Enhanced Network Safety Strategy

AMS – Electricity Distribution Network

PUBLIC

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1 EXECUTIVE SUMMARY

The purpose of the Enhanced Network Safety Strategy is to provide a consolidated view of the outputs of the Electricity Safety Management Scheme (ESMS), the Asset Management Strategy (AMS), the Bushfire Mitigation Management program and the Health, Safety, Environment and Quality (HSEQ) Management System view with regards to network safety.

The programs described in this document are designed to provide incremental improvements to network safety. These programs complement the business as usual work programs that identify asset replacements through the condition based cyclic inspection of overhead line assets and asset condition assessments for zone substation primary and secondary assets which are designed to maintain network safety.

An aspiration of the Asset Management Strategy (AMS) is to reduce serious incidents by 20% through successive regulatory review periods.

Analysis of network performance and incident data has identified a number of proactive replacement programs as the most effective and cost efficient means of enhancing community and business health and safety outcomes against key operating environment risk drivers of climate change and increasing age of assets.

Figure 1 provides a summary of the enhanced network safety programs

Table 1: Enhanced Network Safety Programs

Enhanced Network Safety Program	Description
Service Cables	• Condition driven program (based on AMI data) • Volumes estimated on historical replacement rates
EDO fuse targeted replacement	• Targeted risk-based replacement program • Approximately 1,750 fuses per year
Overhead Conductor	• Targeted risk-based replacement program • Approximately 290km per year
Codified Areas SWER	• Insulating and undergrounding approximately 100km of SWER line in Codified Areas. Project contingent on funding approval in 2022-26 EDPR.
Vibration Dampers and Armour Rods	• Approximately 11,022 sites remaining due for completion in FY2020
Conductor Spacers and Circuit Clearances	• Program has been completed
Government Funded Conductor Replacement	• Refer to BFM 10-01 Bushfire Mitigation Plan
Crossarms	• Targeted risk-based replacement program • Approximately 4,135 crossarms per year
Bird and Animal Proofing	• Reactive program • Volumes estimated on historical replacement rates
Installation of REFCLs	• As per REFCL program
Vegetation Management – Hazard Trees	• Based on inspections • 5,000 trees per year

Enhanced Network Safety Strategy

Enhanced Network Safety Program	Description
Vegetation Management – Overhangs	• Program completed • Managed as business as usual going forward
No Go Zones	• Continued support of public awareness programs
Overhead Conductor Ground Clearance	• Reactive program • Forecast based on historical expenditure
Asbestos	• Addressed as part of planned zone substation refurbishment projects
Lattice Towers – Fall arrest systems	• Ongoing program • 18 towers per year
Explosive Failure	• Asset replacement programs informed by risk models

2 INTRODUCTION

2.1 Purpose

The purpose of this document is to provide a consolidated overview of the programs that deliver enhanced network safety to the public and employees.

2.2 Scope

This document describes the key programs designed to *improve* network safety outcomes and to mitigate key safety risks *as far as practicable*.

Network safety results from many elements of asset management including standards, design, operation, construction and maintenance. This document is not intended to describe how safety is incorporated into each asset management element in business as usual maintenance of safety outcomes.

2.3 Asset Management Objectives

As stated in *AMS 01-01 Asset Management System Overview*, the high-level asset management objectives are:

- Comply with legal and contractual obligations;
- Maintain safety;
- Be future ready;
- Maintain network performance at the lowest sustainable cost; and
- Meet customer needs.

As stated in *AMS 20-01 Electricity Distribution Network Asset Management Strategy*, the electricity distribution network objectives are:

- Improve efficiency of network investments
- Maintain long-term network reliability
- Implement REFCLs within prescribed timeframes
- Reduce risks in highest bushfire risk areas
- Achieve top quartile operational efficiency
- Prepare for changing network usage.

2.4 Asset Management Strategy

As a consequence of the high exposure of the public to the 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 Electricity Safety Act's Electricity Safety Management Scheme (ESMS).

AusNet Services' 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 line inspection and testing programs.

The Enhanced Network Safety Plan assumes this core asset management activity continues and 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.

An aspirational objective of the asset management strategy is to reduce the annual number of network related incidents reported to Energy Safe Victoria (ESV) by 20% per regulatory

period following the guiding regulatory principle of the ESMS of reducing risk *as far as practicable*.

Review of network asset performance data provides the ability to perform root cause analysis of incidents in order to understand the failure mechanisms and drivers behind asset failures and is fundamental to achieving AusNet Services' asset management objectives.

2.5 Electricity Safety Management Scheme (ESMS)

Management of risks associated with network related incidents is achieved through AusNet Services' Electricity Safety Management Scheme (ESMS), which has been a legislative requirement since 2010.

AusNet Services' ESMS seeks to enhance network safety outcomes and comply with the *Electricity Safety (Management) Regulations* through identification of network asset performance risks and implementation of asset management strategies that manage risk *as far as practicable*.

Cost-effective utilisation of resources to obtain optimum reduction of risk is achieved through a prioritisation process using AusNet Services' corporate risk management framework, which is consistent with AS/NZS ISO 31000:2018 *Risk management – Guidelines*.

For each asset class identified as contributing significantly to the frequency of network related incidents, a strategy has been developed that identifies a range of maintenance and replacement strategies to manage the risks.

Analysis has revealed that accelerated replacement of selected assets can efficiently and effectively lead to a reduction in safety incidents. This involves replacing assets in high risk areas with new assets. These new assets either have a lower probability of failure or are technically superior.

2.6 Bushfire Mitigation

AusNet Services' Bushfire Mitigation Management program is a mature and integral part of the ESMS and facilitates the identification and quantification of the causes of fire ignition incidents on the network.

The Bushfire Mitigation Management program provides a focused and continuous improvement program directed at those assets in hazardous bushfire risk areas (HBRA) and meets the objectives of the *Electricity Safety (Bushfire Mitigation) Regulations*.

2.7 Health and Safety

AusNet Services is committed to providing a safe and healthy workplace for employees and contractors. The vision is encapsulated in the missionZero strategy and is supported by a comprehensive Health, Safety, Environment and Quality (HSEQ) Management System.

The AusNet Services HSEQ Management System is certified against the AS/NZS 4801 standard and compliance is verified by regular internal and external audits.

The missionZero strategy is founded on the premise that workplace injuries are unacceptable and avoidable.

The strategy has four key components that set clear expectations about what is acceptable safety behaviour in our workplaces:

1. Safety leadership
2. Safe behaviour
3. Safe work environment
4. Safety systems and measurement

3 RISK ASSESSMENT

3.1 Introduction

Identification of business health and safety risks requires the identification of the likelihood and consequence of events through quantitative, semi-quantitative or qualitative processes in accordance with AusNet Services' corporate Risk Management Policy and Framework and AS/NZS ISO 31000:2018.

Groups and/or individuals exposed to health and safety risks through AusNet Services' business operations are the public and employees.

Risk to the public is primarily managed and controlled through AusNet Services' ESMS and Bushfire Mitigation processes, whilst risk to employees is monitored and controlled through AusNet Services' HSEQ Management System.

A comprehensive process of risk identification and assessment is conducted to inform the five yearly revision of the ESMS, which is submitted to ESV for acceptance.

The resultant risks are recorded in a register and reviewed on a regular basis. New risks subsequently identified are also included in this register.

Risks assessed as Level A or Level B are recorded and managed through AusNet Services' corporate risk management information system (Enablon).

3.2 Serious Electrical Incidents

Serious electrical incidents, including electric shocks, are recorded through AusNet Services' Incident Management System (Enablon).

The Network Safety Management Committee is responsible for monitoring network performance trends together with identification and implementation of asset management strategies designed to manage risk *as far as practicable*.

The Electricity Safety Act 1998 defines "serious electrical incident" to mean:

> *An incident involving electricity which causes or has the potential to cause –*
>
> *(a) the death of or injury to a person; or*
>
> *(b) significant damage to property; or*
>
> *(c) a serious risk to public safety;*

The Electricity Safety (Management) Regulations 2009 require the reporting of electrical incidents:

> *…if the incident –*
>
> *(a) causes the death of or injury to a person; or*
>
> *(b) causes significant property damage; or*
>
> *(c) causes significant disruption to the community; or*
>
> *(d) involves a transmission line; or*
>
> *(e) involves an imminent risk of electrocution.*

Serious electrical incidents are categorised in accordance with established criteria and reported to Energy Safe Victoria (ESV).

Figure 1 shows the number of serious electrical incidents reported to ESV.

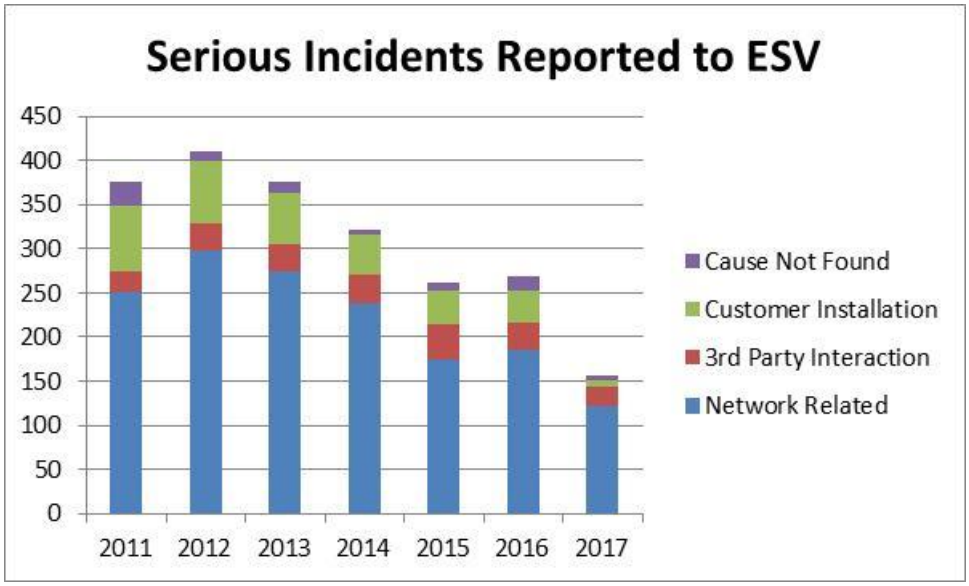


Figure 1: Number of network related serious electrical incidents, inclusive of electrical shocks and fires

Currently AusNet Services reports approximately 261 serious electrical incidents per annum (four year average). Of this total, approximately 180 per annum can be attributed to network related incidents.

Figure 2 shows the number of network related electrical shock incidents. Currently AusNet Services reports approximately 37 network related electric shock incidents per annum (four year average).

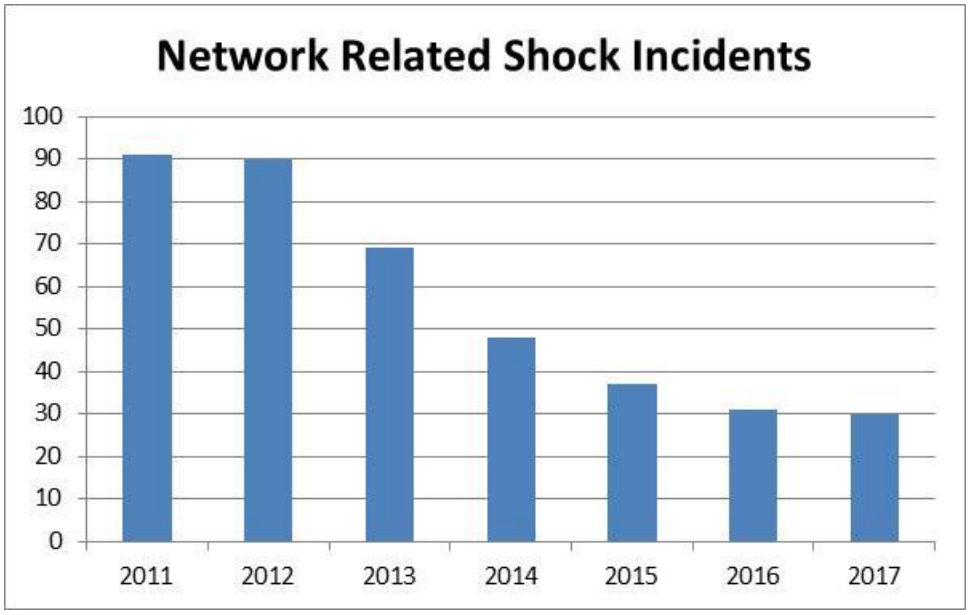


Figure 2: Number of network related electrical shocks

Figure 3 shows the causes of network related electric shocks.

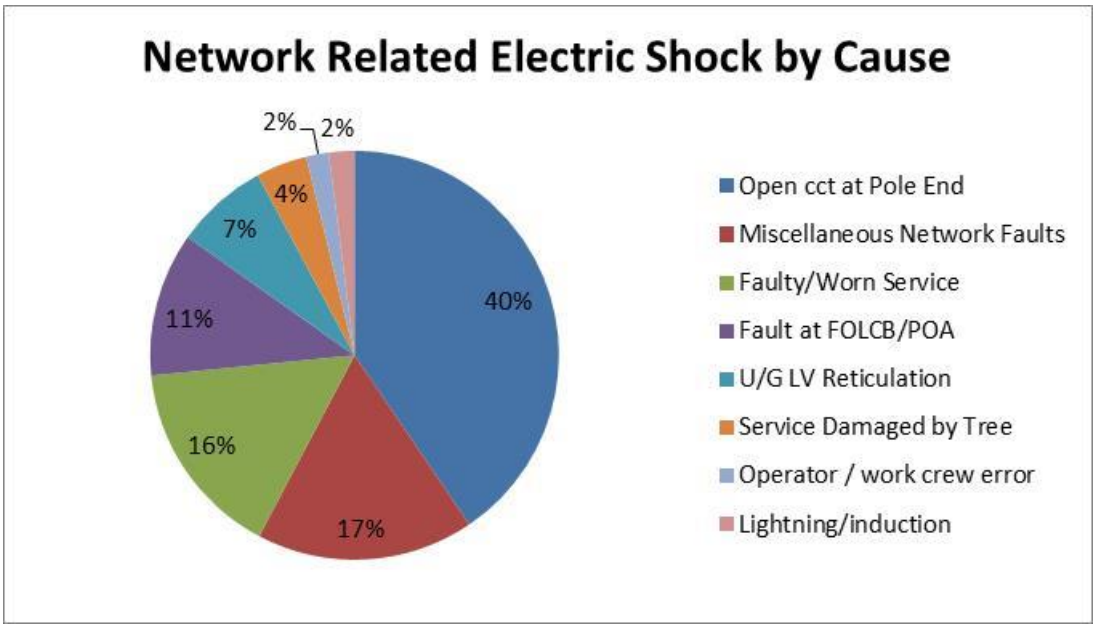


Figure 3: Network Related Electric Shock by Cause

Service cable failures are the primary cause for network related electric shock incidents reported to ESV and are discussed in more detail in Section 4.1.

Figure 4 shows the causes of network related serious incidents, excluding electric shock, by cause.

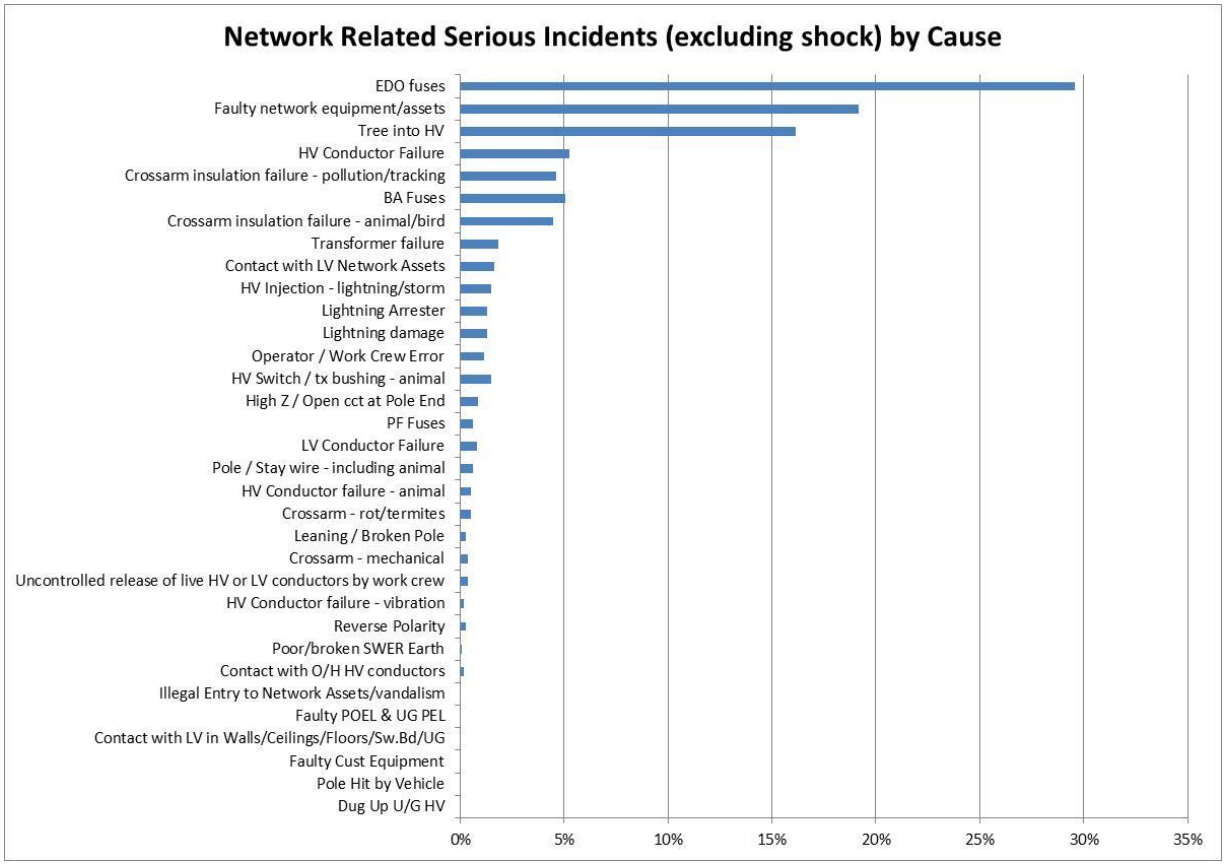


Figure 4: Network Related Serious Incidents (excluding shock) by cause

EDO fuses are the primary cause for other serious incidents reported to ESV and are discussed in more detail in Section 4.2.

AusNet Services also has a focus on reducing the number of asset and ground fires. Figure 5 shows the number of fire start serious incidents reported to ESV. The four year average for asset fires is 77 and for ground fires the four year average is 60.

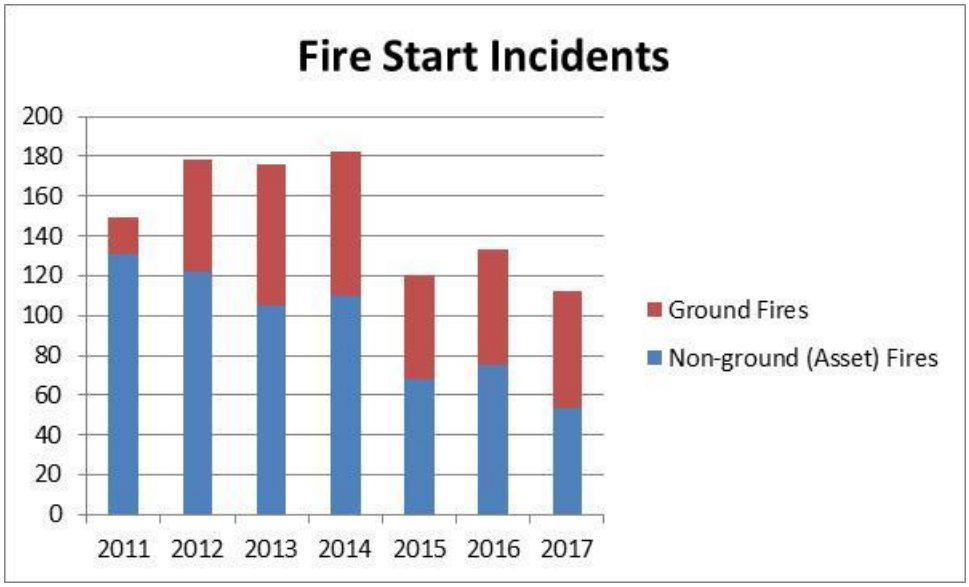


Figure 5: Fire Start Incidents

Fires can occur on the assets themselves (such as a timber pole fire) or can be ignited on the ground adjacent to the network. Both asset and ground fires are monitored by the Network Safety Management Committee.

The causes of asset fires and ground fires are shown in Figure 6 and Figure 7 respectively.

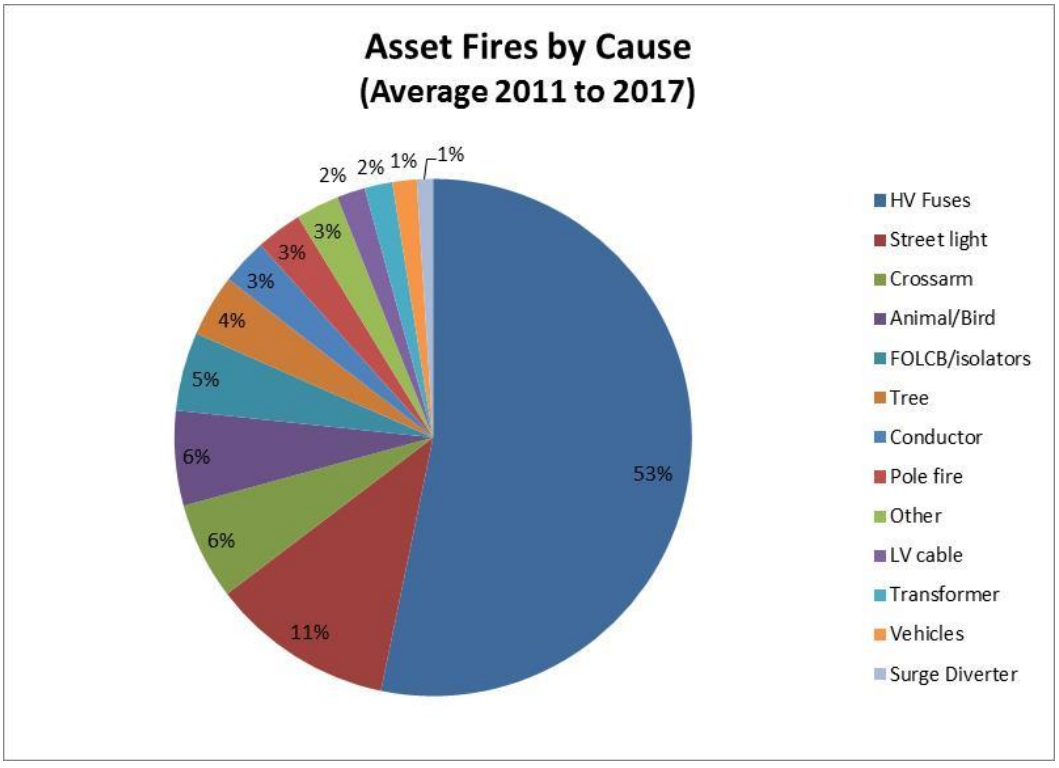


Figure 6: Causes of Asset Fires

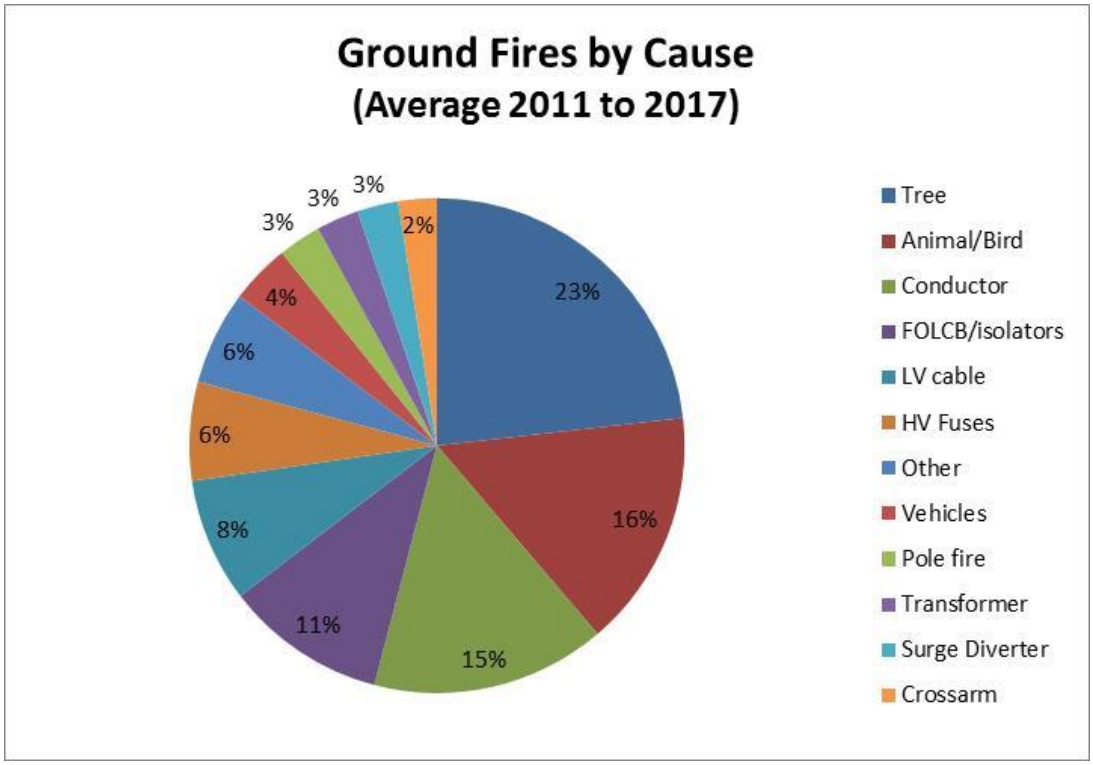


Figure 7: Causes of Ground Fires

Many asset failures do not lead to ground fires and therefore the consequence of these asset fires is generally less than the consequence of ground fires.

Ground fires can have severe consequences, particularly when the fire occurs in a densely populated, heavily vegetated area in extreme weather conditions.

Analysis of network performance and incident data also reveals that contact with overhead assets poses a significant public safety risk.

In response to electricity-related deaths and accidents on work sites and farms, the No Go Zone rules were developed. These rules describe the minimum safety requirements when working near overhead power lines.

The most prevalent cause of contact is breach of the No Go Zone rules. However, some overhead conductor and service cables installed by the former State Electricity Commission were installed at heights, and whilst compliant at the time of installation, do not comply with current design standard clearances and may pose a slightly increased risk to the public.

3.3 Occupational Health and Safety Risks

Occupational health and safety (OH&S) risks arise through operation, maintenance and construction activities.

These risks include the risk of injury from:

- Electric shock;
- Explosive or mechanical failure;
- Falls; and
- Exposure to electro-magnetic fields (EMF).

The AusNet Services Health, Safety, Environment and Quality (HSEQ) Management System has a range of strategies that continue to maintain a safe work environment, such as adherence to industry work practice standards and procedures.

Many of these OH&S risks, such as the risk of exposure to EMF, are managed through the application of design and work standards.

Other risks, such as the risk of falling from a structure, are managed by a combination of work standards and physical measures.

Maintenance of safe work environments requires constant review and challenge of existing practices and standards to ensure risk is being managed *as far as practicable*.

Historically, the asset replacement and operational initiatives implemented by AusNet Services following actual incidents of asset failure that have presented risk to personnel have included, but are not limited to:

- Continuous improvement of line inspection and condition monitoring;
- Replacement of lightning arrestors prone to explosive failure;
- Live line work restrictions on copper conductor;
- On-going replacement of powder filled fuses with alternative devices;
- Implementation of EDO replacement strategy including units prone to mechanical failure; and
- Replacement of HV air-break switches with gas insulated switches.

The above programs form part of on-going asset management practices that have been primarily influenced by asset performance data.

The key strategy associated with OH&S is to continue to maintain a comprehensive HSEQ management system. This system comprises a policy, manual and processes and is certified to relevant standards such as AS/NZS 4801:2001 Safety Management System.

Unlike risks to the public, which have been identified and assessed through quantitative analysis of network incident data, the employee risks rely more upon semi-quantitative and qualitative reviews as there is little empirical incident data upon which to perform analysis.

The likelihood of an incident occurring is low, but the consequences of such incidents can be severe.

Key areas identified for safety improvement programs include:

- Asbestos containing materials within AusNet Services' zone substations and buildings;
- Lattice tower fall restraints; and
- Potential risk to employees from explosive failure of ageing plant.

3.4 Fire Loss Consequence Model (FLCM)

An outcome of the Powerline Bushfire Safety Taskforce (PBST) was the development of a fire loss consequence model (FLCM) by Dr K Tolhurst of Melbourne University, referenced in the PBST Final Report dated 30 September 2011.

The FLCM provides a methodology for identifying areas of highest fire loss consequence within areas previously treated homogenously as HBRA.

The model was subsequently used by ESV to support their Directive[1] for the suppression of high voltage feeder protection on Total Fire Ban days in those areas designated of highest fire loss consequence.

[1] ESV Directive issued under cover letter dated 23 December 2011.

Since 2011, AusNet Services have used a model, based on the FLCM, to determine a value of risk that can be attributed to asset failures and is a key factor in planning asset replacement programs and developing asset management strategies.

Figure 8 shows the Fire Loss Consequence Model map.

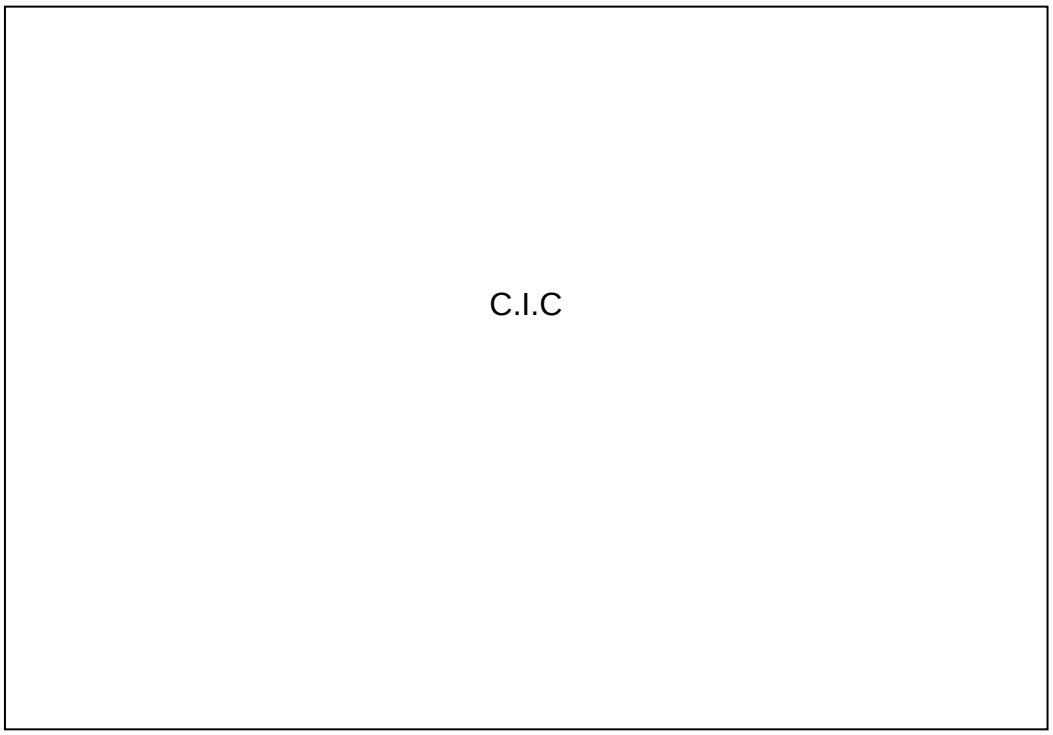


Figure 8: Fire Loss Consequence Model (FLCM) map

3.5 F-Factor and Ignition Risk Units

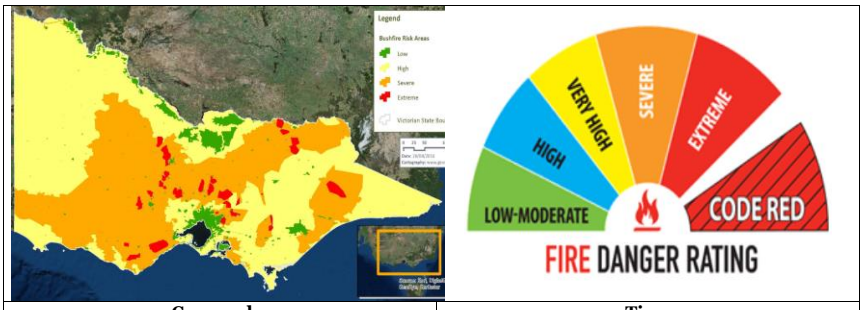
In 2011, "F-Factor" was introduced as a scheme to incentivise Distribution Businesses to reduce the number of asset failures causing fire ignitions. AusNet Services has successfully implemented programs targeting at reducing fire ignitions, the resulting decline in asset fires is shown in Figure 5.

In December 2016, following a review of the F-factor target setting process, a new target setting process was put in place.

In the new risk based scheme, difference weights are applied to fires based on:

- the location of ignition (geography multiplier); and
- the prevailing fire danger rating in the relevant fire district in which the ignition occurred at the time the ignition occurred (time multiplier).

This combination of geography and time are used to calculate the ignition risk unit (IRU), as shown in Figure 9, with $15,000 allocated to each IRU under/over the benchmark.



Geography | Time

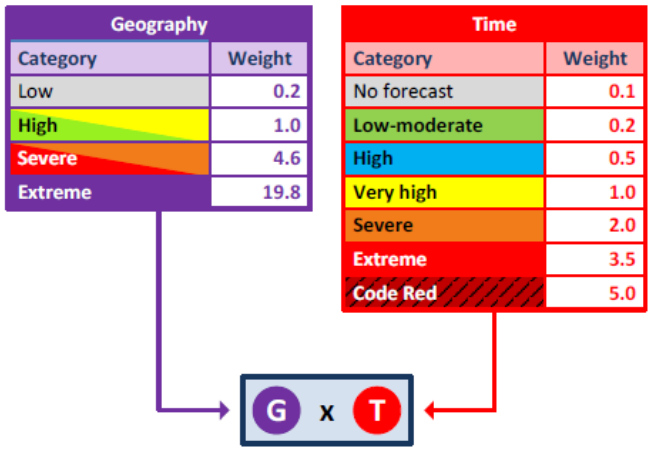


Figure 9: Ignition Risk Unit Input Multipliers

Table 2 gives the IRU targets as published in the Victoria Government Gazette 22 December 2016.

Table 2: IRU Targets

Measure	FY2016/17	FY2017/18	FY2018/19	FY2019/20	FY2020/21	FY2021/22
F-Factor – IRU Target	247.7	247.7	247.7	221.1	221.1	221.1
AusNet Services reported IRU	148.7	267.4	-	-	-	-

4 MANAGEMENT STRATEGIES

4.1 Service Cables

4.1.1 Analysis

Since the introduction of a program utilising advanced metering infrastructure (AMI) data to detect safety issues associated with service cables, there has been a significant reduction in the number of electric shocks from service cables.

Figure 10 shows the electric shock incidents reported to Energy Safe Victoria since the introduction of the AMI data triggered replacement program.

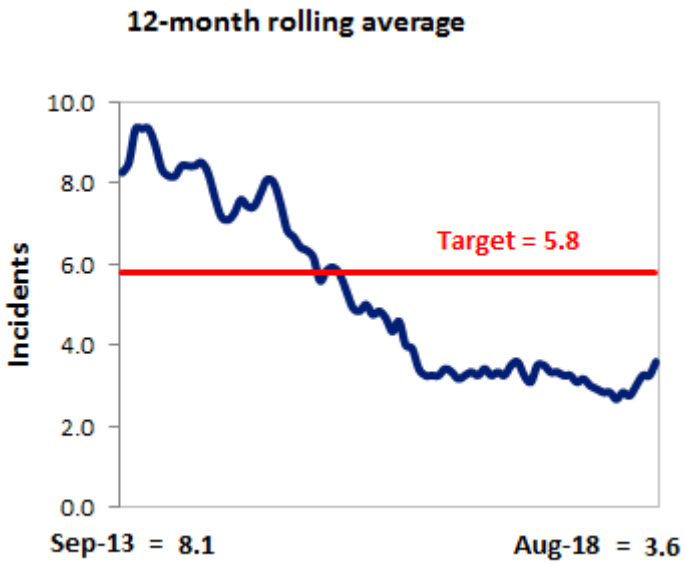


Figure 10: Electric Shock Incidents[2] (12 month rolling average)

4.1.2 Strategy

The success of the AMI data program in detecting issues with services cables has resulted in service cable replacements now primarily driven by AMI data, with the dispatch of fault crews to emerging service cable failures to mitigate risk of electrical shock in customers' premises.

In addition to replacements triggered by AMI data, when work is to be undertaken on assets adjacent to any neutral screened service cable, the service cable is also replaced.

Table 3 shows the recent history of service cable replacement volumes (number of services).

Table 3: Program Delivery History – Service Cables[3]

Program	CY2013	CY2014	CY2015	CY2016	CY2017	Total
Service Cable Replacement	2,913	2,041	1,425	3,289	8,712	**18,380**

[2] Network Performance Dashboard 201809 (final)

[3] From Category Analysis RIN Data, Table 2.2 Repex

Table 4 gives the forecast volumes of the two reactive programs for managing service cable replacement.

Table 4: Volumes of Service Replacements (Sources: 2020 – Works Program FY19 Ed and FY20 Budget Submission, 2022-26 – EDPR Forecast)

Program	2020	2021	2022	2023	2024	2025
Coincident service replacements		1,089	1,089	1,089	1,089	1,089
Service Replacements (number services)	3,144	908	908	908	908	908
Total	**3,144**	**1,997**	**1,997**	**1,997**	**1,997**	**1,997**

4.2 Expulsion Drop Out (EDO) Fuses

4.2.1 Analysis

Expulsion Drop Out (EDO) fuses are designed for use in low fault energy locations, which are often areas of greatest bushfire risk. The fuse element and carrier combinations and fire-chokes are specified to minimise the risk of fire ignition.

Despite this, EDO fuse failures contribute the greatest proportion of asset fires and one of the largest causes of ground fires.

Whilst all current technology fuse switch disconnectors demonstrate modes of failure that may result in fire ignition, Boric Acid fuse failure rates are lower than EDO fuses.

High salt pollution areas result in corrosion of the metal fittings and subsequent cracking of the porcelain insulators of EDO fuses. This presents an operating risk to personnel undertaking high voltage operations of these assets.

Monitoring of fire incident data has indicated bird and animal flashovers to earthed EDO brackets on concrete poles together with ‘candling’ or ‘hang-ups’ of EDO fuse tubes as key sources of fire ignition requiring targeted replacement.

AusNet Services utilises the fire loss consequence model (FLCM) (refer to Section 3.4) to undertake an economic analysis of the fuse population.

The program is to replace EDO units with Boric Acid or equivalent technology that has the same or improved performance.

4.2.2 Program Delivery History

Table 5: Program Delivery History – EDO Fuses[4]

Program	FY2017	FY2018	FY2019	Total
EDO Fuse Replacement	4,401	3,037	3,122	**10,560**

4.2.3 Strategy

The focus of the EDO strategy is to continue replacing the EDO fuses which represent the highest risk with Boric Acid fuses, or equivalent.

[4] From the April Network Safety Report for the relevant year, except FY2019, which it the forecast volumes from February 2019 report.

Table 6: EDO fuse replacement volumes (Source: 2020 – Business Case DD-001319, 2022-26 – EDPR Forecast)

Program	2020	2021	2022	2023	2024	2025
EDO fuse unit replacements	1,211	1,750	1,750	1,750	1,750	1,750

4.3 Overhead Conductor

4.3.1 Analysis

Conductor failure presents both electric shock and bushfire ignition risks, with conductors being the third highest cause of ground fires.

A proactive program of conductor replacement targeted at steel and copper conductor has been undertaken in the 2016-2020 regulatory period as well as routine condition-based replacement of bare conductor, replacement of approximately 59 km of deteriorated HV ABC, and some Government funded replacement work.

A cost benefit analysis of the risks posed by conductor has been conducted. The analysis considered the age, type, location and condition of the spans to determine the likelihood of failure and combines this with safety, bushfire and unserved energy consequences to determine the overall risk associated with each conductor span.

This identifies conductor spans where the benefit gained by replacing the span is greater than the cost of the span, so justifies the replacement of the span.

This analysis identifies the volume of conductor that should be replaced to reduce the risks associated with conductor *as far as practicable*.

4.3.2 Program Delivery History

Table 7: Program Delivery History – Overhead Conductor[5]

Program	FY2016	FY2017	FY2018	FY2019	Total
Steel Conductor	861	251	109	109	**1330**
Copper Conductor	63	24	0	24	**111**
HV ABC (NMS)		7	14	9	**30**
Total	**924**	**282**	**123**	**142**	**1471**

4.3.3 Codified Areas

The 2009 Victorian Bushfires Royal Commission (VBRC) and the Powerline Bushfire Safety Taskforce (PBST) both recommended the replacement of SWER powerlines with underground or insulated overhead cables within 10 years.

These recommendations were implemented through changes to the Electricity Safety (Bushfire Mitigation) Regulations 2013 which requires that conductors within Codified Areas which have reached the end of life to be put underground or insulated.

AusNet Services' current condition based replacement forecast is for 7 km of SWER conductor in Codified Areas to reach end of life over the 2022-26 regulatory period.

[5] From the April Network Safety Report for the relevant year, except FY2019, which it the forecast volumes from February 2019 report.

This represents 1% of the SWER conductor in Codified Areas replaced over a 5-year period.

AusNet Services does not believe that this rate of replacement meets the expectations of our customers and stakeholders, so is proposing an additional program to accelerate the replacement of bare SWER conductor installed within the distribution network. This program will proceed if the expenditure is approved as part of the 2022-26 EDPR.

4.3.4 Strategy

The strategy is to continue the program of conductor replacement targeting deteriorated conductor in HBRA to reduce risk *as far as practicable*, based on the risk modelling outcomes.

Table 8: Overhead Conductor volumes (Source: 2020 – Works Program FY19 Ed, 2022-2026 – EDPR Forecast)

Program	2020	2021	2022	2023	2024	2025
Conductor (Non Codified Areas) (km)	105	268	268	268	268	268
Conductor (Codified Areas) (km)	126	2	2	2	2	2
Conductor (Codified Areas accelerated SWER program) (km)	-	20	20	20	20	20
Total (km)	**231**	**290**	**290**	**290**	**290**	**290**

4.4 Vibration Dampers and Armour Rods

Subsequent to the 2009 Victorian Bushfires Royal Commission recommendations, ESV issued a Directive, dated 4 January, 2011 for AusNet Services to prepare a plan requiring the fitting of vibration dampers and armour rods to its network in accordance with the Victorian Electricity Supply Industry (VESI) standards VX9/7037 and VX9/7037/1.

The Directive requires the plan to address the program in two broad stages as follows:

- Stage 1 – hazardous bushfire fire risk areas (HBRAs) before 1 November 2015, and
- Stage 2 – all other areas by 1 November 2020.

Accordingly, a number of plans were submitted before ESV accepted AusNet Services' *'Program for Fitting of Distribution Armour Rods and Vibration Dampers (AMS 20-52-1)*.

The agreed program has ensured the highest fire risk consequence areas within HBRAs, as modelled by Dr Tolhurst of Melbourne University, are addressed in Stage 1 of the program (by 2015) in accordance with the Directive.

Assets in HBRAs outside the highest fire risk consequence areas will be addressed together with assets in 'all other areas' in Stage 2.

Stage 2 is being undertaken in the 2016-2020 regulatory period. The initial plan was for the installation of dampers and armour rods at 110,000 structures at a rate of 22,000 per year.

In February 2017, a revised plan AMS 20-52-1 Issue 4 was accepted by ESV following an engineering assessment based on AS/NZS 7000 to clarify where vibration control should be applied.

This resulted in a revision of the total number of structures to be addressed in Stage 2 to 80,980.

Table 9: Program Delivery History – Armour Rod and Vibration Dampers[6]

Program	FY2016	FY2017	FY2018	FY2019	Total
Armour Rods and Vibration Dampers	19,890	18,500	17,200	13,054	**68,644**

The volumes remaining are given in Table 10.

Table 10: Armour Rods and Vibration Dampers

Program	FY20
Install Armour Rods and Vibration Dampers (HBRA and LBRA)	11,022

4.5 Conductor Spacers and Circuit Clearances

Subsequent to the 2009 Victorian Bushfires Royal Commission recommendations, ESV issued a Directive, dated 4 January, 2011 for AusNet Services to prepare a plan requiring:

- Fitting of low voltage spacers to its network in accordance with the VESI standard VX9/7020/150; and
- Maintenance of separation of conductors in accordance with clearances contained within Section 10.3 – Conductors on the same supports (same or different circuits and shared spans) of the current release of the Energy Networks Association document C(b)1 – Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines.

The Directive requires that the program ensures:

- Low voltage spacers are audited for compliance prior to 1 November each year;
- Maintenance of conductor clearances is achieved in HBRAs by 1 November 2015; and
- Maintenance of conductor clearance in 'all other areas' by 1 November 2020.

The strategies to meet these requirements are described in the following sections.

4.5.1 Low Voltage Spacers

Asset inspection criteria established around 1983 has ensured that assessment for LV spacers in HBRA is fully compliant as they have been regularly installed and inspected regardless of span length or construction type.

Only routine maintenance and ad hoc replacement is required.

4.5.2 Medium Voltage Circuit Clearances

The plan for completion of the program involved:

1. Complete all HBRA surveys and assessments by 1 November 2015
2. Complete the remaining LBRA surveys and assessments by April 2017
3. Complete all HBRA rectifications based on risk ranking by April 2017 with all 3-5 ranked spans completed by the 2016 bushfire season.

   Pending rectification, circuits ranked 3-5 will be placed on a list to be monitored through the control room (CEOT) to identify circuit loads that exceed predetermined thresholds. Circuits exceeding thresholds will be managed under business as usual processes for network load management.

[6] From the April Network Safety Report for the relevant year, except FY2019, which was from an email from A Attar-Bashi 18 April 2019

4. Develop a programme for completion of all LBRA rectifications based on risk ranking by November 2020.

Table 11: Program Delivery History – Conductor Spacers[7]

Program	FY2016	FY2017	FY2018	Total
Conductor Spacer	459	36	9	**504**

This program has been completed.

4.6 Government Funded Conductor Replacement

In 2011 the Victorian Government announced a $750 million Powerline Bushfire Safety Program (PBSP). The 10-year program will deliver on recommendations (27 and 32) of the 2009 Victorian Bushfires Royal Commission and aims to reduce the risk of bushfires caused by electrical assets without causing significant impact on electricity supply reliability.

The program includes a Government contribution of up to $200 million over 10 years towards the replacement of the most dangerous power lines in the state that would otherwise not have been replaced.

Areas of high risk in both the Powercor and AusNet Services' network areas have been identified and replacement work involving the undergrounding of conductor or installation of covered conductor to replace bare conductor has commenced.

The size of the program and the allocation of the funds to Distribution Network Businesses, or other overhead line owners, are determined by the Government.

Further information pertaining to the details can be found in the *Bushfire Mitigation Plan*[8].

4.7 Crossarms

4.7.1 Analysis

Crossarm failure can result in live conductors being dislodged and breaching regulatory safety clearances and/or serious incidents such as high voltage injections into customer installations that have resulted in fire.

A proactive program to replace deteriorated timber crossarms in HBRA with steel arms was introduced in 2009 and by the end of 2014 had replaced a significant proportion of deteriorated high voltage timber crossarms in HBRA.

Crossarm replacements have continued in the 2016-2020 regulatory period and it is forecast to replace approximately 17,000 high voltage and 29,000 low voltage timber crossarms due to condition.

This forecast is based on current inspection driven replacements and analysis of the risk of crossarm related bushfire ignition using the Fire Loss Consequence Model has been completed to determine the volume of crossarms that should be replaced to meet safety obligations *as far as practicable*.

[7] From the April Network Safety Report for the relevant year, except FY2019, which it the forecast volumes from February 2019 report.

[8] BFM 10-01 Bushfire Mitigation Plan

4.7.2 Program Delivery History

Table 12: Program Delivery History – Crossarms[9]

Program	FY2015	FY2016	FY2017	FY2018	Total
Sub-transmission	126	64	42	29	**261**
High Voltage	2,296	2,388	1,492	2,050	**8,226**
Low Voltage	5,359	5,740	4,001	4,479	**19,579**
Total Crossarm Replacements	**7,781**	**8,192**	**5,535**	**6,558**	**28,066**

4.7.3 Strategy

Table 13: Crossarm Replacement Volumes (Sources: 2020 – Works Program FY19 Ed and FY20 Budget Submission, 2022-26 – EDPR Forecast)

Program	2020	2021	2022	2023	2024	2025
Crossarm Replacements	5,927	4,135	4,135	4,135	4,135	4,135

4.8 Complex High Voltage Structures – Bird and Animal Proofing

AusNet Services' current initiatives and standards for reducing the risk of bushfire caused by Bird and Animal flashovers include:

- Standard design for complex structures includes insulated leads and covers;
- Standard applied for all new, replacement and augmentation works;
- Concrete poles with steel HV crossarms and standard post insulators fitted with bird covers;
- Standard application of stretch post insulators on conductive structures;
- Neutral earth resistors in zone substations;
- Animal guards to prevent access to assets.

Section 3.2 indicates bird and animal flashover incidents remain a significant contributor to ground fire ignitions.

AusNet services will continue to Bird and Animal Proof existing pole top assets in HBRA as a part of the Bushfire Mitigation Program.

This is a reactive program, so does not have target volumes, and instead is based on historical expenditure. Forecast expenditure in this category is given in Table 14.

Table 14: Bird and Animal Proofing Forecast Expenditure

Program	2020	2021	2022	2023	2024	2025
Bird and Animal Proofing (2018 $,000)	C.I.C					

4.9 Rapid Earth Fault Current Limiters

A Rapid Earth Fault Current Limiter (REFCL) is a type of electricity network protection device that reduces the amount of energy dissipated during an earth fault. Implementation of the

[9] Electricity Networks FY19 to FY23 Works Program, FY19 Edition

technology involves changing the way the 22kV network is earthed, from resistance earthing to resonant earthing. It was originally developed for its reliability benefits in Europe. In Victoria, however, it will be used to help reduce the risk of bushfires. Trials of the technology were conducted in 2014 and 2015.

An earth fault occurs when a connection is made between a powerline and the ground. This could occur as a result of a fallen powerline, a tree falling against a powerline or wildlife touching the pole and powerline at the same time.

The change to resonant earthing technology significantly reduces the fault current and the small residual current is compensated by injecting an equal and opposite current into the transformer neutral using an inverter.

When a fault occurs, a REFCL detects and significantly limits the energy flow within a tenth of a second. This reduces the possibility of a fire being started, or of a person or animal nearby receiving an electric shock.

If the fault is able to fix itself quickly (for example a tree branch that had touched the powerline then falls away), the REFCL allows the powerline to continue operating so that customers will not be affected.

Currently, without a REFCL, these faults can cause power to turn off for several minutes, lead to fires or even property damage. If the fault remains (for example a tree has fallen on a line or a car has hit a powerpole) then all power will be cut around the fault area.

Changes to the Electricity Safety Act together with Bushfire Mitigation Regulations require AusNet Services to install REFCL technology at 22 sites by April 2023 through three tranches. Each tranche is made up of a number of zone substations and the installation of the REFCL technology within each zone substation will be managed as a separate project. The location and timing for implementation of the REFCL technology through three tranches prescribed in Schedule 2 of the Regulations is illustrated in Figure 11.

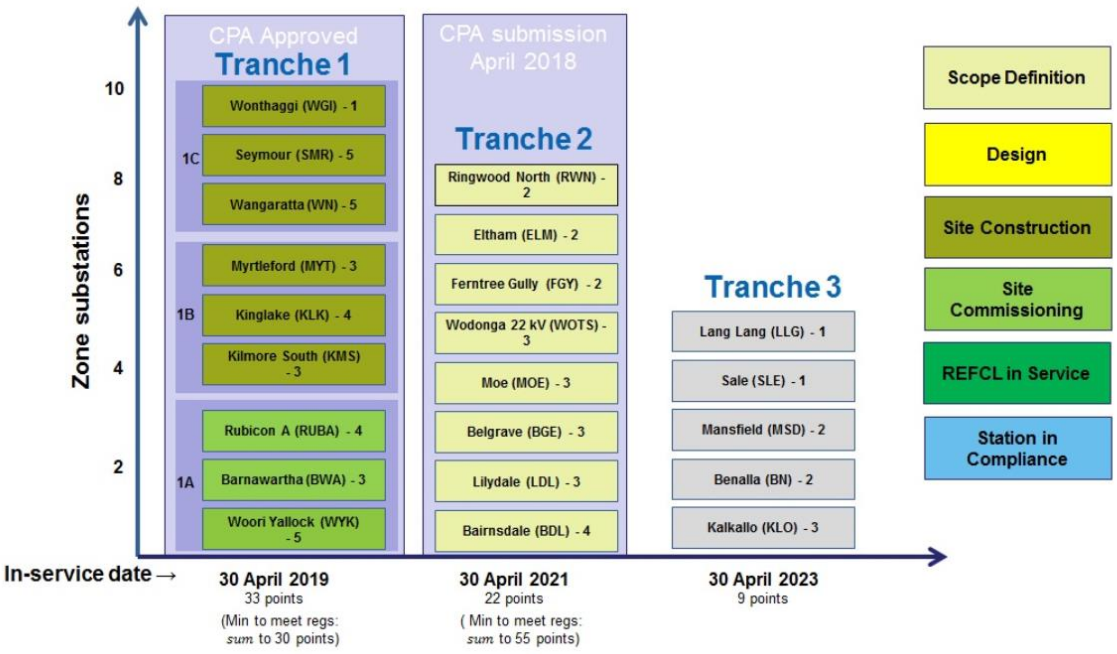


Figure 11: REFCL Tranches

4.10 Vegetation Management – Hazard Trees

4.10.1 Analysis

Vegetation related faults are a material cause of asset and ground fires. Review of these incidents consistently indicates that trees and limbs falling from outside the clearance space are the cause of asset related failures that result in fire ignition. Primary causes for tree failure are strong wind storms, tree/limb defects or a combination of both.

In accordance with the *Electricity Safety (Electric Line Clearance) Regulations 2010*, vegetation outside the clearance space is managed to mitigate the risk of falling trees or parts of trees entering the clearance space. Vegetation outside the clearance space is assessed to identify obvious hazard trees. These trees may be identified as being a hazard due to their physical condition or location with the potential to fall into the clearance space.

Hazard trees represent a significant risk to the security of electricity supply and consequently the safety of customers and the community.

In accordance with AusNet Services' Vegetation Management Plan, approved by Energy Safe Victoria, hazard tree assessment procedures and guidelines require the management of approximately 5,000 hazard trees[10] per annum in HBRA.

[10] BFM 10-05 Vegetation Management Plan

4.10.2 Program Delivery History

Table 15: Program Delivery History – Hazard Trees[11]

Program	FY2016	FY2017	FY2018	FY2019	Total
Hazard Tree Removal	12,602	4,994	5,000	5,000	**27,596**

4.10.3 Strategy

This program was established during the 2011-2015 regulatory period and remains on-going as shown in Table 16.

Table 16: Hazardous tree removal details for 2019-2020

Program	2020
Hazard Tree Removals	5,000

4.11 Vegetation Management – Overhangs

Regulatory compliance has been achieved for all vegetation overhanging bare overhead powerlines in HBRA and LBRA within Codified Areas during the 2016-2020 regulatory period.

Table 17: Program Delivery History – Overhangs (56M)[12]

Program	FY2015	FY2016	Total
Overhang Removal	587	232	**819**

As a result, no specific program is required to manage this issue and any future overhangs shall be managed via business as usual vegetation management practices.

4.12 No Go Zone

4.12.1 Analysis

Contact with overhead or underground distribution assets are usually attributable to plant and equipment being operated in breach of the Electricity Safety (Network Asset) Regulations.

Analysis of third party contacts with AusNet Services' assets indicates contact with overhead high voltage conductors as the most prevalent No Go Zone breach.

Encroachment on No Go Zone clearances can result in fatalities. All incidents are investigated and recorded by ESV.

Recent known occurrences of fatal incidents involve contact with overhead high voltage distribution assets, most occurred in rural areas and predominantly involved persons undertaking work activities in relation to agriculture.

A common cause of death was persons operating mobile cranes and tippers on trucks, being in contact with the vehicle and ground simultaneously as the mobile plant made contact with overhead high voltage conductors.

[11] From the April Network Safety Report for the relevant year, except FY2019, which it the forecast volumes from February 2019 report.

[12] From the April Network Safety Report for the relevant year, except FY2019, which it the forecast volumes from February 2019 report.

Contact with overhead high voltage conductors was also frequent for mobile excavators, particularly in conjunction with land development works. Fortunately, these works activities are generally confined to a single operator working on or in the plant which has meant the operators have not formed part of the electrical path to earth subsequent to inadvertent contact. However, there still remains significant risk for any individual/s working on the ground in close vicinity to the operating plant.

Advertising programs such as the 'look up and live' campaigns are targeted at reducing the number of contact with overhead high voltage conductor incidents. These programs are initiated by ESV and financially sponsored by the distribution businesses.

In addition, AusNet Services has introduced two sections on its web site that provide information on No Go Zones and links to relevant sites:

https://www.ausnetservices.com.au/en/Business/Electricity/Safety/Transmission-Easements/No-Go-Zones

https://www.ausnetservices.com.au/Business/Electricity/Safety/Working-Near-Lines

Whilst not represented in the above data, instances of electrical fatalities outside of Victoria have been experienced with unauthorised access to distribution assets, particularly children entering high voltage zone substation and substation enclosures.

AusNet Services has an ongoing program of enhanced standards and security arrangements for new installations together with implementation of a prioritised retro-fit of existing installations. To mitigate potential safety risk to AusNet Services' personnel, public and un-authorised access, AusNet Services' *Asset Management Strategy – Infrastructure Security*[13] program has been developed to address this risk.

4.12.2 Strategy

AusNet Services will continue to support the maintenance of an industry advertising, education and awareness campaign through ESV. This should be supported through the maintenance of personnel within AusNet Services engaged in the administration of No Go Zone inquiries. Whilst a broad application of augmentation and line marking policies for overhead lines is not considered economical, targeted programs for assets considered high risk over public land provides an opportunity for mitigating risk to the public.

This has included:

- Identification of electrical hazards in the vicinity of boat ramps and has resulted in augmentation of network assets and/or the implementation of barriers and warning signs; *and*
- Relocation of network assets identified as being high risk of vehicle impact.

4.13 Overhead Conductor Ground Clearances

AusNet Services maintain a risk management approach for the management of overhead conductors and services cables below current design standard clearances (refer Section 7 of the Asset Inspection Manual 30-4111).

Overhead conductor and services cables identified as being below minimum clearance thresholds or scheduled for replacement are re-established to current design standards.

Cyclic inspections, together with asset maintenance and replacement are the network activities that initiate the low conductor clearance replacement program.

Table 18 gives the historic volumes of re-engineering work to address clearance issues.

[13] AMS 20-14 Infrastructure Security

Table 18: Program Delivery History – Clearance[14]

Program	FY2015	FY2016	FY2017	FY2018	Total
Clearance Re-engineering	187	94	196	238	**715**

This is an inspection-driven program, with the anticipated volumes given in Table 19.

Table 19: Overhead conductor clearance volumes (Source: 2020 – Works Program FY19 Ed, 2022–2026 – EDPR Forecast)

Program	2020	2021	2022	2023	2024	2025
Overhead conductor clearance volumes	195	203	203	203	203	203

4.14 Asbestos

4.14.1 Analysis

According to WorkSafe Victoria's *Compliance Code: Managing asbestos in workplaces*, if asbestos containing material (ACM) is in good condition and left undisturbed, it is unlikely that asbestos fibres will be released into the air and the risk to health is extremely low. It is usually safer to leave it fixed or installed and review its condition over time.

However if ACM is deteriorated, has been disturbed or is asbestos-contaminated dust is present, the likelihood that asbestos fibres will be released into the air is increased.

Asbestos risk has been divided into four residual risk categories using the AusNet Services corporate risk management framework, with Level I representing the highest risk and Level IV representing the lowest risk.

Levels I and II generally contain risks that either need immediate attendance or can be cost effectively addressed independent of broader asset replacement projects.

Levels III and IV are generally considered risks that can be managed with on-going asset management controls and removed under an opportunistic basis with works such as:

- Station rebuild or augmentation projects
- Secondary system upgrade projects
- Building renewal or refurbishment projects

As of October 2018, there are no asbestos containing materials assessed as Level I or II.

4.14.2 Strategy

Level III and IV risks will be addressed through on-going asset management procedures and processes with asbestos removal being cost effectively integrated with broader asset replacement projects on an opportunistic basis as part of station refurbishment projects.

4.15 Lattice Towers – Fall Arrest Systems

4.15.1 Analysis

The distribution network is primarily constructed using poles. However, there are 465 steel lattice towers in the 66kV sub-transmission network.

The original design of the sub-transmission towers did not consider the provision of adequate electrical clearance for tower access. This lack of electrical clearance exposes line

[14] Electricity Networks FY19 to FY23 Works Program, FY19 Edition

workers to the risk of a flashover event when climbing along the tower leg at the conductor level.

Additionally, at the time the majority of these towers were designed and constructed, there were no requirements to provide fall arrest systems. In the intervening years a range of Occupational Health and Safety laws have been introduced that require employers to provide a safe working environment for workers.

All infrastructure owners which require workers climbing up to a level greater than two metres above ground are now retrofitting a permanent fall arrest system on their assets.

A program to install fall arrest systems to sub-transmission line towers is ongoing.

4.15.2 Strategy

The program to install fall arrest systems on sub-transmission lattice towers has commenced[15]. This program will result in the installation of a fall arrest system on 50 towers in each year of the 2016-2020 regulatory period. This will then reduce to 18 towers per year in the 2022-26 regulatory period.

Table 20: Fall Arrest System Volumes (Source: 2020 – AMS 20-13 Issue 10, 2022-26 – EDPR Forecast)

Program	2020	2021	2022	2023	2024	2025
Fall Arrest Systems	50	18	18	18	18	18

4.16 Explosive Failure

4.16.1 Analysis

This risk relates to the possible explosive failure mode of some current transformers (CTs) and voltage transformers (VTs) and also of the bushings of power transformer and circuit breakers. This can result in injury to people and collateral damage to adjacent plant and equipment within zone substation stations.

AusNet Services has not had any explosive failures of equipment in the distribution network; however there have been a number of explosive failures within terminal stations, with equipment similar to that located within zone substations. The equipment within zone substations operates at a lower voltage, so it is thought that the risk is lower than in terminal stations; however there is still a risk.

4.16.2 Strategy

Explosive failure is one of several consequences included in the risk models for zone substation equipment.

These risk models inform the replacement programs for high risk equipment.

[15] Project 74316513 66kV Towers VFAS Installation – Stage 1

5 ENHANCED NETWORK SAFETY PROGRAM SUMMARY

Table 21: Enhanced Network Safety Programs

Enhanced Network Safety Program	Description
Service Cables	• Condition driven program (based on AMI data) • Volumes estimated on historical replacement rates
EDO fuse targeted replacement	• Targeted risk-based replacement program • Approximately 1,750 fuses per year
Overhead Conductor	• Targeted risk-based replacement program • Approximately 290km per year
Vibration Dampers and Armour Rods	• Approximately 11,022 sites remaining due for completion in FY2020
Conductor Spacers and Circuit Clearances	• Program has been completed
Government Funded Conductor Replacement	• Refer to BFM 10-01 Bushfire Mitigation Plan
Crossarms	• Targeted risk-based replacement program • Approximately 4,135 crossarms per year
Bird and Animal Proofing	• Reactive program • Volumes estimated on historical replacement rates
Installation of REFCLs	• As per REFCL program
Vegetation Management – Hazard Trees	• Based on inspections • 5,000 trees per year
Vegetation Management – Overhangs	• Program completed • Managed as business as usual going forward
No Go Zones	• Continued support of public awareness programs
Overhead Conductor Ground Clearance	• Reactive program • Forecast based on historical expenditure
Asbestos	• Addressed as part of planned zone substation refurbishment projects
Lattice Towers – Fall arrest systems	• Ongoing program • 18 towers per year
Explosive Failure	• Asset replacement programs informed by risk models