distribution and transmission networks, as well as the gas network, that are the responsibility of AusNet.

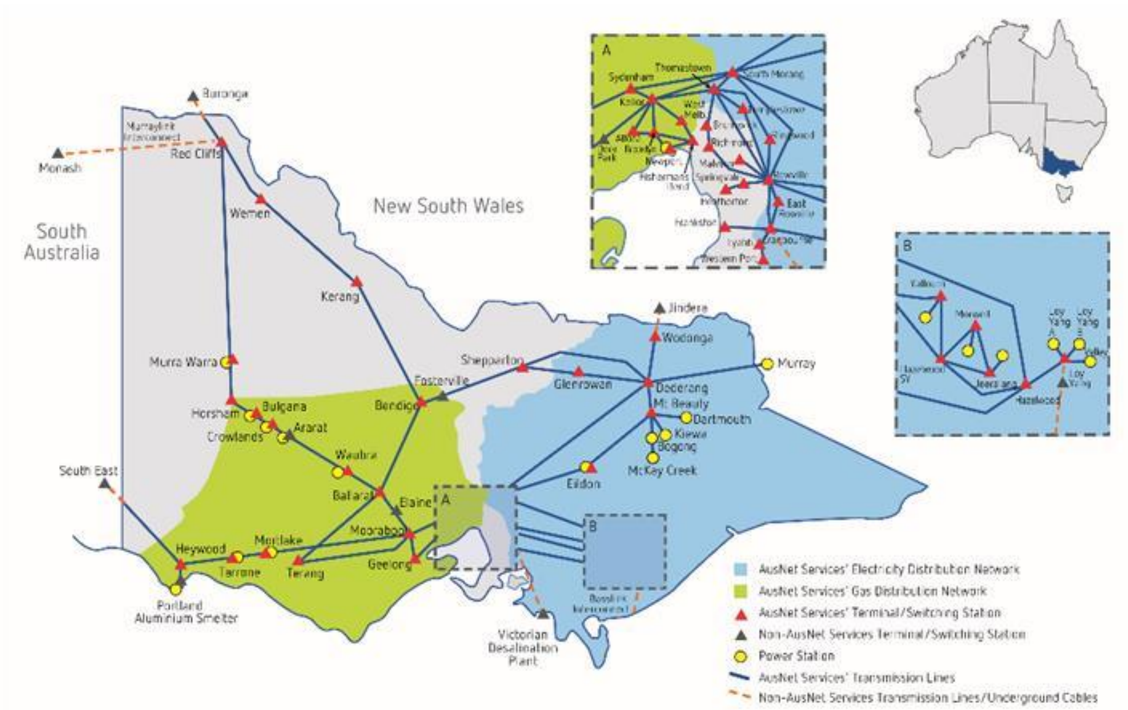

Figure 2 AusNet's Electricity and Gas Networks

3.2 Asset Summary

AusNet's core assets and functions include:

- An **electricity transmission network** comprising approximately 13,000 high voltage towers supporting approximately 6,580km of transmission lines that carry high voltage electricity from power stations to electricity distributors across Victoria;
- An **electricity distribution network** delivering electricity from the high voltage transmission grid along approximately 54,700km of conductors and cable to approximately 800,000 customer connection points in an area of more than 80,000 square kilometres of eastern Victoria; and
- A **gas distribution network** delivering gas to approximately 790,000 customer supply points in an area of more than 60,000 square kilometres in central and western Victoria. This network spans approximately 12,600km of buried pipelines.

AusNet owns and operates the electricity distribution network that provides services to customers located in the eastern half of Victoria, spanning from the northern and eastern suburbs of Melbourne eastward to Mallacoota, and north to the Murray River.

AusNet is one of five major electrical companies that operate an electricity distribution network within the State of Victoria. The ownership of AusNet electricity distribution assets is designated in the Enterprise Asset Management System SAP, which is discussed in Section 12.3.

3.3 Strategic Business Context

AusNet's purpose is to:

Connect communities with energy and accelerate a sustainable future.

The provision of a superior network requires the management of network assets over their lifecycle. This will be achieved by sound risk management and the continuous improvement practices of our integrated safety, health, environment, quality and asset management systems.

The purpose acknowledges that the nature of the energy sector will alter fundamentally over the next decade, responding to community concerns about energy prices, shifting consumer behaviour and developments in the energy environment.

3.3.1 Corporate values

AusNet corporate values reflect the evolution of our business and our operating environment. They are shown in **Figure 3**.

Figure 3 AusNet's Corporate Values

Our corporate values include a commitment to work safely. We never compromise on safety and we genuinely care for the wellbeing of people.

3.3.2 Strategic objectives

The purpose is underpinned by four Strategic pillars:

(1) Grow through the energy transition

(2) Evolve operational performance

(3) Deliver for customers

(4) Energise our people

Strategic initiatives are designed to promote behaviours and activities consistent with AusNet's corporate values.

3.4 Safety Philosophy

As discussed in Section 3.3.1, safety is a core value at AusNet.

3.4.1 Safety policy

AusNet's Health, Safety, Environment and Quality Policy is included in Appendix A. It includes the missionZero strategy, which has been implemented to promote a culture within the organisation that is focussed on reducing injuries in the workplace. This cultural change is supported by various current and planned investments in systems that allow the network to be operated and maintained more safely and has resulted in the rate at which employees are hurt falling from a recordable injury frequency rate (RIFR[3]) of 16 to less than 5 over the period from 2010 to the present.

The Health, Safety, Environment and Quality Policy also states that AusNet will be:

> *"Ensuring that an effective health, safety and environment risk management framework is in place, including a focus on the management of critical risks to protect our people, environment, assets and community."*

This recognises the importance of implementing asset and risk management strategies to identify and manage network safety related risks.

3.4.2 Safety vision and strategy

Our safety vision is symbolised by the simple expression missionZero. The missionZero Health Safety Environment and Quality (HSEQ) strategy represented in Figure 4 will be achieved through strong safety leadership, safe behaviour, commitment to creating safe workplace environments and continuous improvements in safety systems and measurement. These missionZero strategic elements illustrate our goals and objectives.

Figure 4 MissionZero Integrated Framework

The AusNet's missionZero strategic elements provide the framework with which AusNet will achieve missionZero. We rely on our leaders to set clear behavioural expectations and reinforce the reasons why it is important to work safely. In turn, our people must always have safety "front of mind" and apply safe

[3] RIFR measures the total number of LTIs and MTIs per million manhours worked for all employees and contractors

behavioural decision making guided by our HSEQ management systems (policy, procedures, guidance materials, training and audit program).

The AusNet's missionZero HSEQ strategy aims to achieve the following objectives:

- Zero injuries to our people, contractors and visitors;
- Zero tolerance of unsafe behaviour and acts;
- Zero compromise on safety; and
- Zero impacts to our families and communities

AusNet baseline for safety is our present level of performance and under the missionZero strategy we are aiming to continually improve this performance. Continuous improvement in HSEQ performance requires a commitment to improving line management accountability for safety and environment. Our leaders take responsibility for the safety of our people.

The AusNet's HSEQ plan has been developed in consultation with the executive and forms the basis of the AusNet's vision and applies to all AusNet's operations.

3.5 Asset Management and Risk Management Philosophy

AusNet's Asset Management Policy and Risk Management Policy are included in Appendix B and Appendix C respectively. They are closely linked in that a robust approach to the management of assets contributes significantly to the management of network safety risks. This recognises that some such risks arise as a result of asset failure or deterioration.

Our asset management philosophy is to utilise Reliability Centred Maintenance (RCM) as a key tool in providing structured decision making processes for the subsequent development of controls that manage the likelihood and/or consequence for identified network failure modes. RCM is an integral tool within AusNet's Asset Management Strategy (AMS) for individual key asset classes for maintaining or improving the performance of the network.

AusNet's Asset Management Policy and risk management philosophy is to minimise risk *as far as practicable*. This is consistent with the provisions of Section 98 of the *Electricity Safety Act 1998* which is to:

> *"design, construct, operate, maintain and decommission its supply network to minimise as far as practicable:*
>
> - *the hazards and risks to the safety of any person arising from the supply network;*
> - *the hazards and risks of damage to the property of any person arising from the supply network; and*
> - *the bushfire danger arising from the supply network".*

3.6 Commitment to Risk Based Network Management

AusNet is committed to risk-based network management. The Risk Management Process involves the systematic application of policies, procedures and practices to the activities of communicating and consulting, establishing the context and assessing, treating, monitoring, reviewing, recording and reporting risk. Below is an illustration of the Risk Management Process.

AusNet adopts a structured and consistent process for recognising, understanding and responding to risk.

The Risk Management Process at AusNet is an integral part of management and decision making and is integrated into the structure, operations and processes of the organisation. The Risk Management process can be applied at Strategic, Operational, Initiative and Project levels.

In broad terms, a risk-based management approach directs and prioritises risk reduction measures having regard to the likelihood and consequence of an event occurring. The objective is to minimise, monitor, and control the likelihood and/or consequence of a network safety event.

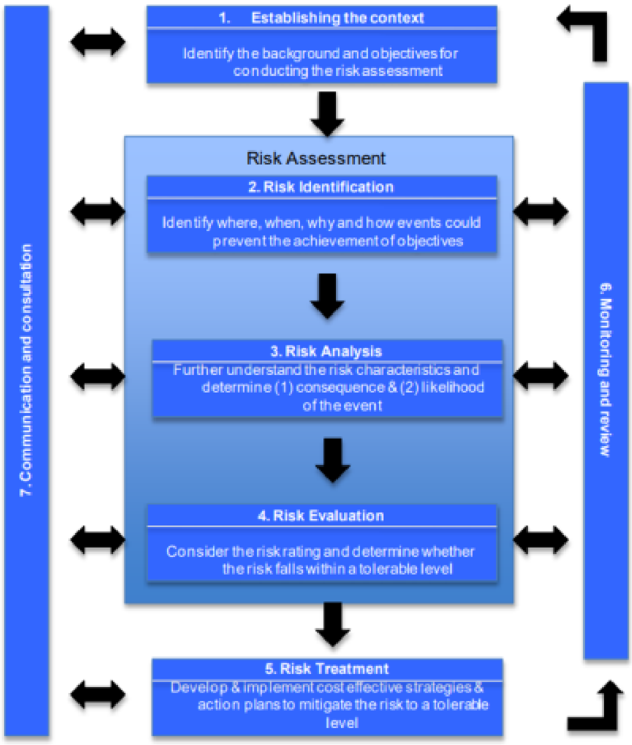

Figure 5 AusNet Risk Management Process

3.7 Key network safety risks

The key network safety risks identified by AusNet can be grouped into three broad categories, summarised below. As discussed in Section 3.5, AusNet risk management philosophy is to minimise these and other network safety risks as far as practicable.

3.7.1.1 AusNet's Assets Cause a Catastrophic Bushfire

The flow of electrical current from network assets to other than where it is intended is known as a fault and can lead to overheating and resultant ignition of flammable material such as vegetation. Depending on the level and duration of the fault and local environmental conditions such as ambient temperature, humidity, wind, and also the level and dryness of vegetation, this may result in a bushfire.

3.7.1.2 Electric Shock from Electricity Distribution Network Assets

The inherently hazardous nature of the electricity distribution network presents the risk of electric shock to employees, contractors and the public. Customers, members of the community or workers may be injured by electrical shock if they come into contact with energised electrical equipment forming the distribution network.

3.7.1.3 Loss of Supply during Extreme Weather Conditions

Loss of supply during very hot or very cold weather may have health and safety implications, in particular for elderly or infirm customers.

The context of these risks depends on the operating environment, which is discussed in Section 6, and their effective management requires identification and understanding of the causes and impacts and analysis of the controls and associated actions in place to mitigate them as far as practicable. This is discussed in detail in Sections 8, 9 and 10.

The process of mitigating risks "as far as practicable" is explained in detail in Section 10.4.1, along with the use of cost benefit analysis in achieving this. In general terms, the costs associated with removing or mitigating a risk need to be considered against the value of the benefit that will result. Where the cost is determined to be "grossly disproportionate" to the value of the resultant benefit then it may not be practicable to further reduce the risk.

4. Legislative Requirements

It is a requirement of the *Electricity Safety Act 1998* that a major electrical company (MEC) submit to Energy Safe Victoria (ESV), an electricity safety management scheme (ESMS) in respect of the design, construction, operation, maintenance and de-commissioning of each supply network.

ESV may accept an ESMS when it is satisfied that the documented scheme is appropriate to the supply network to which it applies, and that it complies with the *Electricity Safety Act 1998* and *Electricity Safety (Management) Regulations 2009*.

A MEC must comply with an ESMS which has been accepted by ESV.

Appendix L contains a list of the key Acts, Regulation and Codes pertinent to the safe management of an electricity distribution network in the State of Victoria.

The Electricity Safety (Management) Regulations 2019 and the following provide a framework for preparation of this ESMS:

- Australian Standard AS 5577-2013 "Electricity network safety management systems"; and
- ESV developed guideline "General guidance and requirements for developing acceptable Electricity Safety Management Schemes".

4.1 Requirements of AS 5577

The scope of the ESMS meets the requirements of AS 5577, as this standard provides an overarching framework for an ESMS that recognises relevant industry network engineering, technical and safety standards, codes and guidelines. Appendix MM provides a table to indicate the relevant sections within this document that demonstrate compliance with AS 5577.

4.2 Requirements of Act and Regulations

The ESMS meets the requirements of the *Electricity Safety Act 1998* and *Electricity Safety (Management) Regulations 2019,* as shown in the tables in Appendix N and Appendix O respectively.

5. Network Description

AusNet owns, operates and manages the electricity distribution network that provides access to electricity for approximately 800,000 customers.

The particular characteristics of the network affect the likelihood and consequences of a network safety event occurring and so a risk based management approach to network safety requires an understanding of network characteristics in order to minimise risk as far as practicable.

This section describes AusNet's electricity distribution network, highlighting those aspects that have the potential to adversely affect the significant network safety risks of bushfire ignition, electric shocks from the network and interruption of supply.

5.1 Network Size and Boundaries

The electricity distribution network serves the fringes of the northern and eastern Melbourne metropolitan area and the eastern half of rural Victoria, as shown in Figure 6. The network area included some densely populated suburbs such as the heavily vegetated Dandenong Ranges and growth corridors such as South Morang and Pakenham.

While the network spans an area of over 80,000km^2, the majority of customers are located in suburban Melbourne or in regional centres and towns, meaning the majority of the network services a very wide spread of minority rural customers.

The network consists of approximately 54,660km of electricity lines, predominantly consisting of overhead network that deliver electricity to approximately 800,000 customers. The network was built over a period from the 1950s to the present.

Much of the area spanned by the network is defined as Hazardous Bushfire Risk Area (HBRA), under Section 80 of the Electricity Safety Act. Assets within the HBRA are defined under the Electricity Safety (Bushfire Mitigation) Regulations as "at risk supply networks".

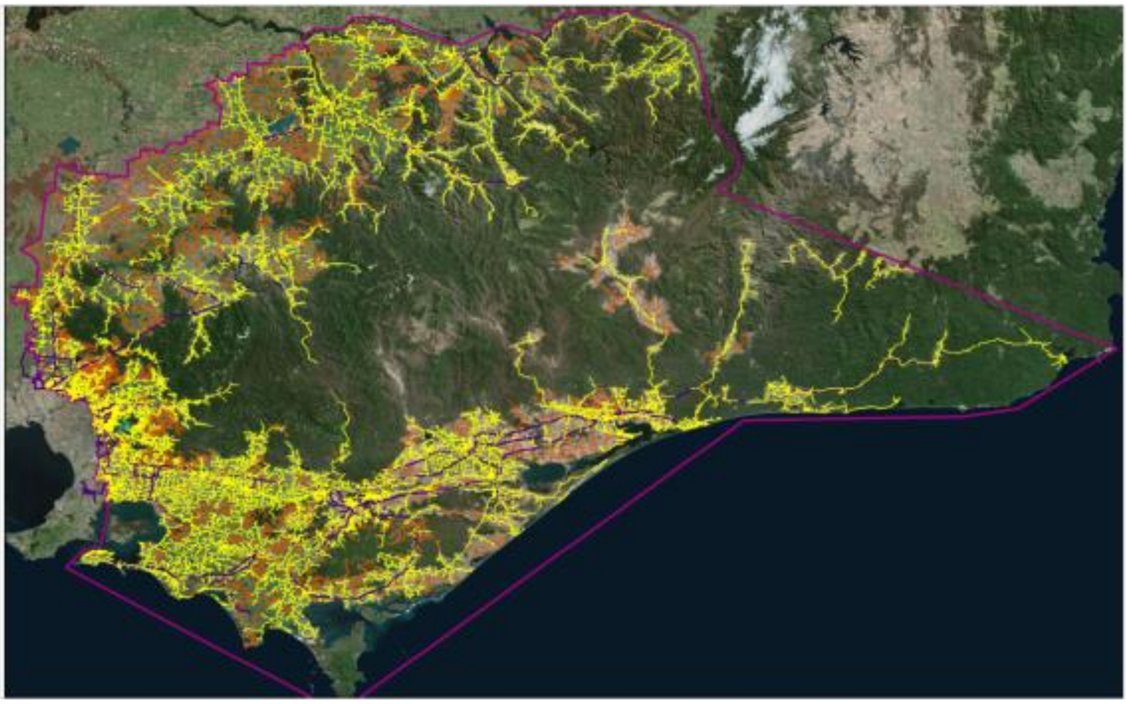

Figure 6 Size and Boundaries of Electricity Distribution Network

The purple lines in Figure 6 represent sub-transmission lines operated at 66kV, yellow lines represent distribution lines operated at 22kV, 11kV and 6.6kV, whilst orange lines represent distribution lines operated at 12.7kV.

AusNet has divided the electricity distribution network into three operating regions which are discussed in Section 6.2, including their climate conditions and topography. To safely and effectively manage the network, these regions are serviced by nine key depots located at Wodonga, Benalla, Seymour, South Morang, Lilydale, Beaconsfield, Leongatha, Traralgon and Bairnsdale.

5.2 Network Configuration

The general configuration of the electricity distribution network is included in Figure 7, which also shows the interconnection between the other components of the overall electricity system, namely generation and transmission.

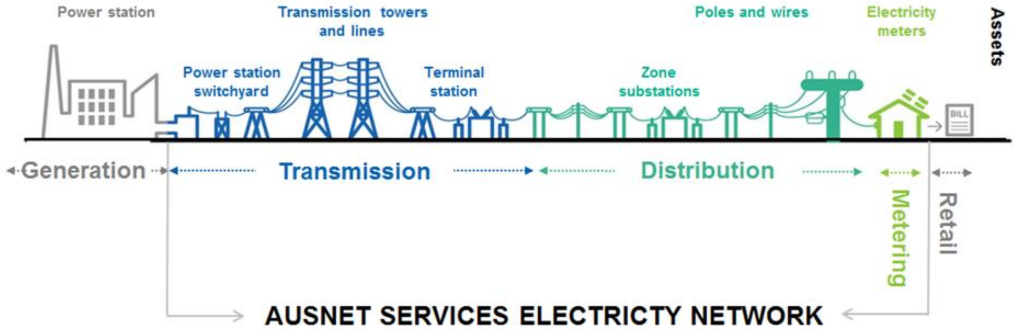

Figure 7 Typical Electricity Network Configuration

Figure 8 provides further details of how power is supplied to industrial, commercial and residential customers using both overhead and underground lines. AusNet has among the highest residential proportion of its customer base in Australia, with approximately 90% of customers classified as residential.

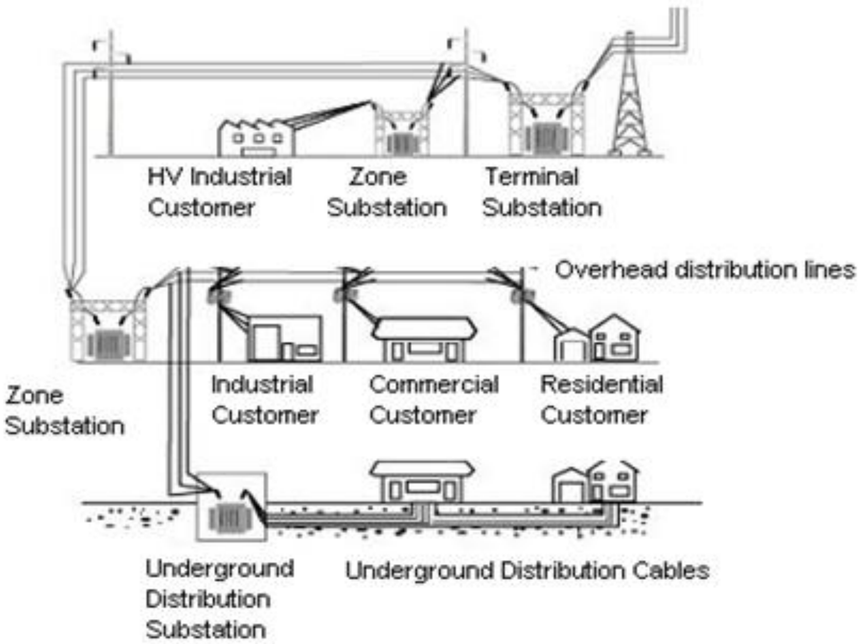

Figure 8 Typical Distribution Network Configuration

As discussed in Section 5.5.1, customers are supplied from urban and short and long rural feeders. Urban feeders are typically loop connected, which provides alternative means of maintaining electricity supply in the event of a fault on a section of the network.

However, rural feeders are typically radial in nature, which means that alternative supply points are not available. This combined with a far greater length of powerline and asset exposure per customer means that rural customers tend to have lower levels of reliability compared to those located in urban areas.

5.3 Overall Network Assets

The overall network consists of a "sub-transmission" network operated at 66kV and a "distribution" network comprising a medium voltage (MV) component (operating at voltages of 22kV, 12.7kV, 11kV, 6.6kV) and a low voltage (LV) component (operating at voltages of 230/400 V and 230/460 V).

A summary list of overall network assets is included in the table in Appendix D.

This section provides a detailed description of assets that are common to the overall network. Those assets that are specific to the "sub-transmission" and "distribution" parts of the network and/or justify special mention are discussed in Sections 5.4 to 5.8 inclusive.

The safe operation and management of all network assets is underpinned by asset management practices that conform to the principles of ISO 55001, the international standard for Asset Management.

5.3.1 Poles

AusNet's electricity distribution network has in excess of 430,000 poles of which approximately 100,000 are steel public lighting columns. The overhead distribution network consists of approximately 330,000 poles of which approximately 60% are wood poles and 40% are concrete.

Since the late 1980s, most new customers have been connected to the electricity distribution network via underground residential distribution (URD) systems. However, approximately 3,000 new poles are installed each year, driven primarily by the installation of new steel public-lighting columns.

Application of wood pole preservative treatments during pole testing, together with reinforcement techniques using steel staking or rebutting are two key factors that extend the service life of wood poles. In 2019 AusNet introduced the use of WoodScan® , a non-destructive method of monitoring pole condition and is applied to poles nearing the end of their engineering life.

The use of fibre composite poles and galvanised steel distribution poles has been researched, and analysis reveals that wood and concrete poles remain the most economic options for high volume application .

A detailed description of all poles installed in the network, including their age and condition and asset management strategies is included in the asset management strategy AMS 20-70 Poles.

5.3.2 Crossarms

There are in excess of 400,00 crossarms, of which approximately 50% are steel and 50% timber supporting the overhead distribution network.

Since 1991, low-voltage aerial bundled cable (LVABC) programs have resulted in replacement of some groups of deteriorated cross-arms, however the majority of LV circuits are still supported by Australian hardwood cross-arms. The LV timber cross-arm population is stable as most new LV circuits are underground cable or LVABC.

In the early 1970s, HV steel cross-arms were introduced with concrete poles and became standard construction for 66kV lines in the late 1970s and for 22kV, 11kV and 6.6kV circuits following the 1983 bushfires. Accordingly, the number of steel cross-arms in service continues to rise, and the number of HV timber cross-arms is declining quickly, as new and replaced HV cross-arms are galvanized steel.

In 2011,the replacement rate of timber cross-arms increased significantly following the introduction of aerial inspection that is effective in detection of timber crossarm deterioration. As a result of the enhanced condition assessment techniques and the steel crossarm policy, crossarm failure rates have fallen.

A detailed description of all cross-arms, including their age and condition and asset management strategies is included in AMS 20-57 Cross-arms.

5.3.3 Insulators

In total, the network has approximately 990,000 high voltage and medium voltage insulators supporting conductors. The total number of insulators comprises approximately 80,000 66kV insulators, with the balance utilised on medium voltage networks consisting of 22kV, 11kV and 6.6kV circuits.

The steel crossarm policy for high and medium voltages has driven the progressive removal of fog profile pin type insulators from the network which represent the oldest cohort of insulators.

A detailed description of insulators including their age and condition and asset management strategies is included in AMS 20-66 Insulators – High and Medium Voltage.

5.3.4 Conductors

In total, the network includes more than 39,000km of bare overhead conductor of which approximately 80% is high and medium voltage. Bare conductor is manufactured from four main categories of material; galvanised or aluminised steel strands, aluminium conductor with steel reinforcing strands, all aluminium strands, and copper strands.

Spacers are used primarily on LV circuits to maintain required separation between conductor phases during adverse weather conditions. To simplify decisions regarding where and when to install spacers the practice to install them on all LV spans in Hazardous Bushfire Risk Areas (HBRA) was introduced in the 1990s.

Tension and non-tension joints are widely used across the network. Joint failures account for the majority of unassisted conductor failures. The majority of mechanical damage to conductors occurs at the end of spans where the conductors are secured to insulators. Conductor movement and vibration are factors that may cause strands to rub against each other, as well as against the supporting insulator and conductor ties. Depending upon factors that include conductor type, tension and location, armour rods and vibration dampers are used to protect and prevent respectively, deterioration of conductors and ties.

A detailed description of conductor installed, including its age and condition and asset management strategies, is included in AMS 20-52 Conductors.

5.3.5 Insulated cables

The network includes high voltage, medium voltage and low voltage insulated underground cables and medium voltage and low voltage insulated overhead cables including covered conductor systems.

In total, there are approximately 15,600km of underground insulated cables and more than 1,000km of overhead insulated cables.

Underground insulated cable systems have been in service since the 1970s and overhead insulated cable systems were introduced in the 1990s. These populations have significantly increased over the past two decades, attributed to requirements of housing in underground residential development (URD) estates using medium voltage and low voltage underground cables.

The majority of 22kV underground cables are located in road reserves in housing estates with underground power lines. The remainder are MV underground feeder exits or 66kV line entries to zone substations. They are typically short lengths of cable from a switchyard to a cable-head pole in a nearby street, from where the feeder or line then reverts to overhead construction.

Although underground insulated cable systems are exhibiting low failure rates, objective health information of the cable system is required to ensure prudent future economic replacement programs are developed. Implementation of REFCL technology has been a driver for replacement of medium voltage cables in deteriorated condition.

Medium voltage overhead insulated cable consist of three design types; non-metallic screened high voltage aerial bundled cable (NMS HV ABC), light duty metallic screened high voltage aerial bundled cable (LDMS HV ABC) and insulated unscreened conductor (IUC), which includes spacer cable systems

(SCS) and open wire covered conductor (OWCC). Each of these designs use cross-linked polyethylene (XLPE) as the main insulation. HV ABC are fully insulated cables whereas IUC systems cables are not.

Overhead NMS HV ABC systems have been replaced with LDMS on 22kV systems as they were demonstrating insulation failure due to voltage stresses.

AMS 20-65 Insulated Cable Systems identifies risks and contains specific management strategies, including replacement of insulated cable terminations and joints and sections of underground cable and replacement of HVABC circuits which have been damaged by falling trees.

5.3.6 Distribution transformers

The network includes approximately 62,800 distribution transformers to convert electrical energy from 22kV, 11kV or 6.6kV to 420/230 V in urban areas or 460/230 V in rural areas.

Approximately 90% of distribution transformers are mounted on poles located in road reserves or on private property. The remainder are in kiosks, small outdoor switchyards or within a room in a commercial building. Over 60% of transformers are small capacity single-phase units or single wire earth return (SWER) units located in rural areas.

A detailed description of distribution transformers installed the electricity distribution network, including their age and condition is included in AMS 20-58 Distribution Transformers.

5.3.7 Earthing

In total, AusNet's electricity distribution network has approximately 300,000 earths connecting electrical equipment to the general mass of earth at more than 220,000 sites throughout the eastern part of the state of Victoria.

The earths range from individually designed zone substation earth grids comprising large grids of copper conductor buried beneath each switchyard to include more than 175,000 simple earths for poles or pole-mounted equipment and more than 120,000 earths associated with distribution substations arranged as Multiple Earthed Neutral (MEN) earthing systems located in public places and in easements on private property.

Earths are constructed from materials specifically selected for high electrical conductivity and high corrosion resistance. They are designed to match the expected life of the equipment they service and are installed at sufficient depths below ground level to minimise disruption by excavation.

To ensure the reliable operation of electrical protection systems and the management of step, touch and transfer potentials, a rigorous testing regime, based on statistically representative samples, ensures that corrosion or mechanical damage has not jeopardised the resistance to ground of earthing assets.

Earth maintenance and replacement is primarily driven by the testing program and secondarily by the maintenance and replacement of the electrical equipment which the earth serves.

In zone substations, capacitor bank stations, power station switchyards and for line voltage regulators, individual designs require each piece of high voltage, medium voltage and low voltage electrical equipment to be directly connected to a single large earth grid located within the security fence. These earth grids were installed when the substation switchyards were originally established and may have been progressively augmented as additional plant was installed.

A detailed description of the earthing assets in zone substations, including their age and condition and management strategies is included in AMS 20-59 Electrical Earths.

5.3.8 Protection, control and monitoring

Protection relays provide electrical protection and operational control of 66kV lines, zone substation bus bars, power transformers, capacitors and MV feeders.

The principal goals for protection and control system development, as detailed in the asset management strategy AMS 20-72 Protection and Control Systems, are:

- Replacement of protection relays that do not meet bushfire mitigation requirements;
- Replacement of unreliable and maintenance intensive equipment;

- Replacement of equipment that is no longer available for purchase and not manufacturer supported;
- Standardisation of schemes and relay types; and
- Progressive replacement of electro-mechanical and analogue electronic relays with Intelligent Electronic Devices (IEDs)

Remote control and monitoring systems refer to the control and monitoring of zone substations and MV feeder installations from the Customer Energy and Operations Team (CEOT) via remote terminal units (RTUs) and station controllers (SCs). These systems are summarised in AMS 20-72.

Further detail on the management of protection, control and monitoring assets, including associated risks, is included in AMS 20-72.

5.3.9 Communication systems

The network operates communication related assets at different geographical locations which include zone substations, control centres, data centres, administrative offices and pole-top locations.

High-speed real-time communications links are used for protection signalling to reduce the time required to disconnect both ends of a faulted 66kV line and to ensure that no other 'healthy' line is also disconnected. Communications links also provide reliable voice communications to zone substations, remote Supervisory Control and Data Acquisition (SCADA), status, instrumentation, metering and alarms to the CEOT for zone substations and remote-control MV switches.

Optical Fibre cable is the preferred communications bearer and is used wherever economic. Optical Fibre Bearers are very reliable and can be used over long distances depending on the terminating equipment used (e.g. 80km is typically supported by most equipment vendors). Where Optical Fibre is not economic and terrain supports line-of-sight mediums, point-to-point Microwave and RF Radio links have been deployed as bearer communication links. Microwave and RF radio bearers can also be used over long distances with 40km being a typical distance. In the event the above options are not possible, third party services such as Asymmetric Digital Subscriber Line (ADSL), Broadband Digital Subscriber Line (BDSL), and Integrated Services Digital Network (ISDN) and Frame Relay are used as bearer links. These are typically provided by Telstra and others depending on which operator has service coverage in that geographical area.

Wireless communication services enable communication services where there is no fibre or radio link connectivity and last mile (access) communication to nearest site with fibre or radio link connectivity.

AusNet uses the Victorian State Government State Mobile Radio system, also known as the Trunk Mobile Radio (TMR), for mobile voice and slow-speed data communications. TMR is maintained and operated by Telstra and provides mobile voice and slow-speed data communications to utilities and emergency-services vehicles. TMR has coverage of 90% of Victoria.

A detailed description of Communication Systems installed in the network, including their age and condition and management strategies is included in AMS 20-81.

5.3.10 Operating parameters

In accordance with the Electricity Distribution Code[4] nominal operating voltages within the AusNet electricity distribution network are listed in Table 1.

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[4] Electricity Distribution Code 2012, Essential Services Commission

Table 1: Operating Voltages

Network	Voltage	Location
Subtransmission – 3 Phase	66kV	Urban and Rural areas
Distribution 3 Phase and Single Phase	22kV	Urban and Rural areas
Single Wire Earth Return (SWER)	12.7kV	Rural areas
Distribution - 3 Phase	11kV	Coal mines and power stations in Latrobe Valley
Distribution - 3 Phase	6.6kV	Areas of Dandenong Ranges from MDG, SFS and UWY zone substations and coal mines and power stations in Latrobe Valley
Distribution - 3 Phase	400/230V	Supply to consumers in Urban areas and larger consumers in Rural areas
Distribution - Single Phase	460/230V	Supply to smaller consumers in Rural areas

The Electricity Distribution Code requires AusNet to control operating voltages within the values depicted in Figure 9.

STANDARD NOMINAL VOLTAGE VARIATIONS				
Voltage Level in kV	Voltage Range for Time Periods			Impulse Voltage
	Steady State	Less than 1 minute	Less than 10 seconds	
< 1.0	+10% - 6%	+14% - 10%	Phase to Earth +50%-100% Phase to Phase +20%-100%	6 kV peak
1-6.6	± 6 % (± 10 % Rural Areas)	± 10%	Phase to Earth +80%-100% Phase to Phase +20%-100%	60 kV peak
11				95 kV peak
22				150 kV peak
66	± 10%	± 15%	Phase to Earth +50%-100% Phase to Phase +20%-100%	325 kV peak

Figure 9 Nominal Operating Voltage Variations

Voltages in the sub-transmission network can vary considerably in response to variations in circuit loading. To protect customers' installations from voltage variations, on-load tapchangers are fitted to the power transformers within zone substations.

Other equipment employed for voltage control includes:

- Terminal Station Transformer on load tap changers (for control of the 66kV network voltage);
- Line voltage regulators (regulating transformers) for both 66kV and 22kV network voltage control;
- Capacitor Banks in zone substations;
- Pole Top Capacitors;
- Off-load voltage taps on distribution transformers (for adjustment of the 400/230V and 460/230V supplies to consumers);
- Static VAr Compensators (SVCs); and
- Generation – embedded in 22kV feeders

5.3.11 Operating constraints

With the network intact, there are no operating constraints at the forecast loading levels within either the "sub-transmission" or "distribution" parts of the network. Under network abnormal conditions, such as the contingency outage of a major network component (eg. zone substation transformer) two constraints may apply:

- Thermal overloading – where excess current flow results in conductor temperatures rising above design limits. Typically only applies at periods of high ambient temperatures; and
- Voltage collapse – where excess current flow results in a decrease in the network voltage to the extent that the operating voltage collapses. That is, the network is unable to sustain the operating voltage within the limits of the Distribution Code;

For both constraints, it is necessary to reduce load on the network concerned to a level pre-determined by network engineering studies until such time as repairs to the faulted equipment can be completed.

5.3.12 Security of supply

Security of supply is primarily provided by the configuration of circuits within the network. The sub-transmission network is normally configured as a series of loops from each terminal station (connection point) to provide two supply circuits to each of two or three zone substations within each loop. The design philosophy for sub-transmission circuits is that supply is maintained to all consumers in the event of an outage of any single element in the sub-transmission loop.

The security of supply of the distribution network, which is generally operated as a series of radial feeders from each zone substation, is primarily provided by normally-closed switches in the backbone of each feeder and normally-open switches between selected feeders. Strategic placement of switches allows segregation of each feeder into healthy or faulted segments and interconnection between selected feeders enables supply to healthy feeder segments from alternate feeders. In urban areas interconnections between feeders are common and automated switching schemes can automatically re-configure alternate supplies to healthy feeder segments around a faulted segment. However, in the more remote rural areas there is limited interconnectivity between feeders and under fault conditions or network operation and maintenance activities there is limited capacity or, in many cases, ability to support these sections of the network from adjacent feeders.

Extensive use is made of auto-reclose controls on circuit breakers in both the sub-transmission and distribution supply networks to minimise supply disruptions due to transient faults such as birds or animals or wind-blown vegetation. Automatic circuit reclosers (ACRs) are installed in MV feeders in rural areas to minimise the effects to customers of transient faults. The controls of ACRs are configured to operate in conjunction with sectionalisers and MV fuses located downstream of the ACR to permit the disconnection of faulted feeder segments and automatic supply restoration to the healthy upstream feeder segments.

In addition to the abovementioned, security of supply for the network as a whole is also maintained by:

- Selection of appropriate materials for the specific application (e.g. longer insulators for high pollution areas);
- Development and application of appropriate design standards;
- Plant and equipment performance specification;
- Construction and maintenance procedures and practices (eg. "live line working", appropriate levels of maintenance);
- Operational procedures and practices for efficient and timely response to events and application of contingency switching;
- Redundancy in key functions (duplicated protection systems);
- Online monitoring (network and individual assets and individual customer connections);
- Uninterruptable power supplies for network control and key functions;
- Emergency management procedures and processes (SPIRACS[5]); and
- Contingency planning

[5] SPIRACS is the Strategic Plan for Integrated Response and Contingency System

5.3.13 Embedded generation

Embedded generation is a generic term describing any generation that is located within an electricity network which is not dispatched by the network operator.

There are more than 80,000 embedded generators connected within the AusNet electricity distribution network. All but 23 are small (<5kW) photovoltaic arrays which have been connected over the last decade. The remaining 23 installations range in capacity from a few kVA for LV (460/230V) interconnected micro-generators to more than 10MW for units connected to 66kV sub-transmission circuits. Larger (40MW and 90MW) units are gas and briquette fired but the energy sources are varied and include:

- Hydro;
- Biomass;
- Landfill Gas;
- LPG / LNG;
- Wind;
- Solar;
- Photovoltaic; and
- Briquettes.

Generation installations embedded in the AusNet electricity distribution supply network are not owned or operated by AusNet. However the requirements for their connection to the network, including protection, operation and voltage control are defined by AusNet in accordance with the requirements contained in the Electricity Distribution Code. This Code also defines the responsibilities of the embedded generators to AusNet and to other parties connected to the electricity distribution supply network.

5.3.14 Distributed Energy Sources

Increasingly, distributed power supplies are playing a greater role in supplying electricity to remote communities. These options are considered where they provide benefits in lower overall service delivery costs, network support and mitigation of bushfire risk.

AusNet has recently commenced a small number of developmental trials that will better inform the effectiveness and operational requirements for Battery Energy Storage Systems (BESS) and Stand-alone Power Supplies (SAPS).

BESS assets are typically lithium-ion battery installations (>1MW) providing network support whereas SAPS are being trialled as an ‘edge of grid’ alternative to maintaining existing poles and wire assets to supply existing customers. SAPS consist of a battery, solar panel and generator configuration that typically service single, small capacity installations.

5.3.15 Critical assets

This section discusses elements of the electricity distribution network considered critical to network integrity and delivery of network safety objectives.

As discussed in Section 3.5, some network safety related risks arise due to asset failure or deterioration and so the integrity of critical assets is very important. With respect to the three most significant network safety risks discussed in Section 3.7, we regard the overhead distribution network in hazardous bushfire risk areas, electrical protection, and earthing as critical network assets, as discussed below. Because of the criticality of these assets, they are included in the Enhanced Network Safety strategy (AMS 20-13).

Overhead Distribution Network Assets

The distribution network, predominantly consisting of overhead lines, traverses suburban, regional and rural areas in the east of Victoria. Experience indicates that such networks have the potential to cause fire ignition. The network is located in areas which have among the world’s highest level of bushfire risk. The Powerline Bushfire Safety Taskforce (PBST) and 2009 Victorian Bushfires Royal Commission (VBRC) acknowledged this and the challenges in cost effectively addressing bushfire risk through new technologies.

With respect to network safety, the overhead network assets that are most critical are MV fuses, wooden crossarms, conductors and service cables, as failure of these assets have the potential to cause fires and/or electric shocks.

As discussed in detail in Section 12.1.1, a specific Enhanced Network Safety strategy (AMS 20-13) addresses the issues regarding these assets. This includes programs of work to reduce the risk, the timely completion of which is tracked by the Network Safety Management Committee.

Electrical Protection Assets

Electrical protection assets such as instrument transformers, protection relays, fuses and circuit breakers (CBs) are used to detect and disconnect abnormal electrical currents that would otherwise expose customers and the community to hazardous voltages, ignite vegetation or building fires and damage electricity network assets entailing long outages for repair and replacements.

The sensitivity, speed and reliability of protection systems in disconnecting abnormal electrical currents is critical to public safety and network reliability so each electrical protection scheme is duplicated to provide functional redundancy or backed-up by an independent scheme. Discrete protection zones ensure that each part of the network is protected and that only selected (faulted) portions of the network are disconnected in order to minimise customer disruption.

Modern electronic protection relays controlling CBs and automatic circuit reclosers (ACRs) now include self-testing and self-monitoring facilities to warn network operators of emerging defects via supervisory control and data acquisition (SCADA) communications.

AusNet apply settings of greater sensitivity to electrical protection assets in those parts of the network located in high bushfire risk areas on Total Fire Ban days. This is in accordance with recommendations from the Powerline Bushfire Safety Taskforce and Direction issued by ESV.

AusNet has completed the installation of Rapid Earth Fault Current Limiter (REFCL)[6] technology in twenty two zone substations prescribed under the *Electricity Safety (Bushfire Mitigation) Regulations* by May 2023. The purpose of the technology is to provide a higher degree of electrical protection sensitivity than traditional protection schemes so that earth fault currents on high fire danger days are maintained below levels considered to minimise the risk of fire ignition. Further details of the Plan and the technology are provided in AusNet's Bushfire Mitigation Plan (BFM 10-01).

Overarching protection philosophies employed by AusNet throughout the electricity distribution network are detailed in the Station Design Manual SDM 06-0100 Protection and Control Philosophy and Distribution Design Manual 30–4161–09 Distribution Feeder Protection.

Earthing Systems

The AusNet electricity distribution supply network is an effectively earthed network. In the event of a fault to earth the earthing assets enable the flow of electricity to the general mass of earth under such circumstances that step, touch and transfer voltages are managed, fire ignition is minimised and electrical protection systems operate to limit network damage.

Complex installations such as zone substations employ a local earthing system in which each piece of electrical equipment and each conductive structure is connected to the general mass of earth via a dedicated earth grid located within the security fence.

Other MV equipment such as line voltage regulators, automatic circuit reclosers, conductive poles, switches and distribution transformers also employ local earthing systems comprising dedicated earthing conductors and electrodes in order to establish a low resistance electrical connection to the general mass of earth.

AusNet employs Individual Multiple Earthed Neutral (IMEN), Interconnected Multiple Earthed Neutral, Common Multiple Earthed Neutral (CMEN) and Direct Earth (DE) systems to connect the star point of the LV winding of distribution transformers, LV neutral conductors and customer LV neutral conductors to the general mass of earth.

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[6] Ground Fault Neutralisers (GFNs) are a proprietary REFCL product that AusNet are currently installing.

A detailed description of earthing systems, including their age and condition and management strategies is included in AMS 20-59 Electrical Earths.

5.3.16 Design and construction

The electricity distribution network is designed and constructed in accordance with the Standard Installations Manual 30-4142 and the relevant standards nominated in Appendix J "Published Technical Standards" and Appendix K "Industry/Company Technical Standards".

Further details can be found in Sections 11.3.5 and 11.3.6.

5.3.17 Maintenance

The electricity distribution network assets are maintained through scheduled inspection cycles contained in the SAP based Enterprise Asset Management information system (previously Q4), discussed in Section 12.3. Inspection and condition assessment criteria are provided by the Asset Inspection Manual 30-4111.

5.3.18 Operation

Operation of the electricity distribution network assets is controlled through the CEOT in accordance with the standards nominated in Appendix J "Published Technical Standards" and Appendix K "Industry/Company Technical Standards". Access to assets is controlled by the CEOT in accordance with the procedures and processes discussed in Section 11.3.9.

5.4 Sub-transmission Network Assets

This section includes a detailed description of the sub-transmission assets and the relevant asset management strategies that are used in their management. More detailed discussion of asset management strategies is included in Section 12.

The sub-transmission network is supplied from the Extra High Voltage (EHV – 500kV, 330kV, 220kV) transmission network at 11 terminal stations[7] (connection points). It consists of 2,500km of 66kV lines made up from more than 100 individual circuits supplying more than sixty zone substations/switching stations[8].

The 66kV networks are generally formed in loops which are fed from individual terminal stations. The sub-transmission loops are generally not interconnected except under abnormal or emergency conditions. The loop configuration serves to maximise the reliability of the sub-transmission network by providing to most zone substations at least two sources of supply. However, supplies to Barnawartha, Phillip Island, Cann River, Newmerella, Mansfield and Merrijig substations are radial with limited alternate supplies available via 22kV feeders during periods of low loadings.

In some instances AusNet shares part of its sub-transmission network with other distribution businesses, namely United Energy and Jemena.

The extent and location of the AusNet's sub-transmission network is summarised in drawing VX6/306/7 - Diagram of 66kV System.

5.4.1 Sub transmission lines

Sub-transmission lines transmit electricity at 66kV from terminal stations to zone substations and between zone substations. Their key asset components are poles, crossarms, conductors and insulators. They are constructed on a mixture of timber and steel-reinforced concrete poles with predominantly steel crossarms and all aluminium or aluminium conductor steel reinforced conductors.

[7] Refer to Appendix E for list of AusNet's terminal station connection points
[8] Refer to Appendix F for list of AusNet's zone substations/switching stations

Sub-transmission poles are essentially the same as those used for medium voltage distribution circuits. Section 5.3.1 of this document discusses poles and refers to AMS 20-70 Poles for detail on the risks and management strategies.

Galvanized steel crossarms have been the standard for sub-transmission circuits since the 1980s, but there remain several thousand timber crossarms supporting sub-transmission circuits. Section 5.3.2 of this document also discusses crossarms and refers to AMS 20-57 Crossarms for detail on the risks and management strategies.

Aerodynamic shaped porcelain post insulators have been the standard for sub-transmission circuits since the 1980s, but there remain several thousand installations where pin type insulators and timber crossarms support sub-transmission circuits. Section 5.3.3 of this document discusses insulators and refers to AMS 20-66 Insulators - High and Medium Voltage for detail on the risks and management strategies.

Sub-transmission circuits are predominantly formed from all aluminium conductors (AAC) but there are significant quantities of aluminium conductor steel reinforced (ACSR) in service. Section 5.3.4 of this document discusses conductors and refers to AMS 20-52 Conductors for detail on the risks and management strategies.

5.4.2 Zone substations

Zone Substations connect the 66kV sub-transmission network to the distribution supply network. They are strategically located close to the load centres. Typically several zone substations are supplied from each sub-transmission network “loop”.

Appendix F lists the zone substations/switching stations in the AusNet electricity distribution supply network.

Zone substations are supplied from one to four incoming 66kV lines which are either connected directly to a 66kV transformer bus or connected via a circuit breaker to a 66kV bus. Incoming 66kV lines are fitted with disconnector switches to facilitate isolation and earthing for maintenance work on the line or the voltage transformers or surge arrestors connected to the line entry conductors. 66kV busses are arranged in linear, tee or ring configurations depending on the number of 66kV lines and transformers within the station.

Zone substations, strategically located near regional load centres convert the electrical energy from 66kV to a medium voltage (MV) of 22kV, 11kV or 6.6kV. The majority of these zone substations contain 66/22kV transformers to supply a mixture of urban, long rural and short rural feeders operating at 22kV. The Latrobe valley power stations and mines are supplied via six dedicated zone substations supplying feeders operating at 11kV and 6.6kV. Three 22/6.6kV zone substations supply the Dandenong ranges via three 6.6kV feeders.

Smaller capacity zone substations, supplying relatively few customers, have power transformers connected in banks with a single differential protection zone covering all assets in the zone substation. Larger capacity transformers, in stations supplying many customers, are individually protected by circuit breakers and have individual protection schemes. Each transformer is fitted with surge arrestors and disconnector switches with earthing facilities, on both the HV and MV sides. The transformers are equipped with On Load Tap Changing facilities to provide automatic control of the distribution voltage.

Transformers supply from one to three medium voltage busses which are interconnected via manually operated disconnector switches in smaller zone substations, and by medium voltage circuit breakers in larger zone substations. Voltage transformers and auxiliary power transformers are connected to the MV busses to power protection equipment, provide status information and to power auxiliary lighting and power circuits including battery chargers.

MV feeders are connected to the MV busses via individual circuit breakers and manually operated disconnectors. Each MV feeder exiting the zone substation by way of overhead conductors is equipped with surge arresters inside the substation.

Other assets within zone substations include:

- 22kV Capacitors for power factor correction and network voltage support;
- Neutral Earthing Resistors to limit fault current and improve quality of supply on the distribution supply network;

- Protection systems to limit the impact of faults in terms of safety, supply disruption and plant and equipment damage;
- SCADA facilities to provide remote monitoring and control from the Customer Energy and Operating Centre;
- Communications equipment to support the SCADA system and network operations functions;
- Metering equipment; and
- Batteries and battery chargers to provide DC power for circuit breakers, protection relays and SCADA and communications equipment.

Power Transformers and Station Voltage Regulators

Power transformers and station voltage regulators are the more critical and costly items in AusNet's inventory. They are subject to high utilisation levels, which has resulted in some stations requiring augmentation. The power transformer fleet consists of approximately 140 transformers with nameplate continuous ratings ranging from 2 MVA, to maximum continuous power ratings of 45 MVA. The network also contains approximately six station voltage regulators, with nameplate continuous ratings ranging from 20 MVA, to maximum continuous power ratings of 40 MVA.

The most common power transformers in the distribution network have a 66/22kV voltage ratio – supplying approximately 80% of the distribution network capacity. The two most common transformer vector groups are the Yy0 and Dy1.

AMS 20-71 Power Transformers and Station Voltage Regulators summarises the strategies and plans to manage power transformers, including replacement and refurbishment, to maintain the reliability and quality of electricity supplies.

Neutral Earthing Devices (NEDs)

The power transformer medium voltage winding neutral points within zone substations are directly connected to earth or connected via neutral earthing resistors (NERs), or in stations with delta-connected phases, through neutral earthing compensators (NECs). In general, both NERs and NECs are referred as NEDs with a primary function to reduce fault currents and thereby minimise damage to plant and equipment together with reducing wider system disturbance.

There are approximately 50 NERs and six NECs installed in zone substations. AusNet completed the installation of Rapid Earth Fault Current Limiters (REFCL) at 22 zone substations as prescribed in the Electricity Safety (Bushfire Mitigation) Regulations. Some zone substations have the REFCL technology installed remotely from the zone substation. The primary function of REFCLs is for bushfire mitigation purposes through the minimisation of earth fault currents on days of high fire danger.

Strategies for the management of risks associated with NERs, NECs and REFCLs are described in AMS 20-79 Neutral Earthing Devices.

Circuit Breakers

AMS 20-54 Circuit Breakers applies to approximately 1,000 circuit breakers operating at 66kV, 22kV, 11kV and 6.6kV located in zone substations.

Availability Work Bench software has been used to create reliability centred maintenance models of the circuit breakers in this fleet. The probabilities of failure have been derived from circuit breaker condition and the safety, reliability, plant collateral damage and environmental effects of failures have been calibrated to recent observations.

AMS 20-54 discusses this modelling and the strategies for the management of circuit breakers.

HV Switches, Disconnectors and Earth Switches

There are more than 2,300 HV switches, disconnectors and earthing switches installed within zone substations in the AusNet electricity distribution network.

The most common failure modes of HV switches and disconnectors are insulator failure, primary contact welding and disconnector blade misalignments. Most of these failures occurred during switching operations, which may pose health and safety risks to the operators.

AMS 20-62 HV Switches, Disconnectors and Earth Switches describes the strategies required to manage these assets.

Instrument Transformers

AMS 20-63 Instrument Transformers applies to approximately 1,300 independent single-phase and three-phase post type current transformers (CTs) and approximately 600 voltage transformers (VTs), magnetic voltage transformers (MVTs) and capacitive voltage transformers (CVTs) in the electricity distribution network. Toroidal current transformers that are built into transformers, Gas Insulated Switchgear (GIS) and bulk oil circuit breaker bushings are not included in this assessment.

AMS 20-63 includes risk modelling and the strategies for the management of instrument transformers.

Capacitor Banks

AMS 20-53 Zone Substation Capacitor Banks includes asset information and relevant strategies for capacitor banks in zone substations and the capacitor bank station at Erica (CERA). This document defines the asset management strategies for the fleet of approximately 60 medium voltage capacitor banks located in zone substations to maintain the safety, reliability, quality and security of supply of the electricity distribution network in the eastern part of Victoria. The main purpose of capacitor banks is to provide reactive (VAr) support, to maintain voltage and power factor within the limits of the Electricity Distribution Code and to maintain voltage stability.

Some stations have one, two or three capacitor banks depending on the reactive support required at that location. Capacitor banks are switched "ON" only when required. To provide the appropriate amount of reactive power they are connected through step switches. These step switches are circuit breakers, for which asset management strategies are included in AMS 20-54 Circuit Breakers.

The general strategy is to replace key components such as capacitor cans, series reactors, circuit breakers, step switches and neutral current transformers upon failure. In some cases it is practical and economical to replace the whole bank when it is technically obsolete, suitable spares are not available and no manufacturer support is available.

Surge Arresters

AusNet has about 1,600 surge arresters installed in zone substations. These surge arresters are installed between conductors and electrical earth on 66kV line entries, on each side of power transformers, on insulated cable ends and on 22kV, 11kV and 6.6kV feeder exits from zone substations.

With the replacement of selected silicon carbide surge arresters, the fleet has become predominantly metal oxide (60%) with the remaining units (40%) being silicon carbide.

A detailed description of surge arresters installed in zone substations, including their age and condition and asset management strategies is included in AMS 20-77 Surge Arrestors in Zone Substations.

Protection and Control Systems

Protection relays provide the basis for all protection and control schemes within zone substations. They work in combination with instrument transformers, to detect electrical faults and, via the operation of circuit breakers, rapidly disconnect faulted circuits from sound circuits.

Station Design Manual SDM 06-0100 Protection and Control Philosophy contains information on the principles and practices defining the application of electrical protection within zone substations. A fundamental philosophy is that protection systems within zone substations are either fully duplicated or paired in primary/backup schemes. The duplicated systems are referred to as X and Y systems and are designed to operate independently and without common points of failure. If a fault occurs, X and Y schemes are both expected to operate within a similar time. For a failure of one of the X or Y protection schemes, the alternate protection will remain in service. In a primary /backup scheme, if the primary device fails to operate for a fault, the backup device is relied upon to clear the fault. Unlike X and Y schemes, the operation time of the backup device is set to be slower than the primary device. Operation of the backup protection may affect clearance times or lead to outage of a larger section of the network than otherwise necessary to isolate the fault, but is designed to isolate the fault within an acceptable time to minimise equipment damage and protect operators and the public from hazardous electrical conditions.

Automatic reclose facilities are provided for 66kV circuit breakers within the sub-transmission network to minimise supply disruption and outage times associated with temporary faults.

Auxiliary Power Supplies

There are approximately 130 batteries installed in zone substations, ranging from 6V to 240V, 125 ampere-hours. The majority (80%) are valve regulated lead acid gel batteries. The remainder are flooded lead acid batteries, which are being phased out.

Zone substation AC systems supply energy for transformer cooling, transformer on load tap changers, lighting, air conditioning and general purpose outlets. There are approximately 80 station service transformers installed in zone substations with ratings up to 300kVA.

Batteries are subject to maintenance on a six-month interval and planned replacement after their expected life.

Further detail is included in AMS 20-80 Auxiliary Power Supplies.

Civil Infrastructure

AMS 20-55 Civil Infrastructure defines the asset management strategies for the civil infrastructure associated with the electricity distribution network to maintain the safety, quality and security of electricity supply.

AusNet operates about 70 sites including zone substations, voltage regulator sites and shared assets in terminal stations, as critical hubs in the electricity distribution network. These substations provide switching and/or transformation functions. The civil aspects of these stations affect the environmental performance, safety, security and reliability of the network.

Assets within the classification of civil infrastructure are generally situated within the boundaries of each site. Civil infrastructure includes buildings, environmental systems, security fencing, switchyard, equipment support structures, foundations, cable ducts and trenches, signage and nameplates, access roads, station lighting, transformer enclosures and water supply and drainage systems.

The majority of these assets are maintained by corrective maintenance activities based on condition with limited preventative maintenance specific to civil infrastructure. Condition assessment has been performed on major civil infrastructure assets such as buildings, environmental systems, security fences and switchyards.

Key issues related to the civil assets include the significant volume of asbestos within buildings, compliance to standards of environmental systems, buildings and security fence condition, and condition of switchyard surfaces, cable trenches, access roads and station lighting. Asbestos is present in 80% of zone substations with varying levels of volume and condition.

Where economic, civil infrastructure maintenance has been integrated with other replacement/maintenance activities in zone substation augmentation and redevelopment projects.

A detailed description of the civil infrastructure assets and their age and condition is included in AMS 20-55.

5.4.3 Earthing

The sub-transmission network is an effectively earthed system. In the event of a fault to earth on the network, the earthing assets enable the flow of electricity to the general mass of earth under such circumstances that step, touch and transfer voltages are managed, fire ignition is minimised and electrical protection systems operate to minimise safety risks and equipment damage.

Plant and equipment within the sub-transmission network employ local earthing whereby each piece of electrical equipment and each conductive structure is directly connected to the general mass of earth via a dedicated earth connection. 66kV sub-transmission lines containing a continuous series of concrete poles have an aerial earth installed. Each concrete pole is earthed and bonded to the aerial earth which is isolated from the earthing grid of any zone substation. Technical details of earthing arrangements can be found in 30-4142 Standard Installations Manual and the Station Design Manual (SDM). The risk and management strategies for earthing assets are discussed in AMS 20-59 Electrical Earths.

5.4.4 Voltage control

Voltage control on the sub-transmission network is achieved by a combination of means including:

- Automatic, on load tapping of transformers at terminal stations;
- 66kV Line Regulators;
- Static VAr Compensators (SVCs);
- Generation (embedded and main); and
- 66kV and 22kV Capacitor Switching.

Not all these facilities are controlled by AusNet and hence the voltage targets require negotiation with other connected parties. Target voltages for the terminal stations are provided to AEMO on an annual basis.

5.5 Distribution Network Assets

5.5.1 Medium voltage distribution assets

The 22kV distribution network is supplied by more than 60 zone substations/switching stations, which are strategically located close to regional load centres. Additionally, three terminal stations also supply 22kV distribution feeders. Three 22/6.6kV zone substations supply the Mount Dandenong area via three 6.6kV feeders. The Latrobe Valley power stations and mines are supplied via five dedicated zone substations operating at 11kV and 6.6kV.

The distribution supply network includes more than 340 medium voltage (MV) feeders supplying approximately 800,000 customers.

Approximately 42% of customers are supplied from approximately 166 feeders classified as urban, 42% are supplied from approximately 146 short-rural feeders and 16% from approximately 45 feeders classified as long-rural. Alternate supply points are available for urban feeders, some short rural feeders and are limited in number and capacity for long rural feeders. Approximately 80% of the MV network spans are located in areas categorised by the Country Fire Authority as a Hazardous Bush Fire Risk areas.

The distribution and low voltage reticulation network consists of approximately 330,000 timber and steel reinforced concrete poles equipped with a mixture of steel and timber crossarms and steel, all aluminium (AAC) and aluminium conductor steel reinforced (ACSR) conductors.

The medium voltage supply network includes approximately 62,800 distribution substations, of which approximately 56,500 are constructed on poles and the remainder are of kiosk, ground mounted or indoor design. The MV network includes approximately 1,200 remote controlled automatic circuit reclosers and in excess of 6,000 pole mounted switches, of which over 600 are SCADA controlled.

Pole Top Capacitors

Pole–top capacitors are used to provide reactive power at 70 selected locations in medium voltage feeders to provide voltage support, correct power factor and to improve the energy transfer efficiency of the immediate and upstream network. A majority of these units (approx. 40%) are installed in the Eastern region, while 30% are in the Central region and 30% are in the Northern region. Each pole-top capacitor is generally rated at 900kVAr.

The pole-top capacitors, introduced in 2001, consist of a number of components that include capacitor cans, control box, fuses, current sensor, voltage transformer, surge arresters and vacuum switches. Failure of any of these assets could affect the overall performance of the pole-top capacitor bank.

Detailed asset information and relevant strategies for the management of pole-top capacitors are included in AMS 20-69 Pole-Top Capacitors.

MV Switches and ACRs

The main functions of MV switches and ACRs are to isolate a part of the distribution network for operational purposes or to isolate a faulty section from the healthy network to maintain supply reliability.

The 22kV, 12.7kV, 11kV and 6.6kV or medium voltage (MV) overhead distribution network is switched by approximately 1,200 ACRs and in excess of 6,000 pole-mounted air-break switches and SF_6 gas insulated switches. The MV underground cable network is switched by more than 6,600 metal-clad switches located in more than 1,500 kiosk or indoor substations.

Approximately half of MV switching installations are pole-mounted and the remaining half can be found in kiosk substations and indoor substations. Many of the pole-mounted air-break switches were installed to facilitate the construction and commissioning of network augmentations in the 1970s and 1980s. Accordingly, some of these installations have become redundant and there are opportunities for rationalisation of pole-mounted MV switches. Other installations are infrequently operated but are necessary to connect significant network loads, embedded generators or underground cable networks or to "by-pass" ACRs or line voltage regulator installations.

Air-break MV switches have relatively low reliability and high operating and maintenance costs, whereas metal enclosed SF_6 insulated units in both pole and ground mounted configurations have proven to be reliable and cost effective. Climate change drivers are expected to drive electricity utilities and manufacturers toward other switch devices that don't contain SF_6.

Pro-active management will continue to be required to optimise the transition from a low-customer-density overhead network, controlled by manual-operation, pole-mounted, air-break switches to a network with significant high-customer-density underground circuits switched by SCADA controlled metal-clad switchgear in both pole and ground mounted configurations.

A detailed description of MV Switches and ACRs, including their age and condition, is included in AMS 20-60 MV Switches and ACRs.

MV Fuse Switch Disconnectors

Fuse Switch Disconnectors (FSDs) are installed on the MV network to provide over-current protection and disconnection facilities to enable safe work on electrical equipment.

There are in excess of 103,500 MV FSDs protecting distribution substations and sections of single wire earth return (SWER) lines and single-phase spurs on medium voltage feeders. The main types of FSDs installed are Expulsion Drop Out (EDO), Boric Acid (BA), Powder Filled (PF), and Fault Tamer (FT).

Commencing circa 2010, significant volumes of EDOs were replaced with BA fuses that were considered a more reliable device and less prone to fire ignition risk and did initially result in a reduction of fuse related fire incidents. However, BA fuses are now demonstrating similar characteristics to EDOs (hang-ups & candling) with FT currently the preferred FSD. Powder filled FSDs, largely used in urban areas, are significantly older.

The failure modes of FSDs include "hang-ups", "candling", bird or animal initiated arcing faults and corrosion initiated insulator failures. FSD failures can cause sustained supply outages, quality of supply events, bushfire ignitions and present safety risks.

A detailed description of FSDs installed on the electricity distribution network, including their age and condition and asset management strategies is included in AMS 20-61 MV Fuse Switch Disconnectors.

Line Voltage Regulators

Line voltage regulators are required to maintain the steady state operating voltage of supply to customers connected to long rural distribution feeders.

The regulator fleet includes a total of approximatley134 regulator units with nameplate continuous ratings ranging from 25kVA to 10 MVA. The majority (99.3%) of the regulators are rated at 22kV. Three different types of line voltage regulators are used on this distribution network; three-phase regulators, sets of three single-phase regulators or single-phase regulators.

Current assessment defines the fleet of AusNet's line voltage regulators in 'average' condition. Corrective maintenance (CM) work orders have been declining since 2002 due to both increased preventative maintenance (PM) and changes in the asset management data systems.

A detailed description of line voltage regulators installed, including their age and condition is included in AMS 20-68 Line Voltage Regulators.

Line Surge Arresters

AMS 20-67 Line Surge Arresters is focused on approximately 125,000 surge arresters protecting distribution substations, automatic circuit reclosers (ACRs) and gas-insulated switches, line voltage regulators, capacitors, and underground cable termination poles.

The eastern half of the state of Victoria has average annual lightning ground flash densities twice that of the western half. Seventy percent of lightning strikes are of sufficient magnitude to damage unprotected electricity distribution equipment.

Surge arresters have been included on all new medium-voltage installations since the mid-1970s to limit electricity supply outages and to protect equipment from over-voltage damage due to lightning strikes and switching surges.

A detailed description of line surge arresters installed on the electricity distribution network, including their age and condition and asset management strategies is included in AMS 20-67. FMECA, including consideration of line surge arrester failure as a root cause of fire ignitions, is also included in AMS 20-67.

AMS 20-67 is allied to and complements AMS 20-77 Surge Arresters in Zone Substations.

HV and MV Metering

There are approximately five major consumers directly connected to AusNet's HV sub-transmission network and approximately 80 major consumers directly connected to AusNet's MV network.

Voltage Transformers and Current Transformers (CTs) provide the input to time of use "smart" meters at the point of supply for each of these major consumers. Meters are provided by a registered meter provider of the customer's choice; many are provided by AusNet's Mondo division.

Preparation of the consumers' installation for the installation of metering equipment is undertaken by independent electrical contractors engaged by the consumer. Installation of the metering equipment is undertaken by Mondo division or the consumers' nominated Metering Provider.

Protection

Electrical protection equipment is applied to the MV network to mitigate the effects of insulation failure; the principle causes of which are weather, flora, fauna, plant or equipment failure and human intervention. The operating duty for MV feeder and LV distribution asset protection schemes is generally higher than for other assets.

Protection for MV distribution feeders is achieved via a combination of station-based and distributed (pole-top) protection schemes.

MV feeder protection schemes include settings designed especially for use when work is occurring in the vicinity of MV feeders, including vegetation management works, live line works and adjacent line works. These settings provide accelerated fault isolation and suppress reclose, to further support the safety of line and vegetation workers. MV Feeder protection systems in particular also play an important role in mitigating the risk of fire starts by minimising the energy discharged as a result of insulation failure.

Distribution Design Manual 30-4161-09 provides detailed information regarding protection philosophies applied for MV distribution feeders, Central to these philosophies is the concept of "primary" protection and "backup" protection, which is used in the design and configuration of the feeder protection system to provide sufficient redundancy to ensure protection objectives are met even in the event of a failure within the protection system.

The protection and control schemes controlling the operation of circuit breakers, located in zone substations, which protect the upstream portions of MV feeders are summarised in AMS 20-72 Protection and Control Systems, together with the associated risks and management strategies. Distribution feeder devices (DFDs), including automatic circuit reclosers (ACRs), sectionalising switches and MV fuses, used to provide distributed protection of MV feeders and their associated condition and risks are summarised in AMS 20-60 MV Switches and ACRs.

There has been significant investment in both station-based and distributed protection schemes for MV distribution feeders that include:

- Replacement of protection relays and DFDs that do not meet bushfire mitigation requirements, including oil circuit reclosers (OCRs);

- Elimination of unreliable and maintenance intensive equipment, including air break switches (ABS);
- Installation of SCADA enabled ACRs on SWER circuits; and
- Implementation of Rapid Earth Fault Current Limiters (REFCL) at 22 prescribed zone substations.

A detailed description of protection systems installed in the MV network, including their age and condition and asset management strategies is included in AMS 20-72 and AMS 20-60.

Earthing

Electrical earths define a circuit for fault currents, enable protection systems to disconnect unsafe electrical conditions, maintain step, touch and transfer potentials within allowable limits and define an electrical circuit for SWER load currents. The metallic frames, handles, cable screens, conductive structures (e.g. concrete poles), surge arrestors and any exposed metal parts of MV equipment containing or supporting MV conductors, are directly connected to a MV earth. MV earthing systems are also designed to:

- Ensure correct functioning of the protection systems;
- Limit over-voltages during fault conditions; and
- Manage earth potential rise within the limits of other authorities' nearby assets.

Prior to 1980, distribution substation earths were constructed from stranded copper conductor, mild steel electrodes and "split bolt" clamp connectors. They were predominantly installed in the surface soil layers using manual techniques. The mild steel electrodes (otherwise known as steel fencing pickets) had a relatively short life due to corrosion. Frequent testing of early earths was necessary to ensure that corrosion and seasonal moisture variations had not reduced their effectiveness.

In 1983, the transition to high reliability copper clad mild steel extensible earth electrodes, purpose designed connectors and soil resistivity enhancing agents was completed. These new materials enabled earth electrodes to be driven into sub-surface soil layers well below the water table to achieve low resistance values with more compact configurations and lower risks of damage by excavation. The new materials had superior corrosion resistance effectively extending the life and reliability of earths.

A detailed description of the earthing systems for MV distribution assets, including their age and condition and management strategies is included in AMS 20-59 Electrical Earths.

Remote Control and Monitoring

The MV distribution network has more than 2,000 distribution feeder devices (DFDs), which include fault indicators, automatic circuit reclosers, remote-control switches, pole-mounted capacitor banks and ring main unit (RMU) switchgear in kiosks and indoor substations. Using wireless communication links, the SCADA master station polls DFDs for data, which it then interprets and displays to operators in the CEOT. The SCADA system can also issue control commands to the remote plant and equipment via wireless communications infrastructure.

All wireless communication supporting the SCADA services are currently built on a combination of internal TRIO and external 3G networks. AusNet owned TRIO network is a point-to-multipoint wireless system, built based on the General Electric / Schneider Electric's E-Series licensed radios which operate at the 400 MHz spectrum, as licensed by the Australian Communication and Media Authority (ACMA).

The current TRIO network for the electricity distribution business provides telemetry and control for pole top devices and remote terminal units (RTUs) at zone substations using TRIO base stations.

Voltage Control

Voltage control for the MV distribution network is essentially provided by On Load Tap Changing facilities installed on the power transformers within the respective zone substations and by capacitor banks connected to the MV buses. The on-load tap changers provide automatic control of the MV bus voltage in relation to load variations through a system of voltage regulating relays. The capacitor banks at the zone substations match the reactive power requirements of the MV network via time-switch or VAR sensing controllers. They also support the voltage on the MV bus.

On long or heavily loaded MV feeders, where effective voltage control from the zone substation is difficult to achieve, line voltage regulators are installed at discrete locations in the feeder to improve the voltage profile. The line regulators operate in a similar manner to the transformer OLTCs installed within the zone substations. They utilise a voltage regulating relay (VRR) to control the regulator output voltage in relation to the load in order to maintain appropriate voltages along the feeder beyond the regulator.

Switchable pole-mounted capacitors are also installed on a number of MV feeders to provide additional reactive power to the network and as such assist with voltage control.

5.5.2 Low voltage distribution assets

This section includes a description of the low voltage distribution assets and the relevant asset management strategies that are used in their management.

There are approximately 20,600km of LV circuits which transport energy from the LV terminals of a distribution substation to a connection point at each customer's installation. Approximately 7,600km of these circuits are constructed on poles with timber crossarms, porcelain/pin type insulators and all aluminium conductors. The remainder are underground cable circuits.

The connection of the customer's installation to an LV mains circuit, or in the case of rural locations to the LV terminals of the distribution transformer, is completed by insulated service cables. There are approximately 470,000, of which approximately 40% are service cables formed by insulated cables strung directly from a pole to the customers' installation and the remainder constructed using insulated cables laid underground. Customer numbers are greater than services due to dual and multiple occupancy installations.

Lines

Electricity reticulation in new medium-density residential subdivisions is by way of insulated cables laid underground in road reserves. Cables are sized to suit each application but generally comprise four aluminium conductors with a cross sectional area of 240m^2 or 185mm^2 insulated by cross linked polyethylene (XLPE). LV underground cable circuits are most commonly supplied from kiosk substations and interconnect with consumers' underground service cables in pits near the consumer's property boundary.

The LV overhead network consists of both bare conductor and insulated cables formed by Low Voltage Aerial Bundled Cable (LVABC) construction. Most bare conductors are all aluminium (AAC) although some copper is in service in older areas. LVABC consists of four aluminium conductors insulated by cross linked polyethylene (XLPE) with common conductor sizes of 95mm^2 and 150mm^2.

LV mains circuits are frequently co-located on poles containing MV circuits and/or subtransmission circuits. However, by route length the most common configuration is a single LV circuit serving consumers on both sides of the roadway and the public lighting lanterns located on alternate poles.

New LV overhead circuits are constructed from LVABC and existing overhead circuits are re-constructed from LVABC when a significant proportion of the crossarms, insulators and LV conductors require replacement.

AMS 20-52 Conductors and AMS 20-65 Insulated Cable Systems contain analysis of the risks and strategies for the safe management of LV lines.

Service Cables

The majority of new installations are underground cables noting that these typically consist of a service mains t-off to a service pit within URD estates; however where undergrounding is unsuitable, Twisted Black aerial service cables are used.

The main types of service cables are Twisted Black cross-linked polyethylene insulated Aerial Bundled Cable (XLPE – ABC), Twisted Grey PVC insulated aluminium conductors, and Neutral Screened cables with aluminium and copper conductors.

There is currently a targeted strategy for the replacement of Neutral Screened and Twisted Grey PVC service cables (with Twisted Black aerial service cables) when undertaking pole and LV crossarm replacement works.

An established program, whereby near real time analysis of Advanced Metering Infrastructure (AMI) data is used to identify deterioration of service neutral connections, results in the despatch of fault crews to investigate and repair or replace as required.

A detailed description of service cables installed on the electricity distribution network, including their age and condition and asset management strategies is included in AMS 20-76 Service Cables.

Private Electric Lines

Connected to AusNet's LV circuits are approximately 13,000 privately owned overhead LV lines to connect supply to installations in rural areas. The lines are wholly owned by the respective customer who is responsible for their condition, maintenance and safety.

These privately owned lines are included in line inspections performed by AusNet on behalf of the customer, in accordance with the Electricity Safety (Bushfire Mitigation) Regulations, to ensure the safety of the customer's assets. Management of the inspection process and any remedial actions are undertaken via the SAP based Enterprise Asset Management information system (previously Q4) asset management system. Any defects are recorded within the SAP database and communicated to the customer concerned in accordance with the procedures established in BFM 21-79 Bush Fire Mitigation manual.

Voltage Control

The operating voltages of LV circuits are controlled by use of the off-load tap change facilities on each distribution transformer. AusNet has developed a guideline for setting LV voltage at the time of commissioning of new or replacement distribution transformers in order to maintain the voltage within Victorian Electricity Distribution Code limits. The stipulated target voltage allows for standard LV design without causing voltage limit violations. The guideline is also used in power quality investigations resulting from customer complaints.

AusNet is able to utilise customers' smart meter data to optimise LV network voltage. This strategy is applied at the zone substation secondary bus through detailed voltage analysis along the feeder and at customers' end.

When new zone substations are commissioned the associated feeders and their distribution transformers' tap settings are reviewed and appropriate actions are taken to maintain the LV within code limits.

AusNet has an ongoing capex program to augment overloaded distribution transformers. These projects also include balancing LV network and applying the correct target voltage settings as described above to maintain voltage within code limits.

Protection

Predominantly, the LV network is protected by high rupture capacity fuses installed at the source-end of LV circuits or consumer service cables. The fuses are sized to suit the capacity of the associated substation. Some kiosk and indoor distribution substations utilise LV circuit breakers to protect LV insulated cables supplying consumers. Some of fuses have been found to contain asbestos within the sealed fuse unit.

The selection and application of LV fuses and settings for LV circuit breakers are detailed in 30-4161 Distribution Design Manual.

Earthing

Effective earthing of the LV network is achieved by direct connection of the neutral point of the low voltage winding of each distribution transformer to the general mass of earth. The neutral point of the LV winding is thus maintained at or near earth potential. Two types of earthing system are applied within the LV network; Multiple Earth Neutral (MEN) and Direct Earthing.

There are several variations on the Multiple Earthed Neutral system:

- Individual Multiple Earthed Neutral (IMEN) – An earthing arrangement where the LV neutral conductor is permanently connected to earth at the substation supplying the circuit, each consumers' installation and as required an auxiliary earth at the remote end of the LV circuit. IMEN earthing is common in rural areas where each distribution transformer directly serves one or two consumers via an individual service cable or private electric line.
- Interconnected Multiple Earthed Neutral - An earthing arrangement where the LV neutral conductor at each of several substations, permanently interconnects individual LV earths at each substation

and each LV earth at multiple consumer's installations. Interconnected MEN earthing is common in urban areas where LV circuits can be interconnected between distribution substations. The impedance to the general mass of earth of the interconnected earths is less than 1 Ohm.

- Common Multiple Earthed Neutral (CMEN) - An earthing arrangement in which the earths of each piece of MV and LV equipment is permanently connected to a single common earth formed by interconnecting the LV neutral conductors and hence the HV and LV earths at each of many distribution substations and the LV earths at each of many consumers' installations. CMEN earthing systems are individually designed and commonly have an impedance to the general mass of earth less than 0.1 Ohm.

A Direct Earthing system is where the consumer's neutral conductor is only connected to earth at the distribution substation and the consumers' earthing conductor is only connected to earth via an underground cable sheath or dedicated overhead earth conductor running directly from the installation to the distribution substation LV earth. Direct Earthing systems are uncommon. They are only employed when it is not possible to establish an effective earth within the consumers' installation. Direct Earthing systems are individually designed and are subject to the approval of Energy Safe Victoria.

The design, arrangement and materials to be applied in LV earths are detailed in 30-4161 Distribution Design Manual.

A detailed description of the earthing systems for LV distribution assets, including their age and condition and management strategies is included in AMS 20-59 Electrical Earths.

Metering – Advanced Metering Infrastructure

Metering equipment for measurement of electricity consumption is installed on approved meter panels that are supplied and installed by the customers' electrical contractor. Meter panels are installed inside metal metering enclosures generally fixed to the external face of a building structure or on metal frame internally fixed within the building. Directly connected meters are used for installations with maximum demand up to 100 Amps per phase whilst current transformers are used for maximum demands in excess of this value.

AusNet's metering team is responsible for the development of Meter Asset Management Plans, meter installations for all types of utility meters, meter reading (manually and remotely), processing of data including validation, delivery and billing.

An Advanced Metering Infrastructure (AMI) program that commenced in 2010 was completed circa 2014. The replacement program was the consequence of the government of Victoria's decision to mandate the roll out of an AMI for the remaining customer base in Victoria consuming less than 160MWh per annum. Installation of remotely read meters for customers above 160 MWh per annum was first introduced during the 1990s.

The AMI roll out was preceded by an extensive period of industry and stakeholder consultation in which societal impacts, including safety were considered. A key enhancement to the AMI program over the existing meter fleet has been the inclusion, within meter specifications, of a number of additional functions including the capability to record a range of supply quality parameters and remotely connect and disconnect the metered electrical installation.

AusNet's Network Innovation team have utilised the near real time monitoring of supply quality data to develop algorithms that provide the capability to identify network abnormal conditions. The ability to identify the manifestation of different network abnormalities and their typical causes has enabled response by fault crews before the condition develops into an in-service asset failure. The most successful feature to date has been the identification and response to deterioration of LV service and mains neutral connections.

AusNet is represented on the Victorian Electricity Supply Industry (VESI) Service and Installation Rules (SIR) Management Committee which has established the SIR/AMI sub-committee to establish AMI installation standards, including new meter panel layouts and wiring diagrams.

To facilitate safe and effective meter replacements, AusNet's AMI installation standards include pre-installation checks for installation defects. Known hazards such as asbestos containing material (ACM) are managed in accordance with established work procedures.

Resources used for meter installation are required to hold and maintain an Electricity Supply Industry (ESI) passport with either of the following training qualifications:

- Certificate III in ESI – Distribution line worker;
- Certificate III in Electro technology electrician; and
- Standard Electrical Meter Installation (course code 22001VIC, Gippsland TAFE)

The AMI roll out in the field was conducted under the Order in Counsel established to support this industry activity initiated by the Victorian government.

5.6 Latrobe Valley Power Generation

AusNet owns and operates distribution supply networks within the Latrobe Valley which are dedicated to the supply of electricity to power stations and their associated open cut mines. The networks are concentrated in three locations at Yallourn, Morwell and Traralgon South and are interconnected via the 66kV sub-transmission network and the 220kV transmission network which is owned and operated by AusNet.

The Yallourn network supplies Yallourn Energy Power Station and Mine. The Morwell system provides supply for Hazelwood Power Station, Mine and Energy Brix (Morwell Power Station). The Loy Yang network provides supply to Loy Yang A and B Power Stations and the Loy Yang Mine. The extent and location of these networks are summarised in the following drawings:

- VX6/306/8 A - 6.6, 11 and 22kV System at Yallourn and Morwell Open Cut; and
- VX6/306/9 A - Open Cut substations in the Latrobe Valley VicPool Metering.

5.6.1 Network standards

The standards applied to the design, operation, construction and maintenance of the Latrobe Valley network are those applied to the electricity distribution network as a whole and as detailed in Appendix J and Appendix K.

5.6.2 Operating voltages

Operating voltages, fault levels and security of supply are the major factors which differentiate the Latrobe Valley network from the balance of the AusNet network.

The Yallourn network operates at 11kV, which corresponds to the bus voltage at the Yallourn Power Station (YPS) site and the output voltage of the generator transformers previously associated with Yallourn A, B and C Power stations.

The Morwell network operates primarily at 66kV for the newer parts of the installation which are supplied from the sub-transmission network at Morwell Terminal Station but at 11kV for that part associated with the older Morwell Power Station area.

The Loy Yang network, which is of the most recent construction, operates at the contemporary network standard distribution voltage of 22kV.

The routes of many of the MV feeders and distribution circuits are over coal fields, which has a very high resistivity and consequently, in the event of a fault to earth on the network, presents a greater step and touch potential hazard. As such neutral earthing devices are employed to reduce the potential fault current to a maximum of 50 Amps.

Protection systems applied within the Latrobe Valley Power Generation Areas operate to the same principles as the "main" network but with settings altered accordingly to reflect the lower fault levels.

5.6.3 Supply security

The distribution network within the Latrobe Valley power generation area provides supply to approximately 6200 MW of brown coal fired and 500 MW of gas fired generation. This supply is typically for coal handling, power station auxiliary supplies and station water supplies. Within each major network area (Yallourn, Morwell and Loy Yang) the loss of supply for an extended period has the potential to cause disruption to generation, although diversification in generation sources over the last decade has reduced this risk. Even so, the distribution network within the Latrobe Valley power generation area has higher levels of redundancy than the distribution network in other areas of eastern Victoria.

5.6.4 Yallourn network

The Yallourn network, commonly referred to as the "works areas", consists primarily of 11kV distribution which emanates from the Yallourn Power Station 11kV switchyard and supplies Yallourn North (YN) zone substation where energy is transformed to 6.6kV for reticulation to open cut mines and commercial installations in the immediate area.

The Yallourn network is connected to the sub-transmission network via a single 35/45MVA 66/11kV transformer located in the YPS GS switchyard and interconnected to the Victorian electricity transmission network via a single 54 MVA, 220/11kV transformer which is a transmission network asset.

The 11kV distribution supply network consists primarily of overhead conductor strung in a conventional manner on timber poles. The network includes approximately 10km of overhead circuit and 1km of underground cable. The underground cable circuits are primarily utilised for station entry and exit purposes.

5.6.5 Morwell network

The Morwell network consists of four zone substations, two of which, Morwell North (MWN) and Morwell West (MWW), are supplied from the AusNet 66kV sub-transmission network and Morwell East (MWE) and Morwell Hernes-Oak (MHO)[9], which are supplied from the AusNet 11kV network at the Morwell Power Station.

At each of the substations the incoming supply is transformed to 6.6kV for reticulation in the immediate area. AusNet assets include the outgoing 6.6kV feeder cable exits from the zone substation substations.

MWN is connected to the sub-transmission network via two 10/13.5MVA 66/6.6kV transformers. MWW is connected to the sub-transmission network via two 20/30MVA 66/6.6kV transformers. Substation MWE is interconnected via two 10/13.5MVA, 11/6.6kV transformers.

The 11kV network at the Morwell Power Station connects to the sub-transmission network via three 35/45MVA, 66/11kV transformers and to the 22kV distribution supply network via three 20/27MVA, 11/22kV transformers. All of these transformers are located within the Morwell Power Station switchyard. There is also an interconnection to the transmission network via three 150MVA, 220/66kV transformers located at the adjacent Morwell Terminal Station (MWTS).

The sub-transmission network which serves substations MWW and MWN consists of 16km of overhead conductor strung on a combination of wooden and concrete poles. The 11kV distribution network consists of a combination of 2km of underground cables and 4km of conventional overhead construction.

5.6.6 Loy Yang network

The Loy Yang network, located at Traralgon South, comprises a single AusNet owned substation, Loy Yang South (LYS), which is supplied from the local 66kV network. At LYS energy is transformed via three 25/40MVA, 66/22kV transformers for reticulation in the immediate area. AusNet assets include the outgoing 22kV cable exits from LYS.

An interconnection of this distribution supply network with the transmission network is via the local Loy Yang 66kV switching station which is a transmission network asset. LY is interconnected to the Victorian 220kV transmission network via three 150MVA, 220/66kV transformers at Morwell terminal station.

LYS is supplied via three 66kV circuits, two of which are underground, oil filled cables and one is of overhead construction. LYS supplies the open cut mine, the BassLink infrastructure and interconnects with TGN23 feeder. The total length of underground 66kV circuit is approximately 4km and the total length of overhead 66kV circuit is approximately 4km.

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[9] Formerly Yallourn Open Cut (YHO)

5.7 Bendoc, East Gippsland

Following the expiration of an agreement between the Victorian and New South Wales governments, responsibility for the ownership, operation and maintenance of approximately 230km of distribution network assets in the Bendoc area was formally transferred from Essential Energy to AusNet in June 2012. This distribution network, which supplies approximately 270 customers, is remotely located in north-eastern Gippsland, as shown in Figure 10.

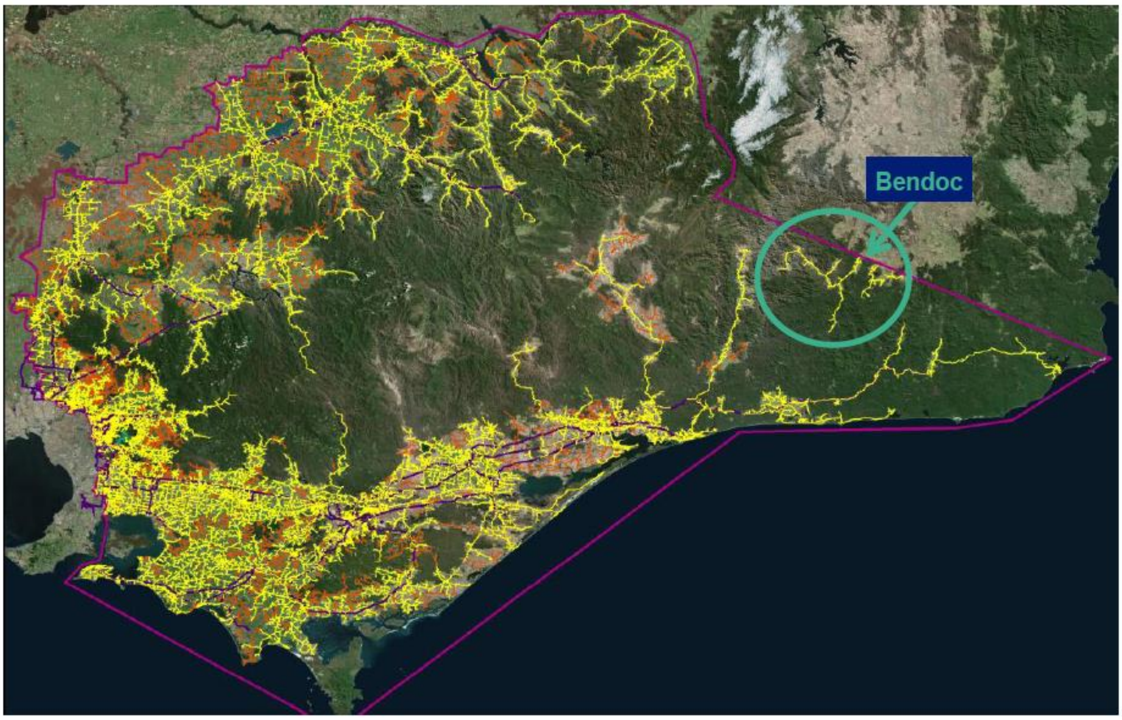

Figure 10 AusNet's Electricity Distribution Network in the Bendoc Area

The Bendoc network is not electrically connected to AusNet's Victorian networks and is supplied from Essential Energy's Bombala zone substation in the NSW distribution network via three connection points along the NSW-Victoria border. A first response services agreement has been executed with Essential Energy for them to provide local resources and services in initial response to network incidents.

5.7.1 Regulations

The Council of the Monaro County District and the State Electricity Commission of Victoria entered into an agreement (the Victorian Franchise Agreement) on 17 April 1991 for the operation and maintenance of the franchise area for a period of twenty years.

Under the Agreement the Council of the Monaro County District (and its successors, including Country Energy and Essential Energy) were obligated to manage the assets in accordance with:

- The Overhead Line Construction and Maintenance Regulations of the Electricity Development Act 1945 of New South Wales and any amendments thereto;
- The requirements of the Electricity Supply and Construction Regulations and the Code of Practice for Tree Clearing both made pursuant to the State Electricity Commission Act 1958 (Vic);
- All relevant standards and specifications published by Standards Australia; and
- The Ordinances under the Local Government Act application in NSW.

The Electricity Supply and Construction Regulations (ES&C) 1988 were superseded by the Electricity Safety (Network Asset) Regulations 1998 which were subsequently revoked in 2010. Construction and maintenance not covered by the ES&C 1988 Regulations were in accordance with relevant NSW standards.

In accordance with the Electricity Safety Act, Electricity Safety (Bushfire Mitigation) Regulations and Electricity Safety (Electric Line Clearance) Regulations, the former owners of the Bendoc distribution assets have submitted annual bushfire mitigation and vegetation management plans to Energy Safe Victoria (formerly Office of the Chief Electrical Inspector) for approval.

5.7.2 Standards

The Victorian Franchise area assets were constructed by the Council of the Monaro County District to Energy Australia (EA) standards. This has meant that some asset design and construction standards are not consistent with AusNet's Standard Installations Manual. In particular, there are no private electric lines as the NSW supply authority maintained low voltage servicing and cabling through the installation point of attachment to the meter position.

AusNet applies its inspection, construction and design standards to all new and replacement works.

5.8 Public Lighting Assets

There are more than 170,000 lights registered as connected to the AusNet electricity distribution network, with the majority being LED lanterns. These are supported on electricity distribution poles and galvanized public lighting standards. Generally, these lighting systems are supplied directly from the low voltage distribution supply network and do not have manual switching or centralized main control or metering. The key elements of the public lighting network are supply wiring, mounting poles and brackets, lanterns and photo-electric or photo-voltaic controls.

Public lighting installations are currently growing by 2% per annum driven by the establishment of new medium density housing estates in the south-eastern and northern growth corridors of metropolitan Melbourne.

Network Service Providers are obligated to comply with the Public Lighting Code, which requires robust systems and procedures to accurately collect, assess and process data to demonstrate a professional approach to public lighting asset management.

AusNet has in place contractual agreements with third-party service providers to accept, issue, rectify and report on public lighting faults. Condition monitoring and assessment of the lighting network is carried out by pole inspection teams as well as dedicated light patrol teams that cover all installations three times each year.

As approximately 40% of Victorian councils' greenhouse gas emissions are attributed to the energy consumed by public lighting, Victorian local government authorities desire a reduction in their energy consumption in order to reduce costs as well as benefit the environment and their communities. In response Mercury Vapour and High Pressure Sodium lanterns are being progressively replaced with light emitting diodes (LEDs).

A detailed description of public lighting connected to the electricity distribution network, including its age and condition and asset management strategies is included in AMS 20-73 Public Lighting.

5.8.1 Applicable codes and standards

The design, construction and maintenance standards applied to public lighting assets are as identified in Appendix J and Appendix K.

5.8.2 Environment

Some lantern and control equipment (prior to 1976) utilised PCB capacitors and asbestos weather seals. These have now been largely removed from the network. Guidelines for their identification, handling and disposal are provided in QMS 10-01 Health, Safety, Environment and Quality Management System Manual.

5.8.3 Inventory and faults

AusNet records the public lighting asset inventory data in the SDMe electronic graphical database. This data provides information on the lamp wattage and type, physical location and associated customer. Reporting of faulty lights is via the continuously manned call centre staffed by the Customer Energy and Operating Team. Faults and planned maintenance of public lights are managed via SDMe.

6. Network Operating Environment

This section discusses the environment in which the electricity distribution network assets are operated, including the aspects of topography, climatic conditions, vegetation, network demand, asset management and the technical and management challenges that arise from this. As mentioned in Section 3.7, the context of network safety risks is very dependent on the network operating environment.

6.1 Topography

Split by the Great Dividing Range, AusNet's electricity distribution network spans from the northern and eastern suburbs of Melbourne eastward to Mallacoota, and north to the Murray River, covering heavily forested and mountainous areas, as well as the low lying and coastal regions of Gippsland. This area includes alpine regions, rural areas, highly populated suburbs, forested areas with few customers and coastal areas that are subject to high winds and salt.

The physical and environmental attributes of this area affect network performance and expenditure. The Great Dividing Range imposes a physical separation between AusNet's northern and eastern regions, reducing network operational flexibility, with the mountainous terrain also giving rise to higher vegetation management costs than in flatter regions. For example, service teams must be placed within close proximity to regional centres that are separated by the Great Dividing Range (e.g. Bairnsdale, Wodonga and Wangaratta), resulting in lower resource utilisation than other rural networks with less difficult terrain. Further, the heavily vegetated nature of parts of this network means that vegetation related outages are the primary cause of supply interruptions during storms.

Error! Reference source not found. in Section 5.1 shows the details of the physical location of AusNet's High Voltage electricity distribution network.

6.2 Climatic Conditions, Effects and Patterns

AusNet's distribution network is located in an area that has among the world's highest levels of bushfire risk, meaning significant expenditure is required to manage the risk of bushfire ignition. Figure 11 shows the location of the network and the terrain it covers.

The network covers difficult terrain … … with very high fire risk

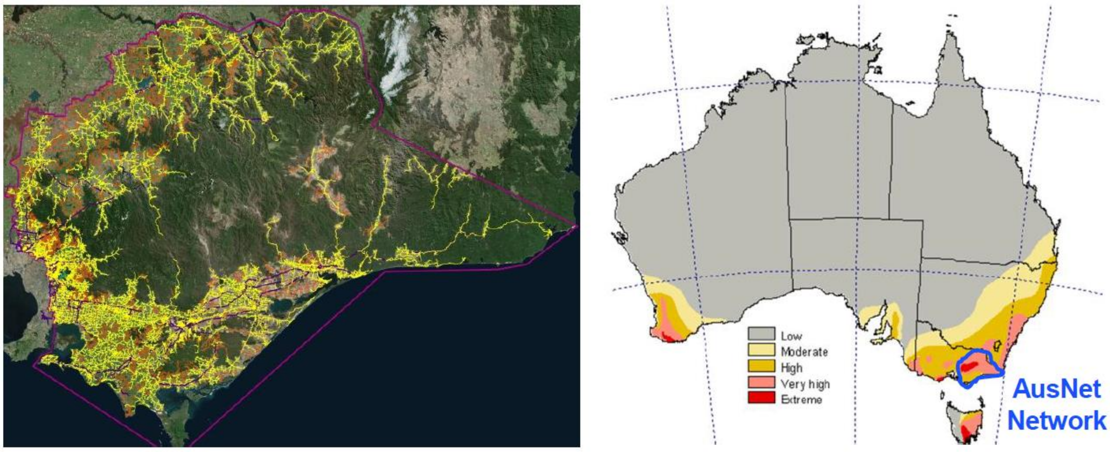

Figure 11 AusNet's Network Location and Terrain

AusNet's has divided its electricity distribution network into three operational regions - north, central and east - reflecting the topography and climate of eastern Victoria, as illustrated in Figure12.

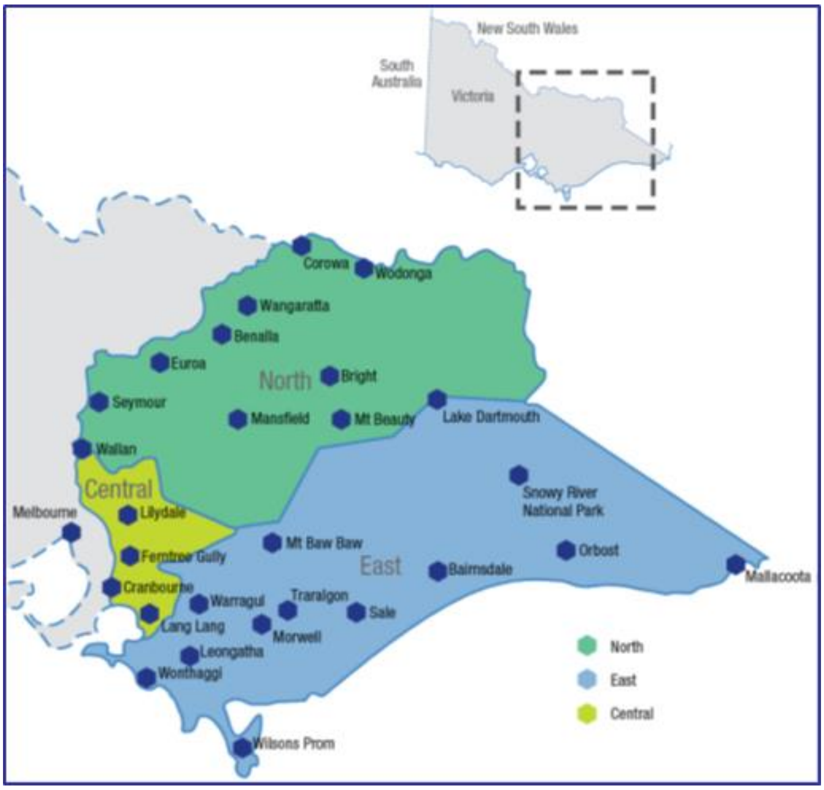

Figure 12 AusNet's Service Regions

The topography and climatic conditions in each of the three regions is discussed below. It is also discussed in Section 6.5 as it constitutes a technical challenge.

6.2.1 North region

In the North region there are two distinct topographic and climatic regions; the Alpine region which includes Mansfield, Bright and Mt Beauty and the agricultural plains adjacent to the Hume Freeway, which includes Wodonga, Wangaratta, Benalla and Seymour townships.

The Alpine region is characterised by the heavily vegetated mountains of the Great Dividing Range, which rise to 1,900 m in elevation. This region has cool summers and cold winters, with ambient temperatures ranging from 30°C to -10°C. An average of 1,300mm of rain falls each year and mountain peaks have a winter snow base of 1 m. The mountainous parts of this region are subject to higher than average lightning frequency (1.5 ground strikes/km^2/annum) and significant windstorms each year.

The areas adjacent the Hume Freeway include agricultural plains and low undulating hills punctuated by elevated areas such as the Warby Ranges near Wangaratta and several major river systems. There are significant forests near the Hume Freeway and rural road reserves are well vegetated. High summer ambient temperatures above 40°C are common. Winters include severe frosts with temperatures falling well below freezing point. This region has rainfall between 550mm and 650mm per annum and the river systems are prone to flooding after heavy rains in the adjacent mountains. Lightning frequency is above the Victorian average and this area is subject to extreme downburst or microburst wind events.

6.2.2 Central region

The Central region extends from Wallan to the north of Melbourne, east to Healesville and south to Lang Lang. It includes the faster growing northern and south-eastern urban growth corridors of metropolitan Melbourne as well as the mature outer-eastern suburbs of Lilydale, Ringwood and Ferntree Gully.

The topography of central region varies from urban subdivisions on the rural grassy plains and gentle rolling hills north and south-east of Melbourne to the temperate rain forests and heavily timbered slopes of the Dandenong Ranges and foothills of the Great Dividing Range in the east. The outer eastern suburbs of Melbourne are well populated and heavily vegetated. Native vegetation growth rates are the highest in the state. Average annual rainfall in central region varies from 800mm to 1,000mm. Ambient temperatures range from 40°C in Summer to -2°C in Winter.

While winter frosts are common on the central region plains, they tend to be less severe and snowfall is rare. However, snowfall is common in the Dandenong Ranges and the foothills of the Great Dividing Range. In spring and early summer, the eastern portion of central region including the Dandenong Ranges is subjected to severe wind and rainstorms, which cause significant vegetation damage. Lightning frequency and intensity in central region is similar to the Victorian average.

6.2.3 East region

The East region can be considered in three parts - South West Gippsland, North Gippsland and East Gippsland.

South West Gippsland includes urban centres such as Wonthaggi, Leongatha, Warragul, Morwell and Traralgon. The topography varies widely from the coastal plains east of Westernport bay, includes the temperate rain forests of Wilson's Promontory and the Strzelecki Ranges as well as the plains at the foot of the Great Dividing Range. Weather in this area is dominated by its proximity to Bass Strait, with consistent wind and annual rainfall between 750 and 1,000mm per annum. Ambient temperatures range from -1°C in Winter to 38°C in Summer. Lightning frequency (> 2 ground strikes/km^2/annum) in South West Gippsland is twice the average for the state of Victoria.

North Gippsland is located within an Alpine area, which includes Mt Baw Baw, Dinner Plain, Mt Hotham and Omeo. Weather in this area is dominated by the mountainous Great Dividing Range with heavy vegetation, cool summers and cold winters. Ambient temperatures range from -10 °C in winter to 35 °C in summer and rainfall averages 670mm per annum. Lightning frequency is double the average for the state of Victoria.

East Gippsland includes the urban centres of Sale and Bairnsdale, and extends to Mallacoota. The topography includes major river systems and large inland lakes, coastal plains and the temperate rain forests on the southern slopes of the Great Dividing Range. The cooler summers and milder winters in these coastal plains are influenced by Bass Strait with ambient temperatures ranging from -3 °C in winter to 40 °C in summer. Annual rainfall averages 600 to 700mm and lightning frequency (> 1 ground strike/km^2/annum) is above the average for the state of Victoria.

Due to the proximity to the coast, salt pollution is a factor unique to the East region that influences network asset deterioration and performance.

6.3 Demand Patterns and Cycles

Customer mix and demand profiles

A key factor in maintaining supply reliability is the ability to plan and forecast network demand to ensure network infrastructure has the capacity to maintain continuity of supply during peak demand events, which is influenced by customer mix, location and temperature. In terms of location, network customers are categorised approximately as follows:

- Approximately 42% are supplied via urban[10] feeders;
- Approximately 42% are supplied via short rural[11] feeders; and
- Approximately 16% are supplied via long rural[12] feeders.

The configuration of the feeders supplying each of these categories of customers presents technical challenges, as discussed in Section 6.5.3. For example, rural feeders are typically radial in nature, which means that alternative supply points are not available and so reliability of supply tends to be lower than for urban feeders.

With respect to total load, AusNet has the second highest level of residential load as a proportion of total load in the National Energy Market (NEM)[13].

This largely residential customer base means that energy use is peaky, driven by air-conditioning use during summer and largely reliant on network supply.

AusNet's summer peak demand occurs in the evening, reflecting the commuting times of residents of outer metropolitan Melbourne. Consequently, while there in excess on 980MW of solar connections, the timing of the network peak means that on AusNet's distribution network, solar energy is reducing overall energy delivered but not peak demand.

Winter load maximums occur on only a small part of AusNet's distribution network, notably on those circuits associated with the ski resorts located in Alpine areas.

For the majority of the network, maximum loading conditions occur in summer for only 50 hours each year; that is, during the late afternoons and evenings of about five to ten hot summer days each year. The typical load-duration profile is thus extremely "peaky" with maximum loads occurring for less than 1% of the hours in each year.

6.3.1 Growth in peak demand

As shown in Figure 13, AusNet's peak demand growth rate levelled out after 2009 before recommencing an increasing trend in 2018. Zone substation peak demand utilisation has softened from the peak of 79% in 2009 and remained below 70% every year apart from 2021. The installation of additional capacity at zone substations, in combination with consumer response to the critical peak demand tariff, improvements in appliance efficiency and building thermal efficiency and consumer installations of solar photovoltaic (PV) arrays have driven this reduction in utilisation.

[10] Maximum demand on the feeder > 300 kVA per km of route length
[11] Maximum demand on the feeder < 300 kVA per km and the total route length < 200 km
[12] Maximum demand on the feeder < 300 kVA per km and the total route length > 200 km
[13] Comparison of NEM DNSPs' 2013 Energy Delivered (MWh) per Customer

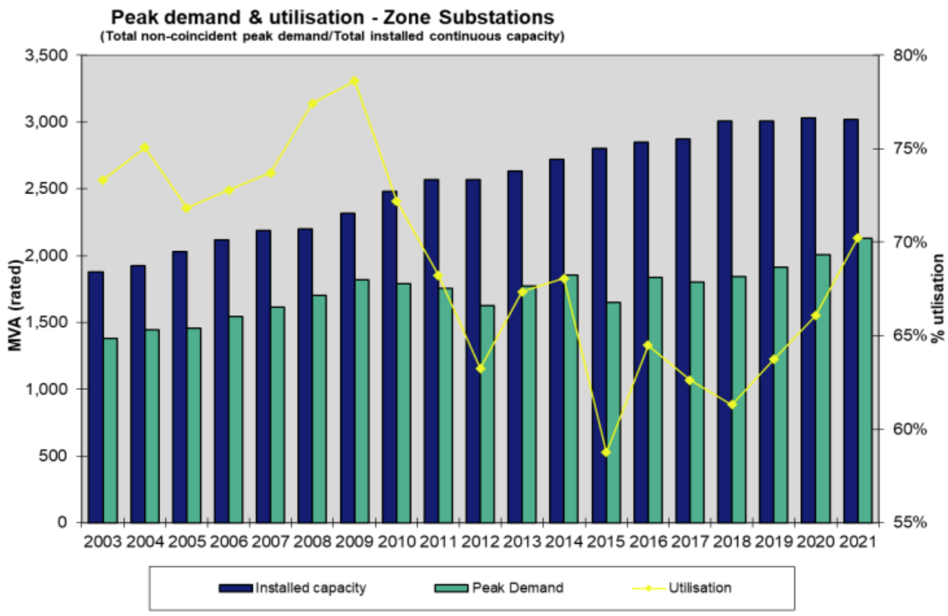

Figure 13 Peak Demand, Capacity and Utilisation

Relatively strong peak demand growth is forecast in the growth corridors at Officer, Pakenham and Clyde North in the south east and Epping, Doreen and Kalkallo in the north of Melbourne. This is primarily due to new housing estates that lead to new customer connections. Victoria's transition away from natural gas reticulation are expected to impact electricity networks.

6.3.2 Critical loads

There are a number of loads on the network that are regarded as critical because of the serious consequences if supply is interrupted. For example, reliable electricity supply to hospitals and sewerage pumps is essential to the welfare of Victorians. These facilities are typically located on urban network feeders that have greater capacity and flexibility to maintain supply through network reconfiguration.

As well as hospitals and sewerage pumps, the Alpine area is also regarded as a critical load, as loss of supply to this area during winter has the potential to affect the health and welfare of Victorians in that area.

Customers with critical loads also determine whether to invest in additional standby generation based on their intimate knowledge of their business risks.

If an event occurs that requires load to be curtailed, AusNet's operational procedures ensure that supply to the most critical loads is maintained in preference to other loads.

The operating procedure DOP 70-09 "Selective Load Shedding" details how the process of load shedding occurs in five stages according to increasing impact to the community from supply interruption. The first stage includes predominantly domestic loads and the final stage comprises critical loads such as major hospitals that would not normally be shed.

6.4 Impact of Vegetation

AusNet's electricity distribution network operates across the diverse environment of eastern Victoria. Split by the Great Dividing Range, the network covers heavily forested and mountainous areas, as well as the low lying and coastal regions of Gippsland. On the northern and eastern fringes of Melbourne, the network serves highly populated suburbs including through the heavily vegetated Dandenong Ranges. As already noted, vegetation is a significant cause of bushfire risk and is managed through cutting and pruning maintenance cycles.

Within AusNet's distribution network, there are approximately 189,000 overhead line spans in Hazardous Bushfire Risk Areas (HBRA) and 125,000 spans in the Low Bushfire Risk Areas (LBRA) that require management of vegetation. The map in Figure 14 illustrates the area of eastern Victoria that the electricity distribution network supplies, and the extent to which it is impacted by vegetation.

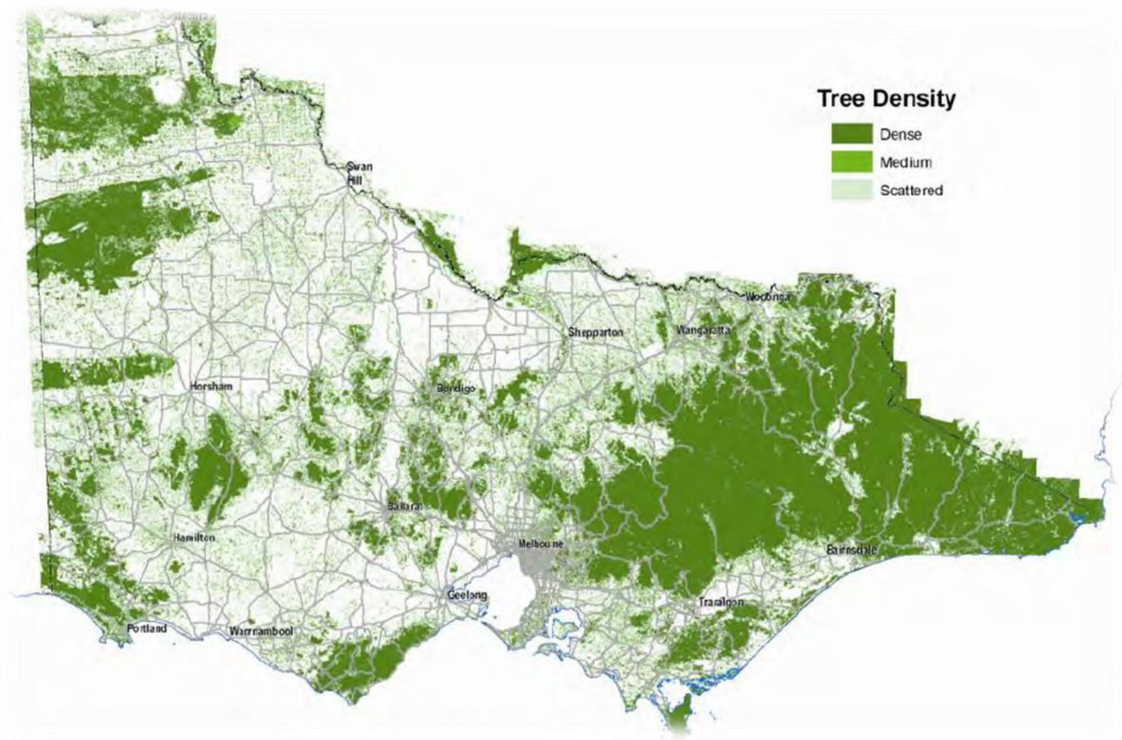

Figure 14 Tree Density in State of Victoria

Network performance is significantly impacted by vegetation falling or being blown from outside the prescribed line clearance space onto overhead powerlines. AusNet maintains a hazardous tree program which seeks to identify and remove trees outside the prescribed clearance space that have visible defects.

6.5 Technical Challenges

The electricity distribution network presents challenges given the inherently hazardous nature of the assets in presenting the risk of electric shock to employees, contractors and the public. The environment of eastern Victoria also presents unique challenges for operating an electricity distribution network, as bushfires in this area have the potential to cause the most catastrophic losses to life and property in the world.

6.5.1 Network status/condition and performance

Electrification of regional Victoria occurred predominantly through the 1960s and 1970s. The average service age of most assets has continued to increase, due largely to the introduction of extremely long life assets such as concrete poles, steel crossarms and porcelain post insulators in the 1970s and life extension techniques such as timber-rot chemical treatment and pole staking in the 1980s.

With respect to AusNet's key assets, time based inspection and testing programs are maintained, from which condition based assessments are made to determine maintenance or replacement requirements. Inspection cycles for overhead distribution networks in hazardous bushfire risk areas are on a shorter interval relative to low bushfire risk areas. Inspection is supported by on-going advances in asset assessment techniques and technologies.

The purpose of condition monitoring is to detect early stages of asset degradation, regardless of age, before poor condition becomes a significant risk to the safety of personnel, the environment, network reliability and the asset itself. Condition monitoring is also an essential component of sound asset management, which allows AusNet to evaluate, quantify and manage a variety of asset failure risks impinging on compliance, performance and network safety through economic maintenance and renewal programs.

While asset age and condition provides an indication of the likelihood of asset failure, AusNet also considers the consequences of such failures. The consequence varies depending on the type of asset and its location. In relation to bushfire, for example, the consequence is identified through a Fire Loss Consequence Model, developed by the Powerline Bushfire Safety Taskforce (PBST)[14].

Table 2 provides a brief summary of the performance and condition of the key asset classes from a network safety perspective.

Table 2: Summary of Condition and Performance for Key Network Assets

Asset Type	Performance and Condition
Poles	Increasing volume of deteriorating white stringy bark and messmate timber poles. The concrete pole population is in very good condition. Wood and steel pole population is in good to average condition. Condition is maintained by ongoing programs involving reinforcement or replacement of individual poles when sound wood readings identify a pole as unfit for service.
Cross arms	Significant volumes of HV and MV timber cross-arm replacements in the last ten years have resulted in a small population being in good to average condition. Increasing volumes of deteriorating LV wood cross-arms are becoming apparent from inspections. A significant volume of steel cross arms are in good to excellent condition.
Conductors	Failures due to conductor breakage are decreasing. Damaged stranded conductor and tie related failures are increasing. Generally bare conductors are in good to average condition. Insulated conductor (NMS HV ABC) is demonstrating end of life condition in some locations and has been replaced due to high failure rates and the potential consequence of failure.
Switches and Fuses	Low failure rates for gas switches, which are generally in good to average condition. Air break switches and overhead fuses are currently exhibiting low failure rates and are in average condition. Targeted Expulsion Drop Out (EDO) MV fuse replacement programs to mitigate the potential failure consequences are continuing. These replacement programs are discussed in both AMS 20-61 MV Fuse Switch Disconnectors and AMS 20-13 Enhanced Network Safety.
Services	Low failure rates and limited observable end of life characteristics indicate that services are generally in good condition. Aluminium neutral screened and grey PVC aerial service cables represent the oldest cables in the fleet and are subject to a replacement strategy whereby they are replaced in association with other replacement works such as for poles and crossarms. AMI data analytics are also utilised to monitor service cable integrity.
Electrical Protection Assets	Secondary and protection technology is constantly developing and new secondary and protection assets typically become obsolete over a 10-15 year period. This results in equipment becoming uneconomic to maintain due to incompatibility with newer equipment or because it is no longer supported by manufacturers. Additionally, some obsolete equipment does not comply with relevant industry rules. The replacement programs for protection and control assets are discussed in AMS 20-72 Protection and Control Systems and AMS 20-13 Enhanced Network Safety.

6.5.2 Geography and climate

The presence of the heavily vegetated Great Dividing Range in the centre of AusNet's electricity distribution network determines the location of depots and hence line-worker resources. The rugged nature of this mountain range limits the transfer of resources between the north and east regions. The

[14] PBST established by the Victorian Government to review and provide expert advice on implementation of recommendations 27 and 32 of the 2009 Victorian Bushfires Royal Commission.

steep and relatively inaccessible topography also limits the use of mobile plant for construction and maintenance purposes.

The combination of long radial circuits, weather events and heavy vegetation influences the network performance and operating costs of the predominantly overhead network in the more remote rural areas of the Great Dividing Range.

Figure 14 shows that the eastern half of Victoria has significantly higher vegetation densities than the average[15], whilst Figure 6 illustrates the location of the overhead network supplying customers in these heavily vegetated areas.

Year to year variations in the climate of eastern Victoria can be significant. In particular, high annual rainfall gives rise to rapid vegetation growth and flooding of river systems and lakes. Additional vegetation management frequently follows high rainfall years and whilst the electricity distribution network is generally resistant to flooding, line-worker access to service remote townships is periodically restricted by floodwaters.

Extended periods of dry weather elevate bushfire ignition risks and the early declaration of fire hazard seasons creates workload challenges for vegetation management and asset maintenance processes. Large grass or bushfires have caused significant damage to network assets, requiring additional financial and physical resources to restore reliable service.

Figure 15 shows the Fire Loss Consequence Ratings[16] for AusNet distribution network, with the areas shaded red having a higher fire loss consequence and the areas shaded green having a lower fire loss consequence. The Fire Loss Consequence Ratings represent potential house loss numbers under the worst weather conditions and ground fuel load conditions by assuming a Forest Fire Danger Index (FFDI) of 145.

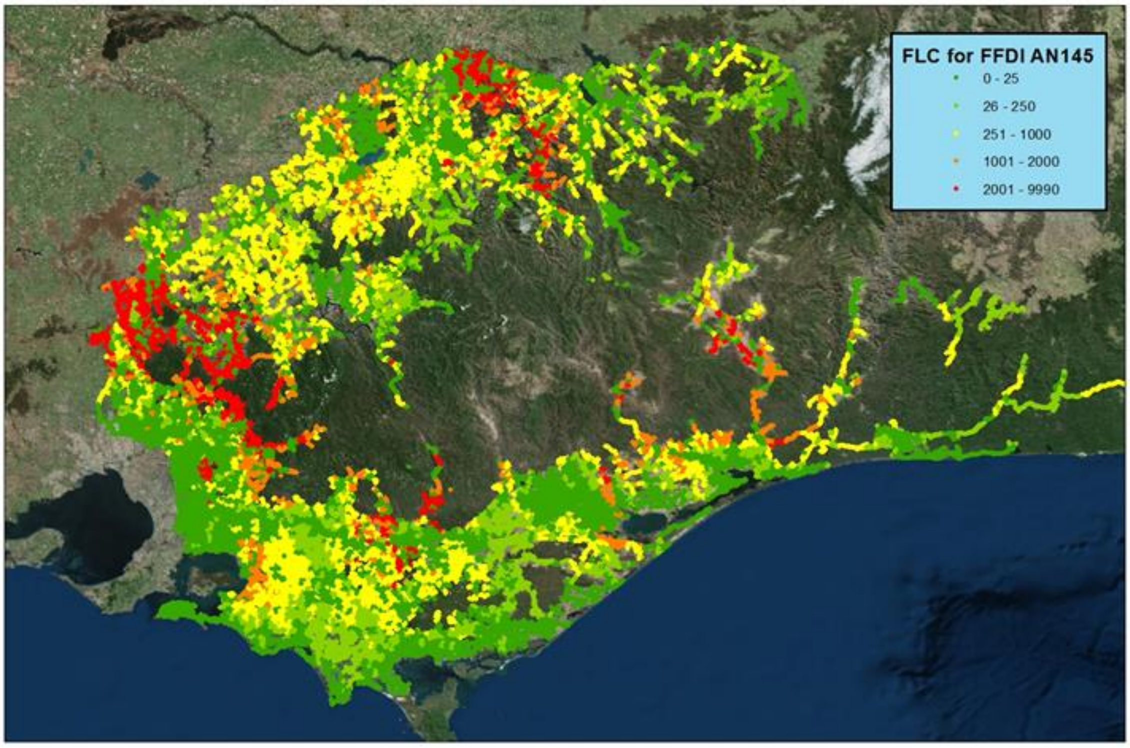

Figure 15 Fire Loss Consequence Ratings

AusNet uses these ratings to guide its asset management and operating decisions, including informing risk based modelling of asset replacement strategies. Fire risk modelling applies “return periods” (the probability of an FFDI of 145) in respect of weather, as illustrated in **Error! Reference source not found.**5, to the Fire Loss Consequence Ratings in order to establish a network bushfire risk profile.

[15] Powerline Bushfire Safety Taskforce Final Report, 30 Sep 2011
[16] The consequence ratings are expressed in ranges of the worst case number of house losses.

Approximately 7% of distribution network assets are estimated to experience an FFDI of 140 once in every 100 years, whilst approximately 17% are estimated to experience an FFDI of 140 once every 1000 years.

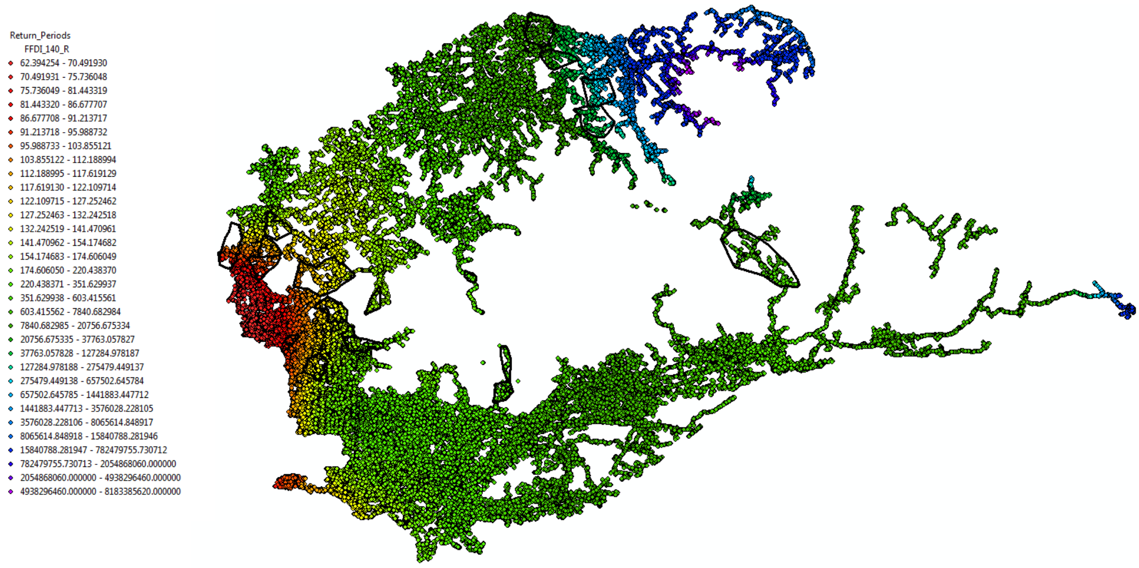

Figure 16 FFID 140 Return Periods

As discussed in Section 6.2.3, due to the proximity to the coast salt pollution is a factor unique to the East region and this has a significant effect on network asset deterioration and performance.

6.5.3 High maintenance requirements, complexity and reliability

In the wake of the Black Saturday bushfires in February 2009 and subsequent Royal Commission, substantial changes to legislative and regulatory obligations concerning bushfire mitigation has resulted in significant increases to asset maintenance, operating and replacement, and to vegetation management costs.

Vegetation Management

Incidents involving vegetation contact with overhead powerlines are a key factor in poor network reliability, fire incidents and hazardous conductor down incidents. Such incidents are typically associated with high wind and storm activity, which often results in high impact network events. Past experience indicates these events can cause the interruption to supply to up to 100,000 customers, which requires a large resource concentration over a relatively short period of time (12-48 hours) to address.

Compliance with regulatory obligations designed to minimise impact of vegetation on network safety requires a significant resource deployed in customer consultation, maintaining the prescribed clearance spaces around powerlines, and hazard tree management. Vegetation near overhead powerlines in HBRA is assessed annually.

A particular complexity associated with vegetation management is that tree contact with overhead powerlines is typically associated with vegetation being blown or falling from outside the prescribed clearance space. Regulations provide for the removal of trees assessed by an arborist as hazardous. Such trees will typically be identified through observations of a structural weakness or signs of the tree being in poor health. However, review of vegetation over powerline incidents indicates that approximately 60% involve trees that have not shown evidence of structural weakness or poor health.

In the event that vegetation management activities are unable to prevent vegetation contact with overhead powerlines, the distribution network electrical protection schemes are designed to maintain network safety through the de-energisation of faulted network assets.

Rural Distribution Network

The bare conductor rural distribution network consists of a significant population of poles, crossarms and conductors (approximately 80%) that are located in one of the world's highest fire risk areas. Accordingly, the prevention of asset failures within this operating environment presents a significant challenge due to a diverse range of possible asset failure modes and causes.

As mentioned in Section 6.5.1, AusNet maintains a higher frequency of asset condition based inspection in hazardous bushfire risk areas (HBRAs) relative to the remainder of the distribution network in low bushfire risk areas. The asset inspection manual (AIM) is a key tool in supporting an effective asset condition assessment program. It integrates learnings from reliability centred maintenance studies, asset performance and evolving inspection technologies and techniques.

As with vegetation contact, in the event of unanticipated asset failures, the distribution network electrical protection schemes are designed to maintain network safety through de-energisation of faulted network assets.

Electrical Protection Systems

As discussed in Section 5.3.14, electrical protection assets are critical to network safety as they operate to disconnect faulted network assets that would otherwise increase the risks from hazardous voltages and of bushfire ignition.

Consistent with other Australian networks, the AusNet's electricity distribution network protection system utilises a directly connected earth system which enables network faults to generate fault currents that can be quickly detected by the system. However, a few fault currents may flow through very high resistance paths to earth, which means the protection system may not detect the network fault. This can result in hazards associated with live powerlines at unsafe clearances or arcing that may result in fire ignition.

In accordance with recommendations from the Powerline Bushfire Safety Taskforce, AusNet apply settings of greater sensitivity to electrical protection devices in those parts of the network located in HBRA on Total Fire Ban days. This requires additional resources, increases complexity and can potentially lead to a reduction in network reliability.

AusNet has installed Rapid Earth Fault Current Limiting (REFCL) technology within 22 prescribed zone substations that were selected by Government based upon potential consequences derived through their Fire Loss Consequence Model. This technology is designed to specifically address the risk of bushfire ignition from powerlines and is proposed to be operated in parallel with current protection schemes.

The adoption of REFCL technology has introduced a significant complexity in operating and coordinating network electrical protection, requiring a substantive change to current protection philosophies and equipment replacement such as for surge diverters and HV cables.

6.5.4 Asset management and maintenance

AusNet's asset management policy is included in Appendix B and a detailed discussion of asset management is included in Section 12.

Asset Management Systems

Asset management systems that are core to the safe operation of the network relate to two key network management activities, namely;

- Electrical operation and fault management; and
- Network maintenance and replacement

High network activity events associated with storms require effective asset management systems that provide information on electrical assets, network configuration and customer connection points. AusNet maintains an integrated system known as the Distribution Outage Management System (DOMS) that coordinates this information in order to maintain the safe and reliable operation of the network. Inaccurate information in DOMS can result in unintended or extended duration of interruptions to customer supply during planned or unplanned work on the network. DOMS also includes key information in relation to network asset failures, which provide a basis for RCM analysis on network performance.

The scheduling of inspection and maintenance programs is maintained within an asset management information system (based on a SAP platform) which contains information on asset type, location, age, condition and scheduled maintenance and inspection intervals. AusNet has invested significantly over recent years in the implementation of SAP in 2016, and is continuing to work towards the integration of SAP data with other data and information management systems.

A key challenge is maintaining systems and processes that ensure data integrity and accuracy is maintained within these core asset management systems. The continual development of technology related to assets and their condition monitoring drives the need for continual review of asset management systems to ensure they maintain currency.

The business performance management framework defines the principles, tools and methods to enable business performance and continuous improvement to be effectively managed within the organisation and that business processes are constantly evaluated and improved.

Processes for maintaining data quality within electronic management systems include mandatory fields, standardised data descriptions, exception reporting and auditing.

Work Planning and Forecasting

AusNet's Asset Management Strategy includes a range of asset strategies at a network component level that provide bottom up modelling and forecast of asset remaining life, maintenance and replacement requirements. Modelling and forecasting is calibrated against actual work volumes that are driven by asset inspection programs. Accurate forecasting of asset inspection, maintenance and replacement is vital to securing financial and physical resources to ensure the safe and reliable operation of the network over both the short and long term.

In planning the asset management and maintenance activities, AusNet uses a resource model to forecast its enterprise-wide resource needs, taking account of the work volumes and required skill sets. The resource model includes the use of internal and external resources in the delivery of maintenance and capital works programs. Strategic alliances have been formed with companies that provide design, construction and maintenance services.

The work program exhibits a summer peak, as easement access improves in drier weather conditions. Peak workload issues may also arise if a particular asset type begins to exhibit unexpectedly poor performance or rapid deterioration in condition. It is important to manage peaks in resource requirements to ensure cost efficiency and minimise delays in project delivery.

The peak and uncertainty in workload are managed through AusNet's use of a combination of internal and external workforce. Resource challenges arise in the event of unexpected asset deterioration rates or additional programs that may be imposed through external intervention. Further information on our contracting arrangements is provided in Section 6.6.3.

6.5.5 Other technical challenges

Rapid Earth Fault Current Limiters

The installation of REFCL technology offers the potential to significantly reduce network related bushfire risk. The potential safety benefit is delivered by reducing the fault current almost instantaneously when conductor-to-earth faults occur. The Victorian Government introduced regulations in May 2016 to mandate the installation of REFCLs that were completed in 2023. In the three summers 2020/21 to 2022/23, Victoria experienced three consecutive years of La Nina and subsequently has not required significant periods for operation of REFCLs at '*required capacity*'.

Using REFCL technology to reduce bushfire risk requires on-going monitoring and constant network augmentation to manage network capacitance within the limits of REFCL capacities and to manage negative impacts to network reliability.

Embedded Generation

Solar PV and wind generation has increased significantly, as illustrated in Figure 17. The increase in wind generation in 2015 is attributable to the Bald Hills windfarm, which is connected to the sub transmission system. There has been rapid growth in small scale (<30kW) Solar PV connections, driven by lower technology costs and government rebates. Over 984MW of residential solar PV is currently connected to the LV network and provides more than half of the embedded generation capacity within the network.

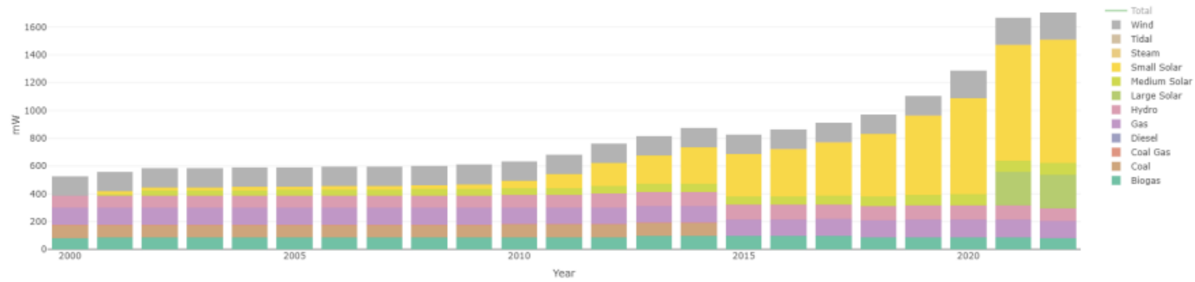

Figure 17 Embedded Generation

PV installations raise new challenges in relation to network safety, in particular:

- Ensuring that the PV installations can be isolated from the network to allow works to be undertaken safety; and
- Protection and control systems must be capable of operating under conditions of cyclical two-way power flows.

AusNet has working processes and expenditure plans to address these challenges.

Mini-Grid or Distributed Energy Supplies for Remote Communities

Increasingly, mini-grids or distributed power supplies are playing a greater role in supplying electricity to remote communities. This trend is driven by a number of factors including the increasing desire of communities for self-sufficiency, sustainability and increased control over their power supplies. In order to inform AusNet's approach to the technical and commercial challenges presented by this trend, a combination of Stand-alone Power Systems that will be part of the regulated asset base are being trialled together with other network support initiatives that include portable generators and combination battery and generators.

Human Error Incidents

AusNet defines a human error incident (HEI) as "one in which a planned sequence of mental or physical activities fails to achieve its intended outcome and results in inadvertent operation of, or impact on the performance of network assets". They can potentially have a significant impact on network safety.

There are five levels of HEIs defined, ranging from Level 1 – "Near Miss" to Level 5 – "Catastrophic Event".

AusNet's reporting processes employ leading and lagging indicators to report on and manage HEIs.

Asset Age and Fleet Performance

Asset installation dates and a summary of the condition and performance of key network assets are included in Section 6.5.1. The average service age of most assets has continued to increase, due largely to the introduction of long life assets and life extension techniques implemented for certain asset types.

Detailed information on asset age profiles and condition scoring for all assets is included in the individual plant strategies which form part of the suite of documents making up the Asset Management Strategy (AMS). Asset age and condition provides an indication of the likelihood of asset failure and so this information is used as an input to the risk modelling that has been performed to help formulate the strategies for the management of fleets of plant items. Further information on the structure and content of the AMS is included in Section 12.1.

Non Standard Assets

Further to the discussion in Section 5.7, the assets in the Bendoc area have been designed, constructed and maintained by respective NSW authorities and audited by ESV in accordance with the relevant regulations and standards. Where these standards vary from AusNet's Standard Installations Manual 30-4142, they have been included in the Non-Standard Installations Manual 30-4143.

Replacement of these assets will be determined in accordance with standards contained within AusNet's Asset Inspection Manual (AIM) and the replacement assets will be designed and constructed in accordance with AusNet's standard installation requirements.

Ensuring that the replacement assets meet the requirements of AusNet technical standards presents a technical challenge with respect to the interface with existing assets designed and constructed to NSW network standards applicable at that time.

Because inclusion of the above assets was considered to be a material change to AusNet electricity distribution network, an update to the ESMS, including accompanying risk assessments was submitted to ESV in 2012. Some of the risks identified related to asset failures, for example of the expulsion drop out (EDO) type of HV fuses, which were identified in Section 5.3.14 as one of the most critical assets with respect to network safety.

A key difference in standards between NSW and Victoria for the Bendoc assets is that the NSW supply authority maintained low voltage servicing and cabling through the installation point of attachment to the meter position. The point of supply will be progressively aligned with the Victorian Service and Installation Rules as general maintenance and replacement activities arise.

6.6 Management Challenges

This section summarises the management challenges facing AusNet in the operation of the electricity distribution network.

6.6.1 Anticipated changes in operating environment

AusNet expects to see a continuation of trends that have emerged in recent years, namely:

- Energy consumption will be flat, but demand is forecast to continue to grow, concentrated in growth corridors in the northern and eastern fringes of Melbourne;
- Implementation of the 2009 Victorian Bushfire Royal Commission (VBRC) recommendations will continue to shape AusNet's network safety obligations. While a number of the VBRC programs have been completed, new obligations are likely to emerge, particularly as new technologies are identified as effective in reducing the risk of bushfire ignition.
- Climate change is likely to drive further incremental increases in bushfire risk. A business risk entitled "Effects of Climate Change on Network Safety and Reliability" has been recorded in Enablon, the risk management information system. This includes the controls that have been identified to manage this risk, such as the asset management strategies and contingency plans for the networks;
- Technological developments will continue to shape customers' use of the distribution network. Established technologies such as small scale solar generation and smart meters will become further embedded. Other technologies, particularly small scale battery storage and electric vehicles, are likely to be more widely adopted, although the pace of change is uncertain; and
- Mini-grids or distributed power supplies are playing a greater role in supplying electricity to remote communities. Stand-alone Power Systems, portable generators and batteries are likely to play an increasing role as part of the distribution network in managing the distribution network.

The technical challenges associated with solar generation and mini-grids are discussed in Section 6.5.5.

6.6.2 Changes in commercial arrangements or ownership, and budgetary controls

The Board is ultimately responsible for overseeing the management of risk, as well as approving the strategic direction of the business, annual budgets and business plans and delegations of authority. The Board will ensure that any risk management issues arising from changes in commercial arrangements or ownership are addressed.

The Board has established a sub-committee called the Audit and Risk Management Committee (ARMC) to assist in fulfilling its responsibilities in relation to risk management and may delegate responsibilities or authorities to this Committee.

A role of the ARMC is to ensure compliance with the regulatory framework established by the Victorian government for the protection of the Victorian electricity networks and management of network risks in accordance with the corporate risk management framework.

6.6.3 Contracting arrangements and resourcing

Works affecting network safety are the responsibility of the Network Management and Digital division as it is responsible for the design, operation and maintenance of the regulated networks. In order to discharge these responsibilities Network Management and Digital division uses a combination of internal and external resources (delivery partners).

Mondo Division

Mondo division is responsible for development and provision of unregulated business and services for AusNet. This division includes asset inspection and vegetation management services provided to external businesses that formerly operated under the Select Solutions company brand. Inspection and vegetation management services for the NM&D division are provided from resources within the Network Operations and Safety division.

Delivery Partners

The combination of insourcing and outsourcing provides a sufficient pool of resources to complete the required works programs, whilst ensuring flexibility. Additional external resources are engaged to meet peak workloads, but are not retained when the volume of work reduces, ensuring that internal resources are always fully occupied.

The establishment of pre-qualified panels of service providers using a competitive tender process ensures that services are provided to the required level of safety and quality and at an efficient cost. Furthermore, this reduces the time and cost taken to engage resources when required.

From the panel of service providers, AusNet has established a key contract with one provider to work in partnership for the delivery of field construction and maintenance.

The selection, engagement and management of independent service providers is undertaken in accordance with the QMS 21-01 suite of quality management system procedures. These procedures include the assessment of the suitability of a service provider's processes, procedures, competencies and management systems. Accordingly, contracts are not awarded on price alone.

Each contract includes the relevant competence of service provider personnel and relevant awareness of AusNet's objectives and the standards of information and documentation required. In general, contracted service providers are required to comply with AusNet's policies, procedures and standards in relation to the safe operation and management of the network.

Contracted and internal resources are subject to regular audits to verify compliance with specified safety, technical, and operational standards and legislative requirements. Audits are undertaken in accordance with QMS 21-11 "Guideline – Technical Compliance Audit", to ensure the requisite compliance is achieved in all aspects of the design, construction, installation, operation and maintenance of the AusNet network. As discussed in Section 10.3.2, a statistically valid sample of fieldwork audits are undertaken in accordance with Section 4.3.1 in the document QMS 21-10 HSEQ Systems and Compliance Audits, which complies with the requirements of AS 1199.1[17] in determining the audit sample size. Vegetation management capability and knowledge retention

AusNet has a specialist team who are dedicated to the management of vegetation adjacent to electricity distribution network assets, which includes inspection, assessment and cutting activities. Cutting and assessment activities are undertaken by contract service providers. The vegetation management group is represented on the Network Safety Management Committee (NSMC).

AusNet's Vegetation Management Plan (BFM 10-05) details the management procedures to ensure compliance with the Electricity Safety Act and Electricity Safety (Electric Line Clearance) Regulations.

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[17] AS 1199.1 2003 "Sampling Procedures for Inspection by Attributes"

The effectiveness of the plan is monitored through the use of key performance indicators (KPIs) such as the Bushfire Mitigation Index (BMI), Fire Ignition Risk Indicator and F Factor, the analysis of the underlying data that supports these indicators, and the use of auditing.

While vegetation management often faces customer and/or community resistance, there are no systemic resourcing or risk control issues.

6.6.4 Skills and intellectual property with an ageing workforce

The effective management of network safety risk requires the retention of existing skills, together with the development of new skills to accommodate changing technology and standards. AusNet monitors age and skill profiles, together with attrition rates, in order to forecast changes in personnel resource and skill levels. This information is profiled against forecast asset management requirements to identify resource and skill gaps.

AusNet maintains the intake of apprentices, technical officers and engineers to be trained and developed to meet AusNet medium to long term forecast resource requirements. Intellectual property is captured through the use of formal management systems and coordinated activities to retain experienced people and maintain contact with retiring personnel.

Knowledge mapping and formal succession planning is coupled to mentoring programs to identify and commence the transfer of intellectual property.

In relation to risk management specifically, AusNet provides the following training:

- Awareness briefings for all staff, including via the company induction training;
- Competency training for Risk Management Leaders/Coordinators;
- Skills enhancement for facilitators, typically in risk assessment and root-cause analysis;
- Coaching and tools for line manager review and control assurance, design and self-assessment; and
- Periodic re-training and continuing professional development of Risk Management Leaders/Coordinators and other risk management professionals.

6.6.5 Competency and training

To ensure only competent and qualified personnel are permitted to work on the distribution network, competencies and training are recorded in AusNet's learning content management systems and are shown in the individual's VESI network passport.

The procedure QMS 22-03 ESO Passports describes the use of VESI passports within AusNet. It includes the methods and responsibilities necessary to control the issue and endorsement of passports, as well as those for maintenance and inspection.

The procedure QMS 22-01 Training and Development provides the necessary framework within which AusNet manages the professional training and development of its employees and provides opportunity for further education.

The minimum levels of skill and competence for each category of worker are established by the VESI and are based on the standards in the national Electricity Supply Industry (ESI) – Transmission, Distribution and Rail Sector Training Package (UET12) in accordance with National Competency Guidelines. This includes initial and cyclic refresher training requirements. Competencies and training of service providers are managed by the respective service providers and are also required to comply with the ESI requirements.

National training competencies are delivered by a Registered Training Organisation (RTO), whose scope of registration includes the required competencies. All RTOs are required to meet the standards as outlined in the Standards for Registered Training Organisations (RTOs) 2015. All passport refresher modules which are not nationally accredited may be delivered by a person who holds as a minimum a Certificate IV in Workplace Training and Assessment (or equivalent) and is able to demonstrate vocational competence and experience in the subject matter of the passport module they are delivering.

AusNet's training and competency requirements are reflected, as required, in respective contracts with third party service providers.

As discussed in Section 11.3.15, audits are performed to ensure employees and contractors are competent to carry out their duties and are following the appropriate procedures. This is backed up by management review, as discussed in Section 11.3.16.

Live Line Workers

Live line working allows maintenance to be undertaken without inconveniencing customers. It is an inherently hazardous activity and therefore training is an essential aspect of ensuring safety. In adverse weather conditions, live line working has the potential to compromise worker safety.

AusNet's approach is to always put safety first, rather than seeking to optimise network reliability outcomes. Our crews on the ground always make the final decision on whether to undertake live line working.

The training requirements for live line workers, as for other field roles, are specified in the VESI Skills and Training Matrix, which includes the requirement to complete nominated Qualifications/Competent Units.

Protection and Control Testers

Protection and Control Testers have special obligations to AusNet customers, distribution and transmission network, as their actions may potentially introduce risks to normal operation of the network, work force and the general public.

The minimum requirements for qualifications and competencies of protection and control testers are outlined in procedure TDP 200-04 Qualifications and Competencies: Protection and Control Testers.

6.6.6 Local body jurisdictional issues

Local jurisdictional planning requirements, including aboriginal heritage issues, are addressed as part of AusNet's normal work planning processes. As planning issues are normally associated with new works, these processes do not normally impact on maintaining the safe and reliable operation of the existing network.

However, they can influence project objectives, cost, scope, and delivery timeframes. This is generally exclusive to projects that will develop or alter land use, such as relocating or undergrounding overhead power lines. Aboriginal heritage, environmental impacts and health and safety impacts can involve special studies/assessments and the findings can be restrictive or prohibitive.

Community consultation and public participation through the land use planning process (principles of the International Association of Public Participation) can also play a part in altering the direction of projects.

6.6.7 Third party interactions

Network safety issues may arise as a result of interactions with third parties. Figure18 shows the number of inadvertent network contacts by third parties since 2013, each of which had potentially serious reliability and safety consequences.

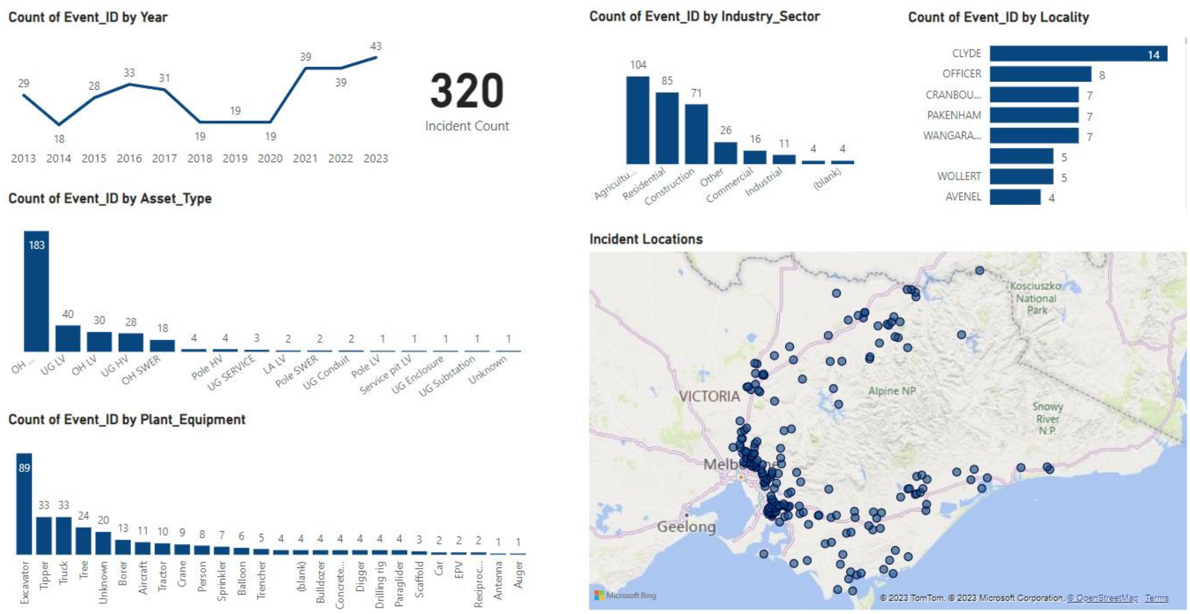


Figure 18 Electricity Network Contact by Other Parties

AusNet also experiences physical security incidents. Infrastructure security events include unauthorised entry, graffiti, theft from depots or company vehicles, and wilful damage. Copper conductor theft is the most common driver for breaking into and entering network installations and depots. Unauthorised entry to substations gives rise to a number of network safety issues, including risk of electric shock and fire ignition.

All incidents are investigated and reported to ESV. Historically, for occurrences of fatal incidents involving contact with overhead medium voltage distribution assets, most occur in rural areas and mainly involve persons undertaking work activities in relation to agriculture. A common cause of fatality are persons operating mobile cranes and tippers on trucks, being in contact with the mobile plant and ground simultaneously as the mobile plant makes contact with medium voltage overhead conductors.

Awareness programs such as the "look up and live" campaign are targeted at reducing the number of incidents involving contact with overhead lines. These programs are initiated and promoted by ESV as the regulatory authority responsible for administration of the *Electricity Safety Act 1998*.

In addition, AusNet has introduced a section on its web site that provides information and services available on "No Go Zones", including links to other relevant sites.

Distribution Fieldwork Procedure DP 05-05-01 'No Go Zone Enquiries' details the methods and responsibilities necessary to control and ensure that compliance with the "No Go Zone" is maintained.

6.6.8 External stakeholders

With respect to network safety, AusNet has interaction with a number of external stakeholders, which presents a range of management challenges as discussed below.

Interaction Between Economic and Safety Regulation

Economic and Safety Regulation is not perfectly aligned, although ESV and the Australian Energy Regulator (AER) have managed this pragmatically since the 2010 price review process.

Firstly, the National Electricity Rules state AER must only fund a network to maintain risk unless a changed external standard, regulation or law imposes new obligations. Therefore, a network initiated improvement will not be funded regardless of its merits. This has led to an effective requirement for an independent body (ESV or Government) to mandate or approve the improvement through the ESMS before funding is provided.

Secondly, the cost benefit trade off embedded in the operation of the National Electricity Rules is not aligned to that required in key safety legislation. Specifically:

- Safety legislation requires investment that is as far as practicable – that is, invest until costs are disproportionate to benefits; while
- The Rules require that investment must not exceed the point at which marginal costs and benefits are equal.

Customer Engagement

AusNet undertook a new approach, commencing for the 2021-2026 EDPR, to ensure our service priorities and expenditures plans are informed by customer needs. With support from the Australian Energy Regulator and Energy Consumers Australia, we have an established a Customer Forum, comprising highly skilled customer representatives to work with us to develop a customer-focused proposal. The Customer Forum has helped guide a substantial customer research program and a range of initiatives to improve customer experience outcomes for customers, such as improving communications and customer-facing processes (e.g. managing outages) and strengthening the accountability of our staff for improving customer outcomes.

Key stakeholders

AusNet's Asset Management System Overview (AMS 01-10) identifies a range of other external stakeholders and expectations which include community, employees/contractors, business owners, retailers and government agencies at state and federal level.

Published Technical Standards

Standards Groups, including Standards Association of Australia, may from time to time develop standards that have been initiated to accommodate a particular jurisdiction or operating environment that introduces inconsistencies with other established published technical standards. The review of changes to standards often requires complex review of existing Victorian Electricity Supply Industry (VESI) standards to ensure safety levels are maintained or enhanced.

6.6.9 Other challenges

From a management perspective, the impact of adverse weather and storm activity is an important challenge due to the high resource requirement needed for network restoration activities during these emergency response events. AusNet has an Integrated Response and Contingency System (SPIRACS) to address emergencies. This system ensures effective and timely response to emergency events (such as storm activity), which may affect the operation of the network and the health and safety of personnel or the public.

Being able to secure the necessary outages of network assets in order to implement work programs to reduce network safety risks is also a significant challenge, especially at certain times of the year when for example access off road during winter is restricted by wet ground conditions.

Restriction of access during the winter season often results in increased network maintenance and replacement to be undertaken during summer periods, which can be restricted by limitations on interrupting customer supply during high heat and TFB days.

7. Network Safety Performance

Key performance indicators (KPIs) for the safety of the electricity distribution network are focussed on the three significant network safety risks of bushfire ignition, electric shock from the network and interruption of supply. Details of historic performance and trends in each of these areas are provided below, along with the internal governance process for network safety performance.

AusNet also monitors KPIs for Occupational Health and Safety processes and procedures, as part of the missionZero strategy.

7.1 Bushfire Ignition

Figure 19 shows an example (FY23) of the total number of fire starts by cause for the network relative to the five year moving average, with Figure 21 used as a 'leading' indicator of network incidents that have the potential to cause fire ignitions.

Whilst HV fuses (figure 19) are currently the significant cause of fire incidents, most are contained to the asset as opposed to resulting in a ground fire. The leading indicator "Network Incidents with Potential to Start Fire"(figure 20) is used to identify opportunities to establish network investment programs that seek to reduce the overall number of faults on the network that have potential to result in fire incidents. Over recent years, vegetation related faults have been driven by significant storm events that have impacted network reliability rather than bushfire risk.

Many asset failures lead only to an asset fire and not to a ground fire, and so the consequences are significantly less. Ground fires can have major consequences, particularly when the fire occurs in extreme weather conditions in a populated, heavily vegetated area. The consequences are heavily influenced by environmental conditions, such as annual rainfall, temperature and high winds.

July to June Cycle

Fire Cause	Ground Fires	Asset Fires	YTD Jun Fires VS YTD Jun 5yr Avg
Animal/Bird	6	1	7 ▼ compared to 13
Conductor	6	3	9 ▼ compared to 10
Crossarm	1	1	2 — compared to 2
FOLCB/isolators	5	7	12 ▼ compared to 18
HV Fuses	7	77	84 ▲ compared to 53
LV cable	3	4	7 ▲ compared to 6
Other	7	2	9 ▲ compared to 7
Pole fire	0	1	1 ▼ compared to 2
Street light	0	3	3 ▼ compared to 9
Surge Diverter	0	0	0 — compared to 0
Transformer	0	0	0 ▼ compared to 2
Tree	8	4	12 ▼ compared to 22
Vehicles	1	2	3 ▼ compared to 5
Total	**44**	**105**	**149 ▲ compared to 148**

Figure 19 Example - FY23 Total Fire Start Trends by Cause

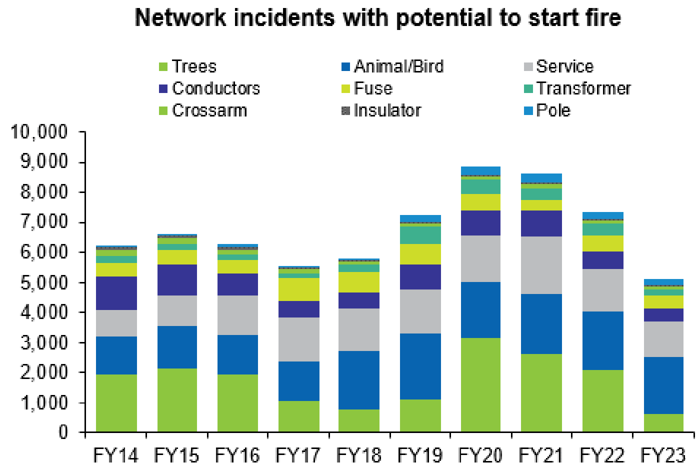


Figure 20 'Leading' Indicator - Incidents with Potential of Fire Ignition

The major causes of asset and ground fires are being addressed by the implementation of the Enhanced Network Safety strategy (AMS 20-13) that delivers network investment programs that are additional to the standard maintenance and replacement programs derived through asset inspections.

The **F Factor** is a lagging indicator that was introduced by the Victorian government and administered by the Australian Energy Regulator (AER) following the 2009 Victorian Bushfires Royal Commission (VBRC). It is a financial incentive scheme to reduce the number of fire starts associated with electricity distribution networks. The scheme was initially based upon fire incidents with the initial benchmark established based upon actual network incidents over the five year period from 2006 to 2010.

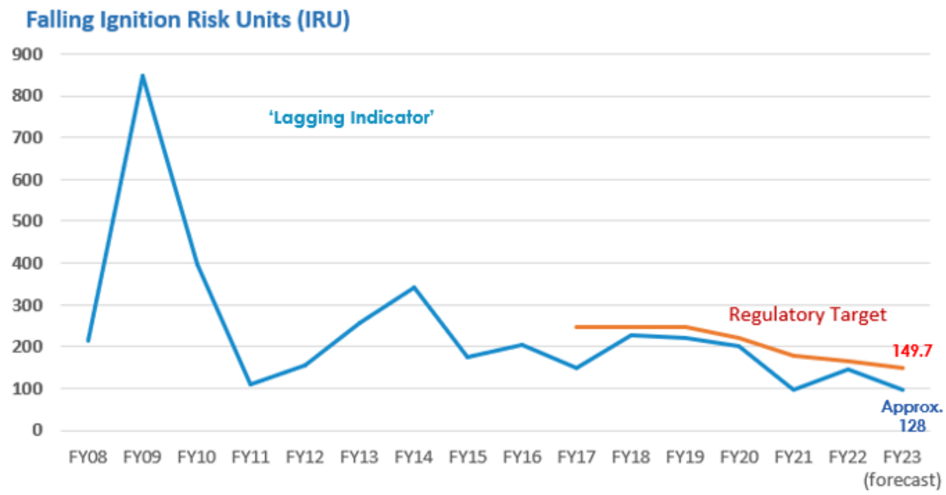


Figure 21 F-Factor – Risk Based Indicator

In 2016 the Victorian Government revised the F-factor scheme whereby it introduced a new risk based F-Factor Incentive Scheme that took effect from 1 July 16 and applies to financial years. It set an initial benchmark for Ignition Risk Units (IRU) of 247.7 commencing for the 2016/17 financial year, based upon performance over the period 2012-2015. It also has an annual benchmark decrement process that reflects the benefits from implementation of the Rapid Earth Fault Current Limiters (REFCLs) technology and actual performance over a five-year moving average. AusNet has used historical data to back cast IRU performance prior to 2016/17.

7.2 Electric Shocks from the Network

The total number of incidents involving electric shocks caused by network assets has been steadily declining, as shown in Figure 22. These incidents are typically people receiving a minor electric shock within their electrical installation due to a deterioration or high resistance of the network supply neutral. This can result in a voltage rise on the customer's installation earth that may be connected to metal plumbing within installations pre-1980s.

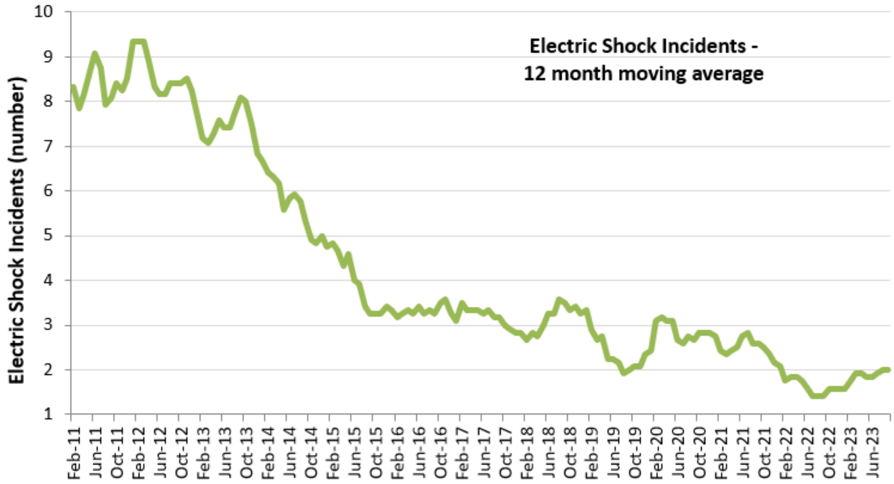


Figure 22 Incidents of Electric Shock from Network

Figure indicates the causes of electric shock incidents which has assisted in targeting of service cable classes for replacement. In addition, AusNet has been able to detect high resistance neutrals through AMI data.

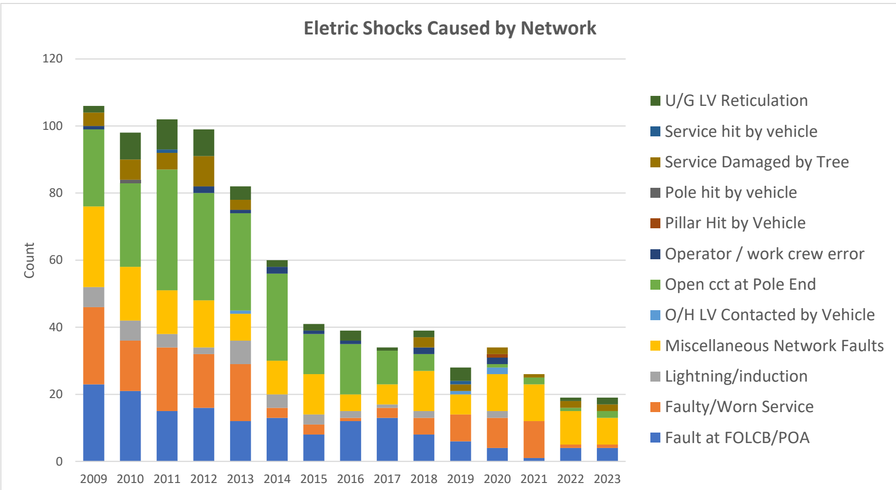


Figure 23: Incidents of Electric Shock from Service Failures

7.3 Interruption of Supply

Unplanned interruptions to supply can give rise to customer and community health and safety issues, particularly during extreme hot or cold weather. The reliability of the electricity distribution network is maintained in accordance with the Electricity Distribution Code, the National Electricity Rules and the rewards and penalties provided by the Service Target Performance Incentive Scheme (STPIS). Audited reliability performance reports are submitted annually to the AER, who publish a comprehensive analysis of electricity supply network reliability each year.

AusNet's progressive implementation of distribution feeder automation (DFA) schemes to automatically isolate the faulted portion of medium voltage feeders and rapidly re-configure other circuits to supply the healthy portions of the faulted feeder has been a significant driver of improvement in this area.

The total time that supply is not available each year - Unplanned System Average Interruption Duration Index[18] or USAIDI - varies from year to year depending on the location of faults within the distribution network.

Figure 24 suggests that when abnormal events are appropriately excluded, AusNet's underlying reliability performance remains relatively constant.

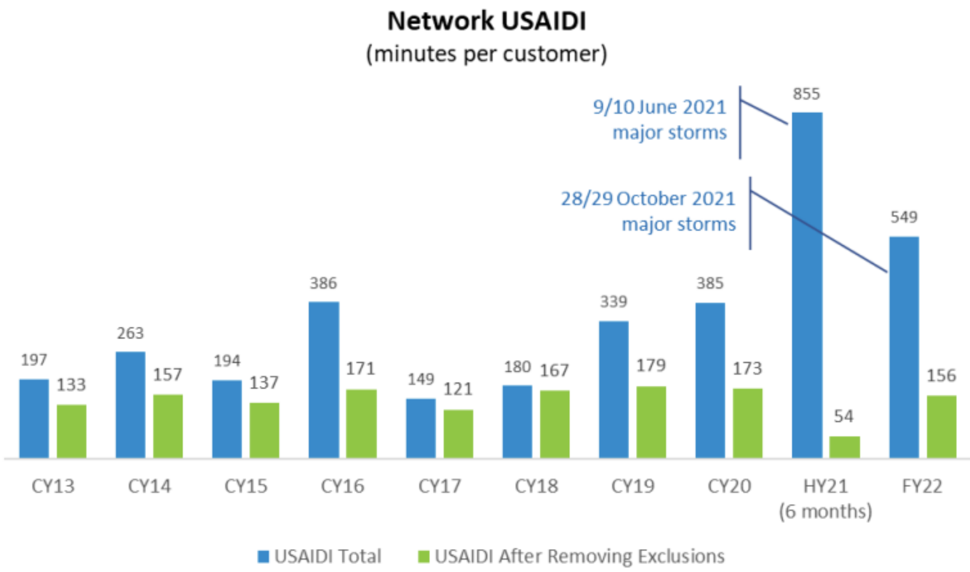


Figure 24 Unplanned Supply Interruptions Performance

7.4 Governance for Network Safety Performance

The KPIs and risks associated with network safety performance are monitored and communicated in accordance with the relevant discussion in Sections 8.2.4, 10.5.2 and 13.5. The Network Safety Report (NSR), which is prepared for the monthly meetings of the Network Safety Management Committee (NSMC), contains detailed information on the trending of network safety related KPIs.

AusNet's risk governance model is discussed in detail in Section 8.2.4, including the role of the NSMC.

[18] Total time that supply is unavailable to an average customer each year due to unplanned network events

8. Identification of Risk

The purpose of this section is to explain AusNet's methodology for identifying network safety risk and the outcome of that risk identification process.

8.1 Risk Management Framework

AusNet recognises the importance of effective risk management and is committed to continually reviewing and improving its risk management processes and capabilities throughout its business. AusNet's approach is to apply a single, consistent framework for the identification, assessment and management of risks across all parts and activities of the company. This is a key part of our risk management policy, which is included in Appendix C.

AusNet's framework for risk management is embodied in its Risk Management Framework, shown in Figure 25, which provides a "blue print" for risk management. The key themes of the Risk Management Framework are:

- Provide simple to use, relevant tools;
- Build capability and motivate effective risk management; and
- Promote the ownership of risk management by divisions and its integration into the system of management.

Figure 25 Overview of Risk Management Framework

AusNet's Risk Management Framework complies with the international standard for risk management (AS/NZS ISO[19] 31000:2018 Risk Management – Principles and Guidelines). This standard defines risk as 'the effect of uncertainty on objectives' and provides principles, framework and a process for identifying, assessing and managing risk.

AusNet's risks are identified, assessed and managed at all levels in the organisation through network design and operation, incident investigation, asset condition monitoring and performance analysis, workshops, meetings and one-on-one interviews.

[19] ISO is an independent, non-governmental international organisation with a membership of 162 national standards bodies.

8.2 Risk Identification Methodology

8.2.1 Risk identification process

Figure 26 provides an overview of the risk management process and shows how risk identification relates to the other elements in this process. Risk identification is the process of finding, recognising and describing risks. It involves the identification of risk sources, events, their causes and their potential consequences. It is the first part of the risk assessment process, which includes the three steps shown in the shaded area in Figure 26.

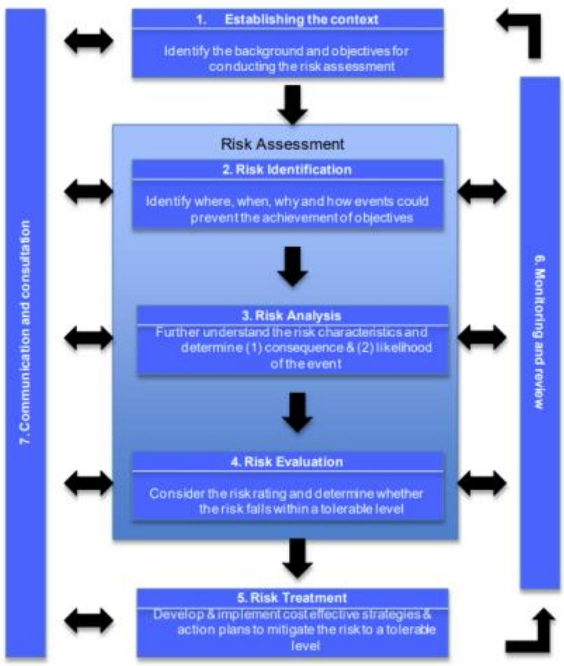


Figure 26 Risk Management Process

Network safety risks have been identified at the two levels, defined within AusNet's Enterprise Risk Management Framework (RM 10-01), as either 'key risks' or 'operational risks'.

Key Risks

Those risks that can impact the achievement of AusNet's strategic and business objectives. The Key Risk assessment is reviewed at a minimum annually and monitored closely by the ELT and Audit and Risk Committee. Key risks identified through the Formal Safety Assessment are registered within the corporate risk register (Enablon). The key risks identified are discussed in more detail below.

Operational Risks

Those risks that occur at AusNet as part of its day-to-day operations and will often feed into a key risk. This might include the risks associated with the achievement of project objectives and business as usual objectives.

Formal Safety Assessment

A Formal Safety Assessment (FSA) has been carried out in accordance with the requirements of the ESMS, to identify and assess network safety related risks. The FSA process is typically a combination of qualitative and semi quantitative risk identification and assessment.

This process involves a number of workshops, which include subject matter experts with a range of backgrounds in electricity distribution. A standard risk assessment template is used during these workshops to ensure that the identification and assessment process aligns with the corporate methodology. The workshops consider the various stages of asset life cycle, asset categories, and processes and systems related to asset management, as explained below.

- **Asset Life Cycle**

  The templates used in the workshops are designed to ensure a full life cycle approach is taken to the identification of risks associated with the management of network assets. The template matrix is divided into asset life cycle categories of System Planning, Design, Procurement/Specification, Construction/Installation, Commissioning, Operations, Inspection/Maintenance and Retirement/Disposal to ensure that potential risks are considered at each stage of an asset's life cycle.

- **Asset Categories**

  The network was divided into the ten broad asset classes of Aerial Service Cables, Distribution Substations, Earthing, Metering, Overhead Lines, Public Lighting, Protection and Control, Switches, Underground Cables and Zone Substations to enable workshops to be organised around personnel with the relevant expertise and experience. Risks are also identified associated with the range of sub-classes of assets within these ten broad asset classes.

- **Processes and Systems**

  The workshops also identified risks associated with the processes and systems that are common across the management of the ten broad asset classes over their full life cycle, as discussed above.

8.2.2 Responsibility for identifying risk

Commensurate with their role, each employee and contractor has been trained and equipped to identify risk prior to starting each physical task, taking decisions or initiating a strategic directive.

For example, prior to commencing work field personnel are required to identify the risks associated with each task by the completion of a Job Safety Analysis (JSA). Before any significant decision for major projects or initiatives, or when significant internal or external changes are planned, risks are identified and a risk assessment conducted to determine the most appropriate course of action.

8.2.3 Constraints, limitations and accuracy

It is important to note that the risk management process, including risk identification, is not an exact science. AusNet relies on the expert knowledge and experience of its staff and contractors to identify and assess network safety related risks. Furthermore, there is a significant element of uncertainty in assessing and managing these risks - for example, weather is an important influencing factor in relation to bushfire risk.

Limitations also include the degree to which assets may contain latent or hidden defects that asset condition-based inspection and assessment techniques are unable to detect. A combination of developing technology and learnings taken from incident investigations are used to continually enhance asset condition monitoring and replacement strategies.

Current and legacy data information systems may also contain limitations in respect to the level of detail regarding an asset's attributes and performance that is captured. Asset information systems are initially designed on the basis of capturing relevant details for known risks and therefore may contain limitations for capture of additional data at a later stage of the asset life cycle.

Whilst it is important to recognise these inherent constraints and limitations in the identification and assessment of risk, the rigorous application of AusNet Risk Management Framework ensures that a systematic and common methodology is adopted at all levels across the entire company.

8.2.4 Risk visibility for senior executives

The outputs from the risk assessment process are made visible to senior executives and the Board. Strong and visible commitment to achieving excellence in risk management must be demonstrated through the implementation of a strong risk governance framework supported by robust policies, processes and systems.

Figure 27 summarises AusNet's risk governance process for engaging senior executives and the Board.

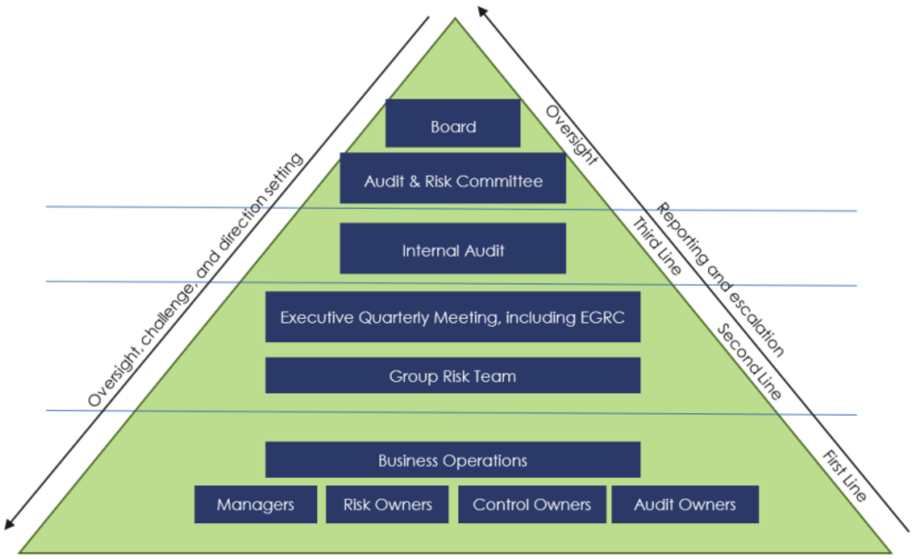


Figure 27 Risk Governance Structure

The Network Safety Management Committee (NSMC) operates within the risk governance structure at the business operations level. The NSMC consists of key management and operational personnel that manage network safety outcomes in accordance with AusNet's risk management framework. Key risks identified through the Formal Safety Assessment process are recorded within the corporate risk register (Enablon) that provides visibility to the ARC.

The purpose of the Network Safety Management Committee (NSMC) is to understand and manage network safety and bushfire ignition risks at the various stages of planning, designing, constructing, operating, maintaining and decommissioning the electricity distribution network. The NSMC monitors the implementation and effectiveness of the AMS and AMP in addressing network safety risks and initiates corrective actions where network safety trends are unfavourable or emerging risks are identified.

8.3 Identified Risks

This section provides a summary and discussion of the key network safety related risks identified using the methodology discussed in Section 8.2.

8.3.1 Key risks

The identification process for the three key risks using the bow tie template format and as risk record reports from the Risk Management Information System (Enablon) is included in Appendix H. These document the identified causes, impacts, and controls to address both the likelihood and consequence of a network safety event.

AusNet's Assets Cause a Catastrophic Bushfire

The Board of Inquiry held in relation to Victorian bushfires in 1977 (Barber inquiry) found the former State Electricity Commission of Victoria (SECV) assets were involved in a significant proportion of the major fire incidents. A preceding period of drought, combined with asset failures, high temperatures, wind and vegetation were identified as contributing factors to the significant consequences.

The SECV developed the Bushfire Mitigation Manual following the 1983 Ash Wednesday bushfires in which a range of asset failure modes and causes, together with external factors, were identified in the Barber Inquiry and subsequent Ash Wednesday events as contributing to network related bushfire risk.

A summary of specific asset classes identified as presenting hazards with respect to bushfire risk included:

- High voltage insulators;
- High voltage fuses;
- SWER earths;
- Timber crossarms;
- Lightning arrestors;
- Low voltage conductor clashing;
- Conductors/ties;
- Timber poles; and
- Pole top hardware – loose bolts

Non network hazards associated with network assets that contributed to bushfire risk included:

- Vegetation;
- Private overhead electric lines (POELs); and
- High fire risk areas

Network asset management systems maintain asset condition and performance records that indicate actual in-service failures, modes and frequencies together with application within availability work bench models that forecast potential failure rates and risk.

In addition, world climatologists indicate that global climate change is likely to result in more frequent periods of drought and higher average temperatures, together with community expectations to retain and protect vegetation near overhead powerlines.

Electric Shock from Electricity Distribution Network Assets

Engineering design for connection of electrical installations to the low voltage distribution network recognises the potential for electricity voltages to rise above normal voltages within the installation in the event of a loss of connection to the mains neutral conductor. As a precautionary measure the installation regulations (AS/NZ 3000) require a multiple earth neutral system that involves the connection of the installation neutral to earth, which is effectively in parallel with the distribution network earth.

Electrical installations prior to the 1980s utilised the metal plumbing within the installation as part of the electrical installation's earthing system. In the event of a loss of connection or high resistance in the distribution network neutral, the installation's earth acts as the operational earth which can create differing voltage potentials between unbonded metal fittings. This potential for voltage differential between kitchen and bathroom taps and the sink or metal drain can result in customers experiencing 'tingles'. Whilst the voltage rise is generally not sufficient to cause severe electric shock, anyone receiving an electric shock, however minor, is advised to seek medical attention. The sensation and subsequent surprise to a person receiving an electric shock can also pose consequential injury through the risk of slips, trips or falls.

In addition, the installation's earth acting as an operational earth can pose a risk of severe electric shock or electrocution to persons, typically plumbers, working on metal plumbing if industry precautions are not used that require the bonding of metal pipes when disconnecting or cutting.

Experience demonstrates that fatalities involving electrocution associated with network assets are typically due to inadvertent contact with overhead bare high voltage powerlines. Contact is generally by machinery or plant being operated in contravention to 'No Go Zone' guidelines administered by WorkSafe.

Loss of Supply During Extreme Weather Conditions

The Climate Council report published in 2014 indicated the following:

> *"Preliminary accounts of the January 2014 heatwave in Victoria point to significant health impacts—203 heat-related deaths, a 20-fold increase in ambulance call-outs, a four-fold increase in calls to nurses-on-call, and a four-fold increase to locum doctors".*[20]

A key finding included the following:

> *"Extreme heat can damage infrastructure such as electricity distribution and transport systems, causing flow-on effects. Heatwaves experienced in Melbourne in recent years have disrupted the railway system and electricity grid."*

With evidence that heatwaves potentially result in fatality rates greater than hazards such as bushfire, the risk of extended electricity supply interruption durations during heatwave events can potentially contribute to increased fatalities through inability for customers to operate air conditioning, impeding effectiveness of emergency services or inability for rural customers who are reliant on electric pressure pumps to access running water.

8.3.2 Operational risks

The network safety related risks identified at the operational level are included within the Formal Safety Assessment register discussed in ESMS 20-02 Formal Safety Assessment document. Whilst most of these risks are managed as part of day-to-day operations, some may be addressed through parent risks at the 'Key Risk' level.

8.3.3 Formal safety assessment risks

Subject matter experts identified more than 500 specific network safety risks. Of these, a number of risks associated with overhead line assets were captured under the 'key' risk, 'assets cause catastrophic bushfire', with the other two 'key' risks identified as 'electric shock from network assets' and 'loss of supply during extreme weather events'. The remaining risks are treated as 'operational' risks.

The formal safety assessment (FSA) is a requirement of AS 5577 Electricity Network Safety Management Systems. It is reviewed as part of the preparation of updates to the ESMS. Any Level A and B risks identified from the FSA are recorded in the corporate risk register and reviewed on an annual basis.

[20] Heatwaves: Hotter, Longer, More Often, Professor Will Steffen, Professor Lesley Hughes and Dr.Sarah Perkins, 2014

9. Assessment of Risk

The purpose of this section is to describe AusNet's methodology for assessing network safety risks and the outcomes from this.

9.1 Risk Assessment Methodology

9.1.1 Overview

The assessment of risk is a component of the Risk Management Framework, which complies with ISO 31000. As discussed in Section 8.2.1 and with reference to Figure 28, risk assessment is the overall process of risk identification, risk analysis and risk evaluation, i.e. the three steps shown in the grey shaded area in Figure 28. Each of these steps is explained below.

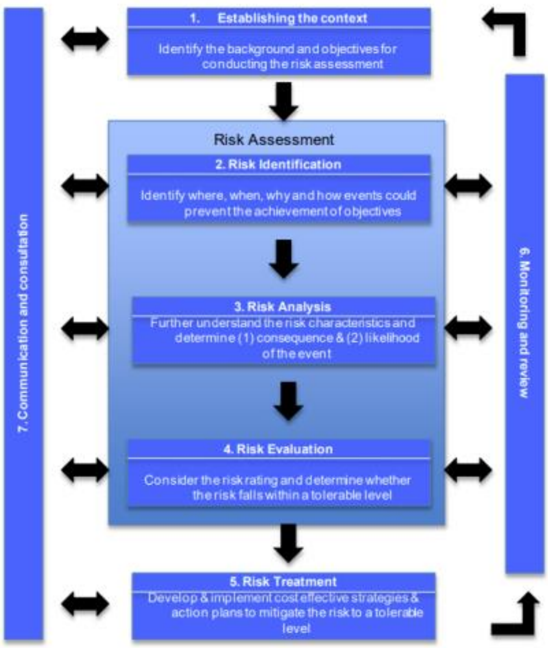


Figure 28 Risk Management Process

Risk assessments are typically carried out at all levels in the organisation utilising workshops attended by managers, employees and delivery partners, including subject matter experts to provide expert input. These workshops are often facilitated by a risk management leader/co-ordinator to ensure consistency in approach.

The risk assessments are recorded, typically by using one of the templates shown in Appendix G.

9.1.2 Identification of risk

This involves clearly defining and describing the risk, its causes, impacts and current and future controls, and is discussed in detail in Section 8.

9.1.3 Analysis of risk

Risk analysis involves understanding the nature of the risk and determining its level, which provides the basis for risk evaluation and decisions about risk treatment. Risk analysis includes determining the risk control effectiveness (RCE) rating of the identified current controls, which is discussed in detail in Section

10, and determining the consequence and likelihood ratings of the risk using the methodology discussed below.

Consequence Rating

The consequences are assessed first and the rating is chosen on the basis of the **expected** or **most likely** impacts on AusNet and its stakeholders after considering the current control environment. The rating is determined using a five point scale where a rating of 1 is the lowest and a rating of 5 the highest level of impact. A rating is determined for each of the consequence areas shown in the table in Table 3 that are relevant to the particular risk. Then the overall consequence rating for the risk is the **highest** level of the ratings for each of the relevant consequence areas.

The consequence areas and criteria illustrated in Table 3 recognise that risks may have multiple tangible and intangible consequences measured via different metrics. Network safety related risks will have consequences in the area of "Health and Safety", but often also in other areas including "Environment and Community", "Customers" and "Regulation, Legal and Compliance".

In arriving at consequence ratings, consideration is given to records or knowledge of past incidents and near misses that had the potential for more significant consequences in AusNet network and elsewhere in the industry.

For example, with reference to Table 3, for risks having consequences in the "Health and Safety" area, a rating of 5 is assigned where multiple fatalities and/or significant irreversible exposure to a health risk that affects greater than 10 people is assessed as the most likely or expected outcome if the risk occurs. A rating of 1 is assigned where minor injury is assessed as the most likely or expected outcome.

For electricity distribution network related risks having consequences in the "Customers" area, a rating of 5 is assigned where loss of supply of more than 100 system minutes/USAIDI is assessed as the most likely or expected outcome if the risk occurs. A rating of 1 is assigned where loss of supply of greater than 1 but less than 3 system minutes/USAIDI is assessed as the most likely or expected outcome.

It is important to note that the above approach ensures that consequences are thoroughly assessed and specific controls to address consequences are defined, as shown in the bow-tie risk assessment template in Appendix G. AusNet's risk management approach considers the absolute exposure in terms of the possible consequence of an event and does not disregard a risk on the grounds that it is very unlikely to occur or assume that the risk is mitigated by a very low likelihood.

Table 3: Consequence Criteria for Risk Assessments

Rating	Health & Safety (Employee & Public)	Environment & Community	Reputation	Customers	Regulation, Legal & Compliance	Management Impact & People	Financial Impact (cash)
5	• 1 or more fatalities (employee and/or public) and/or • Major injures to multiple people. • Significant irreversible exposure to a health risk	• Catastrophic long term environmental harm off-site and/or • Irreversible impact to cultural heritage area • Community outrage-potential large-scale class action	• Critical event that the organisation could be forced to undergo significant change • Sustained adverse press reporting over several weeks (national/int'l) • Total loss of shareholder support who act to divest • Reputation impacted with majority of stakeholders	• Incident resulting in a System Black • Major interruption to CBD services due to multiple asset failures • Life Support Customers unsupported for over 7 days • Severe impact on the level of service resulting in over 50% increase in customer complaints • Significant and widespread customer/Ombudsman/MP/Regulator complaints	• Major and protracted litigation with uninsured exposure • Custodial sentence for company Executive • Prolonged closure of operations by authorities • Regulators control business through directives and suspend ability to operate • Licence to operate threatened	• Full implementation of the Crisis Management Plans • Major impacts to workforce availability in critical areas	• $100m+ loss

Rating	Health & Safety (Employee & Public)	Environment & Community	Reputation	Customers	Regulation, Legal & Compliance	Management Impact & People	Financial Impact (cash)
4	• Serious or permanent Injury e.g. amputation, long term disability or disorder	• Prolonged off-site environmental impact, e.g. significant impact on ecosystems / destruction of area of high cultural heritage • High-profile community concerns raised – requiring significant remediation measures	• Significant event that would require ongoing management and brings the organisation into national spotlight • Sustained adverse national press reporting over several days • Sustained impact on Company reputation	• Incident resulting in a loss of a major terminal station or city gate • Localised rehousing of community over 5 days • Life Support Customers unsupported for over 5 days • Considerable impact on the level of service resulting in a 25% to 50% increase in customer complaints • Significant widespread customer / Ombudsman / MP / Regulator complaints	• Major litigation • Possibility of custodial sentence • Significant fines are imposed and multiple directives issued • Investigation by regulatory body resulting in long term interruption to operations • Extensive reporting and audit regimes are imposed	• Significant event that requires implementation of Emergency or Disaster Recovery plans • Significant impacts to availability of workforce	• $30m-100m loss
3	• Serious Medical / Hospital Treatment (>10 days lost)	• Major event leading to local on and off-site impact on ecology or damage to area of cultural heritage • Medium term recovery • High potential for complaints from interested parties	• Major event that causes adverse local press reporting over several days • Reputation impacted with some stakeholders	• Localised rehousing of community over 3 days • Life Support Customers unsupported for over 3 days • Some impact on the level of service resulting in a 10% to 25% increase in customer complaints • Widespread customer / Ombudsman / MP / Regulator complaints	• Significant litigation involving many weeks of senior management time • Major breach of law with punitive fine • Fines imposed, directive issued and additional audit and reporting requirements	• Major event that can be managed with careful attention, will take some project managers considerable time for several weeks. • Some impacts to availability of the workforce	• $1m-30m loss

Rating	Health & Safety (Employee & Public)	Environment & Community	Reputation	Customers	Regulation, Legal & Compliance	Management Impact & People	Financial Impact (cash)
2	• Medical Treatment Injury (MTI) / Lost Time injury (<10 days lost)	• Medium term recovery, immaterial effect on environment/ community • Required to inform Environmental agencies, (e.g. noise, dust, odour)	• Adverse local press reporting • Reputation impacted with a small number of stakeholders	• Customer / community affected by loss of service for over 24 hours • Life Support Customers unsupported for over 1 day • Minor impact on the level of service resulting in a less 10% increase in customer complaints • Noticeable increase in customer / Ombudsman / MP / Regulator complaints	• Breach of law with investigation or report to authority with prosecution and/or moderate fine possible • Specific regulatory audit with critical findings and recommended actions	• Will require some local management attention over several days • Minor impacts to availability of workforce	• $300k-1m loss
1	• First Aid Treatment / No Treatment	• Small, confined event, no impact on ecology or area of cultural heritage • Short term transient environmental or community impact- little action required	• No press reporting or external interest	• Localised customer complaints • Localised Ombudsman complaints	• Minor legal issues, non-compliances and statutory fine • Routine regulatory reporting and audits	• Impact of event absorbed through normal activity • Small, contained and short term impacts to availability of workforce	• < $300k loss

Likelihood Rating

Once the consequence rating for the risk has been determined, the likelihood rating is then determined on the basis of the chance that AusNet or its stakeholders could be affected at the **chosen level of consequence** as shown in Table 4.

Table 4: Likelihood Criteria for Risk Assessments

Rating	Probability	Frequency	Qualitative factors
Almost Certain	>95%	Could occur "weekly"	Occurrence is imminent
Likely	50-94%	Could occur "monthly"	Balance of probability will occur
Possible	20-49%	Could occur "yearly"	May occur but distinct probability won't
Unlikely	5-19%	Could occur over "decades"	May occur but not anticipated
Rare	<5%	Only occur as a "100 year event"	Occurrence requires exceptional circumstances

Residual and Target Risk Ratings

Both residual and target risk ratings are determined for each risk assessed. The residual risk rating is that which exists now and is determined by considering the current controls only. The target risk rating is the anticipated rating once any improvements to the current controls and also the nominated future controls have been implemented.

9.1.4 Evaluation of risk

Evaluation of risk is the process of comparing the results of risk analysis with risk acceptance criteria to determine whether the level of risk is acceptable or tolerable or can be further reduced where it is considered practicable to do so. This assists in decisions about risk treatment and is discussed further in Section 10.

9.1.5 Data sources and methods

Issue Management System

The principal data source for network safety related risk assessments are the reportable network events recorded in the Issue Management System (IMS) Enablon.

Standard Operating Procedure SOP 30-2010 Electrical Incident Investigation and Reporting for Electricity Distribution Network provides instruction on the required data, timeframes and responsibilities to be recorded in IMS and reported to ESV. The process of recording, investigating and reporting these events is mature and regularly audited. The data is reliable and accurate.

In some cases, relevant data is not available from IMS and similar data is then sought from other agencies such as Work Safe Victoria or the Bureau of Meteorology. Where no relevant data is available the combined experience of the risk assessment workshop team is used to estimate the consequences and likelihood of the risk occurring. This process is underpinned by the experience of the team in similar types of incidents and near misses.

IMS is also the management tool used to record non-conformances and improvement recommendations from all audits within the business.

Distribution Outage Management System

The principal data source for network reliability related events is the Distribution Outage Management system (DOMs). Every planned and unplanned interruption to the electricity supply of every customer is recorded in DOMs. All momentary events and sustained electricity outages captured by SCADA facilities at more than 1500 locations or reported by customers are recorded, together with root causes and impacts on customers. High accuracy data is available for the last decade. These records are reported to the Australian Energy Regulator (AER) and are subject to annual audit. Data from DOMs is reliable and accurate.

Asset Management Information System

The asset management information system (SAP) contains the plant and equipment records which include scheduled asset inspection and maintenance intervals, age, condition and location. This data source provides information used in the Availability Work Bench modelling, which in turn is used to assess and prioritise network asset risks used in the development of the Asset Management Strategy.

Availability Work Bench

Availability Work Bench models contain asset age, condition and probability of failure data that is modelled against consequences of bushfire and loss of supply to establish network risk at an individual asset level. This detailed level of modelling is used in the maintenance of the Asset Management Strategy, through which asset operation, maintenance and replacement programs are derived.

Fire Loss Consequence Model

The Fire Loss Consequence Model (FLCM) was developed by the PBST, established subsequent to the 2009 Victorian Bushfires Royal Commission, and is maintained by the Victorian government. The model is used by the electricity distribution businesses to identify and prioritise the geographical areas of highest bushfire loss consequence, as illustrated in Figure 15. AusNet utilises the consequences of this model, combined with Bureau of Meteorology data on return periods of extreme fire danger indices shown in Figure 16, to model the levels of bushfire risk associated with distribution network assets. This data is modelled with electricity network asset data in Availability Work Bench models.

Smart Meters

Smart meters installed at every customer's installation now provide highly accurate information on supply outages and deviations in electricity supply quality. Data from smart meters is used for customer billing and hence is subject to high quality standards and regular audits for accuracy and completeness. Some of this data is also used for network planning purposes and network safety or reliability risk assessments.

External Data Sources

AusNet retains membership of various national and international technical committees such as the Energy Networks Association (ENA) and International Council on Large Electric Systems (CIGRE) that provide members with a forum to share information on asset and network performance, including that related to network safety.

Information is also obtained annually from the Country Fire Authority (CFA) regarding expectations and outlooks for the forthcoming fire season, the content of which is based on weather predictions from the Bureau of Meteorology. Leading up to and during the fire season each year the CFA also provide grassland curing maps on a frequent basis.

9.1.6 Risk model/matrix

The level of all risks is determined by plotting the consequence and likelihood rating combination on the matrix illustrated in Figure 29 Risk Level Matrix

.

		Consequence				
		1	**2**	**3**	**4**	**5**
Likelihood	**Almost Certain**	C	C	B	A	A
	Likely	D	C	B	B	A
	Possible	E	D	C	B	A
	Unlikely	E	D	D	C	B
	Rare	E	E	D	C	C

Figure 29 Risk Level Matrix

The matrix is used to determine the priority of attention for the risk, as shown in Table 5.

Table 5: Priority for Attention

Residual Risk Rating	Actions	Timing for Reporting	Authority for toleration
A	Take immediate action to treat risk to reduce to acceptable level	Immediate Reporting Included in Monthly Business Report	Board/ARMC
B	Take action to treat risk to aim for acceptable level	Immediate Reporting Included in Monthly Business Report	MD
C	Implement cost-effective additional treatments where appropriate	Within a month	ELT
D	Monitor and review periodically	Part of annual sign off	XLT
E	Manage per identified controls.	Part of annual sign off	Managers

In accordance with the Enterprise Risk Management Framework (RM 10-01), risks identified through the Formal Safety Assessment (FSA) are reviewed at least every five years as part of the formal review of the ESMS. Risks identified through the FSA that are assessed as 'key' risks (typically level A and B risks) are registered within the corporate risk register and are reviewed annually.

9.1.7 Causal factors

An important part of the risk assessment process is to identify the causes of the risk. Weather conditions, vegetation and birds and animals are often identified as causes of network safety related risks, rather than being considered as specific risks themselves.

Causes of the three significant network safety related business risks were discussed in Section 7 and further detail is provided below.

Bushfire Ignition

The risk assessment for the key network safety related risk of "AusNet Assets Cause a Catastrophic Bushfire" includes causes of "Vegetation contact with network assets", "Bird/animal contact with assets" and "Lightning damage to assets", along with other identified causes. In carrying out a risk assessment the aim is always to identify at least one current and/or future control that addresses each of the identified causes i.e. there should be no "orphan" causes.

An important lead indicator with respect to bushfire risk is the Network Incidents with Potential to Start Fire risk indicator, which is used to monitor the trends of faults on the distribution network that have the potential to initiate a fire given the right conditions. The trending of incidents with the potential to cause a fire start from various causes is shown in Figure 30.

Asset Management Strategies for individual asset classes such as conductors, poles and fuses, include reliability centred maintenance (RCM) analysis that identifies the contributing factors to the causes and modes of asset failures. These typically include corrosion, dry rot/fungal attack on timber assets, white ant attack of timber assets, lightning damage, mechanical wear and electrical damage that has occurred between inspection intervals or was not detected through asset condition assessments.

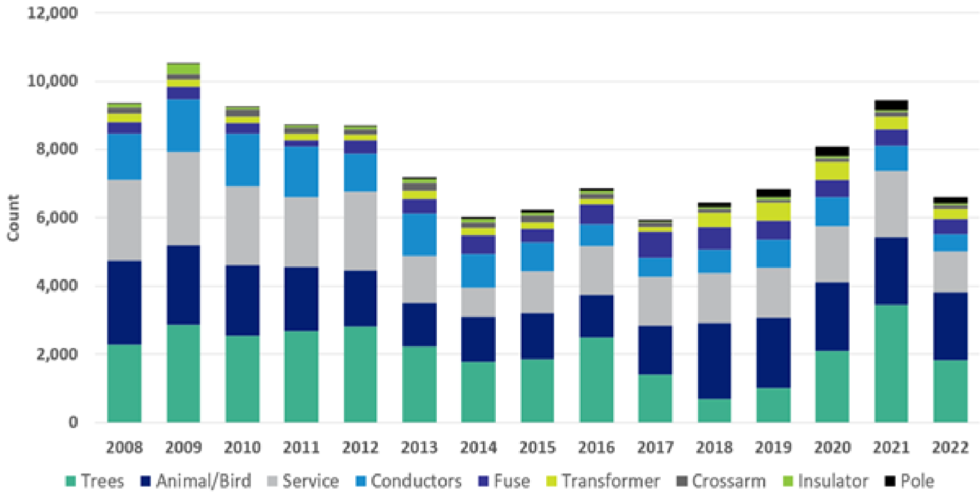
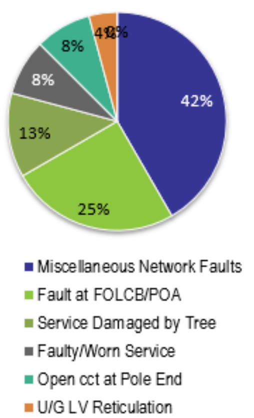


Figure 30 Number of Incidents with Potential to Cause a Fire Start by Causes

Electric Shock from Network

The identified causes of the network safety related business risk of "AusNet Assets Cause an Electric Shock" are shown in Figure . Electric shock incidents are often caused by defective neutral service connections to customer premises.



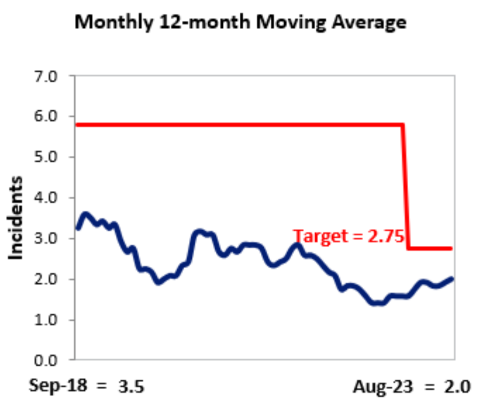


Figure 31: Causes of Electric Shocks

Interruption of Supply

Network reliability is generally impacted by similar causes attributed to the risk of 'bushfire ignition' and these are shown in Figure 32.

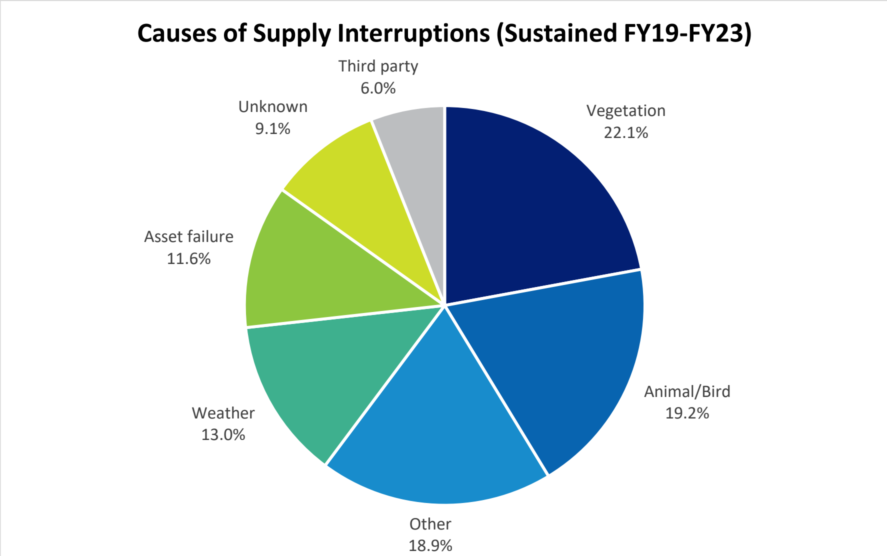


Figure 32: Causes of Supply Interruptions

9.1.8 Constraints and limitations

The risk assessment methodology used is primarily qualitative, although it does not preclude the use of quantitative data (if available) to calculate the consequence and likelihood ratings. For example, the risk modelling that has been performed for failure of key assets and included in their individual asset management strategy documents, uses quantitative data on asset failure rates to determine the likelihood rating.

Some identified risks may be of extremely low likelihood, in which case there is generally little data to determine the expected consequences in order to establish a level of risk. In such cases the collective knowledge and experience of employees and sometimes other sources are used to determine the consequence level and so rate the level of risk. An example of this would be the risk of acts of sabotage or terrorism directed towards the network, the resultant damage from which may then lead to network safety related risks.

Also, because of the relative coarseness of the five by five risk matrix used, it is possible that improvements to a risk can be made without it being reflected in a reduced risk rating i.e. there may be a reduction in the consequence and/or likelihood but not enough to meet the requirements of the next level down in the rating scales.

9.2 Outcomes of Risk Assessment Process

The risk assessment methodology described in Section 9.1 has resulted in the outcomes for identified network safety related risks discussed below. AusNet classifies risks as business, operational, asset related and Formal Safety Assessment related depending on their nature and strategic relevance to the organisation. There are network safety related risks under all these classifications.

9.2.1 Assessment calculations

Details of the rating levels for consequence, likelihood, risk control effectiveness (RCE) and overall risk for the three significant network safety related business level risks are included in the risk assessments using the bow tie template shown in Appendix G.

Details of the methodology and calculations used to assess risk at an individual asset level are contained within respective asset management strategies. Each asset management strategy is supported by a range of data and models used in the development of each strategy. This is discussed in further detail in Section 12.

9.2.2 Risk ratings and prioritisation

Network safety risks have been identified at the two levels, defined within AusNet's Enterprise Risk Management Framework (RM 10-01), as either 'key risks' or 'operational risks'.

Key Risks

Those risks that can impact the achievement of AusNet's strategic and business objectives. The Key Risk assessment is reviewed at a minimum annually and monitored closely by the ELT and Audit and Risk Committee. Key risks identified through the Formal Safety Assessment are registered within the corporate risk register (Enablon) and would typically have a risk rating of Level A or B.

Three significant network safety related business risks first introduced in Section 3.7. The detailed assessments for these risks are conducted in the bow-tie template (Appendix G) and the outcomes of the assessment for the three significant network safety related business risks are summarised in Appendix H. The Risk Management Information System is discussed in more detail in Section 10.5.6.

Whilst monitored by the ARC, the effective management of these risks is delegated to the relevant General Manager and division within AusNet. Business risks are frequently parent to (or overarch) more specific operational risks.

Operational Risks

Those risks that occur at AusNet as part of its day-to-day operations and will often feed into a key risk. This might include the risks associated with the achievement of project objectives and business as usual objectives. These risks are typically those assessed through the FSA and Level C to E risks and are delegated to General Managers to manage.

Formal Safety Assessment Risks

The outcome of the FSA was that there were no identified risks assessed as Level A and three assessed as Level B. These are shown in the table in Appendix H.

In addition to these key risks, more than 500 risks were identified, which were rated at Level C, D and E. These lower level risks are managed by inclusion of their details in relevant asset management strategies and company processes and procedures.

9.2.3 Risk maps

Network Faults

Network dashboards can be created for the purposes of supporting investigation into network incidents and performance that include a map showing the location of all network faults or incidents. An example of this map, which identifies the causes of the faults, is shown in Figure 33.

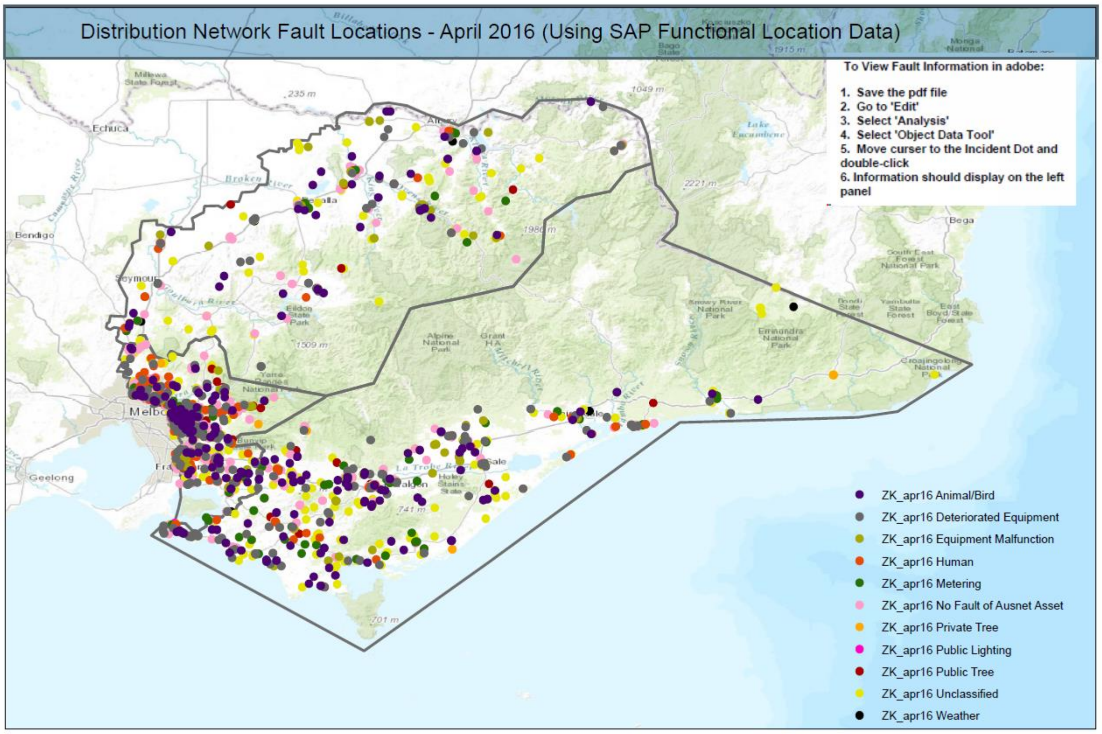


Figure 33 Example - Location of Network Faults

Figure 34 shows the Fire Loss Consequence ratings for the AusNet distribution network, with the areas shaded red having a higher fire loss consequence and the areas shaded green having a lower fire loss consequence. The consequences are derived on the basis of a possible worst case house loss in the event of a bushfire during the most severe weather conditions. The information is integrated within AusNet's Asset Risk Model to apply weather return periods and asset fault data to derive bushfire risk levels at an individual asset level.

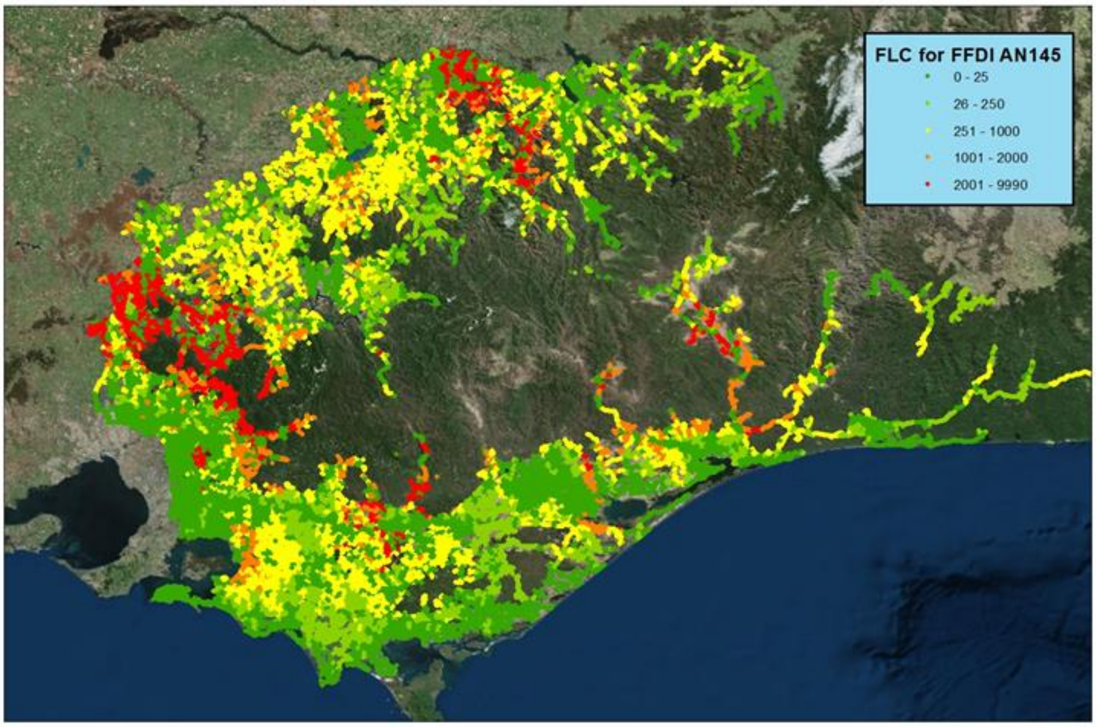


Figure 34 Fire Loss Consequence Ratings

Electric Shock from Network

Third party contact with distribution network assets that result from infringement of No Go Zone rules have historically been linked with fatalities. Figure 35 shows an example of a dashboard analysis of third-party contacts by number, industry and location. This information supports an aggregated approach at a VESI level that supports targeted media and communication programs undertaken by ESV on behalf of the industry.

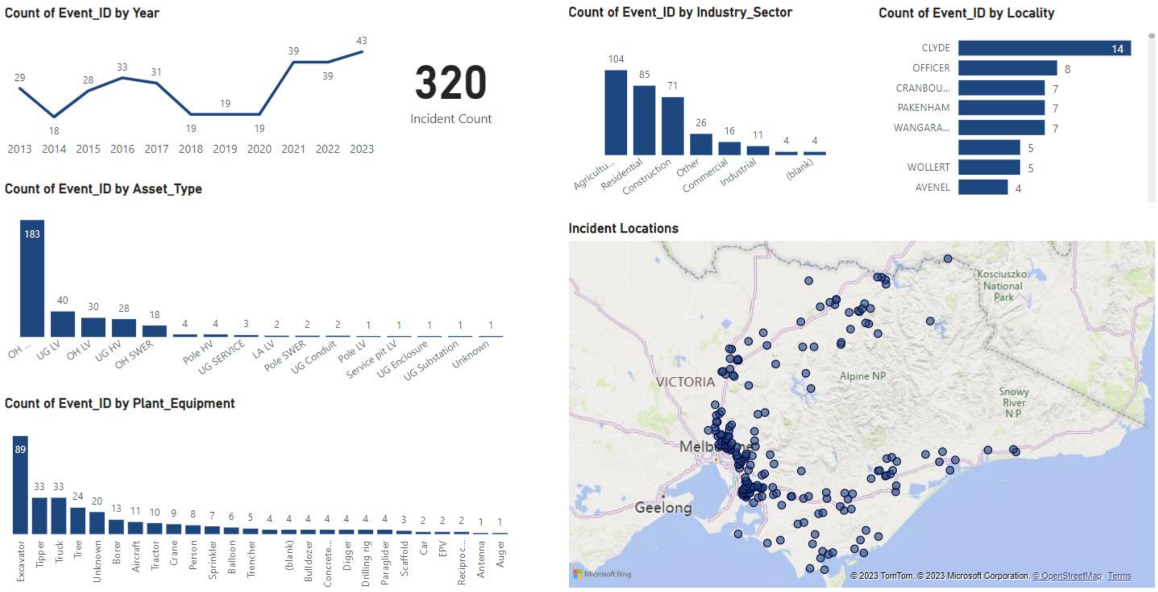


Figure 35 Example – No Go Zone breaches

10. Risk Control Measures

The purpose of this section is to describe how risk control measures are formulated and subsequently approved, maintained and re-evaluated. It also explains the triggers that would initiate a review.

10.1 Risk Mitigation and Control Actions

Each risk assessment includes the specification of current and future controls and treatment actions that are required to reduce the risk as far as practicable. Treatment actions are defined for current controls where improvement is required and for future controls to enable them to be implemented. Owners are assigned to each control and treatment action, with a completion date also defined for each action.

An overall risk control effectiveness (RCE) rating is defined for the current controls for each risk. The controls, treatment actions and RCE rating are determined by the subject matter experts assessing the risk and approved by the risk owner. The risk owner is the nominated person who has the overall responsibility for the management of the risk.

10.1.1 Hierarchy of controls

When identifying risk control measures, consideration is always given to the hierarchy of controls, shown in Figure 36. Possible implementation of the most effective control is always considered first, and only when this is agreed to be not practicable will a less effective control be considered.

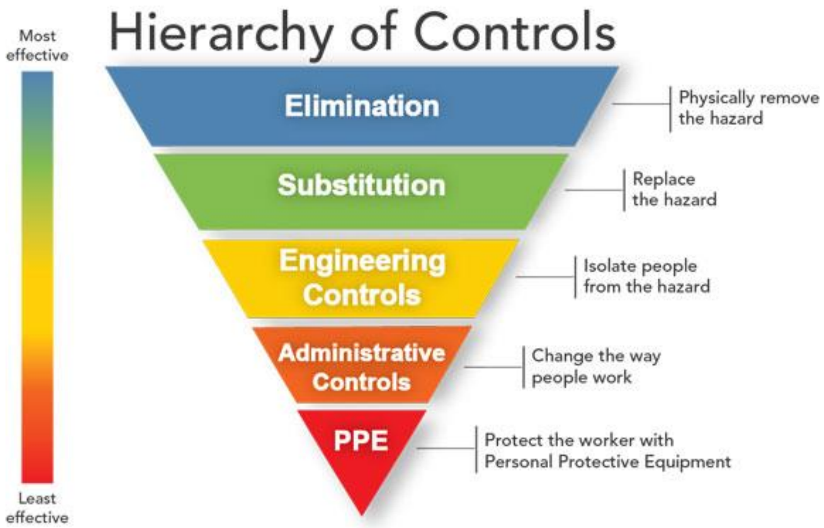


Figure 36 Hierarchy of Controls

10.1.2 Risk control effectiveness

The Risk Control Effectiveness (RCE) rating is the relative assessment of the actual level of control that is currently present and effective compared with what is **reasonably achievable**[21] for that particular risk. The RCE is therefore an indicator as to whether AusNet is doing all it could or should to manage the risk.

The assessment of risk control effectiveness is a key step in the process of defining and evaluating new controls to manage the risk. A four level rating scale is used to make a qualitative assessment of the effectiveness of existing controls over the risk in question and the relative improvement in controls that may be possible. The risk control effectiveness criteria defining each of the four levels of rating are shown Table 6.

Table 6: Risk Control Effectiveness (RCE) Criteria

Title	Definition
Highly effective	The control's design is considered appropriate for its purpose and its operation is determined to be producing the intended effect on risk.
Mostly effective	Most of the control's design or operation is considered effective. Only small design enhancements or operational improvements remain.
Partially effective	Part of the control's design or operation is considered effective. Design enhancements or operational improvements could improve effectiveness.
Ineffective	The control's design is inappropriate, the control's operation has no effect on the risk or the control is non-operational.

10.2 Controls for Key Risks

The key controls identified for the three significant business level risks relevant to network safety are summarised in the formal risk assessments and documented in the bow tie templates in Appendix H.

Figure 37 summarises the activities through which key controls are used to maintain or reduce the existing level of risk.

Figure 37 Activities to Address Identified Key Network Safety Risks

10.2.1 Details of key controls and actions

[21] With respect to the effectiveness of controls "reasonably achievable" has a similar meaning to "as far as practicable" when considering an acceptable level of risk. Refer to Section 10.4.1 for further details.

Discussed below in further detail are the most critical of the key controls for the three key network safety related risks, and relevant actions associated with each critical control.

AusNet's Assets Cause a Bushfire

- **Asset Management Strategies**

AusNet has developed a suite of asset management strategies for the electricity distribution network. This includes an overarching strategy AMS 20-01 "Asset Management Strategy for the Electricity Distribution Network", as well as specific asset and process and system related strategies. These specific strategies include discussion of potential failures and consequences associated with asset classes and resultant actions that are directed at addressing the identified risks.

One of the most critical asset management strategies for this risk is the enhanced network safety strategy (AMS 20-13), which is discussed in detail below.

Also critical are the plant strategies for Service Cables (AMS 20-78), Overhead Conductors (AMS 20-52), Fuse Switch Disconnectors (AMS 20-61), Distribution Transformers (AMS 20-58) and Cross-arms (AMS 20-57), which are discussed in detail in Section 5. The reason these plant strategies are critical is because analysis to develop the fire ignition risk indicator shows that these assets have the greatest potential to cause a fire. Refer to Section 0 for detailed discussion of this.

Important actions for the critical control of asset management strategies are to ensure they are regularly reviewed and that enhanced fire risk modelling is incorporated into the asset risk models.

The asset management strategies are outworked through the annual authorisation and implementation of a five-year Asset Management Plan.

- **Asset Management Plans**

Each year AusNet develops a five-year Asset Management Plan. This plan summarises customer expectations, regulatory obligations and performance targets together with the programs of change in the Bushfire Mitigation and Vegetation Management Plans and Distribution Annual Planning Report and a budget of relevant capital and operating expenditures.

The reliable implementation of the five-year Asset Management Plan is a key feature of the asset management system.

- **Enhanced Network Safety Strategy**

The enhanced network safety strategy (AMS 20-13) summarises the risks arising from the operation of the electricity distribution network, and includes risk assessments and programs of activities in place and planned future programs to address each network safety risk. This strategy consolidates the relevant safety information from individual asset management strategies for service cables, cross-arms, conductors and overhead cables, expulsion drop-out fuses, bird and animal proofing, enhanced electrical protection, no go zone management, management of asbestos containing material and SWER earth management.

Following the devastating Black Saturday bushfires of 2009, Victoria has reassessed both the consequences of bushfire and the way it manages the risk. For electricity networks, this has meant a step change in investment to drive down the risk of bushfire from the electricity distribution network. This includes investment and changes to network operations that implement the recommendations of the 2009 VBRC and programs identified by AusNet as having the potential to reduce fire starts.

- **Bushfire Mitigation Plan**

The Bushfire Mitigation Plan (BMP)[22] summarises AusNet's bushfire mitigation policy, objectives and organisational arrangements, together with preventative strategies for identified fire ignition hazards.

It details the asset inspection program and summarises the elements in the general maintenance program and the enhanced network safety program for the pending fire hazard season. It also outlines the operational plans necessary for Total Fire Bay days and days during the fire hazard season.

[22] BFM 10-01 Bushfire Mitigation Plan

The BMP includes analysis of fire ignitions which target the mitigation programs and outlines the monitoring and auditing programs which ensure the quality and timely completion of each fire mitigation activity. This plan also summarises bushfire preparation awareness programs for customers and the public. It is discussed in further detail in Section 12.6.1.

Key actions for this control are obtaining approval from ESV for the BMP and ongoing compliance with the requirements of the BMP.

- **Vegetation Management Plan**

The reason vegetation management is a critical control for this risk is because analysis to develop the fire ignition risk indicator shows that vegetation has a high potential to cause a fire. Refer to Section 0 for detailed discussion of this.

The Vegetation Management Plan (VMP)[23] summarises AusNet's vegetation management objectives and organisational arrangements. It defines the requirements for managing vegetation near electrical power lines, together with the relevant preventative strategies for a wide range of vegetation hazards.

The VMP outlines responsible vegetation clearance practice and techniques for managing hazardous trees and significant vegetation. It includes the protocols for consulting and notifying stakeholders such as local government and property owners, contains information on monitoring and auditing of vegetation hazards and clearance completion and on the training of vegetation assessors and clearance practitioners. It is discussed in further detail in Section 12.6.2.

Key actions for this control are obtaining annual approval from ESV for the VMP and ongoing compliance with the requirements of the VMP.

- **Network Safety Management Committee**

The purpose of the Network Safety Management Committee (NSMC) is discussed in Section 8.2.4 and its role in monitoring and reporting on the effectiveness of risk management controls associated with the significant network safety related risks is discussed in Section 10.3.1.

Key actions for this control are the monitoring and reporting of the progress of BFM programs and initiatives at the monthly meetings of the NSMC.

Electric Shock from Electricity Distribution Network Assets

- **Asset Management Strategies**

Further to the general discussion of this control above for the risk of "Bushfire Ignition", the specific asset management strategies that are relevant to the risk of "Electric Shock from the Network" are Enhanced Network Safety (AMS 20-13) and Service Cables (AMS 20-76).

In the case of AMS 20-13, the relevant strategies are those for Service Cables (AMS 20-76) and No Go Zone infringements. The reason these strategies are critical for this risk is because analysis in Section 0 shows that Service Cables and No Go Zone infringements are significant causes.

An important action for this control is to ensure that AMS 20-13 and AMS 20-76 are regularly reviewed.

- **Vegetation Management Plan**

Refer to the general discussion of this control above for the risk of "Bushfire Ignition". The reason vegetation management is a critical control for the risk of "Electric Shock from Network" is because as shown in Figure in Section 0 service cables damaged by vegetation are a cause of electric shock.

- **Neutral Integrity Monitoring Through AMI Meter Data**

As discussed in Section 0, electric shock incidents are often caused by defective neutral service connections to customer premises.

As discussed in Section 5.5.2, the use of AMI Meter Data has enabled AusNet to identify different network abnormalities. The most successful feature of this to date has been the identification and response to deterioration of LV services and mains neutral connections before the condition develops into an in-service asset failure.

[23] BFM 10-05 Vegetation Management Plan

- **Network Safety Management Committee**

Electric shock incidents are reported to and discussed by the NSMC at its monthly meetings. This includes analysis of the causes and monitoring of incident trends. Adverse trends may result in the NSMC directing implementation of appropriate actions, for example related to the Neutral Screened Service Cable Replacement Plan discussed in both AMS 20-76 and AMS 20-13.

Loss of Supply during Extreme Weather Conditions

- **Asset Management Strategies**

The particular strategies that are relevant to this risk are "Reliability Maintained (AMS 20-17) and Reliability Improvement (AMS 20-25).

AMS 20-17 is focused on maintaining network reliability by implementing projects matching replacement rates to the deterioration rate of those assets nearing the end of their effective service life. This is important as explained in Section 0, asset failure is a significant cause of supply interruptions.

AMS 20-25 describes how AusNet intends to improve reliability over the five year period to 2020 in order to improve the average performance across the network. This is driven by incentives offered under the Service Target Performance Incentive Scheme (STPIS) and the Guaranteed Service Levels (GSLs).

The strategies to improve network reliability are informed by the Distribution Annual Planning Report, which focusses on circuit capacity and reliability constraints. This report provides information on the distribution network in eastern rural Victoria and the fringe of the northern and eastern Melbourne metropolitan area over a forward planning period of five years. The information includes a description of the network, asset management approach, planning and forecasting methods, demand forecast and demand management activities.

It also provides information on the capacity of the network and constraints for sub-transmission lines, zone substations and the few heavily loaded 22kV feeders. It summarises possible remedial options, including demand management and network support from embedded generators to address each constraint. Information on planned asset replacement work is summarised. Historic performance in the areas of power quality and reliability are covered, as well as information on future remediation and improvement programs.

- **Work Restrictions During Extreme Weather Conditions**

When loss of electricity supply to customers occurs during extremes of hot or cold weather, there may be significant consequences, especially to the vulnerable including the elderly, the very young and those on life support. This can be particularly evident during unplanned loss of supply of extended duration. This arises because supply interruptions lead to loss of air-conditioning, heating and refrigeration, whilst also impeding the effectiveness of emergency services to respond.

Planned work on the network may be restricted due to extreme weather conditions, in accordance with AusNet's "Total Fire Ban and Heat Health Day Management" process. This includes compliance with the "Thermal Environment" procedure (HSP 05-03), the "Heatwave Guideline" (SOP 30-09) and the "Weather Threats and Triggers for the Electricity Distribution Network" procedure (DOP 70-13). The health effects of working in extremes of both heat and cold need to be considered. This process significantly limits the planned network outages on such days and therefore the likelihood of loss of supply to customers.

Also, Distribution Work Risk Assessment - Days of Total Fire Ban (BFM 21-82A) requires a risk assessment to be completed before any work on the network can be carried out on TFB days. On such days extreme heat and high wind conditions are likely to be prevalent. This process also significantly limits the planned network outages on such days and therefore the likelihood of loss of supply to customers.

- **Vegetation Management Plan**

The reason vegetation management is a critical control for the risk of "Interruption of Supply" is because as shown in Figure in Section 0, vegetation is a major cause of this risk.

- **Emergency Preparedness and Response**

As discussed in Section 11.3.12, AusNet's "Strategic Plan for Integrated Response and Contingency System" (SPIRACS) provides an "all hazards" approach to the emergency management of incidents. This ensures effective and timely response to emergencies which may affect network safety, including loss of supply to customers. For example, storm activity affecting the network is normally escalated to level 1, 2 or 3, depending on the severity of the consequences, including the number of customers off supply and for how long.

Field response crews will work under the direction of the Customer Energy and Operations Team (CEOT) to restore supply to affected customers as soon as practicable.

10.3 Monitoring and Reporting of Efficacy of Controls

The efficacy of the controls are monitored by the control and risk owners and considered during the regular reviews of the risk. Control assurance focuses on validating the RCE rating in terms of both the adequacy and effectiveness of controls. The only true way to assess the effectiveness of the control environment is to measure it against predetermined performance measures and hence for network safety related risks the effectiveness of controls is also monitored by the Network Safety Management Committee (NSMC) and checked during various audits, as detailed below.

10.3.1 Network Safety Management Committee

The NSMC meets on a monthly basis and monitors and reports on the effectiveness of risk management controls associated with the key network safety related risks. This is achieved by using key performance indicators (KPIs) to track the management of these risks, including the timely completion of various network safety programs. A leading indicator (such as the fire ignition risk indicator) identifies incidents that could cause a fire start. A lagging indicator (such as number of fire starts) reports incidents that result in an actual fire start. AusNet has systems and processes in place to ensure that these indicators are reported accurately, and therefore provide assurance that network safety risk is being managed appropriately.

10.3.2 Audits

Compliance Audits

Each year a statistically valid sample[24] of fieldwork audits are undertaken in accordance with HSEQ Systems and Compliance Audits (QMS 21-10) and the Guideline - Technical Compliance Audit (QMS 21-11). These audits ensure that agreed safety hazard controls are implemented as specified in design, construction, installation, operation and maintenance standards for the electricity distribution network. The role of audits in the ESMS is discussed in detail in Section 11.3.15.

Management System Audits

The operation of AusNet's Asset Management System designed to meet ISO 55001 requirements, AS 5577 compliant Electricity Safety Management Scheme, compliant Occupational Health and Safety Management System (AS 4801), compliant Quality Management System (ISO 9001), and compliant Environmental Management System (ISO 14001) are subject to regular independent audits to ensure functionality and compliance with good industry practice.

These management system audits ensure that risk identification, monitoring, and management review systems are functional and fit for purpose.

Internal Audits

As shown in Figure 27 in Section 8.2.4, AusNet has established an Internal Audit department to provide an independent, objective assurance service to the company. The internal audit function brings a systematic, disciplined approach to the evaluation and improvement of risk management, control and governance processes on behalf of the ARC. Internal audit review and

[24] In accordance with the requirements of AS 1199.1 2003 "Sampling Procedures for Inspection by Attributes", as indicated in QMS 21-10

provide assurance about whether the risk management framework as a whole is implemented and is effective.

Internal Audit prepares an annual audit work program for approval by the Audit and Risk Committee.

10.4 Acceptable Level of Risk

Both the residual and target risk levels are determined for each risk as part of the risk assessment process. These levels are minimised and determined to be acceptable based on the following criteria.

10.4.1 As far as practicable

Section 98 of the Electricity Safety Act 1998 describes the general duty of major electricity companies as being to:

> *"design, construct, operate, maintain and decommission its supply network to minimise as far as practicable:*
>
> - *the hazards and risks to the safety of any person arising from the supply network;*
> - *the hazards and risks of damage to the property of any person arising from the supply network; and*
> - *the bushfire danger arising from the supply network"*

The *Electricity Safety Act 1998* is quite specific with regards to the criteria which determine what is "practicable" in managing safety risks to customers, the public and workers. The assessment of options to address a safety hazard and the level of residual risk need to demonstrate consideration of:

- The severity of the hazard or risk in question;
- State of knowledge about the hazard or risk and ways of removing or mitigating the hazard or risk;
- The availability and suitability of ways to remove or mitigate the hazard or risk; and
- The cost of removing or mitigating the hazard or risk.

As stated in Section 3.5, AusNet's asset management policy and risk management philosophy is to minimise risk as far as is practicable, in line with the requirements of the *Electricity Safety Act 1998*.

Practicable

In general terms, practicable can be defined as "capable of being put into practice".

AusNet interprets the above definitions of practicable as meaning that the proposed risk mitigation controls need to be established (not the result of leading edge research for example), well understood and accepted and available to be used. They also need to take into account the assessed level of risk and the cost of implementation. The cost needs to be considered on the basis of the disproportionate factors (DFs) discussed below.

AusNet formally considers these criteria in several places:

- Papers on network safety risk and remedial actions considered by the Network Safety Management Committee;
- Asset management strategies considered by the Asset Management Committee; and
- Business cases for remedial projects and programs considered by general and executive managers.

Cost Benefit Analysis

As mentioned above, the costs associated with removing or mitigating a risk need to be considered against the value of the benefit that will result. This is typically done using NPV analysis.

This analysis considers disproportionate factors (DFs), which represent an organisations appetite to spend more than the value of the network safety risk avoided to reduce the risk.

DFs vary in value, with higher values used for situations where the risk is assessed as high and the consequences as significant, i.e. extensive harm can result if the risk occurs. To determine when the cost to reduce network safety risk becomes "grossly disproportionate" therefore requires judgement on a case by case basis.

If the cost is determined to be "grossly disproportionate" to the value of the benefit, then a decision may be made not to proceed with implementing a control. This decision is always carefully considered in light of the nature of the risk and the other criteria discussed above.

An example of where this analysis has been used is in the decision not to replace all overhead distribution lines in HBRA areas with underground cables. Carrying out this work would reduce the risk of these assets causing a bushfire ignition to practically zero and also substantially reduce the risks of electric shock from the network and interruption of supply, but the cost (in excess of $10 billion) would be prohibitive and clearly "grossly disproportionate" to the benefit.

10.4.2 ALARP and SFAIRP

The discussion of ALARP and SFAIRP is included to provide clarity around approaches that are commonly used to determine what is "acceptably safe", even though AusNet aims to minimise risk as far as is practicable, as discussed above.

The concept of "as low as reasonably practicable" (ALARP) is a risk based approach performed by technical professionals using the risk management approaches included in AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines.

The concept of "so far as is reasonably practicable" (SFAIRP) has been included in Australian law for some time and is found in other Acts and the Australian Standard for safety cases.

Both ALARP and SFAIRP endeavour to achieve the same safety outcome, safety risk equity for affected parties. But each provides a different meaning of "safe enough" through their respective decision making processes. The ALARP approach aims to ensure that no one is exposed to unacceptable levels of risk, whereas the SFAIRP approach endeavours to ensure that everyone is afforded (at least) a minimum level of precaution. The essential differences in the approaches are shown in Figure 38.

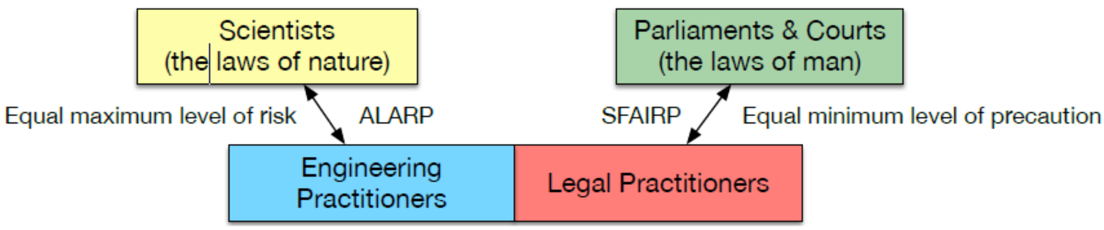


Figure 38 ALARP versus SFAIRP

ALARP is input based and can be prone to the possibility of errors in the risk assessment, typically for high consequence low likelihood events.

SFAIRP uses a precautionary due diligence approach, which is output focused and adopts precautions and mitigations unless it is unreasonable to do so. SFAIRP aims to ensure that all reasonably practicable precautions are in place rather than to achieve a tolerable or acceptable level of risk required by ALARP.

Figure 39 further explains the difference between the two approaches, especially for high consequence, low likelihood events.

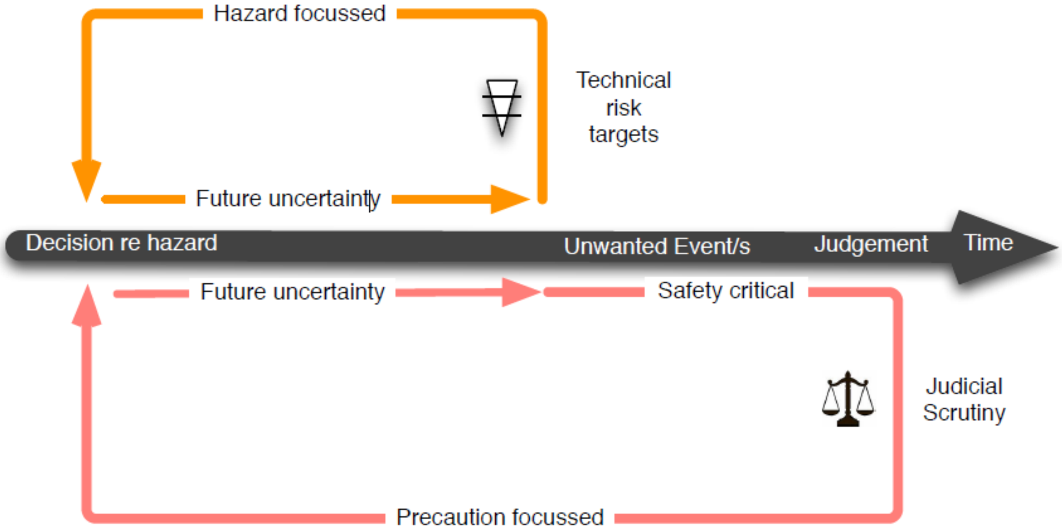


Figure 39 Hazard versus Precaution Based Risk Management

In **Error! Reference source not found.** the top loop describes the ALARP approach. This process requires that engineers look forward in time to identify potential hazards. The risk (likelihood and consequence) associated with them is then determined and compared to criteria for acceptable or tolerable risk. If the criteria are not satisfied, then risk treatments are applied until they are.

The bottom loop describes the common law and SFAIRP process applied by the courts in hindsight. After the event the fact is certain, i.e. the risk has occurred and any predetermined likelihood of occurrence is considered irrelevant in the legal process. The focus of the court is on establishing whether all "reasonably practicable" precautions were in place prior to the event.

Both ALARP and SFAIRP are referred to in the Australian Standard *AS 5577-2013 "Electricity network safety management systems"*. In particular, Item (e) in Section 1.2 of *AS 5577-2013* requires life cycle SFAIRP for safety risk elimination and if this is not reasonably practicable, then ALARP for risk management. Hence the achievement of ALARP does not necessarily mean that SFAIRP has been reached.

Reasonably Practicable

Both ALARP and SFAIRP use the principle of "reasonably practicable", which involves weighing the risk against the effort, time and funding need to control it.

Reasonably practicable is a narrower term than "physically possible" and is determined objectively. Ultimately however, whether something was reasonably practicable will be judged by the courts on the basis of the standard of behaviour expected of a reasonable person in that situation.

As discussed in Section 10.4.1, Section 98 of the *Electricity Safety Act 1998* mandates the management of safety risks "as far as practicable" (AFAP) and defines "practicable". For the reasons discussed above this requirement is more onerous than both ALARP and SFAIRP.

10.4.3 Risk appetite and tolerance

AusNet defines "risk appetite" as the maximum level of risk that the Board is prepared to accept. "Risk tolerance" is the allowable level of risk delegated to management for the routine operation of the business, i.e. the range that management is expected to operate within. Hence the risk tolerance is subset of the risk appetite. Figure 40 illustrates the concepts of risk appetite and tolerance, which lie within overall capacity of the business to bear risk.

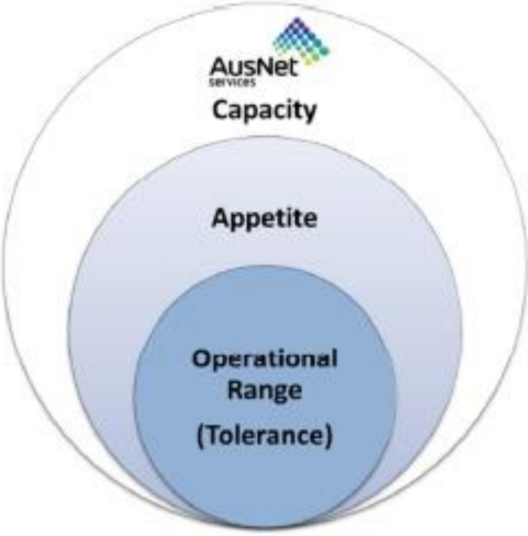


Figure 40 Risk Appetite, Risk Tolerance and Risk Capacity

Figure 41 shows how the concepts of risk appetite, tolerance and capacity are used to monitor decisions and the level of risk taken by the business. It shows that the optimal state is where the actual risk is managed within the tolerance limits. Action is required to reduce risk if it exceeds the tolerance limit. If risk were allowed to exceed the capacity of the business to bear risk, then the viability of the business is threatened.

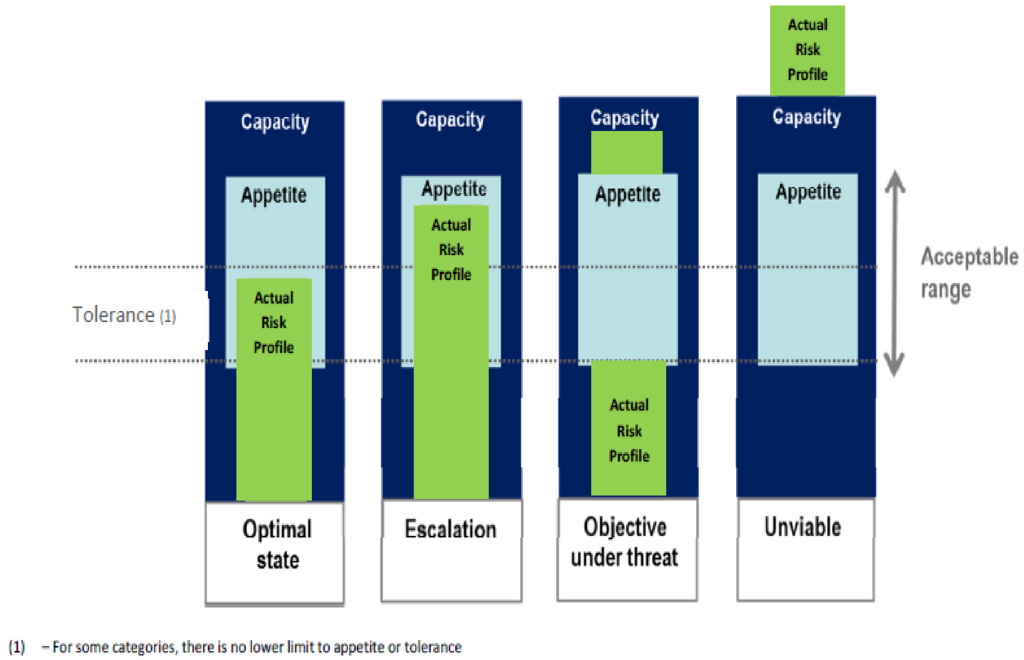


Figure 41 Risk Appetite, Risk Tolerance, and Risk Capacity

For network safety, our risk appetite is also informed by customer and community expectations. Customers tell us that they expect:

- A reliable, uninterrupted supply of electricity to all customers;

  Customers want current reliability levels to be maintained, they will not pay for further reliability improvement and will not accept lower reliability for lower future prices.

- Zero network related fire or safety issues;

  Customers expect AusNet to place a full and thorough focus on network safety, with the benchmark being prevention rather than minimisation. There is a universal expectation that appropriate inspection, maintenance, and asset replacement programs are in place to reduce fire and other safety related risks as far as is practicable.

The above information has been included in a corporate Risk Appetite Statement (RAS). This document includes statements / details of what constitutes the allowable levels of risk defining the appetite and tolerance levels for each division within AusNet. The statements are to an extent subjective and require interpretation and judgement.

The RAS is reliant on a clear and timely line of communication to inform the executive and board when the exposure of the business increases or decreases markedly. Any employee who identifies that risk appetite or tolerance may have been exceeded is encouraged to report it immediately to the Chief Executive Officer (CEO) and / or Board.

All occurrences of exceeding risk appetite or tolerance are included in the MDs report to be tabled at the next Board meeting.

10.4.4 Continued tolerance authority

The decision to tolerate a risk is based on a consideration[25] of:

- Whether the risk is being controlled to a level that is reasonably achievable;
- Whether it would be cost effective to further treat the risk; and
- AusNet willingness to tolerate risks of that type

In AusNet's Risk Assessment Tables there are also criteria regarding the level of authority required for the continued toleration of residual risks at each of the four levels, as shown in Figure 42.

Residual Risk Rating	Actions	Timing for Reporting	Authority for toleration
A	Take immediate action to treat risk to reduce to acceptable level	Immediate Reporting Included in Monthly Business Report	Board/ARMC
B	Take action to treat risk to aim for acceptable level	Immediate Reporting Included in Monthly Business Report	MD
C	Implement cost-effective additional treatments where appropriate	Within a month	ELT
D	Monitor and review periodically	Part of annual sign off	XLT
E	Manage per identified controls.	Part of annual sign off	Managers

Figure 42 Residual Risk Action Priorities & Tolerance Authorities

[25] From the Risk Management Framework Appendix 1: Risk Assessment Tables, an appendix to AusNet Risk Management Policy and Framework document

10.5 Management of Risks

As indicated in our Risk Management Policy, all employees are responsible for the management of risk.

A risk owner is nominated for each identified risk and is accountable for ensuring that risks are appropriately assessed, monitored and reviewed and that appropriate risk treatment occurs in the required timeframe.

The processes and systems used in the ongoing management of risks are discussed below.

10.5.1 Lines of defence

Error! Reference source not found. shows in general terms AusNet's organisation in providing lines of defence in the management of risks. For network safety related risks the first line of defence is at the operational level in Regulated Energy Services, Operations and Services and Mondo divisions. Risks are owned, assessed and regularly reviewed by personnel within these divisions and are reported and escalated (as required) to the second and third lines of defence.

The second line of defence is mainly provided by Risk and Assurance division through the enterprise risk and regulatory compliance teams, but also by the Group Risk Committee which includes the Executive Leadership team and CEO.

The third line of defence comes from the internal audit function provided by Risk and Assurance division, and the ARC, which is a board committee.

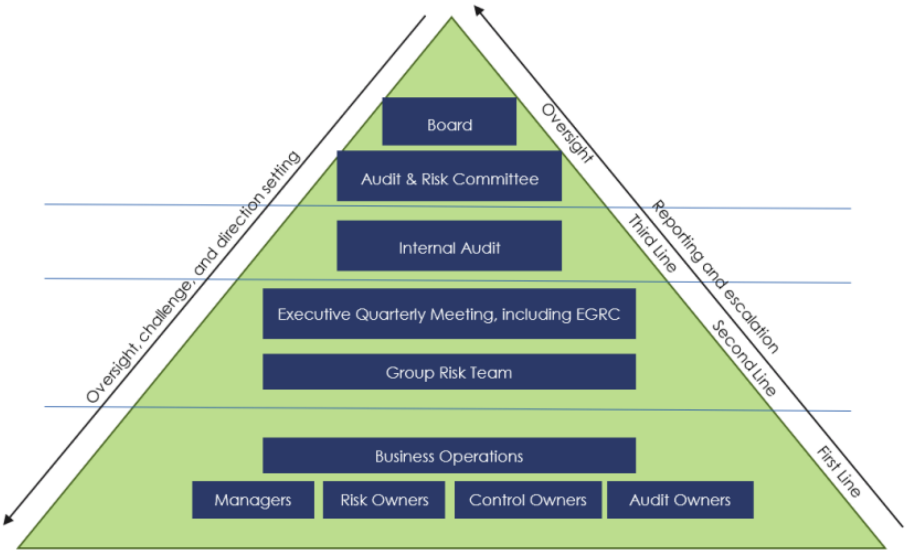


Figure 43 AusNet's Organisation in the Lines of Defence in Management of Risks

10.5.2 Monitoring of risks

Risks are continuously monitored through the application of key performance indicators, which provide the ability to monitor trends and the effectiveness of network safety related programs.

The Audit and Risk Committee (ARC) and Group Risk Committee (GRC) also receive regular reports and papers on top tier business and operating risks, including any changes to these and the reasons.

Implementation and effectiveness of the Enhanced Network Safety strategy and its respective network programs are reported monthly to the Network Safety Management Committee (NSMC) through the Network Safety Report (NSR). The NSMC initiates reviews where unfavourable trends are identified.

The main KPIs used to measure the effectiveness of controls for network 'key risks' and 'operational risks' are discussed below.

Network Safety

- Implementation of the Enhanced Network Safety strategy (AMS 20-13) is reducing the overall level of network safety risk. The progress of the implementation of the various programs of work under this strategy is reported monthly in the NSR and monitored by the NSMC. The programs under this strategy are discussed in detail in Section 10.2.1.
- Measurement of ongoing compliance with requirements for asset inspection and maintenance intervals, and cyclic assessment and cutting of vegetation. This information is reported monthly in the NSR and monitored by the NSMC.

Bushfire Ignition

- The Bushfire Mitigation Index (BMI) is a leading indicator that measures the level of asset replacement and maintenance work that is outstanding at a given time. The objective is to maintain a zero index for the duration of the declared fire season, which means that all works in declared areas are completed within the timeframes specified by the business. The BMI is reported monthly in the NSR and also weekly to ESV during the declared period.
- The Number of Network Incidents with Potential to Start Fire Indicator is a leading indicator , trending by incident causes is shown in Figure 20, Section 7.1
- The number of Fire Starts is a lagging indicator that is reported monthly in the NSR. The trend in total fire starts by cause
- The F-Factor is a lagging indicator that is discussed in detail in Section 7.1. It is reported monthly in the NSR. The performance for F-Factor is shown in Figure 21 in Section 7.1.

Electric Shocks from the Network

- The total number of incidents involving electric shock from network assets is a lagging indicator that is discussed in detail in Section 7.2. It is reported monthly in the NSR. The performance is shown in **Error! Reference source not found.** and Figure in Section 7.2.

Interruption of Supply

- Audited network reliability performance reports are submitted annually to the AER, who publish a comprehensive analysis of electricity supply network reliability each year. Reliability performance reports are also provided to the AusNet Executive Leadership and General Management Teams on a monthly and six monthly basis.
- Basis of Preparation documents are used to guide the preparation of information required for the performance reports. An example of this information is the calculation of the Unplanned System Average Interruption Duration Index (USAIDI), which is measured against the targets set by the AER. This is discussed in detail in Section 7.3. The performance for USAIDI is shown in Figure 24 in Section 7.3.

10.5.3 Changes in operating environment

Environmental Scans

AusNet's risk review process includes environmental scans to identify emerging conditions relevant to that risk. This may influence the assessment of this risk and/or lead to the requirement to identify and assess a new risk.

Emerging Conditions

Emerging conditions which may have an impact on the organisation in the longer term are reported to the General Manager of the Division. The risk owner and the risk management leader review the implications of the emerging condition and the degree to which the existing controls address the change. The risk assessment record is then updated in the Risk Management Information System (Enablon).

10.5.4 Review of risks

Formal risk reviews are triggered by the review interval set in Enablon or more frequently if there are concerns raised by risk or control owners that there are significant changes occurring in the operating environment that may have a material effect on the risk. Risk owners, supported by risk management leaders in relevant divisions of AusNet, ensure that network safety related risks are formally reviewed in the required timeframe, which is annually for 'key risks'.

The review will typically be co-ordinated by the risk management leader for the division owning the risk and will comprise a workshop/meeting of the risk owner and key control and task owners. At this workshop all aspects of the risk assessment are reviewed, as discussed below.

Review of risks includes the review of the documented context, causes, impacts, controls (current and future), RCE rating, and the assessed levels of consequence and likelihood for both residual and target risk. Where available, the most recent data such as from root cause analysis from electricity supply interruption records and fire ignitions, and electric shocks and injuries recorded in the Issue Management System (IMS) is used to review the consequence and likelihood levels. Any agreed changes to the risk assessment are updated in Enablon.

Diligent reviews also identify new aspects to existing risks and the possible emergence of new risks.

10.5.5 Communication and reporting of risks

Network safety and reliability related risks are systematically communicated to relevant line managers and executive managers via the formal asset management process.

The principal governance reporting on risk management is to the General Managers forming the Executive Leadership Team and to the Board members and General Managers forming the Group Risk Committee (GRC) and the ARC. The GRC and ARC receive quarterly reports on the headline risks, any changes to these and the reasons for changes.

10.5.6 Risk management information system

The details of all business and important operational risks are recorded in the Risk Management Information System (Enablon), including information on all their existing and proposed new controls and control improvement tasks. This includes for all the highest ranked network safety risks listed in Appendix H.

Enablon provides the administrative capability for risk management across AusNet. Its use is mandated to avoid duplication and inconsistent information or reports. Enablon is accessible by all those with a risk management role, ownership or accountability for a risk, control or task. Enablon's functionality includes:

- Recording of risk, control and task owners;
- Prompting of risk reviews, control checking and task completion;
- Recording risk and control checking arrangements;
- Tracking of progress on control checking and task completion; and
- Producing performance and governance reports.

11. Electricity Safety Management System

The purpose of this section is to explain how the relevant business processes, integral to the ESMS, are integrated into an asset management process to ensure that risks inform decision making and business planning. A system in this context is the integration of the various business processes that are relevant to the ESMS. This section defines these processes as ESMS elements and explains their role in contributing to the overall safety management system.

11.1 Planning and Decision Making

The performance evaluation and improvements function of the asset management process has two key components as inputs to the Asset Management Strategy, these being performance monitoring at both the network system level and individual asset level.

At the network system level performance parameters such as network reliability, safety, capacity, quality of supply and compliance are monitored through bespoke monitoring and reporting systems. These systems generally aggregate data and information from individual asset level to inform the business as to the overall level of network performance.

AMS 20-16 Distribution Network Planning Standards and Guidelines provide a framework for the planning of AusNet's high voltage and medium voltage distribution networks. The planning process is depicted in Figure 44.

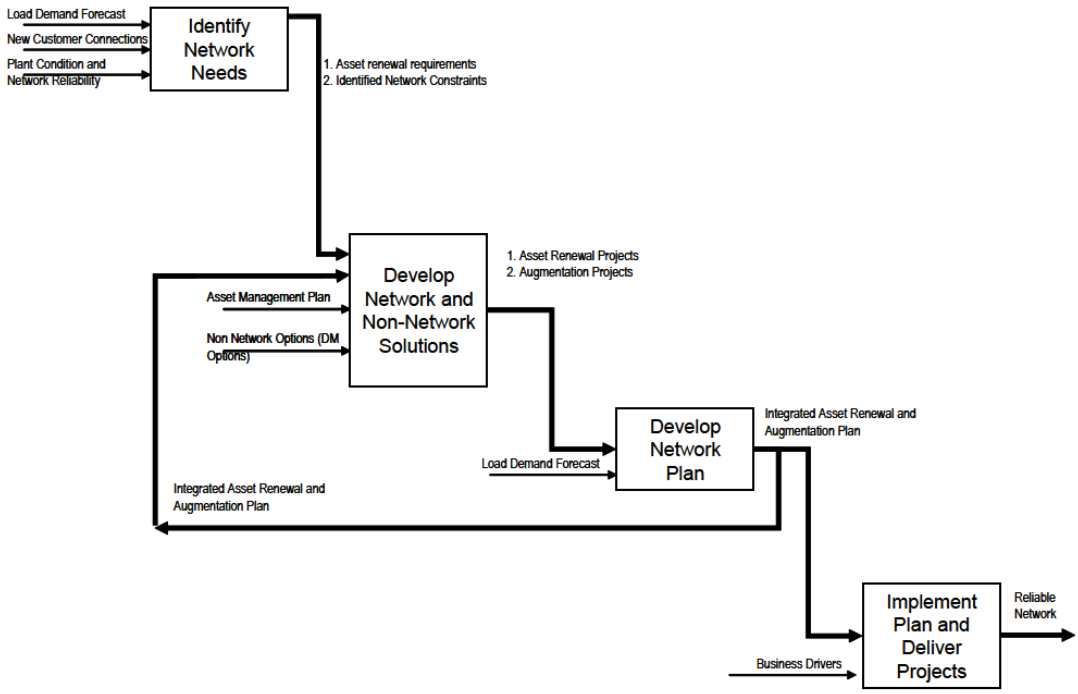


Figure 44 Distribution Network Planning Process

For network safety risks the system level performance parameters are used to determine KPIs such as those discussed in Section 10.5.2.

At the individual asset level, the asset management process provides data and information with respect to an asset's age, condition, performance and remaining life.

Network and asset performance information streams are assessed against two additional key inputs to the Asset Management Strategy, these being asset management policy and environmental analysis.

These inputs provide the desired operating parameters within which the network should operate. With customers and community as key stakeholders, network performance expectations in respect to reliability, safety and quality are expressed through a combination of regulations, codes of practice and regulatory performance incentive mechanisms.

The Asset Management Strategy coordinates the network performance expectations against actual performance in order to identify network activities required to be implemented through the Asset Management Plan to ensure the network achieves and maintains the desired performance outcomes. Asset management strategy and planning decision processes involved in the development of asset management plans require the balance of technical and economic considerations to generate short and long term asset management investment and resource forecasts.

Governance over network safety is achieved through implementation, reporting and monitoring of network safety and compliance programs through the Network Safety Management Committee.

Post implementation reviews (PIRs) may occur at a program or project level in order to identify opportunities to adjust network design standards and/or network operating and maintenance procedures. Figure 46 in Section 11.3.2, shows the idea, plan, build and close phases in the governance framework for the program lifecycle process. PIRs are carried out as part of the close phase of this process, using the Project Review Template.

Additionally, the business has a business performance management framework which defines the principles, tools and methods to ensure that business processes are constantly evaluated and improved.

The business has identified six core business processes which are supported by a Process and Data Sponsor and an end-to-end business process flowchart.

The processes are owned by business units with the Process and Data Sponsors established to monitor overall process performance by phases and provides oversight of improvement projects which cross functional areas.

The effectiveness of changes resulting from PIRs are then reflected through network and asset performance monitoring systems, which closes the loop in the asset life cycle process.

The Asset Management Strategy is discussed in more detail in Section 12.

11.2 Role of ESMS in Business Management System

AusNet's asset management system has the elements of the Electricity Safety Management System (ESMS) integrated within it. The role of the ESMS within the asset management system is to provide the framework for systems and processes that ensure network safety remains a key network outcome throughout the acquisition, design, construction, operation, maintenance, replacement and eventual de-commissioning of network assets.

The asset management strategy, which is outworked through the asset management system using the asset management process, is in turn aligned with the annual five-year corporate business and financial plans. Detailed discussion of these aspects of asset management is included in Section 12.

Whereas the planning and decision making processes discussed in Section 11.1 deal with a range of network operating parameters, the ESMS elements within the asset management process, illustrated in Figure 53 in Section 12.2.4, focus on network safety outcomes. This involves monitoring of network and asset safety performance outcomes that are reconciled with expectations derived through the "Asset Management Policy" and "Environmental Analysis" elements of the asset management process. These inputs to the Asset Management Strategy identify opportunities to implement network programs and standards to ensure network safety outcomes meet expectations.

Elements of the ESMS include risk assessment processes that enable identification and assessments of hazards to the safety of any person or damage to their property arising from the operation of the electricity distribution network. The ESMS focusses resources on the development of projects and programs to manage identified hazards, as far as practicable. As discussed in Section 10.4.1, this includes giving consideration to:

- The severity of the hazard or risk in question;
- State of knowledge about the hazard or risk and any ways to remove or mitigate the hazard or risk;
- The availability and suitability of ways to remove or mitigate the hazard or risk; and
- The cost of removing or mitigating the hazard or risk.

11.3 Role of ESMS Elements

11.3.1 Resourcing

The role of the resourcing process within the ESMS is to ensure manpower and material resources used in the operation of the network are safe and fit for purpose.

Section 6.6.3 discusses the manpower resourcing model used by AusNet to deliver works affecting network safety. Work planning and forecasting, discussed in Section 11.3.2, provides resource volume forecasts that enable delivery partners to adjust their processes to meet future resource requirements.

Material and service procurement is undertaken by the Procurement department in the Finance division in accordance with the requirements of the Procurement Principles and Procurement Framework (PTP 10-01).

This document incorporates general procedures for the procurement of materials and services for the network and includes considerations regarding:

- Quality assurance;
- Technical specification and performance assessment;
- Qualification and skill requirements;
- The concept of "preferred suppliers"; and
- Purchasing processes

11.3.2 Work planning, scheduling and delivery

The role of work planning, scheduling and delivery within the ESMS is to ensure that work programs relating to network safety are delivered in a timely and efficient manner.

In order to achieve this AusNet has refined the program lifecycle process, improving alignment with business processes and ensuring that program delivery objectives are achieved. The program lifecycle model sets out the process for managing programs and projects from conception, through the selection, planning, business case approval, release, delivery and close out phases and is supported by detailed work instruction documentation and an internal resourcing model.

The Planning, Performance and Operations department and the Delivery department in the Regulated Energy Services division are responsible for providing the management and resources to plan, schedule and deliver the maintenance and capital works programs relating to network assets.

This function is supported by the Capital Portfolio Governance (CPG[26]) department in Finance division, who are accountable for strategic portfolio prioritisation, the definition of project management standards, systems, processes and tools and developing the capability that ensures investments pursued across AusNet align to and achieve strategic and performance goals.

The CPG coordinates portfolio optimisation, governance and enablement, in accordance with the three pillars of the program lifecycle process shown in Figure 45.

[26] CPG formerly CPG

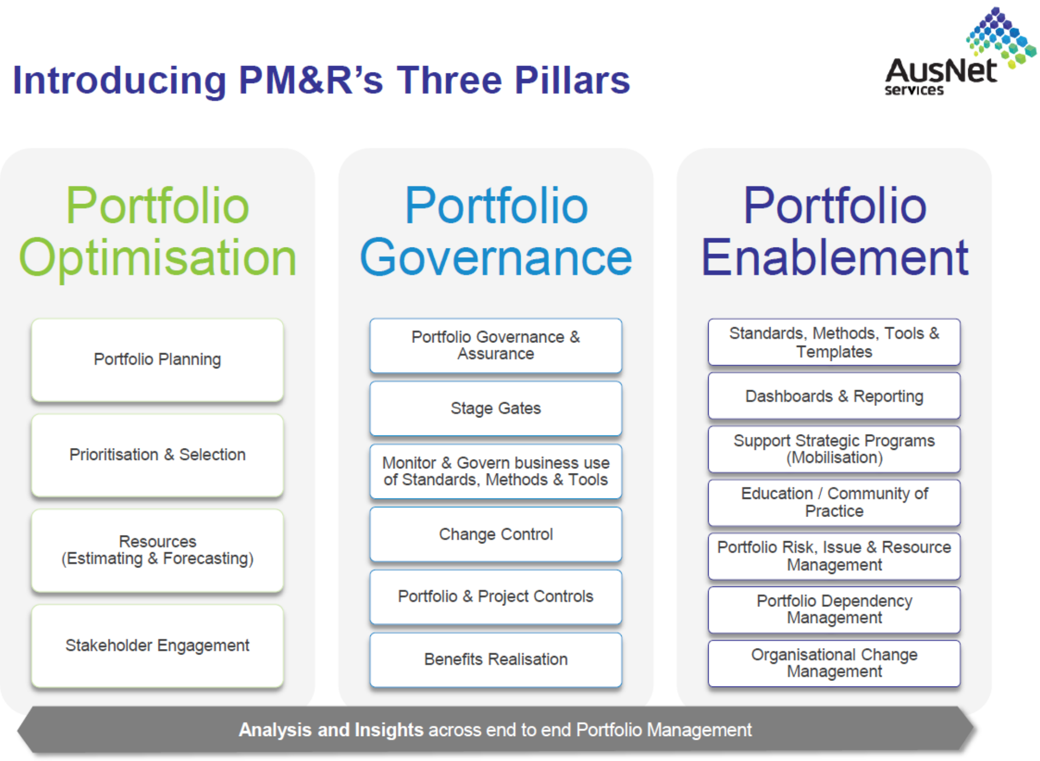


Figure 45 Pillars of Program Lifecycle Process

The program governance framework used by CPG for the program lifecycle process is shown in Figure 46. It features a number of stage-gates that have to be satisfactorily completed and approved prior to progressing to the next stage in the process. Health and safety is a prime consideration at all stages in the lifecycle.

The change management components in the process are discussed in detail in Section 13.4.

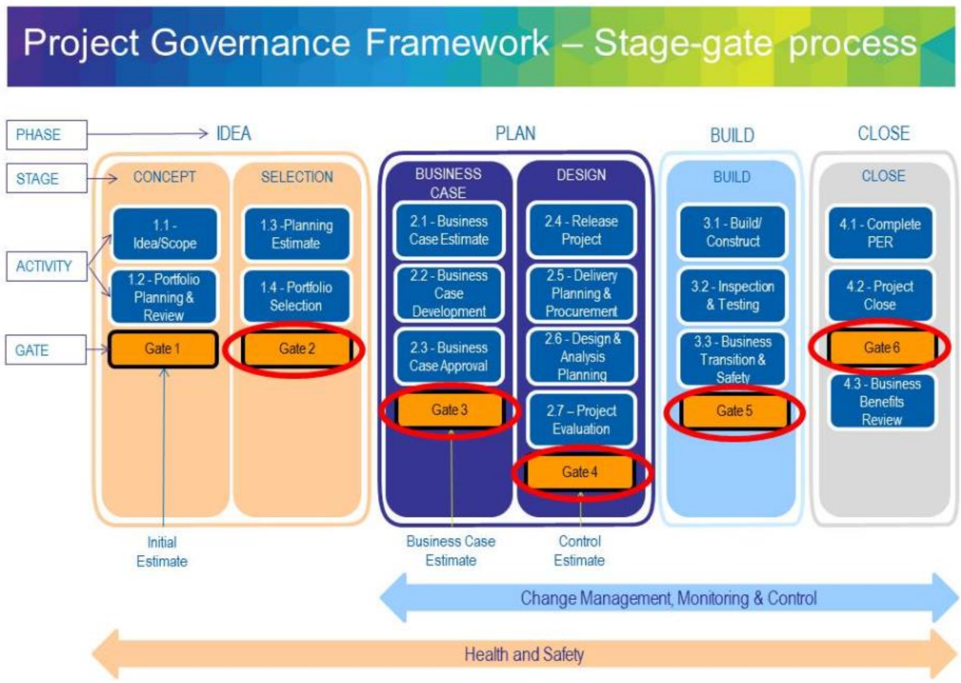


Figure 46 Governance Framework for Program Lifecycle Process

Business case preparation and approval process for which is discussed in Section 12.6.

Program delivery is further supported by the formation of strategic alliances with external companies that provide design, installation and maintenance services. Contract arrangements are performance based with benchmarking of costs and standards to ensure that quality and value is maintained throughout the contract. Delivery of work programs is undertaken through a combination of appropriately skilled and authorised internal and contract service providers, with the latter providing flexibility to address workload peaks.

With respect to inspection and maintenance of assets, AusNet applies a combination of time and asset duty cycle intervals to ensure the assets continue to safely perform their operational function. Intervals may be based upon regulatory requirements, manufacturer recommendations or operational experience. The intervals are recorded against respective asset classes within the asset management system, which in turn provides an automated approach to the planning and scheduling of network inspection and maintenance activities.

Asset condition and defect information obtained from inspection and maintenance activities is recorded within the asset management system, together with prioritisation and scheduling of any subsequent replacement or maintenance activities.

Additional to inspection, maintenance and replacement activities are network augmentation activities, driven by increasing electrical demand and new customer connections. These projects are also managed through the asset management system to provide a consolidated view of the network works program and activities.

The retention of this information within the asset management system provides the ability to develop coordinated short and long term work programs and budget forecasts.

11.3.3 Management structure

The personnel responsible for the management, operation and maintenance of the electricity distribution network are identified by AusNet's organisation charts located on The Loop, the AusNet intranet site. With respect to the ESMS and Safety Policy, the Executive Leadership and General Management Teams, as shown in Appendix I, are responsible for management in accordance with the policies, procedures and standards summarised in the ESMS.

11.3.4 Responsibilities, accountabilities and authorities

The ESMS ensures the business maintains a process for documenting and managing responsibilities, accountabilities and authorities that ensure an end to end management process that maintains network safety and compliance outcomes for personnel engaged in the life cycle management of network assets.

Whilst Appendix I provides the structure for the Executive Leadership Team (ELT) for the enterprise business of AusNet, the Chief Executive Officer and Executive General Manager Regulated Energy Services are directly accountable for implementation and compliance with the ESMS. The following provides a summary of the respective responsibilities and accountabilities for these members of the ELT.

Chief Executive Officer

The Chief Executive Officer, with the support and guidance of the Board of Directors, is ultimately responsible and accountable for the management of AusNet. The Chief Executive Officer oversees the strategies, policies and performance of AusNet and sets the values and standards. Governance arrangements are established in a charter which describes the functions of the Board and those functions delegated to management.

Executive General Manager, Network Management & Digital

The Executive General Manager, Network Management & Digital is responsible and accountable for the standards and stewardship of the regulated electricity networks and digital systems. This includes the strategic functions of regulation and network strategy, network engineering, system planning and performance.

The Asset Management department includes a dedicated Network Safety section which provides the interface to Energy Safe Victoria for network safety and regulatory matters.

Executive General Manager, Network Operations and Safety

The Executive General Manager, Network Operations and Safety is responsible and accountable for the operations, works planning and delivery of network programs.

11.3.5 Standards and codes

Assets forming part of or directly connected to the network must comply with AusNet's technical standards for design, construction, operation and maintenance.

Published Technical Standards

AusNet recognises the technical standards published by Standards Australia (AS), International Electro-technical Commission (IEC) and the Institute of Electrical and Electronic Engineers (IEEE) as the basis for design, construction and maintenance activities on its electricity distribution network.

Appendix J refers to AMS 20-36 Technical Standards, which identifies the published national and international technical standards used by AusNet in the life cycle management of network assets.

Further detail on this is included in Appendix J and AMS 20-36.

The published technical standards form the basis for AusNet's process-specific or installation-specific standards, which are organised in the following four manuals:

- Distribution Design Manual (30-4161);
- Standard Installations Manual (30-4142);
- Non-standard Installations Manual (30-4143); and
- Asset Inspection Manual (30-4111)

Industry and Company Technical Standards and Codes

In addition, AusNet draws from the intellectual property of its predecessor companies, namely the State Electricity Commission of Victoria (SECV), Eastern Energy and TXU Networks as well as that of the Victorian Electricity Supply Industry (VESI) via the VESI Operational Manuals and the Electricity Supply Association of Australia (ESAA) and Energy Networks Australia (ENA).

The VESI Manuals, referred to in Appendix K and listed in AMS 20-36, describe the technical standards to which much of the electricity distribution network was originally constructed prior to designs developed by AusNet.

As discussed in Section 11.3.6, AusNet's design philosophy requires consideration of the following criteria when developing new designs, including new technical standards:

- The design must ensure safety hazards to persons and their property are minimised as far as practicable;
- The design must adhere to accepted Published Technical Standards and, in particular, AusNet standards;
- The design criteria must have environmental compatibility with community expectations; and
- Comply with statutory regulations

Accordingly, ensuring the network is designed safely requires risk identification and assessment which is undertaken in accordance with the methodology in the Risk Management Policy and Framework.

As illustrated in Section 8.2.1, the risk identification and assessment process requires consideration of the full life cycle of an asset which includes:

- System Planning;
- Design;

- Procurement/Specification;
- Construction/Installation;
- Commissioning;
- Operations;
- Inspection/Maintenance;
- Decommissioning; and
- Retirement/Disposal

Section 9 of the Distribution Design Manual includes AusNet's network electrical protection philosophy which is:

> "…*to cause the prompt removal from service of a faulted network element in order to protect customers, the public, workers and plant. This may occur when a network element suffers a short circuit, or when it starts to operate in an abnormal manner that might cause unsafe operating conditions, damage to plant or otherwise interfere with the effective operation of other parts of the distribution network*".

AusNet's protection design criteria include speed, selectivity and sensitivity.

11.3.6 Engineering and design

AusNet applies good engineering practice to the management of network assets over their full life cycle. This is critical at the design stage as the opportunity exists to remove hazards and minimise risks early in the life cycle of the assets.

AusNet's design philosophy, referred to in Section 1 of the Distribution Design Manual (30-4161), requires consideration of the following criteria:

- The design must ensure safety hazards to persons and their property are minimised as far as practicable;
- The design must adhere to accepted Published Technical Standards and, in particular, AusNet standards;
- The design criteria must have environmental compatibility with community expectations; and
- The design must comply with statutory regulations

Safe Engineering Design

Safe Engineering Design is a process defined as the "integration of hazard identification and risk assessment methods early in the engineering design process to eliminate or minimise the risks of injury or damage throughout the life of the item being designed". AusNet has developed a document entitled "Safety in Design" (SDM 01-0800), which is included in the Station Design Manual (SDM) series of documents. SDM 01-0800 Safety in Design includes detailed discussion of the design philosophy and requirements in order to ensure the criteria listed above are appropriately considered.

Design Process

QMS 20-06 *Design Management* defines the procedures for the delivery of complex project / program design activities undertaken by AusNet and its delivery partners.

Minor design projects also follow the design process steps described in QMS 20-06; however the output of designs is managed via SAP.

The overall process is shown in flow chart format in the document QMS 20-06-1 *Overall Project Design Process*.

QMS 20-06 outlines actions that are required to be completed in order to ensure the process outcomes are achieved. These actions include the creation of the Design Intent Document, the Design Plan, and the Inputs and Outputs of the design process, whilst also ensuring that Design Review, Design Validation and management of Design Changes are carried out effectively. Overarching all these actions is the requirement to ensure Design Safety.

Design Safety involves the designer, as far as reasonably practicable, ensuring that the design is without risks to the health and safety of employees at the workplace during construction and maintenance activities. This involves:

- Identifying reasonably foreseeable hazards associated with the design;
- Assessing the risks arising from the hazards;
- Eliminating or minimising the risks by designing control measures;
- Reviewing the control measures; and
- Communicating the risks

The action of Design Review is to evaluate the ability of the design to meet the specified requirements and to ensure the design continues to address:

- Safety and environmental requirements;
- Functionality, serviceability and reliability requirements;
- Risks and information transfer requirements;
- Budgeted cost; and
- Timeliness and quality

In practice Design Review is achieved by the project manager arranging for subject matter experts and/or representatives of all functions involved in the project to generally review each design. The process used for this is known as "Constructability, Operability and Maintainability" (COM) and is carried out at various critical stages in the design process, as shown in QMS 20-06-1.

COM reviews aim to give adequate consideration to what effects the proposed design will have on the future requirement to construct, operate and maintain the assets over their life cycle. The COM review process is discussed in detail in "COM Review Process" (SDM 01-0801), which is included in the SDM series of documents. The outcomes of COM reviews are recorded using QMS 20-06A *Design Review / Verification*.

Co-ordination with External Authorities

Co-ordination of construction works with external authorities is within the responsibilities of the design function, which is then notated on design drawings or indicated in the scope of works.

In particular the design group will liaise and seek approval of designs for:

- Civil works in roadways from VicRoads or Councils
- Easements within private property (preliminary approvals –Deeds of Agreement)
- Earthing near Telstra Pits – Telstra / NBN
- Civil construction near major Gas/ Water authorities' assets.

11.3.7 Network construction

Network construction can be categorised as generic or complex according to the nature and complexity of the installation under construction.

Standard operating procedures provide guidance to ensure all projects are constructed as per the approved scope and that asset information is returned so asset management systems are updated accordingly.

Generic Construction

Generic construction activities typically involve the application of AusNet technical standards, documented procedures, equipment and approved material for the construction of relatively simple installations to a standard common design.

Examples of generic construction activities include overhead line construction, distribution substation installation and underground reticulation installation.

Administration of generic construction activities are undertaken in line with SAP processes and procedures.

Complex Construction

Wherever practical, AusNet use standardised designs, common construction elements and standardised equipment specifications to optimise the efficiency of the design and construction of non-standard or complex installations.

However, by their nature, the construction of a major installation, such as a zone substation, switching station or terminal station is unique. They incorporate a range of non-recurrent activities, such as civil works, structural works and electrical construction and testing, which can involve a wide range of skills over an extended timeframe.

Formal project management is essential to safe construction and commissioning and subsequent safe operation and maintenance.

AusNet may assume complete responsibility for project management or an accredited service provider may be engaged under the terms of either a specific individual contract, turn-key type contractor for the entire facility, or a combination of both.

AusNet appoints a project manager who is responsible for the delivery and quality of the installation.

Key resources in the delivery of a complex construction job are:

- PTP 10-01 Procurement Principles and Procurement Framework
- Constructability, Operability and Maintainability (COM) process (SDM 01-0801)
- CPG processes and procedures

11.3.8 Commissioning of new equipment

The role of commissioning within the ESMS is to ensure new assets being connected to the network have been constructed in accordance with the appropriate design standards and drawings and then tested and calibrated prior to energisation. The purpose of testing and calibration is to ensure items of plant and equipment have not been damaged prior to or during installation and that upon commissioning the assets are performing in accordance with asset and network specifications.

Commissioning is a strictly controlled operational process that occurs as the culmination of the earlier asset life cycle stages of System Planning, Design, Procurement/Specification and Construction/Installation.

Procedure TCPP 10-01 Commissioning Strategy provides a framework outlining how AusNet manages the commissioning of new or replacement plant and equipment. Procedure TCPP 10-02 Commissioning Requirements defines the testing and commissioning requirements for the installation and commissioning of all AusNet capital projects.

The commissioning process is used for all new and previously out of commission assets that are being connected to the network.

In accordance with Section 10 of the Blue Book and Section 3.6 of the Green Book, the notification to the operating authority can be made in writing or by approved procedures, including verbal advice.

There are a number of operational procedures[27] that are used to control the commissioning process to ensure the safety of personnel and the public and also the integrity of the new and existing network plant and equipment. More complex new primary equipment will be subjected to a high voltage test from a test facility prior to being energised from the network. As a precaution, such primary equipment will often also be left energised from the network for a defined period before being placed on load.

11.3.9 Network access

Authorised Access

The requirements for network access depend on whether those requiring access are performing work for / under the control of AusNet or not. The requirements for both situations are covered in the Green Book.

Approach to and within safe approach distances by persons, vehicles and mobile plant requires the appropriate authorisation and/or competencies as described in the Green Book.

To ensure that only persons with the required skills and competence are assigned to carry out work on or near electricity distribution assets AusNet issue individual employees and service providers with Network Authorities.

Procedure DP 09-02-01 "Access Authorities – Types and Use General Guide" outlines the types and applications for the various access authorities which include:

- HV Operating Authority;
- Authority to Make Application;
- Electrical Access Permit Authority;
- Authority to Enter HV Enclosures;
- Sanction for Test Recipient Authority; and
- Sanction for Test Applicant Authority

Accreditation and authorisation requirements are consistent with those of the 'Green Book'.

Training associated with maintaining the effectiveness of these authorities is undertaken every three years and employee outcomes are recorded in Drive, the human resources management system and the authorities database which records individual employee and contractor's access authorities. Refresher training is delivered in line with the VESI Skills Matrix and VESI Refresher Training modules. Specific individuals and work groups have access to the AusNet Authorities database to assist in verification that individuals proposing to undertake work are approved for access to the distribution electricity network.

Auditing and checking of access applications and operator switching activities in accordance with DP 09-02 "Application for Access" and DP 09-02-02 "Applying for Distribution Apparatus" is also facilitated by reference to the authorities database.

Figure 47 shows the distribution procedures relevant to the control centre and field personnel when applying for access to the network.

[27] Distribution Procedure DP 10-01 "Clearance Procedure: Clearance of Electrical Apparatus for Service (Distribution Apparatus)"; Distribution Procedure DP 10-03-03 "Commissioning Standard for Distribution Transformers"; Distribution Procedure DP 10-03-06 "High Voltage Cables/Covered Conductors: Testing, Commissioning and Placing Into Service"; Operations Procedure OP S7-4 "Zone Substations – Construction or Modification Access Procedures".

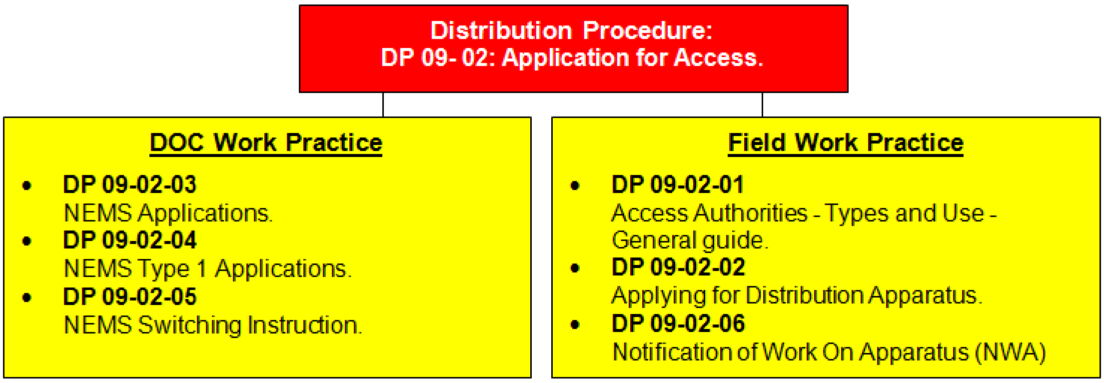


Figure 47 Distribution Procedures for Application for Access to the Network

The process for application for access to the network is shown in Figure 48. The application process runs through a number of stages, starting with the applicant opening an application request. Applications for work on the network are typically submitted using an electronic application tool called NEMS. Some applications are also submitted using the approved VESI “Application for” form.

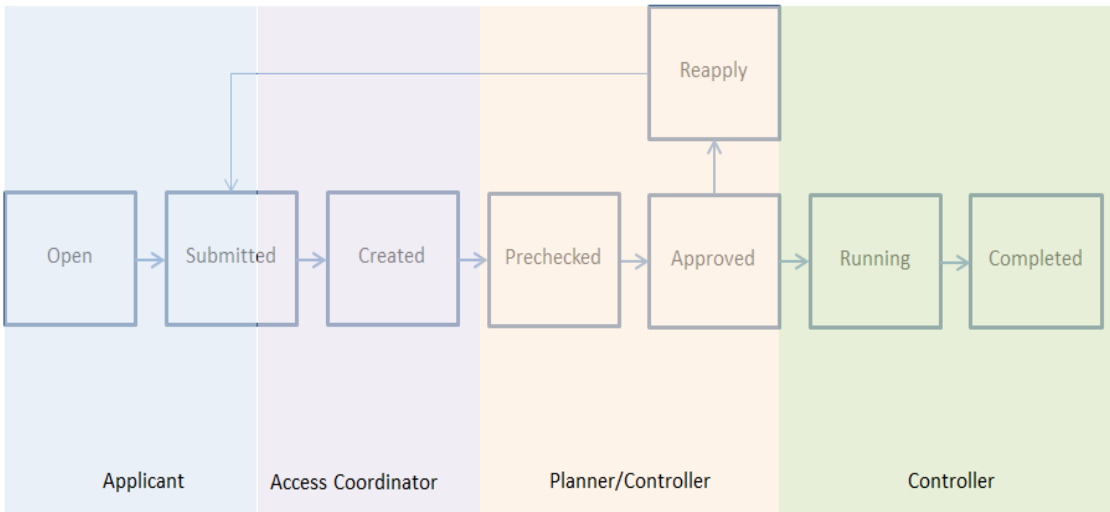


Figure 48 Process for Application for Access to the Network

Access follows a system of controls that assigns roles and responsibilities to persons based upon their respective level of approved authorisation. Key roles described in the DP 09-02 Application for Access procedure for access to the network include:

- Authorised Applicant;
- Authorised Electrical Operator; and
- Recipient in Charge

In addition to the procedural controls, physical controls for zone substations include perimeter security fencing and motion detectors and ground mounted equipment having either perimeter security fencing or fully enclosed and locked cabinets.

Infrastructure Security

The main security threats to AusNet’s electricity distribution network are:

- Safety – of untrained persons in the vicinity of energy-containing equipment;
- Malicious – motivated by revenge, fame, association or challenge;
- Criminal – profit driven; includes theft, fraud, sabotage or extortion; and

- Terrorism – threat or use of force to influence government or public through fear or intimidation

AusNet has assessed physical security risks and control measures in AusNet's installations. AMS 20-14 Infrastructure Security is informed by more than 50 individual assessments of major sites, and 20 generic assessments for the multiplicity of less significant installations.

Physical security control measures are founded on the following principles:

- Consistent risk identification and quantification;
- Defence in depth – increasing the number and sophistication of control measures commensurate with the degree of intrusion risk;
- Deterrence – measures to deflect would-be intruders towards other targets;
- Delay – measures to increase the time and effort required to successfully intrude;
- Detection – measures to promptly and reliably detect intrusion;
- Response – measures to promptly and appropriately deal with intruders and associated consequences; and
- Contingency planning – measures to promptly recover service and minimise societal impact.

Depending on the assessed level of physical security risk to network assets, the following control measures are implemented to varying degrees in accordance with the above principles:

- Intruder resistant fencing;
- Electronic access controls;
- Building hardening;
- Locks and keys;
- Warning signage;
- Intrusion detection;
- Security lighting;
- Patrols and monitoring;
- Inspection, testing, maintenance and auditing; and
- Contingency planning

AMS 20-14 includes detailed strategies for security enhancements for zone substations, ground-mounted kiosks, voltage regulators, substations and indoor substations, forming part of the electricity distribution network.

11.3.10 Training and competency

The processes to ensure employees and contractors are appropriately trained and competent to safely perform work on the network is discussed in Section 6.6.5.

11.3.11 Consultation and communication

The role of consultation and communication within the ESMS is to ensure that when reviewing network hazards and risks, appropriately qualified and experienced personnel are involved in formal risk assessments. Communication of changes to network standards, strategies and procedures is critical to ensuring consistent application of the standards required to ensure the safe operation of the network.

Formal Safety Assessment

Personnel involved in planning, designing, operating, constructing and maintaining the electricity distribution network undertook the identification and assessment of network safety related risks as described in Sections 8.2 and 8.3. The process involved a number of workshops, with selected participants being subject matter experts, who when working together provided operational experience in the work processes and procedures in managing assets over their life cycle.

Publishing of ESMS

The ESMS comprises a suite of manuals, standards, procedures, policies and systems, maintained within the Enterprise Content Management (ECM) system, that provide information used in the safe operation and management of the network. All staff and contractors have access to documents and information systems relevant to those aspects of network activity they are responsible for. An aspect of ECM is the automated notification process to relevant personnel when documents are updated.

Risk Visibility to Senior Management

This is discussed in Section 8.2.4, including explanation of the risk governance model. The process summarised by this model enables consultation and communication regarding risks at and between the various levels in the organisation.

Management of Risks

Consultation and communication of risks within the organisation is part of the process of their management, as discussed in Section 10.5. as to how risks are reported and escalated, and how direction and oversight is provided by the board and executive leadership team, as part of the Lines of Defence process.

11.3.12 Emergency preparedness and response

Whilst the distribution network has experienced a range of emergency events, the maintenance of an emergency management process provides the capability for the business to respond to unforeseen events, in particular those of very low likelihood but potentially very high consequence. The emergency response system (SPIRACS) is discussed below.

Strategic Plan for Integrated Response and Contingency Systems (SPIRACS)

The Strategic Plan for Integrated Response and Contingency System (SPIRACS – PRS 10-07) is AusNet's Incident and Crisis Management Plan, detailing the processes of prevention, preparation, response and recovery for emergency events impacting the business.

AusNet defines an emergency as "an adverse event or series of events that have the potential to seriously harm employees, contractors, the public, or result in service disruption requiring mobilisation and organisation of resources beyond normal business processes and resources."

This plan provides a framework for AusNet's Incident Management Team (IMT), led by the Deputy Incident Commander (DIC) for Level 2, and the Incident Commander (IC) for Level 3 incidents as described in Figure 49.

When at Level 3, the Crisis Management Team (CMT) led by the Crisis Manager (CM) to respond to strategic business priorities in parallel with the IMT. The appendices contain Templates, Checklists and Role Cards which support this plan.

SPIRACS is an 'all hazards, all emergencies' response plan and does not provide a prescriptive set of actions for all eventualities. Each incident is unique, and the response depends upon the circumstances of the incident and the expertise and knowledge of the team.

SPIRACS does not include processes to manage Level 1 or business-as-usual events. Responses to these events are covered in separate business procedures, however notifications for these events are part of the emergency management framework to create awareness of possible escalation to emergency management conditions.

AusNet's emergency response approach reflects Emergency Management Victoria's (EMV) Fundamentals of Emergency Management Class 1 Emergencies. The focus is on protecting life and property, ensuring a coordinated and effective response, and restoring normal operations as quickly and safely as possible with the goal to minimise the impact of emergencies and ensure the well-being of communities and the environment.

SPIRACS' structure aligns with the EMV emergency management phases and accommodates obligations and arrangements with government agencies.

Figure 49 Escalation Levels

Contingency Plans

At the operational level AusNet organisational divisions have developed business continuity plans to avoid unnecessary disruption to services following an adverse natural or man-made event. These plans undergo regular testing, review and communication.

At a network operational level, a Network Contingency Plan for the Electricity Distribution Network (AMS 20-03) has been developed and is reviewed annually.

This plan is applicable to events that directly impact or are likely to directly impact or impede the safe and reliable operation of the distribution network or which interrupt or are likely to interrupt power supply. The objective of the plan is to provide the framework for network contingency planning and provide an overview of the suite of contingency plans established for the distribution network.

The plan includes specific incident response and recovery strategies to cover the summer and winter demand peaks, major transformer failure, selective load shedding and recovery from black starts.

With increased network peak demand experienced during summer and winter peaks and operational issues experienced within alpine resorts, the annual summer and winter contingency plans for targeted sections of the network are becoming more critical.

The implementation of AMS 20-03 is triggered by events that require an escalation level of 2 or greater under SPIRACS.

Mutual Aid

AEMO's Guideline for Requesting Mutual Aid is a joint initiative between AEMO, ESV and the five Victorian electricity distribution businesses (DB's); CitiPower, Jemena, AusNet, PowerCor and United Energy. The guideline provides an agreed process to obtain, where possible, short-term assistance in the form of personnel, equipment, materials, and other related services from other Victorian DBs, outside the area that a DB operates in.

The primary objective is to facilitate rapid, short-term deployment of assistance during an event. Mutual Aid may be requested when an incident occurs, and the DB has exhausted or is nearing exhaustion of all available resources. Mutual Aid is activated in the first instance through the requesting DB making direct contact to other DB's. Downer, as the field service delivery partner, requests Mutual Aid after consultation with the IC. Refer to Mutual Aid Management QMS 21-30.

11.3.13 Incident investigation and reporting

The role of incident investigation and reporting within the ESMS is to ensure network incidents are investigated and reported on to establish the causes and circumstances, which may relate for example to failure to follow correct procedures and work practices or asset failures. Learnings from the investigation may help to identify the need for additional training or possible latent (hidden) or emerging asset defects. Recommendations are then made and implemented to reduce the risk of recurrence. Specific corrective actions, if any, are logged in IMS and assigned to responsible parties to track to completion.

As discussed in Section 6.5.4, the Distribution Outage Management System (DOMS) is used to record details of all incidents affecting or involving the network, including asset related failures.

The level of investigation and reporting of incidents varies, depending primarily on the actual or potential consequences. The AusNet's "Electrical Incident Investigation and Reporting for Electricity Distribution Network" procedure (SOP 30-2010[28]) describes the process and system to investigate and report on serious network safety related incidents, including those that result in death, injury or shock to any person, significant damage to property, a serious risk to public safety, an imminent risk of electrocution, or cause significant disruption to the community.

Upon notification of such incidents to the CEOT, they take responsibility for recording the details and notifying both internal and external parties. Details are logged into the Issue Management System (IMS). The "Distribution Business Electrical Safety Performance Reporting Guide – Reference Guide" (SOP 30-2010-1) provides guidance to the CEOT on the types of incidents that require reporting, the protocols for notifying ESV, and how to enter the details into IMS.

The CEOT also issue a job for a field crew to attend site, make the surrounding area safe, and record details of the incident (including taking photographs as required). The "Input Form for Electrical Incident Investigations (Distribution) (SOP 30-2010A) is used to ensure sufficient incident detail is captured to populate the required fields in IMS.

Feedback from the field crew informs the requirement for the CEOT to notify ESV, contact emergency services and involve the AusNet Network Incident Technical Officer. If electric shock is involved, the CEOT will organise for a licensed electrical inspector (LEI) to attend site.

Incident details in IMS are reviewed by the responsible SMEs for investigation and reporting quality and subsequently work flowed within IMS for approval within 10 business days.

Investigations are undertaken by suitably experienced personnel[29], who will seek specialist assistance where, for example, additional technical expertise is required. This technical expertise includes the analysis of relevant control and protection devices to ascertain whether they operated correctly.

Investigation tools such as Apollo Root Cause Analysis and Failure Modes Effect Criticality Analysis (FMECA) may be utilised, depending on the incident complexity or severity of the consequences. Where the causes of incidents are identified as systemic[30], the resultant recommendations may require implementation across the entire field workforce or an entire asset fleet for example.

AusNet reports all serious and other serious electrical incident information to ESV in accordance with ESV's "Electrical Infrastructure Safety Electrical Incident and Safety Performance Reporting Guidelines".

Further detailed information on incident investigation and reporting is included in SOP 30-2010.

11.3.14 Records

The role of record management within the ESMS is to provide time based information on the age, condition and performance of network assets that may be used to inform the development of asset management strategies for the enhancement of network safety.

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[28] SOP 30-2010 applies to all AusNet personnel, contractors and agents providing services to AusNet.
[29] Suitably experienced personnel means those having sufficient knowledge of and skills relating to the incident to be able to fully understand and make informed decisions regarding the circumstances, likely causes and possible remedial actions required.
[30] Systemic means having wider implications than the single incident. For example, breach of a field work procedure that has implications for all field personnel or an identified asset design or manufacturing defect that applies to all assets within a fleet.

In general, records are managed in accordance with AusNet's certified ISO 9001 records management system.

AusNet's Enterprise Content Management (ECM) system is used to store, distribute, discover, archive and manage content (such as policies, procedures, standards, specifications, manuals and other process related documents) to enable AusNet to deliver relevant content to employees and delivery partners where and when they need it.

The ECM site allows AusNet to manage documents, including legislation, standards, codes, guidelines and procedures relevant to the lifecycle management of network assets. Documents are managed via ECM in accordance with Governance Procedure 10-1030 Document Retention.

Knowledge and record management includes the maintenance of accurate records of asset types and locations, condition assessments from periodic inspections, risk-based testing programs and automated online condition monitoring systems. It also includes the real-time acquisition and management of data regarding network operating parameters and event circumstances. This data facilitates confident, safe and reliable operation of the network, the modelling of future scenarios and the forecasting of performance.

As discussed further in Section 12.3, records of network assets, including their location, class, type, age, maintenance history and scheduled inspection and/or maintenance intervals are included in the asset management system (SAP platform).

Knowledge and record management extends to include the transfer of intellectual property and informal knowledge through training and mentoring programs.

11.3.15 System audits, non-compliance and corrective action

The role of audits is to monitor and ensure compliance with the ESMS. As non-compliance may present a risk to the continued safe operation of the network, any identified areas of non-compliance are investigated to establish the causal factors so that corrective actions may be implemented and monitored.

AusNet's facilities are subject to regular audits to verify compliance with specified technical, operational and safety standards and legislative requirements. The scope, frequency and specifications of audits vary in accordance with the degree of risk associated with respective network assets and activities. The audit sample size is determined in line with "Sampling Procedures for Inspection by Attributes" (AS 1199.1).

As discussed in Section 10.3.2, audits are undertaken in accordance with "HSEQ Systems and Compliance Audits" (QMS 21-10) and the "Guideline - Technical Compliance Audit" (QMS 21-11) to ensure the requisite compliance is achieved in all aspects of the design, construction, installation, operation and maintenance of the network.

QMS 21-10 establishes the audit principles, criteria, practices and guidelines for planning, conducting and documenting audits. QMS 21-11 provides guidance on the classification and interpretation of audit findings to ensure consistency in the management of audit outcomes. Corrective actions identified from audits are recorded and monitored in accordance with the "Corrective and Preventative Action" procedure (QMS 21-04). Non-compliance and recommended improvement opportunities requiring action from all audits within the business are logged in and tracked by the Issues Management System (IMS) Enablon. Allowable timeframes for completion of corrective actions depend on the classification of the audit finding.

Audit teams, whether sourced from external consulting firms or internal staff, are trained to ensure a competent and consistent approach, suitability and effectiveness of auditing. Results of audits are summarised and reported to the s and Audit and Risk Management Committee (ARMC).

AusNet also maintains a compliance data base for registration of all relevant legislative requirements, including those related to network safety. This database records details of the requirement, together with assigned responsible person(s) and compliance review frequencies. At the review frequencies the responsible person(s) must confirm in writing ongoing compliance and provide positive assurance that there has been no breach of the requirement or alternatively identify any breaches that they are aware of.

11.3.16 Management review

Management review of the effectiveness and appropriateness of the ESMS is undertaken to ensure that process capability is reviewed, maintained, improved and that policies and objectives are identified, measured and reported in accordance with the Management Review procedure (QMS 20-01). The review includes items such as:

- On-going performance against internal KPIs, objectives and targets;
- Policies, Business and Management Plans as appropriate;
- Process and system changes in gaps, risks, deficiencies, suitability and effectiveness;
- Results of audits (internal, external and certification);
- Corrective actions statistics and performance; and
- Regulatory and legislative impacts on the system

The annual review of the divisional business plans and the Asset Management Plan ensures alignment with the corporate Business Plan objectives and KPIs. The Business Plan and the Asset Management plan are approved each year by the Board.

Management review with respect to network safety is facilitated by the Network Safety Management Committee (NSMC) and its relationship with the other key management committees and the executive leadership team. The role of the NSMC and this relationship is explained in Section 8.2.4. The NSMC meets monthly and reviews the Network Safety Report prepared for each meeting. This includes monitoring the performance of various network safety KPIs related to for example fire starts and electric shocks from network assets.

12. Asset Management Strategy, Plan and System

The purpose of this element is to describe the mechanisms by which the asset management strategy is developed, formulated into a plan and then put into practice.

12.1 Asset Management Strategy

The Asset Management Strategy (AMS), which was introduced in Section 3.5, documents a holistic approach to the management of electricity distribution network assets over their full life cycle, and establishes linkages with the underpinning processes and plans.

The Asset Management Policy (Appendix B) provides guiding principles when making asset management decisions.

The AMS comprises a suite of documents consistent with the Asset Management Policy and aligned with objectives in the corporate Business Plan. The AMS documents are arranged in a hierarchy, as illustrated in Figure 50, to guide the asset management process.

The AMS guides the development of technical standards, maintenance processes and the scoping of major refurbishment and replacement projects and programs within a 10 to 20-year horizon.

AMS 20-01 Asset Management Strategy (Electricity Distribution), which is the overarching document of the AMS suite of documents, is reviewed annually. The process of review involves the Network Strategy Manager (in the Regulation and Network Strategy division) proposing updates, with input from the Network Engineering division. The proposed changes are submitted to the Asset Management Committee (AMC) for review and ultimate approval.

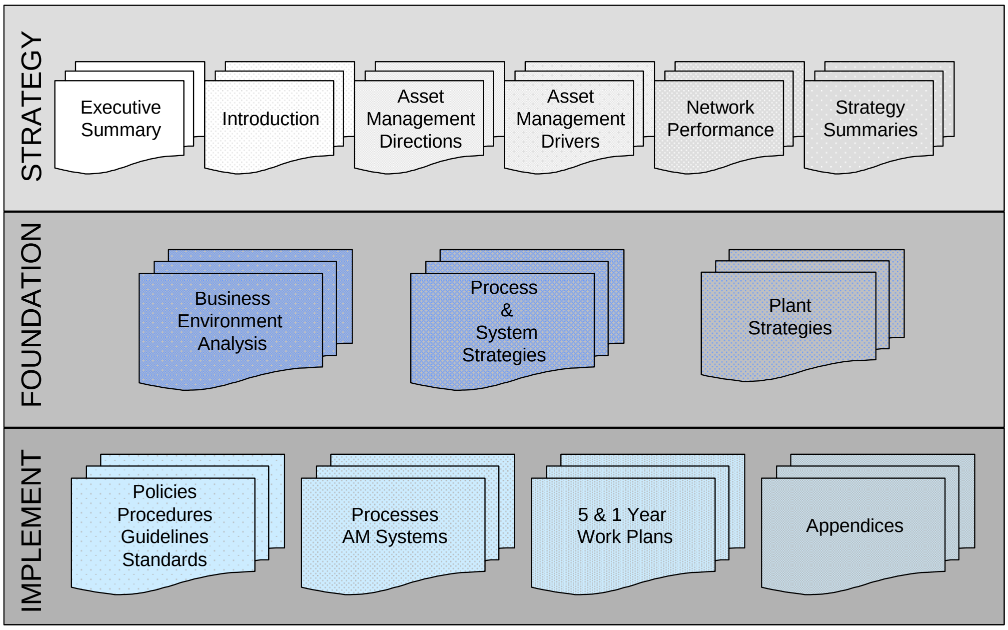


Figure 50 Hierarchy of Asset Management Strategy Documents

At the highest level the AMS brings together external influences, investment drivers, business values and asset management objectives with a summary of the resources and the strategies to deliver sustained performance for the benefit of stakeholders. This is included in AMS 20-01, discussed above.

The second level provides the foundation upon which the AMS is built. It details the assets, issues and investment drivers behind each technical, procedural and support system strategy. This level includes detailed plant and process and system strategies that provide the analysis behind each strategy necessary to achieve agreed performance outcomes.

The third level outlines the implementation of the AMS. At this level, strategies are integrated with AusNet's business systems and practices. These documents provide direct links between asset management strategies and company standards, procedures, support system developments, work programs and plans.

In relation to the key network safety risks first discussed in Section 3.7, specific strategies have been developed as part of the AMS and are discussed below. These strategies draw on relevant information from other strategies such as the detailed plant strategies and are controls that address these risks.

12.1.1 Enhanced network safety strategy

In relation to network safety, a specific strategy AMS 20-13 Enhanced Network Safety has been developed. As a consequence of the high exposure to the public from electricity distribution network assets, implementation of a continuous improvement methodology to maintain or enhance network safety is a key asset management strategic objective and a requirement of the ESMS.

AusNet's core program for asset replacement and refurbishment involving assets with greatest exposure to the public is based primarily upon asset condition, which is determined through cyclic asset inspection and testing programs. The Enhanced Network Safety strategy assumes this core asset management activity continues and also recommends a range of additional asset replacement and refurbishment programs that would not otherwise be identified through condition based asset inspection cycles or zone substation plant condition assessments.

12.1.2 Network reliability strategy

The AER administers a financial performance mechanism (Service Target Performance Incentive Scheme – STPIS) that reflects customer willingness to pay for supply reliability performance levels. The scheme is designed to strike a balance between driving operational efficiencies to maintain or reduce costs to serve customers, whilst maintaining or improving supply reliability.

Accordingly, AusNet monitor supply performance metrics against established benchmarks in order to identify opportunities for supply improvements. Options to maintain or enhance network reliability include network insulation, automation, re-configuration, fault response and vegetation management. The level of investment in these options is guided by STPIS which seeks to drive performance outcomes for customers in respect to both frequency and duration of interruptions.

12.1.3 Vegetation management strategy

AMS 20-23 Vegetation Management is part of the suite of documents that describe the asset management strategy for the electricity distribution network.

The purpose of AMS 20-23 is to identify issues and describe the company's approach to vegetation management and as such is a key document in the management of the safety risk posed by vegetation in the vicinity of the electricity distribution network.

12.2 Asset Management System

This section provides an overview of the Asset Management System including its underlying methodology, context, process, objectives, decision making criteria. AMS 01-01 Asset Management System – Overview, describes AusNet's asset management system in ISO 55001 terms.

The relationships between the key elements of an asset management system[31] are shown in Figure 51.

The asset management system integrates the elements of the ESMS as there is consistency between the ESMS framework and the generic requirements of the Asset Management standard. Section 11.2

[31] From ISO 55002 Asset Management – Management Systems – Guidelines for the Application of ISO 55001

summarises key elements of the ESMS within the overall business management system, including asset management.

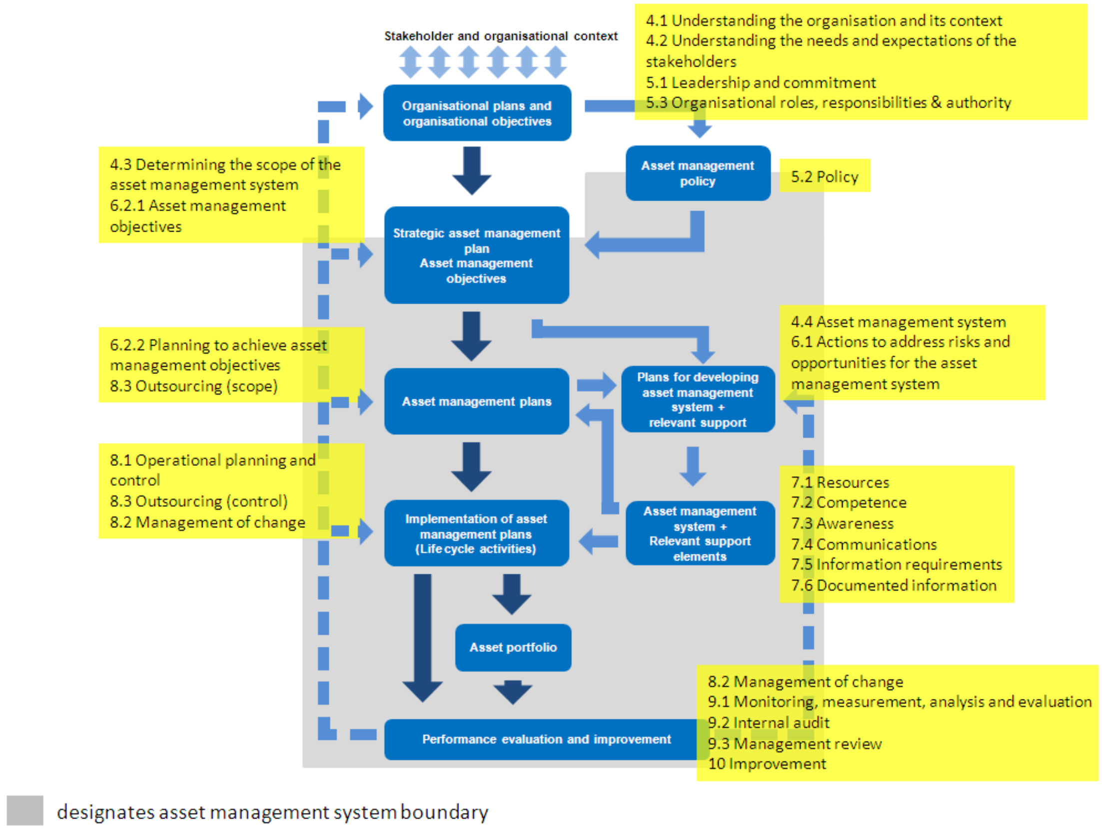


Figure 51 Relationships between Key Elements of an Asset Management System

12.2.1 Asset management methodology

AusNet is focused on delivering optimal distribution network performance at efficient costs. Except in the case where outputs are mandated or the methodology is mandated such as in the Electricity Safety Act, this requires an explicit cost benefit analysis to be undertaken in order to assess whether the overall economic value of capital expenditure and benefits derived will reduce the risks “as far as practicable”.

In doing this, AusNet assesses the incremental costs of delivering an incremental change in network performance to customers, relative to the incremental benefits accruing to customers from the delivery of that enhanced network performance.

The asset management strategy therefore ensures that all decisions to augment, maintain, refurbish or replace network assets are economic. The benefits are a function of the explicit customer value proposition, or proxy via the adoption of minimum performance standards which are stipulated in legislation or other statutory or regulatory instruments.

The various drivers that are brought to bear when undertaking AusNet’s Cost Benefit Analysis are summarised in Figure 52.

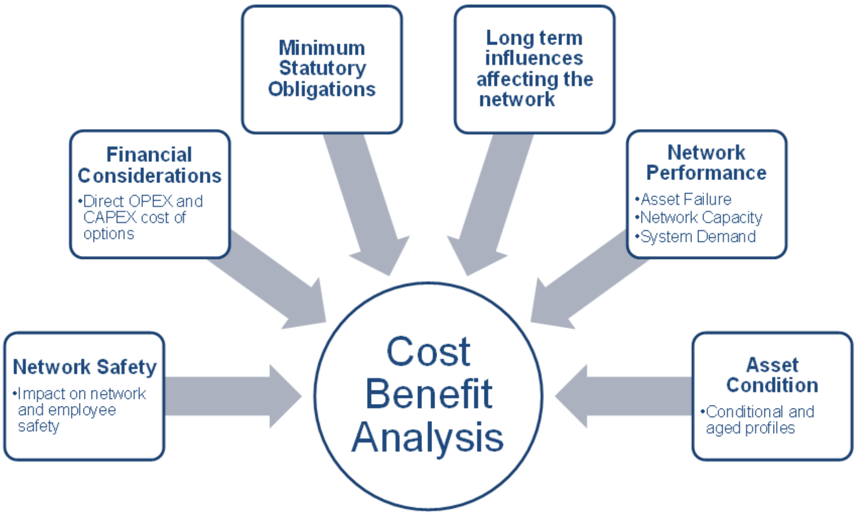


Figure 52 Cost Benefit Analysis Drivers

An assessment of the above drivers – both individually and collectively – are fundamental to the economic analysis that underpins AusNet's approach to managing its network.

12.2.2 Asset management policy

AusNet's Asset Management Policy was first discussed in Section 3.5 and is included in Appendix B. It acknowledges the company's purpose and directs the content and implementation of asset management strategies, objectives and plans for the energy delivery networks and sets the foundation for all asset management decisions. It has been communicated throughout the business and copies are available in each workplace.

The Asset Management Policy recognises that the provision of a superior network requires the management of network assets over their lifecycle. This will be achieved by sound risk management and the continuous improvement practices of our integrated safety, health, environment, quality and asset management systems.

In accordance with ISO 55001, asset decision criteria are published in the Asset Management Policy. These criteria summarise the stakeholder's needs and expectations, guide the development of asset investment proposals and serve as a checklist for executive managers when making investment decisions. The asset decision criteria relevant to the ESMS states that "Hazards and risks to the safety of any person and their property will be minimised *as far as practicable*".

12.2.3 Asset management objectives

The Asset Management Policy summarises AusNet's fundamental asset management objectives, which have been developed to support alignment with AusNet's corporate values discussed in Section 3.3.1, in particular in relation to network safety.

The overarching asset management objectives are to:

1. Comply with legal and contractual obligations;
2. Maintain safety;
3. Be future ready;
4. Maintain network performance at the lowest sustainable cost; and
5. Meet customer needs.

The distribution network specific asset management objectives are to:

1. Improve efficiency of network investments;
2. Maintain long-term network reliability;
3. Implement REFCLs within prescribed timeframes;
4. Reduce risks in highest bushfire risk areas;
5. Achieve top quartile operational efficiency; and
6. Prepare for changing network usage.

The asset management objectives are supported by specific network objectives, which are detailed in each annual edition of the five-year Asset Management Plan (AMP).

12.2.4 Asset management process

The asset management process is informed by an assessment of the external business environment and the corporate business and financial plans. It responds to stakeholder engagement which incorporates customer, generator, regulator, shareholder and government views in the development of asset management strategies. In this context the ESMS represents stakeholder's needs and expectations with respect to improvements in network safety.

The process, illustrated in Figure 53, includes the development of longer-term asset management strategies, the annual five-year asset management plan, the management of projects and programs of change and the application of standards to the life cycle of network assets. Further information is included in AMS 01-01 Asset Management System Overview.

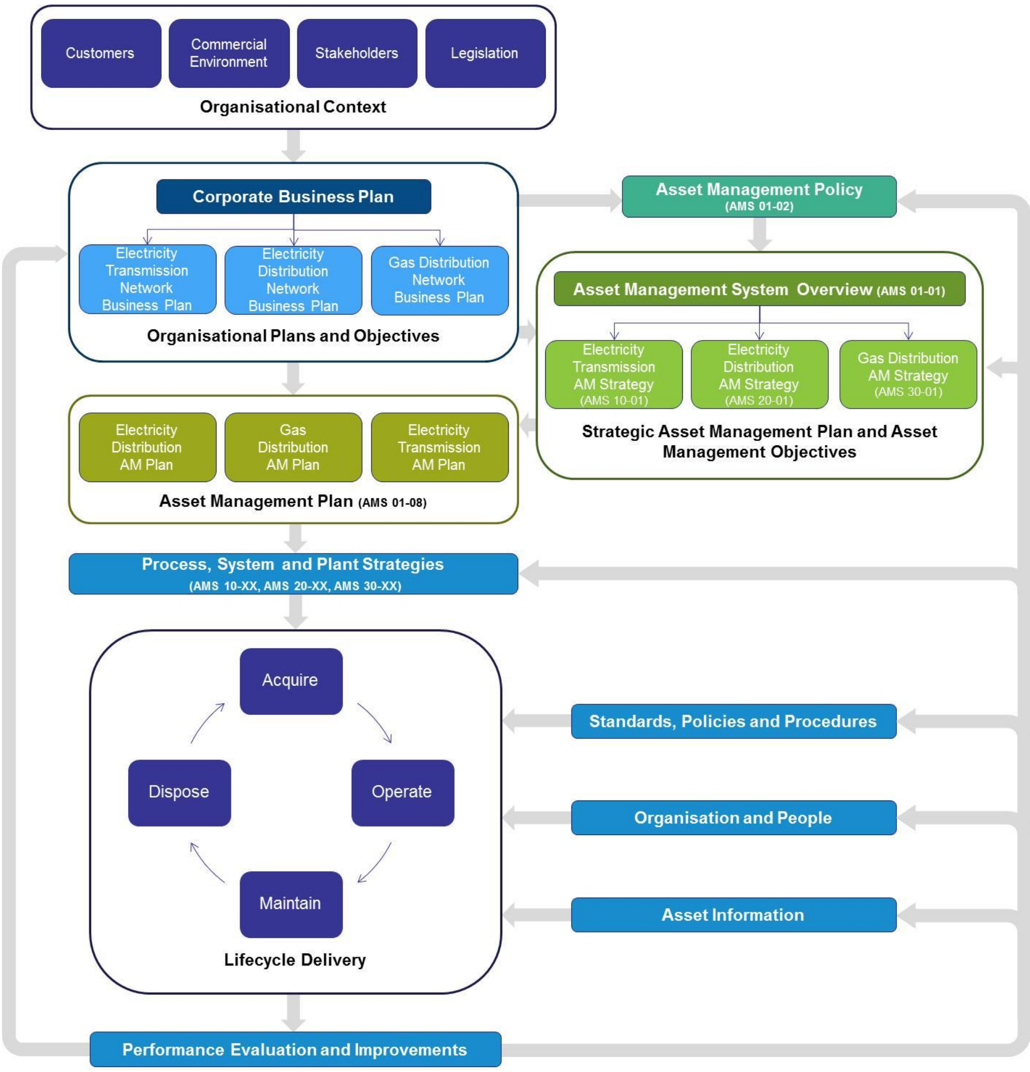


Figure 53 Asset Management Process

12.2.5 System certification

The practices employed in managing the assets which form the electricity distribution network are designed to conform to ISO 55001, the international standard for Asset Management.

12.3 Asset Condition Monitoring and Data Acquisition

The AusNet's electricity distribution network includes approximately 1.2 million assets, including poles and wires, primary plant and secondary (protection, control and metering) assets, the details of which are recorded within the asset management information system (SAP platform). Asset information recorded includes details of the asset location, class, type, age and scheduled inspection and/or maintenance intervals.

The asset management information system schedules the condition monitoring programs and activities for respective asset classes and types. Condition monitoring data obtained through asset inspection and testing programs is recorded and stored in SAP.

Specifications for the methods of inspection and testing, together with condition assessment criteria, are provided in Asset Inspection Manuals and procedures, which are regularly updated from learnings gained through operational experience with the assets.

Condition monitoring includes a range of technologies (visual inspections supported by high resolution digital photography, invasive inspection and testing, off-line testing, discrete and continuous online and non-invasive scanning techniques) which are constantly developing and providing more accurate and less disruptive asset condition evaluations. Annual substation scanning, including portable radio frequency scanning have been incorporated into business as usual.

Technology is providing increased opportunity to install plant with on-line monitoring, which in turn is being used to enhance asset health dashboards. OSI Pi is a software application utilised to undertake data analysis of on-line monitoring systems and devices to provide asset health dashboards. Health indices help to provide an indicator for increasing volumes of replacement work that will occur due to deteriorating condition and serviceability. In addition, service age helps to provide a high level benchmark with the estimated weighted average remaining life (WARL) for distribution network assets.

Asset performance data is also captured in key systems such as the Distribution Outage Management System (DOMS), which is the source for fault causes and electricity reliability data, and the Issues Management System (IMS) for recording, tracking investigations and actions arising from, and reporting of serious electrical incidents.

Detailed information on the condition of fleets of critical plant items are included in the individual plant strategies mentioned in Section 12.1. These plant strategies include detailed risk modelling and address the dynamic risks associated with asset condition.

12.4 Detection of Asset Failures and Defects

Asset failures and defects are detected through the following:

- SCADA system alarms;
- Inspection and testing;
- Planned maintenance activity;
- Incident investigations;
- Asset failure rates;
- Quality of supply complaints from customers;
- Loss of control or monitoring facility; and
- Third party notification

Defects identified from all sources, including through inspection, testing, planned maintenance and notification from customers and the general public, are recorded in SAP and work planners are notified to assess priority and program remedial works.

Unplanned network interruptions and failures may be detected by automated protection and alarm systems monitored through the 24 hour control room or reported by third parties or customers by telephone to the control room. The control room prioritise and dispatch work orders to the relevant geographically located response resources from Service Delivery division. The control room log the details of failures and remedial actions in DOMS to facilitate accurate reliability of supply reporting and improvement.

DOMS data on asset failures is combined with defect data and preventative maintenance activity from the SAP based asset management information system and incident investigation through the IMS to inform the development of asset inspection and condition monitoring procedures together with identification of hidden or latent defects. This information informs the risk modelling in the asset specific strategies which underpin the Asset Management Strategy (AMS 20-01).

12.5 Asset Investment Process

12.5.1 Network investment overview

Regulated capital investment and operating expenditure in the network are undertaken primarily through four activities:

- Customer initiated (capital);
- Network augmentation (capital);
- Asset replacement (capital); and
- Operating and maintenance (operating)

Investment in the network is driven by a combination of requirements to meet customer service and regulatory obligations that include network safety, reliability and quality. There are various methodologies, described below, that are applied to the different network investment activities to forecast and determine network investment and expenditure requirements to cost effectively deliver network service objectives and obligations.

The Asset Management Strategy provides the basis for network investment requirements and also supports the Electricity Distribution Price Review (EDPR) process, which is conducted at five year intervals through the Australian Energy Regulator (AER). This process establishes the revenue requirements, funded through customer network supply charges, for the operation and maintenance of the network.

Budget approval and forecasting is then undertaken annually through the internal revision and update of the rolling five-year Asset Management Plan, which is approved by the Board.

12.5.2 Customer initiated

New and existing customers may request the distribution business to provide terms and conditions for the connection of new installations or provision of additional electricity supply capacity to existing installations. The Essential Services Commission's Electricity Industry Guideline 14 "Provision of Services by Electricity Distributors" provides the obligations through which distributors must provide these customer services on fair and reasonable terms.

The forecasting methodology utilises a combination of geographical mapping using distribution feeder customer growth rates, customer tariff mix and calibration with the Victoria in Future (VIF) planning document published by the Victorian Department of Transport, Planning TPLI. This ensures that the theoretical growth rate on a collection of feeders does not exceed the VIF growth rate for the entire Local Government Area in which those feeders are located.

These forecasts are also used to support forecasts for network maximum demand growth and therefore network augmentation requirements.

12.5.3 Network augmentation

Network maximum demand is forecast through the same process used to forecast customer initiated network activities. As sections of the network approach their maximum demand capacity, network augmentation proposals are investigated, together with non-network solutions, to develop forecasts of network augmentation requirements. Network constraints are identified through network modelling which utilises on-line monitoring system data, including customer interval metering data, to identify where electricity demand is forecast to exceed network circuit design and plant ratings detailed within AusNet's Technical Manuals.

Capital investment in network augmentation follows a probabilistic planning criterion, as opposed to deterministic used in some states, which applies a risk based approach to investment in the network to meet electricity demand. The Value of Customer Reliability (VCR), set by the Australian Energy Market Operator (AEMO) to reflect customer willingness to pay for network reliability, is used to establish the economic threshold above which network augmentation investment occurs to maintain network security requirements.

12.5.4 Asset replacement

Further to the process of "Asset Condition Monitoring and Data Acquisition" discussed in Section 8.3, the asset management information system schedules intervals for condition based inspection and testing programs that identify assets that have reached or are approaching the end of their engineering life. End of life asset assessments are deterministic and are utilised to generate rolling defect rates for respective asset types, class, location and age. This information is then applied to scheduled inspections in SAP to forecast short term (18 months) asset replacement volumes and costs.

For those assets approaching end of life, a risk based approach toward replacement investment takes into consideration factors such as asset condition, age, location, performance, function and replacement costs derived from asset management systems including SAP, DOMS and IMS. Included in the analysis is consideration of a range of potential failure consequences which include customer and community safety risks such as bushfire, electric shock and reduced network reliability. These factors are informed through formal risk assessments, IMS, DOMS and the Government's Fire Loss Consequence Model.

These factors are modelled through Availability Work Bench (AWB), which enables the application of cost benefit analysis to asset replacement scenarios for the management of network safety risks as far as practicable. Scenario analysis includes investigation of the costs and benefits of adjusting maintenance processes and frequencies as a cost effective alternative to asset replacement options. Decisions to defer capital replacement investment can impact operating and maintenance activities, through increased costs to undertake additional or more frequent maintenance activities.

Economic evaluation of network replacement and maintenance proposals has improved steadily with better quantification of asset condition, failure rates and the consequences of failure. Initially, complex Microsoft Excel spreadsheets were developed to analyse life cycle costs using simple reliability centred maintenance (RCM) models. AWB software was introduced circa 2010 to ensure the mathematics of RCM models was robust and to optimise preventative maintenance activities.

Most recently, the introduction of Dependability Management[32] processes places the RCM models within the context of the IEC 60300 Dependability suite of standards, where the concept of dependability is broader than just reliability. AWB software has been used to apply Dependability Management processes to zone substation and line assets to identify those assets with the highest risk of failure and to develop forecasts of future asset replacement capital expenditures.

The results of AWB modelling are reflected within asset management strategies for respective asset classes, which recommend programs of targeted fleet replacement or maintenance. Fleet replacement programs are generally recommended where it is cost effective to address generic and increasing trends in failure rates or condition based inspections are unlikely to identify anticipated latent or hidden defects where the consequences of failure are assessed as material.

The decisions for maintenance and replacement strategies derived through application of Dependability Management and RCM management philosophies are reflected within asset management strategies for individual asset classes. Aggregation of the individual asset management strategies into the overarching Asset Management Strategy is then undertaken and approved by the General Manager, Asset Management.

12.5.5 Operating and maintenance

Forecasts of operating costs consist of a combination of direct network activities (i.e. fixed scheduled inspection and maintenance activities, vegetation management compliance and fault management) and overheads which consist of the personnel and systems required to support the broader functions of the business enterprise.

In general, the cost of inspection and maintenance programs do not vary materially. However, the continual development of technologies and outputs of RCM analysis support a process for continuous improvement in the effectiveness of inspection and maintenance programs.

Inspection and maintenance activities are reviewed through the processes described in Section 12.5.4 and included in the respective asset management strategies. Specifications for inspection and

[32] Explanation and application of Dependability Management is provided in asset management strategy document AMS 20-11

maintenance are detailed in the Asset Inspection Manual (30-4111) and various plant and maintenance guidelines.

12.5.6 Electricity distribution price review

At five year intervals, the business is required to submit its formal proposal to the AER for investment in the network over the forthcoming five year period. The Asset Management Strategy and the methodologies applied to forecast and determine investment and expenditure across the four broad network activities are reviewed and benchmarked to other network service providers by the AER. The AER applies this process in determining an appropriate revenue allowance to be funded through customer network tariffs to maintain network service levels and obligations.

The revenue allowance is calculated through the building block approach illustrated in Figure 54. In summary, revenue is provided on a dollar for dollar basis to meet operating and tax costs whilst capital investment provides revenue to cover the "return on investment" (Regulated Asset Base (RAB) x Weighted Average Cost of Capital (WACC)) and "return of investment" (depreciation).

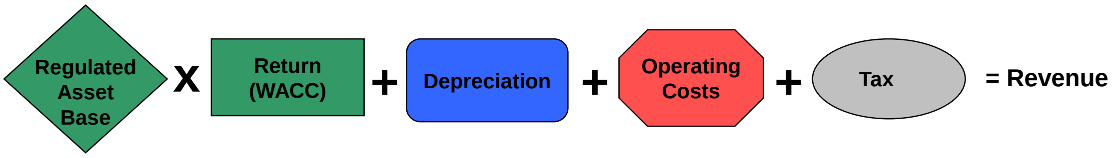


Figure 54 Building Block Approach

12.6 Asset Management Plan

The Asset Management Plan (AMP), which is integral to the asset management process provides a five year plan of network investment and operating expenditure, underpinned by the Asset Management Strategy (AMS 20-01).

The annual review of the AMP is co-ordinated by the Asset Management team and involves a top down and bottom up review to ensure a balanced investment portfolio that takes into account emerging network risks or performance trends that have arisen throughout the year and addresses network safety, reliability and quality obligations.

The review process involves interviews and workshops with key personnel in the Network Management and Network Operations and Safety divisions.

Prioritisation of investment is achieved through financial management and control processes that require application of a consistent framework for cost benefit analysis to be applied to individual project and program expenditure proposals, as shown in Figure 46.

Each project and expenditure program within the five-year AMP is implemented via the authorisation of a business case which contains an evaluation of the options to address the performance risks and demonstrates the economic efficiency of the selected option. Included in this evaluation is the completion of a risk assessment that considers the risks, including network safety related, that will be addressed by the program.

As discussed in Section 11.3.2, the preparation and approval of business cases is part of the governance framework for the program lifecycle process. The CPG department validate the information and coordinate approvals in accordance with the Delegations of Authority Manual.

The business case preparation and approval process is shown in Figure 55.

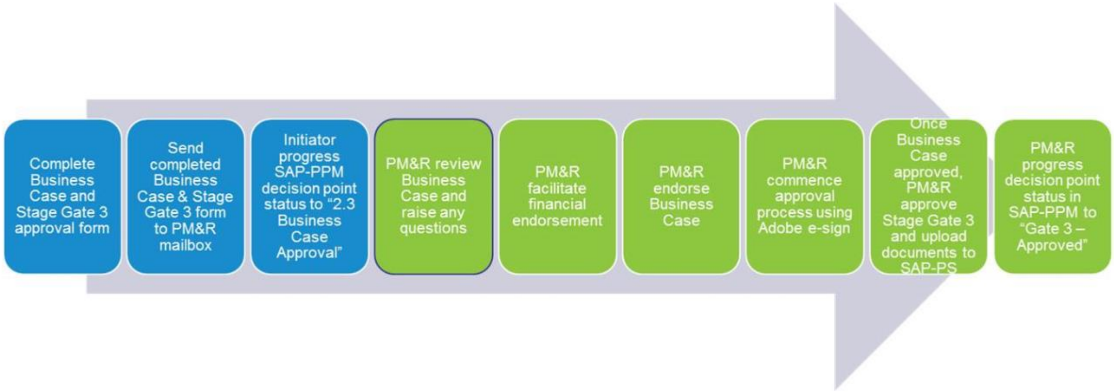


Figure 55 Business Case Preparation and Approval Process

Each Business Case is reviewed by technical and financial managers, including consideration of whether the key risks have been identified, with ownership and appropriate controls, and whether this complies with the corporate risk appetite. Also, governance arrangements are considered, including the proposed governance framework, accountability for delivery, and who the Project Manager will report to.

Approval of the Business Case is by the appropriate business owner.

Once approved, a Project Manager is appointed to deliver the change summarised in each Business Case and the CPG department coordinates that delivery with other projects and programs of change. For major projects, the Major Projects Delivery team in the Network Operations & Safety division is responsible for delivery.

Plans specifically related to network safety, which are incorporated within and developed out of the AMP, are discussed in the following sections.

12.6.1 Bushfire mitigation plan

The Bushfire Mitigation Plan (BMP) for the electricity distribution network is reviewed on an annual basis through the Network Safety Management Committee and submitted to ESV every five years, in accordance with legislation, for their review and acceptance. The BMP provides a system that incorporates all aspects of the management of bushfire risk arising from the network and includes:

- Requirements that ensure compliance with the Act, Regulations and Code;
- Management monitoring, control and overview;
- Key performance indicators, reporting and monitoring systems;
- Process of continuous improvement in risk reduction;
- Contingency planning, including for Total Fire Ban days;
- Asset inspection, maintenance and replacement strategies, standards and targets;
- Private Overhead Electric Line (POEL) management;
- Resource forecasting and deployment;
- Incident investigation, reporting and communication protocols and processes; and
- System and work activity audit processes.

The 2009 Victorian Bushfire Royal Commission (VBRC) provided a range of recommendations relating to distribution networks, which are addressed within the BMP. Recommendations that required further investigation and analysis due to technical complexities were addressed by the Powerlines Bushfires Safety Taskforce (PBST) and their recommendations subsequently accepted by the Victorian Government in December 2011. Recommendations 28 and 29 were implemented through changes to the Electricity Safety (Bushfire Mitigation) Regulations 2003.

As discussed in Section 10.2.1, amendments to the *Electricity Safety (Bushfire Mitigation) Regulations* were made in 2016 to incorporate design standards within Codified Areas (electric line construction area) and the implementation of Rapid Earth Fault Current Limiter (REFCL) technology.

The effectiveness of the BMP is monitored by the Network Safety Management Committee (NSMC) through the use of key performance indicators (KPIs) such as the Bushfire Mitigation Index, the Fire Ignition Risk Indicator, F Factor and also analysis of the underlying data that supports these indicators.

12.6.2 Vegetation management plan

The Vegetation Management Plan is an integral part of the Bushfire Mitigation system. It details the management procedures to ensure compliance with the *Electricity Safety Act 1998* and *Electricity Safety (Electric Line Clearance) Regulations*. In accordance with legislative requirements, it is submitted to ESV at least every five years for review and approval.

AusNet has a specialist team who are dedicated to the management of vegetation adjacent to electricity distribution network assets, which includes inspection, assessment and cutting activities. The vegetation management group is represented on the NSMC.

The effectiveness of the Vegetation Management Plan is monitored by the NSMC through the use of KPIs similar to those discussed above for the BMP.

AMS 20-13 Enhanced Network Safety includes asset management strategies to improve vegetation management, including the hazardous tree removal program.

12.7 Link with Risk Management System

As discussed in Section 3.5, asset management is closely linked to risk management in that a robust approach to the management of assets contributes significantly to the management of network safety risks. This is because some risks arise as a result of asset failure or deterioration.

Section 10.5.6 discusses the corporate risk management information system and register which AusNet maintains, through which Formal Safety Assessments (FSA) are conducted by subject matter experts. The involvement of subject matter experts engaged through the acquisition, planning, design, construction and operational phases of the network asset lifecycle provides the experience and knowledge in identifying and assessing the associated hazards and risks.

The FSA process identifies, predominately through a combination of qualitative and semi-quantitative assessments, the broad range of risks associated with managing the network. This process informs the development of detailed asset management strategies that are supported by a risk-based asset management philosophy that applies a range of techniques for more detailed risk identification, analysis and evaluation. The development of detailed asset management strategies contributes to the development of safe network designs and, where necessary, the development and application of control measures such as inspection, maintenance and replacement programs.

Asset condition data collected during scheduled inspection and maintenance tasks is used to determine dynamic time-based probability of failures and percentage of remaining service potential of the asset in that lifecycle phase. Risk-based asset management techniques model output risk profiles for each asset category, which are used to establish optimised maintenance and asset replacement plans that are necessary to deliver a sustainable or improving risk position.

Continuing development and implementation of new technologies that facilitate condition monitoring enables greater measurement of network risk and consequently the determination of performance. The outputs of this process are sound asset risk management strategies which provide the ability to forecast a significant proportion of the asset replacement budget. This is achieved through consolidation, integration, recording and analysis of data gathered from the field through asset management systems.

Further details of the risk-based asset management process can be obtained from the Asset Risk Assessment Overview (AMS 01-09).

12.7.1 Risk control measures

For any network risk there are generally several risk control measures. In Section 10.2.1. the main control measures were listed for the key network safety risks. Many of these, including "asset management strategies and plans", "enhanced network safety strategy", "condition monitoring, testing, inspection and maintenance of assets" and "bushfire mitigation and vegetation management plans and programs" are directly informed by and outputs of various aspects of the asset management strategy, plan and system discussed above.

The details of these controls and how they are implemented to manage the risks is discussed in Section 10.2.1 and the monitoring and reporting of their efficacy is discussed in Section 10.3.

Risk controls apply a threat barrier process to eliminate or reduce the likelihood and consequences of the respective network safety event. Risk control measures are selected using the principle of the "hierarchy of controls" illustrated in Figure 39 and applied to manage the risk as far as practicable.

Controls are typically identified through the formal safety assessment, which involves subject matter experts with the requisite operational experience and expertise assessing the hazards and available controls for an asset class or category across its life cycle. Following the asset management process, these risk assessments inform the development of asset management strategies for plant and equipment that are integrated into an overarching Asset Management Strategy and outworked through the Asset Management Plans.

12.8 Compliance with Asset Management System

The Asset Management team is responsible for reviewing and improving the effectiveness of the Asset Management System and AMS. This process supports the development of the annual five year AMP, through which investment decisions are implemented.

The NSMC monitors the implementation and effectiveness of the AMS and AMP in addressing network safety risks and initiates corrective actions where network safety trends are unfavourable.

Information on network safety related risks is communicated between the Asset Management team and NSMC. For example, asset failure related risks, which are assessed and documented in the individual asset management strategies are integrated into the overarching AMS and AMP for review and endorsement. The NSMC oversees implementation of the network safety related aspects of the AMP and may initiate the review of respective strategies and plans to achieve network safety performance objectives.

13. Governance and Assurance

The purpose of this section is to describe how changes to the ESMS and supporting plans (e.g. asset replacement and maintenance plans and philosophy) are managed and controlled. Also, to explain how the governance framework for risks is structured and implemented.

13.1 Management of Change Procedure

AusNet's Quality Management System, certified to ISO 9001, includes procedures for management of change within the business to ensure network and the broader enterprise risks are managed appropriately.

The Health, Safety, Environment and Quality (HSEQ) Management System Manual (QMS 10-01) addresses changes in operations, procedures, standards or facilities that must be evaluated and managed to ensure that risks arising from changes remain at an acceptable level.

The process for managing change addresses:

- Authority for approval of changes;
- Analysis of operations integrity implications;
- Compliance with regulations and approved standards;
- Acquisition of needed permits;
- Documentation, including reason for change;
- Communication of risks associated with the change and required mitigation measures;
- Time limitations; and
- Training

Temporary changes that do not exceed initial authorisation of scope or time may proceed without review and approval but are reported in line with regular reporting requirements.

AusNet has a corporate communications team within the HSEQ & Compliance department that is responsible for communication of significant changes in the organisation to employees and also to external stakeholders.

This team has a well-developed process for communicating changes resulting from key projects to external and internal stakeholders, outlined in a company-wide "Stakeholder Engagement Framework". This framework is based on International Standards and best practice stakeholder engagement.

More broadly, AusNet's business strategy focusses on generating trust and respect with customers and partners, resulting in a stakeholder relations strategy that includes a comprehensive annual plan to communicate network safety in the lead up to Summer and other events, including storms and preparing for possible resultant loss of supply.

13.2 Changes to the ESMS

In line with the requirements of the *Electricity Safety Act 1998*, AusNet submits a revised ESMS to ESV where there is a material change to the risk profile of the network. This may result for example from significant changes to network assets or work practices that lead to a material increase to network hazards and risks. The revision will normally be accompanied by relevant risk assessments that consider these changes.

Less material changes to the risk profile are managed by reviewing the relevant identified network safety risks and updating their risk assessments accordingly. This will sometimes lead to a review of and changes to individual asset management strategies and other nominated controls for the risks. Changes and the reasons are recorded in updates to the risk assessments and asset management strategies.

Where the ESMS is amended for administrative purposes and there is no material change to the risk profile of the network, this shall be considered an administrative update, rather than a revision. Administrative updates shall be approved by the line manager of the person responsible for the preparation and submission of the ESMS (listed in the 'Responsibilities' section of this document), having satisfied themselves that a revision is not required.

13.3 Changes to the Asset Management Strategy

The Asset Management Strategy (AMS) underpins the replacement and maintenance policies and procedures that generate the programs of work activities on the network that are included in the five year Asset Management Plan (AMP) that is approved by the Board each year. The AMP includes an overview of the long and short term network safety risks and issues faced each year.

The overarching asset management strategy document AMS 20-01 is reviewed and updated each year and the supporting foundation and implementation strategies and procedures are reviewed as required but at intervals no longer than five years. As discussed in Section 12.5, recommended asset replacement and maintenance activities are included in the asset management strategies for individual asset classes and types. These strategies have applied the principles of asset life cycle management and the obligation to manage network safety risk as low as practicable. Each strategy summarises the asset fleet condition and performance, together with identification of drivers for change.

Changes to any of the asset management strategy documents will be considered during the regular review of the network safety risks, as individual asset management strategies are often controls for these risks and their risk control effectiveness rating (RCE) may have changed.

13.4 Changes to Asset Management Plans and Programs

The annual production of a five-year AMP for approval of the AusNet board establishes a clear program of change for the pending five years, together with an approved budget for the first year of that plan.

Application of the Quality Management System discussed in Section 13.1 at the foundation level of managing change to network standards, procedures and controls feeds through the hierarchy of asset management to ensure changes to asset replacement and maintenance philosophies and the associated changes to network risk is appropriately managed and governed. Section 12.5 provides a detailed description of asset replacement and maintenance approval processes.

13.4.1 Capex programs

As discussed in Section 11.3.2, the delivery of capex programs and projects, which includes the installation of new and replacement assets, is coordinated through the CPG department. Figure 51 in Section 11.3.2 shows change control to be a part of Portfolio Governance.

The impact of change is assessed using the Change Impact Assessment template per Appendix P.

The change control request process workflow is shown in Figure 56. Proposed changes to programs require the project manager to initiate the change control process, which includes the completion of a change control request template. This template includes an assessment of the impacts (consequences) of the proposed change, including in the areas of safety, customer and overall risk as shown in Appendix P. The project initiator must finally accept the proposed change, taking into consideration the impacts and hence the change in risk that may result.

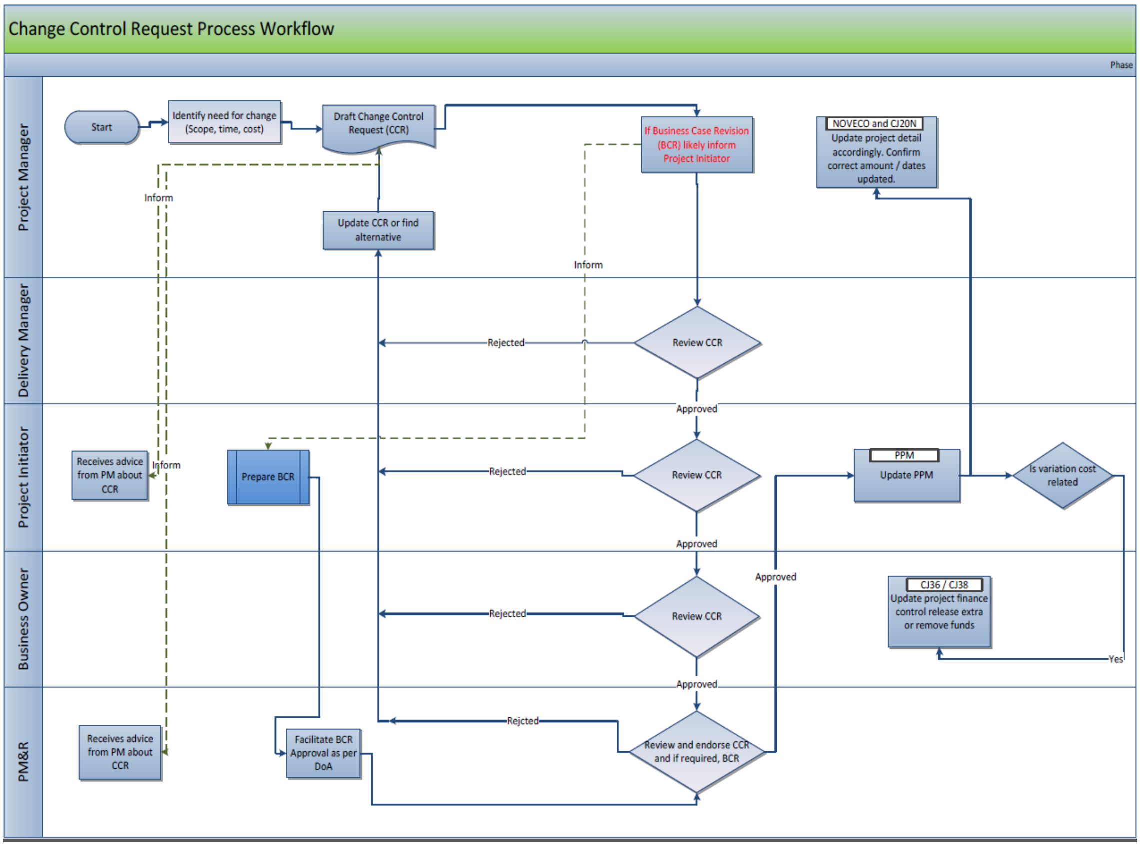


Figure 56 Change Control Request Process

In addition, from the charter of the NSMC, its responsibilities include to "*initiate and endorse changes to policies and procedures which impact the ESMSs, Bushfire Mitigation Manual and Plans and the Vegetation Management Plans*" and to "*initiate investigation and development of recommendations and strategies to address emerging network safety and bushfire risks*".

Progress on the enhanced network safety programs is tracked by the NSMC and discussed at its monthly meetings. Proposed changes to these programs are considered in terms of whether this will introduce a material change to the network safety risk.

13.4.2 Maintenance programs

As discussed in Section 12.5, the maintenance programs for asset inspection, condition monitoring and maintenance, including vegetation assessment and cutting are scheduled via the SAP based asset management information system. The completion of these programs is also monitored by the NSMC and changes assessed in terms of any resultant changes to the network risk profile.

13.4.3 New technology programs

Some asset management programs require special consideration in terms of change management due to their size, significance or unique nature.

The Rapid Change Impact Assessment template is used to assess the magnitude of a change and make a high level assessment of the change management requirements. This ensures that the risks arising from the changes are assessed for their impact on the business. This process considers the impact on processes, systems, people and culture. The template forms part of the CPG stage gating procedures.

This strategy includes stakeholder analysis, engagement and communication. Change management risks are required to be identified and assessed, including those related to operating model changes, capability and knowledge gaps, business readiness and measuring the effectiveness of change in a number of areas including network safety.

13.5 Risk Governance Framework

As discussed in Section 8.2.4, the outputs from the risk assessment process are made visible to senior executives and the Board in accordance with the risk governance model. The monitoring of risks by the various board and senior management committees is discussed in Section 10.5.2.

In relation to network safety risks this is also achieved from the responsibilities of and relationship between the NSMC members that provide representation across senior levels of management from multiple divisions Changes to these risks that lead to or result from changes to the ESMS, asset management strategy or asset management plans are considered by Asset Management and may also be reported to the Board via the ARC.

Appendix A Health, Safety, Environment and Quality Policy

Health, Safety, Environment and Quality Policy

AusNet services

AusNet Services' purpose is to empower communities and their energy future.

AusNet Services owns and operates the Victorian electricity transmission network, one of five electricity distribution networks, and one of three gas distribution networks in Victoria. Through Mondo we provide a range of energy and infrastructure products and services to business, government, communities and households.

Our corporate values underpin how we work: We work safely; We do what's right; We're one team; We deliver.

We regard health, safety and environmental outcomes associated with our business operations as an ethical responsibility. We never compromise on safety and we genuinely care for the physical and emotional wellbeing of people. At AusNet Services, safety is a way of life. Our safety goal is zero injuries - "missionZero".

AusNet Services is committed to enabling people delivering services to our customers and communities to work safely and with excellence, by:

- Displaying health, safety, environment and quality leadership and commitment at all levels.
- Recognising that people, their attitudes and beliefs are central to health and safety in the workplace and to complying with environmental obligations.
- Training and inducting our workforce, so our people can actively take part in the safe planning and performance of work.
- Ensuring that an effective health, safety and environment risk management framework is in place, including a focus on the management of critical risks to protect our people, environment, assets and community.
- Continuously improving our management system, setting clear objectives and monitoring performance.
- Effectively communicating with our people.
- Engaging, supporting and challenging our delivery partners and others in the supply chain to align their standards of safety, quality and environment management and performance.
- Continually innovating to improve health, safety and environment outcomes.
- Accurately recording, reporting and investigating workplace incidents for health, safety and environment.
- Complying with relevant legislative, regulatory, corporate and other requirements.
- Monitoring, reviewing and evaluating our health, safety, environment and quality systems, compliance and performance including through regular audit programs.

Effective health, safety, environment and quality leadership means having clear expectations of behaviour and care that are never compromised.

Peter Mason
Board Chairman

Tony Narvaez
Managing Director

19th May 2020

missionZero

Appendix B Asset Management Policy

Asset Management Policy

AusNet services

Connecting communities with energy and accelerate a sustainable energy future

This policy directs the content and implementation of asset management strategies, objectives and plans for AusNet Services' energy delivery networks. It provides employees, contractors, suppliers and delegates with guiding principles to underpin asset management decisions.

Our approach to Asset Management is centred on enabling our Ausnet Services' purpose of *connecting communities with energy and accelerate a sustainable future* and our strategic priorities of *customer passion; energised people; operational excellence, accelerate growth.*

To achieve this, we will:

- Minimise risks to the safety of any person and their property "as far as practicable".
- Place customers at the centre of our decisions to support their evolving needs and the changing energy landscape.
- Engage with our customers and stakeholders to understand and integrate their requirements in asset management decisions.
- Comply with legislation, regulation, relevant Standards and industry codes and actively contribute to the development of amendments that will benefit our customers and stakeholders.
- Use a risk-based approach to manage the energy networks and balance the environmental, economic, and social needs of today without sacrificing the interests of future generations.
- Use innovation, information and technology to facilitate a sustainable whole of life cycle approach to asset management to deliver value to our customers, communities and partners.
- Continually develop the skills of our people to ensure asset management activities are performed efficiently and effectively.
- Align and continuously improve our asset management processes and capabilities using Agile processes to embed cost, risk performance, compliance & quality in our work.

Tony Narvaez
Managing Director
6 December 2022

We work safely | We do what's right | We're one team | We deliver

Appendix C Risk Management Policy

Risk Management Policy Statement

AusNet services

AusNet Services is committed to understanding and managing risk

The effective management of risk is central to the continued growth and success of AusNet Services. By understanding and managing risk, we can provide greater certainty for our shareholders, employees, customers and suppliers and the communities in which we operate. Being well informed and decisive, we have increased confidence to move to achieve our purpose of empowering communities and their energy future.

By understanding and responding to the sources of uncertainty for our strategic objectives, we ensure our existing business becomes more resilient so that we can lead network transformation and embrace change. Effective risk management will also help us become more agile and responsive, to support the growth of Mondo. Importantly effective risk management will generate trust and respect from our key stakeholders and customers, by encouraging a culture capable of driving efficiency and effectiveness in all of our business activities.

Throughout the company we adopt a structured and consistent process for recognising, understanding and responding to risk. All employees are responsible for the management of risk in accordance with the Risk Management Policy and Risk Appetite Statement. This responsibility includes ensuring that emerging conditions and key controls are identified and monitored so that any early warning of failure leads to pre-emptive action.

We operate under one framework that enables the management of risk to become fully integrated into all our critical systems and processes for making decisions. This enables us to challenge assumptions and preconceptions before decisions are made and then take appropriate actions to reduce uncertainty that our objectives will be achieved. All Divisions will be responsible for developing and implementing their plans for this integration, based on their strategic and operational needs.

Information about risks and their treatments will be documented in the Risk Management Information System and kept up to date through regular review. Tools, training and guidance are available to support consistent risk management activities.

We identify and prepare response and recovery plans for potential disruptive events that may seriously threaten our business. After events and incidents occur, we use systematic processes to learn about our successes and failures. In this way, we drive continuous improvement in the way we manage risk.

Good corporate governance will be assured through the regular measurement and reporting of our risk management performance to the Group Risk Committee, the Audit and Risk Committee and the Board.

We will commit the necessary resources to ensure that this policy is satisfied.

Tony Narvaez
Managing Director

Appendix D Network Assets

#	ASSET TYPE	DESCRIPTION	NUMBER
1	Connection Points	Terminal Stations (66kV Connection Point)	11
2	Connection Points	Terminal Stations (22kV Connection Point)	2
3	Connection Points	Terminal Stations (11kV Connection Point)	1
4	Connection Points	Zone Substations (66/22kV)	57
5	Connection Points	Substations (22/6.6kV)	3
6	Connection Points	Zone Substations (Single Customer)	9
7	Connection Points	Switching Station	1
8	Transformers	Zone Substations Transformers	140
9	Transformers	Distribution Transformers (Pole Mounted)[6]	57,398
10	Transformers	Distribution Transformers (Kiosk, Ground Outdoor or Indoor Chamber Mounted)	5,432
11	Circuit Breakers	High Voltage (>22kV)	188
12	Circuit Breakers	Medium Voltage (≤22kV)	2,585
13	Feeders	Number of 22kV feeders	348
14	Feeders	Number of 11kV feeders	2
15	Feeders	Number of 6.6kV feeders	10
16	Conductors	Overhead (Low Voltage <1kV) (km)	6,590
17	Conductors	Overhead (SWER) (km)	6,418
18	Conductors	Overhead (Medium Voltage 11 and 22kV) (km)	22,542
19	Conductors	Overhead (High Voltage 66kV) (km)	2,485
20	Conductors	Underground (Low Voltage <1kV) (km)	5,302
21	Conductors	Underground (Medium Voltage 11 and 22kV) (km)	2,625
22	Conductors	Underground (High Voltage 66kV) (km)	13
23	Conductors	Service Lines (number of services)	196,592
24	Poles	Wood Poles	202,236
25	Poles	Concrete Poles	129,882
26	Poles	Steel Poles (excluding public lighting poles)	386
27	Poles	Public Lighting Poles[7]	99,277
28	Poles	Crossarms[9]	404,973
29	Communications	Optical fibre Cable (OPGW, ADSS, Underground)	678
30	Communications	Point to point radio (ZSS)	22
31	Communications	Point to point radio links – AMI	8
32	Communications	WiMAX base stations	20
33	Communications	TRIO base stations	32
34	Communications	Network Technologies (PDH, SDH, WDM and TPS)	235
35	Communications	Routers, Switches and Serial servers	183
36	Communications	Telephone exchanges	9

Appendix E Connection Points

Abbreviation	Terminal Station	Supply Voltage (kV)
ERTS	East Rowville	66
GNTS	Glenrowan	66
MBTS	Mt Beauty	66
MWTS 66	Morwell 66kV	66
RWTS 22	Ringwood 22kV	22
RWTS 66	Ringwood 66kV	66
SMTS	South Morang	66
TSTS	Templestowe	66
TTS	Thomastown	66
WOTS 66	Wodonga 66kV	66
WOTS 22	Wodonga 22kV	22
YPS	Yallourn	66
LY	Loy Yang 66kV	66

Appendix F Zone Substations

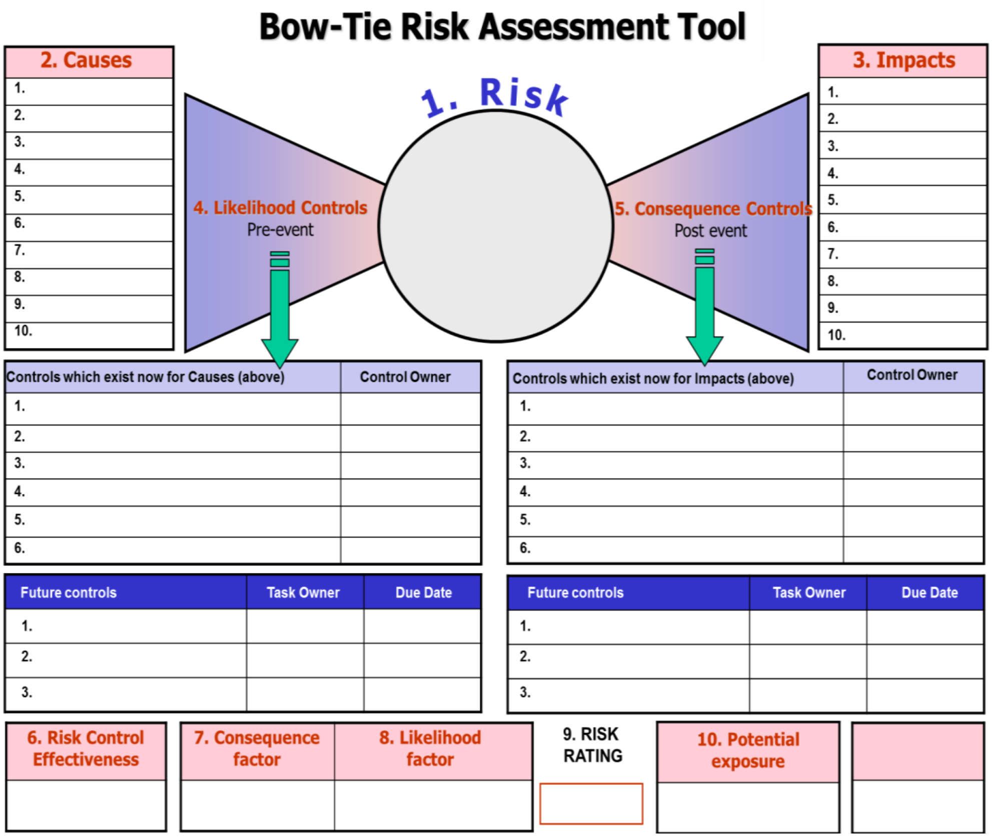
Abbreviation	Zone Substation	Comments
APM	Australian Paper Marysville	66kV assets in customer substation
BDL	Bairnsdale	66/22kV zone substation
BDSS	Bairnsdale Switching Station	66kV switching station
BGE	Belgrave	66/22kV zone substation
BN	Benalla	66/22kV zone substation
BRA	Boronia	66/22kV zone substation
BRT	Bright	66/22kV zone substation
BWA	Barnawartha	66/22kV zone substation
BWN	Berwick North	66/22kV zone substation
BWR	Bayswater	66/22kV zone substation
CF	Clover Flat	66/22kV zone substation
CLPS	Clover Power Station	66/11kV for Clover Power Station only
CNR	Cann River	66/22kV zone substation
CLN	Clyde North	66/22kV zone substation
CYN	Croydon	66/22kV zone substation
DRN	Doreen	66/22kV zone substation
ELM	Eltham	66/22kV zone substation
EPG	Epping	66/22kV zone substation
FGY	Ferntree Gully	66/22kV zone substation
FTR	Foster	66/22kV zone substation
HPK	Hampton Park	66/22kV zone substation
KLK	Kinglake	66/22kV zone substation
KLO	Kalkallo	66/22kV zone substation
KMS	Kilmore South	66/22kV zone substation
LDL	Lilydale	66/22kV zone substation
LGA	Leongatha	66/22kV zone substation
LLG	Lang Lang	66/22kV zone substation
LYD	Lysterfield	66/22kV zone substation

Abbreviation	Zone Substation	Comments
LYS	Loy Yang South	66/22kV mine substation
MBY	Mount Beauty	66/22kV zone substation
MDG	Mt Dandenong	22/6.6kV substation
MDI	Murrindindi	66/22kV zone substation
MFA	Maffra	66/22kV zone substation
MJG	Merrijig	66/22kV zone substation
MOE	Moe	66/22kV zone substation
MSD	Mansfield	66/22kV zone substation
MWE	Morwell East	11/6.6kV mine substation
MWN	Morwell North	66/6.6kV mine substation
MWW	Morwell West	66/6.6kV mine substation
MYT	Myrtleford	66/22kV zone substation
NLA	Newmerella	66/22kV zone substation
NRN	Narre Warren North	66/22kV zone substation
OFR	Officer	66/22kV zone substation
PHI	Phillip Island	66/22kV zone substation
PHM	Pakenham	66/22kV zone substation
RMFN	Maffra line voltage regulator	66kV line voltage regulators
RSMR	Seymour east line voltage regulator	66kV line voltage regulator
RWN	Ringwood North	66/22kV zone substation
RubA	Rubicon A	66/22kV zone substation
SFS	Sassafras	22/6.6kV step down substation
SLE	Sale	66/22kV zone substation
SMR	Seymour	66/22kV zone substation
TGN	Traralgon	66/22kV zone substation
TWF	Toora Wind Farm	66kV line entry in wind farm switchyard
TT	Thomastown	66/22kV zone substation
UWY	Upwey	22/6.6kV substation
WGI	Wonthaggi	66/22kV zone substation

Abbreviation	Zone Substation	Comments
WGL	Warragul	66/22kV zone substation
WN	Wangaratta	66/22kV zone substation
WO	Wodonga	66/22kV zone substation
WT	Watsonia	66/22kV zone substation
WYK	Woori Yallock	66/22kV zone substation
YC	Yallourn Central	11/6.6kV mine substation - out of service
YN	Yallourn North	11/6.6kV mine substation
YPS	Yallourn Power Station	220/11kV substation
YPS GS	YPS General Service	66/11kV zone substation

Appendix G Risk Assessment Templates

The following templates are used to achieve consistency in approach and detail.



Risk Register Template

Scope:

Risk Assessment Team: **Facilitator:** ____________ **Date:** ____________

RISK IDENTIFICATION			RISK TREATMENT			RISK ANALYSIS					
						Residual Risk			Target Risk		
Risk	Causes	Impacts	Controls (Current)	RCE	Treatment Actions (Future)	Conseq Rating	Like. Rating	Residual Risk Rating	Conseq Rating	Like. Rating	Target Risk Rating

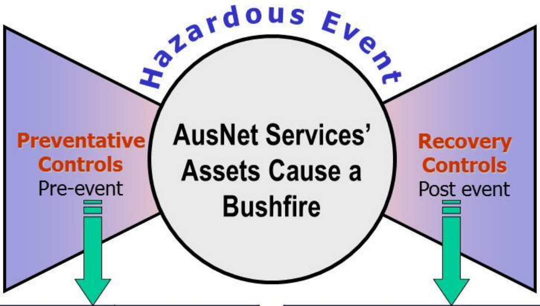
Appendix H Assessment of Key Network Safety Related Risks

The three risks, whose assessments are summarised below, are those identified as being the most significant network safety related risks. The assessments for each of these risks are shown in both the bow-tie template format and as risk record reports from the Risk Management Information System (Enablon).

AusNet's Assets Cause A Bushfire

Bow-Tie Risk Assessment Tool

Causes
Asset failure or deterioration
Vegetation contact with assets
Bird/animal contact with assets
Third party damage to assets
Environmental factors (e.g. lightning)
Faults on network
Human error incidents
Clashing conductors



Consequences
Injury/death to public/employee
Loss of supply to customers
Property damage
Environmental Damage
Community outrage/Reputational damage
Financial impact
Litigation
Business distraction

Controls which exist now for Causes (above)	Control Owner
Asset management strategies and plans, including ENSS	Specified for each control
Network Safety Management Committee	Specified for each control
Bushfire mitigation and veg management plans and programs	Specified for each control
Targeted replacement programs– Codified Areas programs	Specified for each control
Condition monitoring, testing, inspection and maintenance	Specified for each control
Asset Performance monitoring and auditing	Specified for each control
Standards for network planning, design, construction, operation and maintenance	Specified for each control

Controls which exist now for Consequences (above)	Control Owner
Electrical protection systems	Specified for each control
Implementation of PBST programs (e.g. REFCLs)	Specified for each control
Response by emergency services	Specified for each control
AusNet Services emergency response plan (SPIRACS)	Specified for each control
Bushfire preparedness programs	Specified for each control
Building standards (increase fire resistance)	Specified for each control
Insurance coverage	Specified for each control

Future controls	Task Owner	Due Date
Implementation of BBST programs	Specified for each task	Specified for each task
Implementation of 'Codified' areas	Specified for each task	Specified for each task
Bare overhead replacement program	Specified for each task	Specified for each task

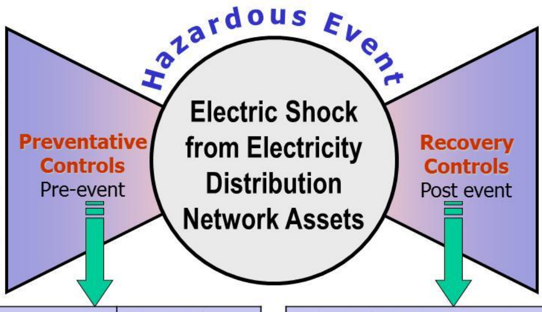
Future controls	Task Owner	Due Date
Enhanced awareness of network by Emergency Services	Specified for each task	Specified for each task

Risk Control Effectiveness	Consequence Factor	Likelihood Factor	RISK RATING	Potential Exposure	Risk Owner
Highly Effective	5	Unlikely	B	$ (estimated for each risk)	Specified for each risk

Electric Shocks from Electricity Distribution Network Assets

Bow-Tie Risk Assessment Tool

Causes
Asset failure or deterioration
Failure of service neutral
Contact with 'live' vegetation
Inadvertent contact with assets
Vehicle/machine contact with assets
Environmental factors (e.g. lightning)
Faults on network
Human error incidents



Consequences
Injury/death to public/employees
Loss of supply to customers
Damage to network assets
Fire
Community outrage/reputational damage
Financial impact
Litigation
Business distractions

Controls which exist now for Causes (above)	Control Owner
Asset management strategies and plans, including ENSS	Specified for each control
Network Safety Management Committee	Specified for each control
Vegetation management plans and programs	Specified for each control
Design and construction standards	Specified for each control
Targeted replacement programs	Specified for each control
Condition monitoring, testing, inspection and maintenance	Specified for each control
Neutral integrity monitoring through AMI data	Specified for each control
Community awareness programs	Specified for each control

Future controls	Task Owner	Due Date
Further analysis of information from AMI meters	Specified for each task	Specified for each task

Controls which exist now for Consequences (above)	Control Owner
Electrical protection systems	Specified for each control
Life support response, i.e. CPR, defibrillators, ambulance	Specified for each control
Service installation standards (earthing and bonding)	Specified for each control
	Specified for each control
	Specified for each control
	Specified for each control
	Specified for each control

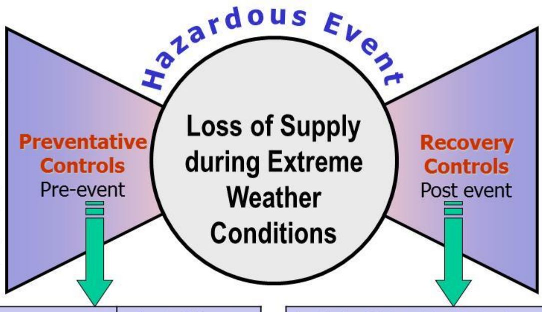
Future controls	Task Owner	Due Date
Enhanced awareness of network by Emergency Services	Specified for each task	Specified for each task

Risk Control Effectiveness	Consequence Factor	Likelihood Factor	RISK RATING	Potential Exposure	Risk Owner
Substantially Effective	3	Likely	B	$ (estimated for each risk)	Specified for each risk

Loss of Supply during Extreme Weather Conditions

Bow-Tie Risk Assessment Tool

Causes
Planned outage of network elements
Forced outage due to:
* Vegetation contact
* Bird/animal contact
* Third party damage
* Environmental factors (e.g. lightning)
* Faults on network
* Asset failure
Human error incident



Consequences
Injury/death to public/employees
Loss of supply to customers
Community outrage/reputational damage
Financial impact
Business distractions

Controls which exist now for Causes (above)	Control Owner
Distribution Annual Planning Report	Specified for each control
Network configuration	Specified for each control
Asset management strategies and plans, including ENSS	Specified for each control
Vegetation management plan and programs	Specified for each control
Standards for network planning, design, construction, operation and maintenance	Specified for each control
Condition monitoring, inspection and maintenance and asset replacement programs	Specified for each control
Restrictions on planned work during extreme weather conditions	Specified for each control

Future controls	Task Owner	Due Date
Improved awareness programs for public	Specified for each task	Specified for each task

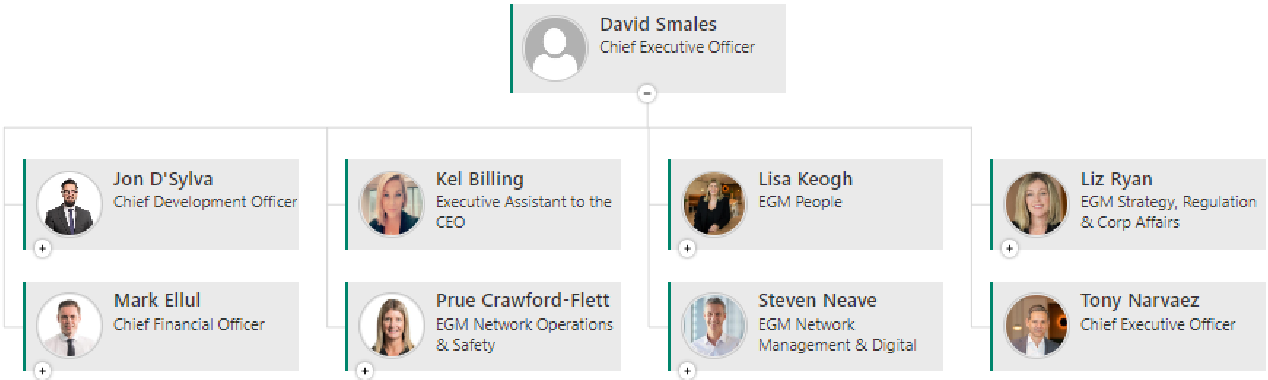
Controls which exist now for Consequences (above)	Control Owner
Fault and emergency procedures, including service support arrangement during high activity events	Specified for each control
Electrical protection systems, including DFA	Specified for each control
Load shedding protocols	Specified for each control
Backup generators to support network	Specified for each control
Temporary relocation of vulnerable member of the public	Specified for each control
Emergency services register and support of vulnerable people	Specified for each control
Coordination with emergency management centres during events	Specified for each control

Future controls	Task Owner	Due Date

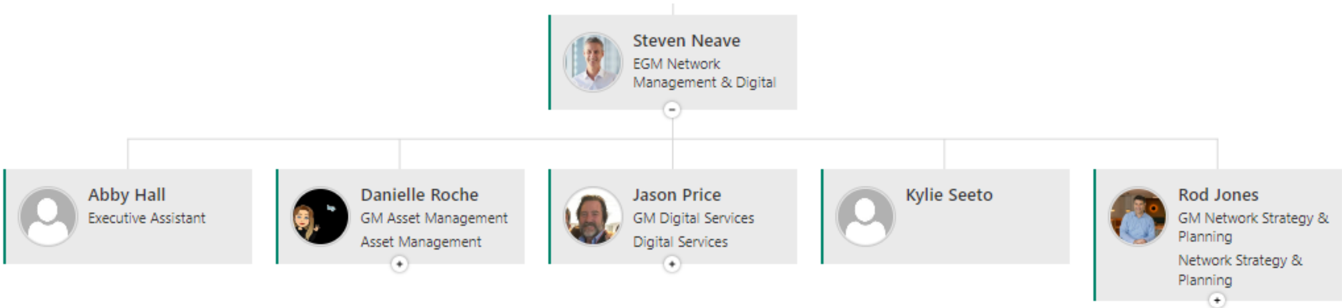
Risk Control Effectiveness	Consequence Factor	Likelihood Factor	RISK RATING	Potential Exposure	Risk Owner
Substantially Effective	3	Likely	B	$ (estimated for each risk)	Specified for each risk

Appendix I Management Structure

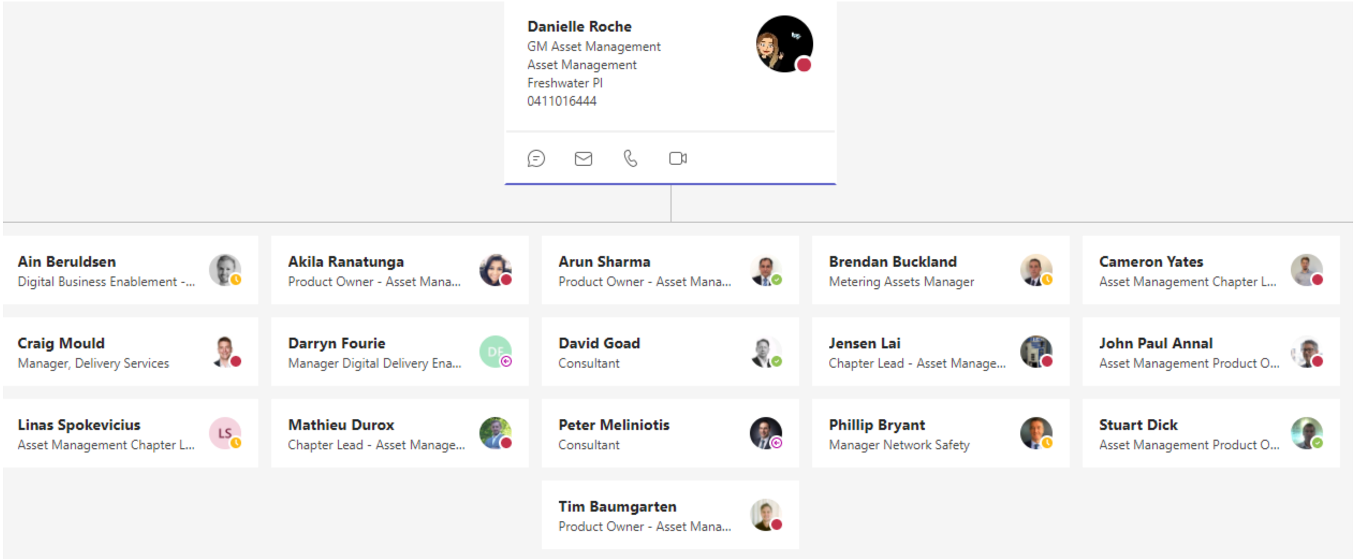
AusNet Executive Leadership Team



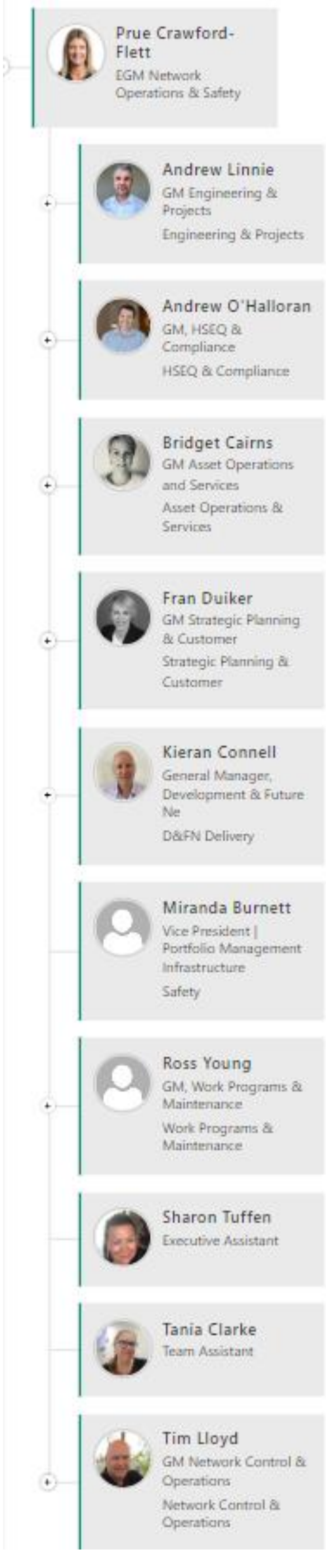
Network Management & Digital General Management Team



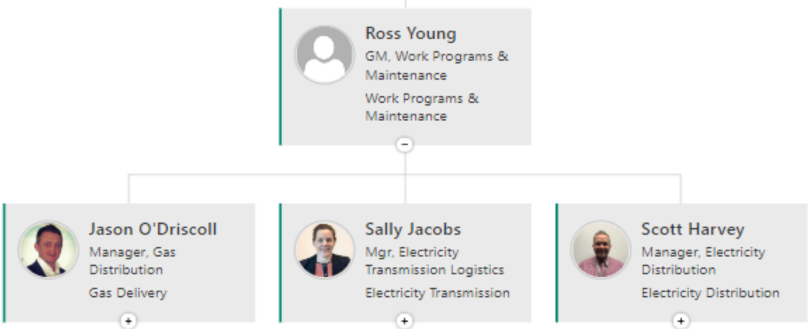
Regulatory and Network Strategy Team, Including Manager Network Safety



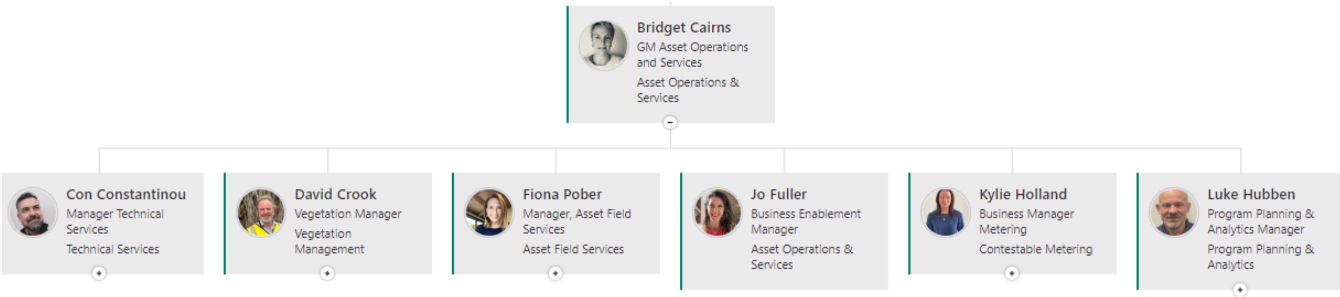
Operations and Safety General Management Team



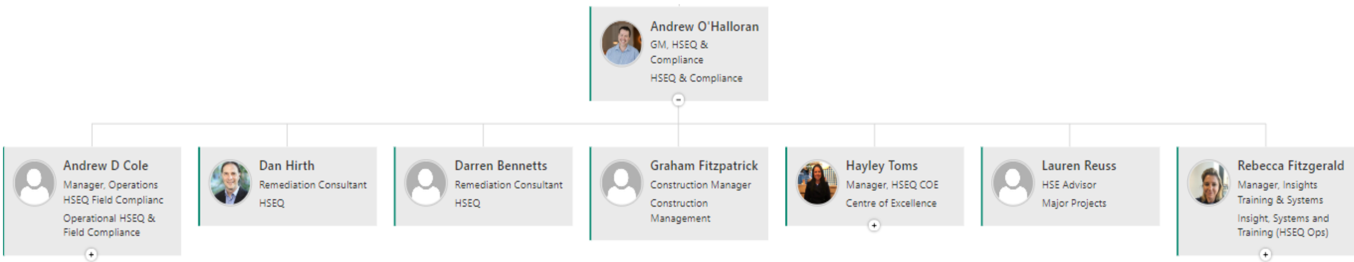
Work Programs & Maintenance Team



Asset Operations & Services Team



HSEQ Team



Appendix J Published Technical Standards

There are a large number of published national and international technical standards that are used by AusNet in the life cycle management of network assets. These standards are identified in AMS 20-36 Technical Standards.

In general terms, AusNet complies with the main requirements of all standards identified in this strategy.

For two of the main published technical standards used there are reviews associated with some parts that have either been completed or are underway, as discussed below.

AS 2067 - 2016

Earthing systems

With respect to Clause 8 Earthing systems in AS 2067, a review of design principles, approach and precautions is underway. This review is due for completion by the end of March 2019.

AusNet is confident that the outcome from this review will result in no diminishment in the level of network safety.

Protection against fire and explosion

The clearances used by AusNet are based upon performance based analysis using fire engineering studies and associated risk assessment. These risk assessed clearances are used for all new designs.

Protection against leakage of insulating oils and SF_6

For larger oil containing equipment, such as voltage regulators, AusNet determines the requirement oil containment based upon a risk assessment of the standard design.

AS/NZS 7000 - 2016

Structural design

With respect to clauses related to 'Structural Design', AusNet is currently transitioning to the AS/NZS 7000 line design methodology, but at present is still using the 'Working Stress' design methodology.

A comparison study has been completed and documented as a draft VESI document entitled "Victorian Distribution Networks Overhead Line Design – Stage 3 – Comparison of Working Stress Method to Limit State Method and Resulting Network Parameters". This comparison exercise has identified that the existing design methodology is more conservative than the AS/NZS 7000 equivalent design methodology, with very minor exceptions.

These minor exceptions relate to very long spans, which are currently rarely used in new designs. AusNet's design manual will be updated by the end of December 2018 to explicitly state a maximum span length to ensure compliance.

Overall it can be concluded that the 'Working Stress' design methodology currently used by AusNet is at least equivalent to the 'Limit State' methodology in terms of network safety outcomes.

Earthing system

With respect to the clause 'Earthing System' in AS/NZS 7000, a comparison of the current practice of using the established VESI and historical regulations with the earthing methodology specified in AS/NZS 7000 is underway. This review is due for completion at the end of March 2019. AusNet is confident that the outcome from this review will result in no diminishment in the level of network safety.

Appendix K Industry/Company Technical Standards

Section 3 in AMS 20-36 identifies the industry/company technical standards used by AusNet in the life cycle management of network assets.

Appendix L Acts, Regulations and Codes

The key Acts, Regulations and Codes that are applicable to the life cycle management of network assets are:

- Electricity Safety Act 1998
- Electricity Industry Act 2000 (Victoria)
- Essential Services Commission Act 2001 (Victoria)
- Occupational Health and Safety Act 2004
- Electricity Safety (Management) Regulations 2019
- Electricity Safety (Bushfire Mitigation) Regulations 2023
- Electricity Safety (Electric Line Clearance) Regulations 2020
- Electricity Safety (Installations) Regulations 2009
- Occupational Health and Safety Regulations 2009
- National Electricity Rules 2015
- Electricity System Code 2000
- Electricity Customer Metering Code 2011
- Electricity Distribution Code 2012
- Public Lighting Code 2005
- Code of Practice of Electrical Safety for Work on or Near High Voltage Electrical Apparatus (The Blue Book) 2017

Appendix M Compliance with AS 5577

The table below summarises the various sections of the ESMS that address the requirements of AS 5577.

Requirement in AS 5577				ESMS References
Section			**Requirement**	
4.2 Policy and Commitment			Define policy and commitment towards the various aspects of operating the network safely	Section 3.4
4.3 Planning	4.3.1 General		Have appropriate planning processes and procedures for ensuring network safety in any situations that may result from normal and foreseeable abnormal operations including emergencies	Sections 11.3.2, 11.3.12
	4.3.2 Planning for safe operation		Complete a formal safety assessment in compliance with ISO 31000	Sections 8, 9, 10
	4.3.3 Planning and preparation for abnormal operations		Plan and prepare for operation of the network in foreseeable abnormal circumstances or during significant disruption to normal operations	Section 11.3.12
	4.3.4 Standards and codes	4.3.4.1 Published national or international technical standards	Identify the published national or international technical standards used in the life cycle management of network assets. Document areas of non-compliance with standards and alternative arrangements used that do not compromise safety	Sections 11.3.5, 11.3.6 and Appendix J
		4.3.4.2 Industry/company codes	Identify the industry or company codes used in the life cycle management of network assets. Document areas of non-compliance with codes and alternative arrangements used that do not compromise safety	Sections 11.3.5 and 11.3.6 and Appendix K and Appendix L
4.4 Implementation	4.4.1 General		Define how the ESMS will be implemented	Section 11
	4.4.2 Resourcing		Identify the resourcing, equipment and material requirements to manage the network	Sections 6.5.4, 6.6.3, 11.3.1, 11.3.16
	4.4.3 Management structure		Define the management structure of the network operator to identify key positions and/or personnel	Sections 11.3.3 and 11.3.4 and Appendix I

Requirement in AS 5577				ESMS References
Section			Requirement	
	4.4.4 Responsibilities, accountabilities and authorities		Detail the responsibilities, accountabilities and authority levels of personnel with respect to the various aspects of the life cycle management of network assets	Sections 11.3.4 and 11.3.16 and Appendix I
	4.4.5 Training and competency		Ensure that all persons involved in the various stages of the life cycle management of network assets are suitably competent and adequately trained	Sections 6.6.4, 6.6.5
	4.4.6 Consultation, communication and reporting.	4.4.6.1 Consultation	Identify stakeholders having a relevant interest in the safety aspects of the lifecycle management of network assets	Sections 1, 11.3.11
		4.4.6.2 Communication and Reporting	Establish procedures for regular consultation and communication with and reporting to relevant stakeholders regarding network safety performance	Section 11.3.16
	4.4.7 Emergency preparedness and response.		Plan and prepare for emergency events resulting from the network's operation and maintenance and also from external events that may affect the safe operation of the network	Section 11.3.12
4.5 Measurement and Evaluation	4.5.1 Monitoring and measurement	4.5.1.1 General	ESMS shall incorporate procedures for measurement and evaluation of the performance of the ESMS elements	Sections 7, 11.3.15
		4.5.1.2 Data acquisition and analysis	Establish procedures for identifying, recording and analysing network operational, maintenance and reliability data to identify trends	Sections 11.3.16, 12.3
	4.5.2 Incident investigation and corrective and preventive action	4.5.2.1 Accident/incident investigation and reporting	Establish procedures for identifying, notifying, recording, investigating and reporting accidents and incidents	Section 11.3.13, 12.3
		4.5.2.2 Corrective and preventative action	Develop and implement procedures for determining, approving and implementing corrective and preventative actions	Sections 11.3.13, 11.3.15

Requirement in AS 5577				ESMS References
Section			Requirement	
	4.5.3 Records		Implement relevant records management arrangements in relation to life cycle management of network assets	Section 11.3.14
	4.5.4 System audits		Plan and implement audits to determine compliance with and effectiveness of the ESMS's plans and procedures	Section 11.3.15
4.6 Management Review and Change Management	4.6.1 Management review		Regular management review of effectiveness and appropriateness of ESMS	Section 11.3.16
	4.6.2 Change management		Establish procedures for managing changes to the ESMS and various stages of the life cycle management of network assets	Section 13
Appendix A Formal Safety Assessment	A1 General		A normative section that explains the requirement for a formal safety assessment in compliance with ISO 31000.	Sections 8, 9, 10
	A2 Establishing the Context		Establish the context for the FSA, including preconditions and the external and internal circumstances affecting the network.	Section 6
	A3 Risk Assessment	A3.1 Risk Identification	The FSA shall identify electricity network hazards that could cause an electricity safety related incident, including loss of supply, work on or near assets, failure modes, design and operating environment of network assets, external hazards and natural disasters and intentional and unintentional human activities	Section 8
		A3.2 Risk Analysis	The FSA shall analyse the risks associated with all identified hazards, and shall regard relevant electricity industry data and evidence. The analysis shall include determining the consequences and likelihood of the identified risks occurring and an estimation of the residual risks.	Section 9.1.3

Requirement in AS 5577			**ESMS References**
Section		**Requirement**	
	A4 Risk Treatment	Apply risk control measures in accordance with the standard hierarchy of controls. Controls are considered effective when the residual risks have been reduced to ALARP.	Section 10
	A5 Risk Evaluation	Evaluate the risks against the risk acceptance criteria and apply controls until an acceptable risk level is achieved.	Sections 9.1.4, 10
Appendix B As Low as Reasonably Practicable (ALARP)		An informative section that explains the concept of ALARP.	Section 10.4.2for explanation of ALARP and SFAIRP. Sections 3.5, 3.7 and 10.4.1 explain the concept of "as far as practicable"
Appendix C Description of Network		An informative section that requires a description of the network, including the resources required to manage it.	Sections 5, 6.6.3

Appendix N Compliance with Electricity Safety Act

The table below summarises the various sections of the ESMS that address the relevant requirements of the Electricity Safety Act 1998.

Relevant Requirements of Electricity Safety Act			ESMS References
Part	**Division**	**Requirement**	
Part 8 – Bushfire mitigation requirements for certain operators and electric line clearance	Division 2 – Responsibility for maintenance of lines Subdivision 1 – Persons responsible for maintaining lines	84 Requirements to keep trees clear of electric lines – distribution companies	Sections 5.5.2, 10.2.1, 12.6.2
Part 10 – Electricity Safety Management	Division 1 - General duty of major electricity companies	98 General duty of major electricity companies	Sections 3.5, 3.6, 8, 9, 10 (especially 10.4)
	Division 2 – Mandatory electricity safety management schemes (major electricity companies)	99 Electricity safety management scheme	Sections 3.5, 3.6, 11, 10.2.1, 12.6.1
		106 Compliance with electricity safety management scheme	Sections 10.3, 10.4, 10.5, 11.3.15
		107 Revision of electricity safety management scheme - change	Section 13.2
	Division 2A – Ongoing bushfire mitigation requirements for major electricity companies	113A Submission of bushfire mitigation plans for acceptance	Sections 10.2.1, 12.6.1
		113B Compliance with bushfire mitigation plan	Section 7.1, 8.2.4, 12.6.1
		113F Inspection of overhead private electric lines	Section 5.5.2
Part 12 - General	Division 2 – Reporting of serious electrical incidents	142 Notification of serious electrical incidents	Section 11.3.13

Appendix O Compliance with Electricity Safety (Management) Regulations

The table below summarises the various sections of the ESMS that address the relevant requirements of the Electricity Safety (Management) Regulations 2019.

Relevant Requirements of Electricity Safety (Management) Regulations			ESMS References
Part	**Division**	**Regulation**	
Part 2 – Safety Management Schemes	Division 1 – Content of electricity safety management scheme	Regulation 7 – Person responsible for supply network or installation, or carrying out of electrical work	Responsibility Section on page 3
		Regulation 8 – Person responsible for electricity safety management scheme	Responsibility Section on page 3
		Regulation 11 – Scheme description – major electricity companies and asset operators	Sections 5, 8, 9, 10, 11
	Division 3 – Content of safety management system –major electricity companies	Regulation 26 – Safety Management System - MEC	Appendix M
Part 3 – Records and reporting		Regulation 27 – Records	Section 11.3.14
		Regulation 28 –requirements for reporting of serious electrical incidents by MEC	Section 11.3.13
		Regulation 29 –reporting of other serious electrical incidents by MEC	Section 11.3.13

Appendix P Capex Program Change Control

An assessment of the resultant change in risk from a proposed change to a Capex program is made by completing the change control request template shown below. This includes an assessment of the impacts (consequences) of the proposed change, including in the areas of safety, customer and overall risk.

Change Impact Analysis for Portfolio (commentary mandatory from Business Owner including substitution information)

<Explain the impact of change to the Portfolio including any changed to the expected benefits to the Portfolio>

Assessment	Business Impact	Scope Impact	Deliverable Impact	Schedule/ Time Impact	Resource Impact	Budget/Cost Impact	Commercial Impact	Regulatory Impact	Safety Impact	Customer (external) Impact	Expected Benefits Impact	Risks	Other
Score (select from a drop-down list)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	<Add comments>
Definitions													
Extreme	Impacts ALL AusNet Services business areas	Impacts PORTFOLIO and MORE than TWO other projects Scope	Impacts PROGRAM deliverables AND adds new/delete planned deliverables	Impacts schedule and/or Agreed in Service dates by more than THREE MONTHS.	Change of planned resources and will impact RELATED PROJECTS.	Impacts PORTFOLIO funding/Total costs (Approved Budget expenditure incl. Management Reserve)	Impacts ALL contract/ vendor commercial arrangements	Impacts regulatory requirements	Impacts Safety and Mission Zero objectives	Impacts ALL customer(s)s	Impacts PORTFOLIO benefits	Impacts and increases current PORTFOLIO risk assessment and introduces NEW risks	
High	Impacts MOST AusNet Services business areas	Impacts the Project and another project	Impacts PROJECTS deliverables MAY add or remove planned deliverables.	Impacts PROJECT schedule and Agreed In Service dates by MORE than ONE MONTH but LESS then THREE MONTHS.	Change in planned PROJECT resources and additional resources required.	Impacts PROJECT Approved funding (Budget incl. Management Reserve)	Impacts TWO OR MORE contract/vendor commercial arrangements	SOME IMPACT t to regulatory requirements	Impacts to safety requirements	Impacts MOST customer(s)s and REQUIRES MITIGATION	Impacts ALL PROJECT benefits as outlined in Business Case(s)	Impacts PROJECT and other RELATED PROJECT risk assessments and has NEW risks	
Medium	Impacts TWO AusNet Services business areas	Increases or Decreases Projects Scope.	Impacts PROJECTs planned deliverables	Impacts PROJECT schedule LESS than ONE month.	Some change in PROJECT resources MAY be required	Impacts PROJECT Approved funding (within Budget excl. Management Reserve)	Impacts ONE or TWO contract/vendor commercial arrangements	MAY IMPACT regulatory requirements	Some impact to safety requirements but CAN BE MANAGED	Impacts SOME customer(s) but CAN BE MANAGED	Impacts ONE or TWO benefits outlined in Business Case	Impacts current PROJECT risk assessment and MAY have new risks	
Low	Impacts ONE AusNet Services business area	NO Impact to Project Scope	Impacts SOME deliverables but NO change in no. of planned deliverables	Impacts PROJECT schedule LESS THAN ONE week.	NO change in PROJECT resources required	NO change in PROJECT funding required	NO impact to commercial arrangements	NO IMPACT to regulatory requirements	NO impact to safety requirements	Impacts NO customer(s)	NO Impact to benefits in Business Case	NO impact to current PROJECT risk assessment AND no new risks	