AusNet Electricity Services Pty Ltd

Electricity Distribution Price Review 2016–20

Appendix 7B: Enhanced Network Safety
(Public Version)

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AMS – Electricity Distribution Network

Enhanced Network Safety Strategy (PUBLIC)

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1 Executive Summary

The objective of the Enhanced Safety Plan is to optimise the output of the Electricity Safety Management Scheme (ESMS), the Bushfire Mitigation Management program and the Health, Safety, Environment and Quality (HSEQ) Management System to identify and prioritise opportunities to develop and implement network asset management initiatives and programs that continuously reduce network related health and safety risks to 'so far as is practicable' (SFAIP) for customers, public and personnel.

This Plan forms an integral part of AusNet Services' *Asset Management Strategy*[1] and is a network initiative that is incremental to the '*Non Demand Related, Reliability and Quality Maintained*' 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.

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, together with individual asset strategies indicates incremental programs shown in Table 1 as providing 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.

[1] AMS 20-01 Asset Management Strategy

Table 1 – Enhanced Network Safety Initiatives 2016-2020

Enhanced Network Safety Program 2016-2020	**Total Volume**
PROGRAMS	
Pre-emptive replacement neutral screened service cables (each)	16,000
Cross-arms -HV Cross-arm Replacement (each) -LV Cross-arm Replacement (each)	 17,000 29,000
Conductor -Pre-emptive replacement of conductor (km) -MV circuit clearance rectifications (span) -Low conductor and service clearance rectifications (pole) -Replacement of HV ABC (km) -Armour rods & vibration dampers Stage 2 (pole)	 2,060 435 1,210 48 110,000
EDO fuse targeted replacement (each)	9,500
Bird & Animal Proofing -Retro-fit to existing complex HV structures (pole) -New complex HV structures	 9,500 11,500
Enhanced control and protection program -Satellite communication services (ACR sites) -MEF relay installation (zone substation) -Automatic sectionalisation of downed conductors (zone substations) -Installation of NERs (zone substation) -Installation of REFCLs (zone substation)	 33 31 TBD 2 TBD
Vegetation Management -Hazardous tree removals (trees) -Vegetation overhang (56M span)	 25,000 655
Asbestos removal at seven planned rebuild zone substations Leongatha, Maffra, Moe, Myrtleford, Seymour, Thomastown, and Watsonia	Integrated with asset works
Occupational Health & Safety - Replace CTs (unit) - Replace disconnectors (unit) - Replace silicon carbide gap surge arrestors (set) - Sub-transmission tower fall arrest system installation (tower)	 17 144 195 250
SWER Earth remediation of non-compliant installations (pole)	1,590

2 Introduction

2.1 Purpose

The purpose of this plan is to provide a co-ordinated approach to the optimised management of network assets and programs that deliver enhanced safety to the public and employees.

Network safety results from many elements of asset management including standards, design, operation, construction and maintenance. This document describes the key programs intended to improve network safety outcomes and to mitigate key safety risks ‘so far as is practicable’ (SFAIP). This document is not intended to describe how safety is incorporated into each asset management element.

2.2 Distribution Asset Management Strategy

AusNet Services has a number of asset management objectives specifically to support each network. The objectives for the electricity distribution network, described in AMS 20-01 Asset Management Strategy – Electricity Distribution Network, are to:

- Modernise the network
- Improve safety
- Meet or manage customer demand
- Improve reliability

As a consequence of the high exposure to the public from the electricity distribution network assets, implementation of a continuous improvement methodology to maintenance or enhancement of 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 objective of this strategy is to reduce the annual number of network related incidents reported to Energy Safe Victoria (ESV), currently 265[2] per annum, by 20% per regulatory period in line with the stretch target of the AMS and the guiding regulatory principle of the Electricity Safety Management Scheme (ESMS) of reducing risk SFAIP. Subsequent 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 the outcomes and objectives of AusNet Services’ AMS.

Key health and safety risks associated with the network include:

- Electrical safety – involving the escape of electrical energy from the network that can result in either fire or electrical shock/fatality.
- Asbestos – management of asbestos containing materials in buildings and structures.
- Explosive failures – management of plant and equipment prone to explosive failures.

[2] 2014 four year moving average, reflecting Energy Safe Victoria’s new incident reporting criteria established in 2011

- EMF – management of electrical plant and equipment in accordance with ARPANZA guidelines.

2.3 Electricity Safety Management Scheme (ESMS)

Management of risks associated with network related incidents is achieved through AusNet Services' ESMS, which has become 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 SFAIP.

Cost-effective utilisation of resources to obtain optimum reduction of risk is achieved through a prioritisation process using AusNet Services' risk assessment methodologies, which are consistent with AS/NZS ISO 31000:2009 (Risk Management – Principles and 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 asset management strategies that will cost effectively reduce network safety risk SFAIP.

Analysis has revealed that accelerated replacement of selected assets can effectively and cost efficiently drive 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.

2.4 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 areas (HBRA) and meets the objectives of the *Electricity Safety (Bushfire Mitigation) Regulations*.

2.5 Health & 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.

- Safety leadership
- Safe behaviour
- Safe work environment
- Safety systems & 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 31000:2009.

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 I or Level II are recorded and managed through AusNet Services' corporate risk management information system.

3.2 Risk to Public

The consequence of electrical energy escaping the distribution network can be summarised as the risk of *Electric Shock* and/or *Fire.* Analysis of network performance and incident data (Section 3.2.1) regarding electric shock and fire incidents revealed the following **asset** classes as presenting the most frequent primary causes of network related safety incidents.

- Service cable neutral failure
- Conductor failure
- Cross arm failure
- Insulator failure
- EDO failure
- Complex high voltage structure *(bird & animal arc flashover)*
- Fault control & protection

Analysis of network performance and incident data (Section 3.2.1) involving the above mentioned consequences also revealed the following **non-asset** related drivers as primary causes for network related safety incidents.

- No Go Zone breaches
- Vegetation

Safe operation of an electrical distribution network requires the control and prevention of electrical energy escaping the network. Utilising Reliability Centred Maintenance (RCM) asset management philosophies, asset management strategies for specific asset classes have been developed to address network safety risks. This Plan also addresses network safety risks associated with non-asset causes.

3.2.1 Electrical Incidents

Serious electrical incidents, including electric shocks, are recorded through AusNet Services' Incident Management System (IMS). 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 SFAIP. The number of network related serious electrical incidents and shocks are shown in Figure 1 and Figure 2 respectively.

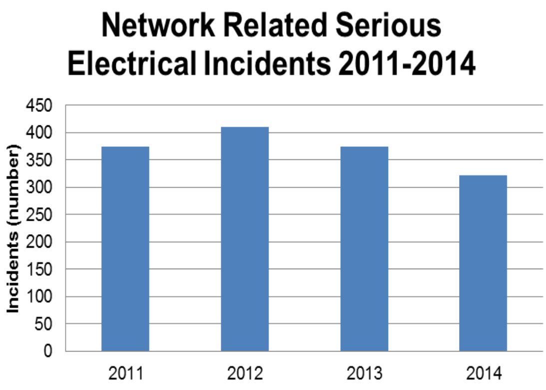

Figure 1 – Number of network related serious electrical incidents, inclusive of electrical shocks and fires 2011-2014

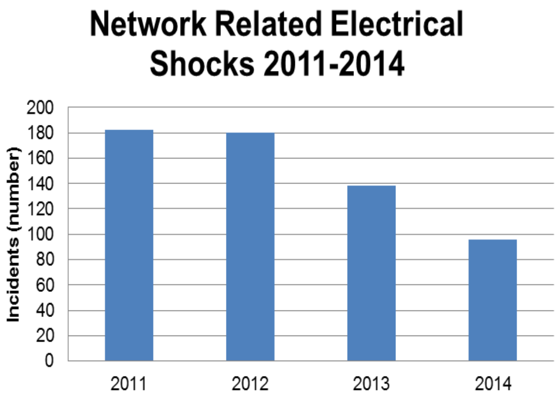

Figure 2 – Number of network related electrical shocks, 2011-2014

Serious electrical incidents are categorised in accordance with established criteria and reported to Energy Safe Victoria (ESV) and currently AusNet Services' reports approximately 371 incidents per annum. Of this total, approximately 265 per annum can be attributed to network related incidents. Service cable failures are the primary cause for electric shock incidents reported to ESV and are discussed in more detail in section 4.1 'Service Cables'.

AusNet Services' goal to reduce the number of network related incidents has a focus on reducing the number of asset and ground fires. 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 number of fire incidents is shown in Figure 3.

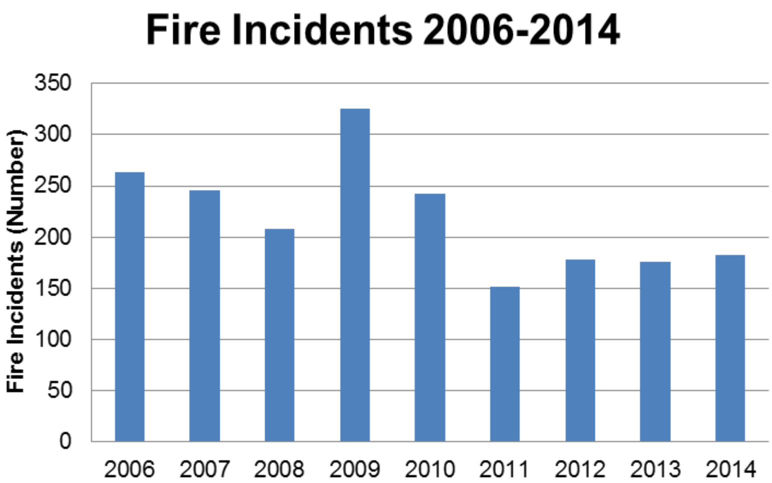

Figure 3 – Number of fire incidents 2006-2014

Despite an abnormal spike in 2009, the total number of fire incidents declined after 2010 and has remained relatively constant since then. The causes of asset and ground fires are in Figure 4.

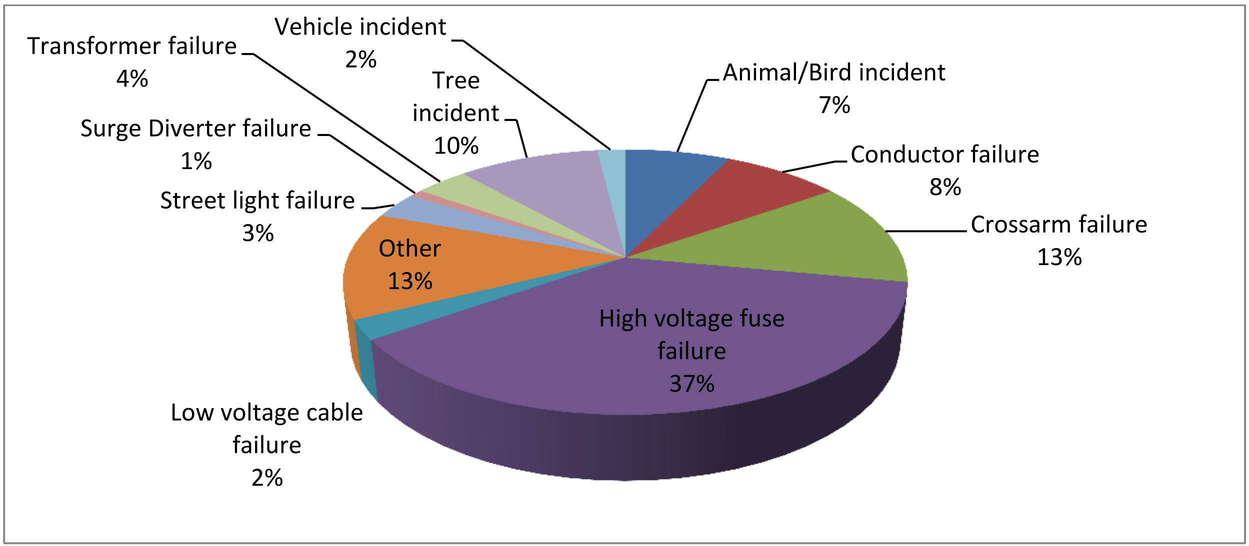

Figure 4 – Causes of Asset and Ground fires

The major causes of asset and ground fires are high voltage fuse failures followed by cross-arm failures, tree incidents, conductor failures and animal/bird incidents. However, many asset failures do not lead to ground fires and therefore the consequence of these asset fires can be less than the consequence of ground fires. Ground fires can have major consequences particularly when the fire occurs in a densely populated, heavily vegetated area in extreme weather conditions. The causes of ground fires are shown in Figure 5.

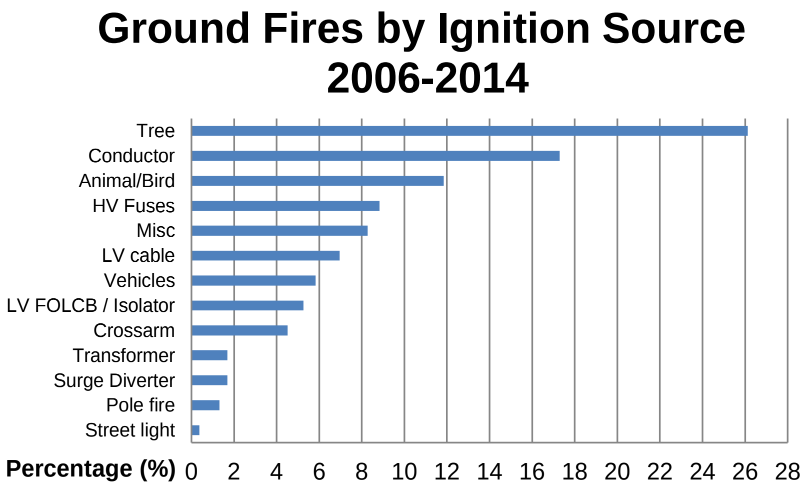

Figure 5 - Ground fires by cause 2006-2014

The main causes of ground fires are trees, conductor, animal/birds and high voltage fuses. Together these four categories generate approximately two thirds of all ground fires. Programs are established to target each of these main causes.

3.3 Risk to Employees

The AusNet Services 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. Maintenance of safe work environments requires constant review and challenge of existing practices and standards to ensure risk is being managed SFAIP.

Key areas reviewed to establish enhanced understanding of risks or improve upon current safety performance include:

- Asbestos based products within AusNet Services' zone substations & buildings
- Lattice tower fall restraints
- Potential risk to employees from explosive failure of ageing plant

Unlike risks to the public that have been identified through quantitative analysis of network incident data, the above mentioned risks rely more upon semi-quantitative and qualitative reviews. With little empirical incident data, the likelihood of an incident occurring involving any of the above mentioned items is considered low, but the consequences are generally considered high.

4 Asset & Business Management Strategies

Strategies to enhance network safety have been developed and are described in this section. The strategies include plant assets, such as cross-arm or conductor replacement, operational strategies such as vegetation management, and business strategies such as occupational health & safety.

4.1 Service Cables

Service cable replacement is primarily driven by replacement of assets that have reached the end of their effective service life. However, service cables have an important role in network safety as customers' receive a number of electric shocks each year due to faulty service cables.

4.1.1 Analysis

The Asset Management Strategy (AMS) - Service Cables[3] indicates that over the period from 2009 to 2013, customers received 388 electrical shocks within their installation due to failure of the service cable neutral conductor. Since 2009, in which there were 106 electrical shock incidents, the planned replacement of neutral screened service cables has progressively reduced electrical shocks to 99 in 2013. Figure 6 represents the reduction in electric shock incidents reported to Energy Safe Victoria.

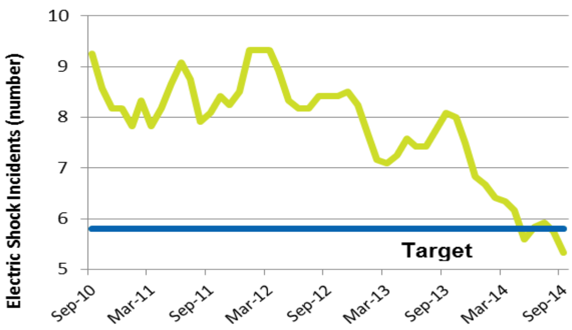

Figure 6 – Electric Shock Incidents[4] (12 month moving average)

Analysis of the service cable failures from 2006 to 2013 revealed an average of 3,800 failures per year. AusNet Services has some level of control for connection and service termination failures which account for 43% and 4% respectively. Whereas clearance encroachment and mechanical damage / failure failures account for 35% and 18% respectively are due to third party incidents and are generally outside the control of AusNet Services.

Analysis of the 2013 Distribution Outage Management System (DOMS) identified that Twisted Black, Twisted Grey and Neutral Screened service cables contributed 3%, 6% and 91% of the known faults respectively. Neutral Screened service cables form only 7% of the service cable population but

[3] AMS 20-76 Service Cables
[4] Network Safety Report – September 2014 page 13, Figure 3.1.12

contribute the majority (91%) of faults. While the targeted replacement program has halved the population of Neutral Screened service cables in recent years, the failure rate has increased. This high failure rate is the driver of the targeted replacement program.

AusNet Services has approximately 600,000 AMI meters recording power quality and consumption data. Through interrogating this data, a defective neutral or loss of neutral connection in a service cable can be detected. This capability to identify emerging service cable faults, in many cases before they manifest as an actual failure, has been tested and proven through 900 successful remediation tasks during 2013 & 2014.

The duration from detection to rectification is illustrated in Figure 7 with a current average time of three days to identify and fix emerging faults.

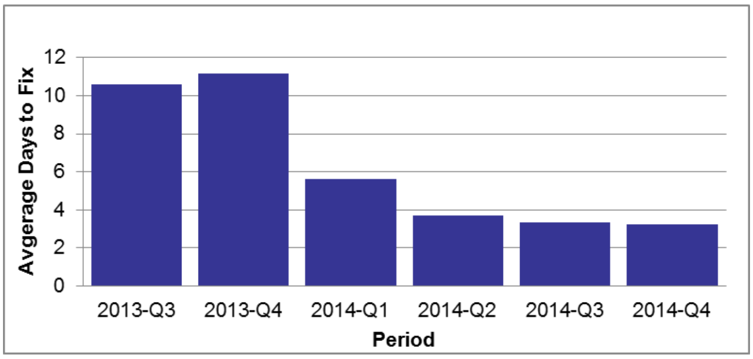

Figure 7 – Loss of Neutral Detection and Rectification Duration

This process has a fundamental safety benefit for consumers supplied from aerial service cables nearing end of life. However, it is a reactive process and hence suffers from lower economic efficiency when compared with a planned replacement program targeted on aerial service cables with high failure rates.

4.1.2 Strategy

The *Asset Management Strategy (AMS) -Service Cables*[5] identifies two key activities to minimise the safety risk associated with service cables. The first strategy involves analysis of AMI data and dispatch of fault crews to emerging service cable failures to mitigate risk of electrical shock in customers' premises. The second strategy is a preventative replacement program of approximately 4000 units per annum declining to 3000 units per annum over the period 2016 to 2020 focussed on Neutral Screened service cables and, to a lesser extent, Twisted Grey PVC service cables.

Table 2 – Neutral Screened Service Cable Replacement Plan 2016-2020

Details	Units
Total number of aerial service cables	257,000
Number of neutral screen service cables	33,000
Forecast number of replacements 2016-2020	16,000
Projected number of neutral screened cables in 2021	17,000
Average annual number of 'shockos' reported to ESV 2013	99
Proposed 'planned' replacement of neutral screened cables 2016-2020	**16,000**

[5] AMS Service Cables 20-76

4.2 Cross-arms

Cross-arm failure presents both unserved energy and bushfire ignition risks. Cross-arm failures are the cause of 13% of all asset and ground fires. A proactive program to replace deteriorated timber cross-arms 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 cross-arms in HBRA.

Cross-arm replacements will continue in the 2016 to 2020 regulatory period and is forecast to replace approximately 17,000 high voltage and 29,000 low voltage timber cross-arms due to condition. This forecast is based on current inspection driven replacements and analysis of the risk of cross-arm related bushfire ignition using the Fire Loss Consequence Model has been completed to determine the volume of cross-arms that should be replaced to meet safety obligations SFAIP.

4.2.1 Analysis

The *Asset Management Strategy (AMS) – Cross-arm*[6] indicates timber type as requiring targeted asset replacement strategies to counter an increasing failure rate which coincides with an increasing mean service age profile. Cross-arm 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. With the failure rate in excess of 160 per annum as shown in Figure 8, this type of asset failure represents a material network safety risk impacting the public, customers and employees.

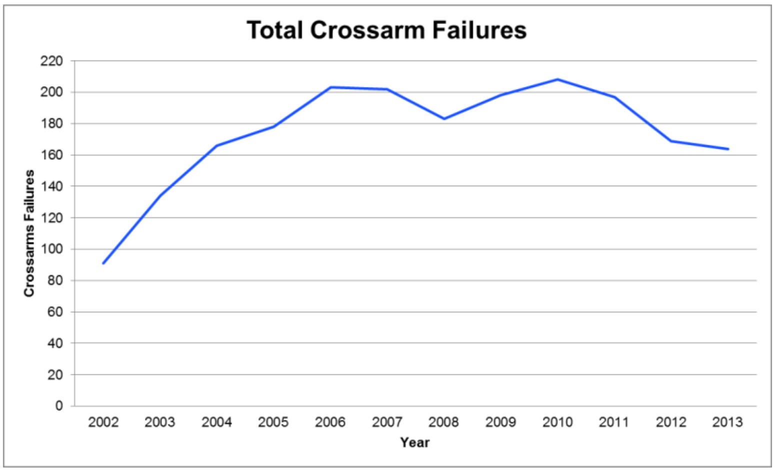

Figure 8 – Cross-arm Failures 2002 to 2013

A cross-arm failure can cause a fire ignition to occur. 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 9.

[6] AMS 20-57 Cross-arm

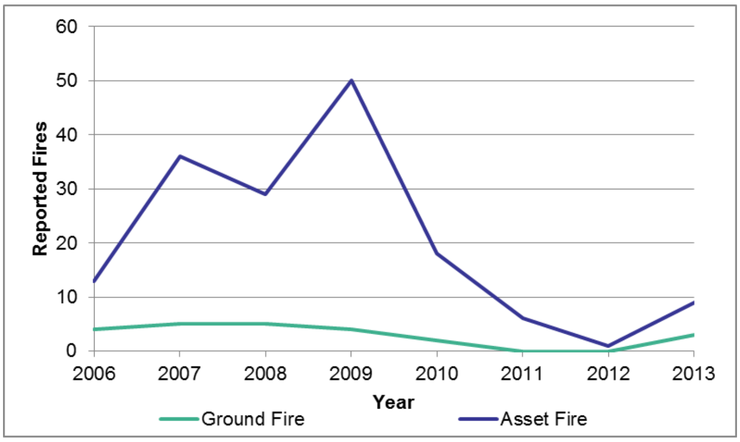

Figure 9 – Fire Starts Attributed to Cross-arm Failures

4.3 Conductor & Overhead Cables

Conductor failure presents both electric shock and bushfire ignition risks. Conductor failures are the cause of 8% of all asset and ground fires and have been the cause of major bushfires. A proactive program of conductor replacement targeted at steel and copper conductor has been undertaken in the current 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.

Detailed analysis of the risk of conductor related bushfire ignition using the FLCM has been completed to determine the volume of conductor that should be replaced to meet safety obligations SFAIP.

4.3.1 Overhead conductor

Analysis

The *Asset Management Strategy (AMS) – Conductor* [7] identifies the length of conductor that should be replaced to meet safety obligations SFAIP. Copper (Cu) and galvanised steel (SC/GZ) are the main conductor cohorts requiring targeted asset replacement to reduce the risk of bushfire ignition. The service age of conductor is shown in Figure 10.

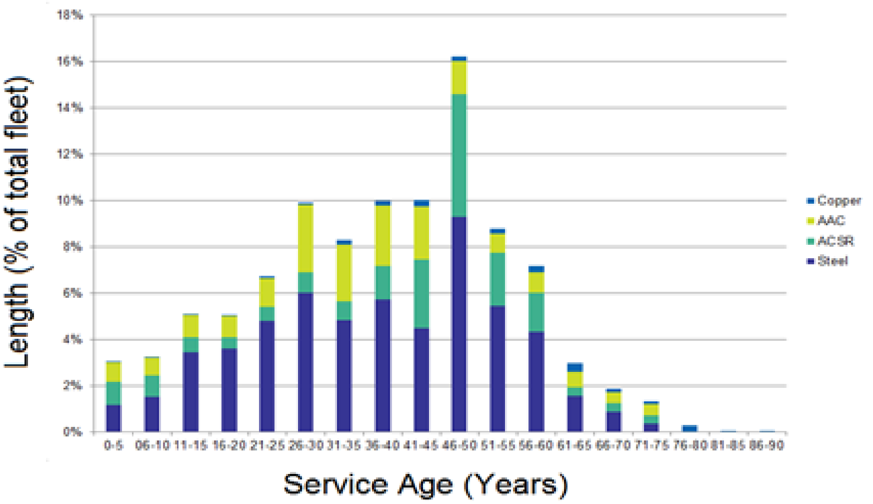

Figure 10 – Service age of bare conductors

[7] AMS 20-52 Conductor

Analysis of conductor failures is shown in Figure 11. Trends indicate that the volume of broken conductors is reducing while the volume of damaged and stranded conductor is increasing. These trends suggest that the current program of conductor replacement has been successful in arresting the number of broken conductors by targeting the conductor in the worst condition. The increase in the volume of damaged or stranded conductor indicates that the volume of conductor that has deteriorated, but not yet reached worst condition, is increasing.

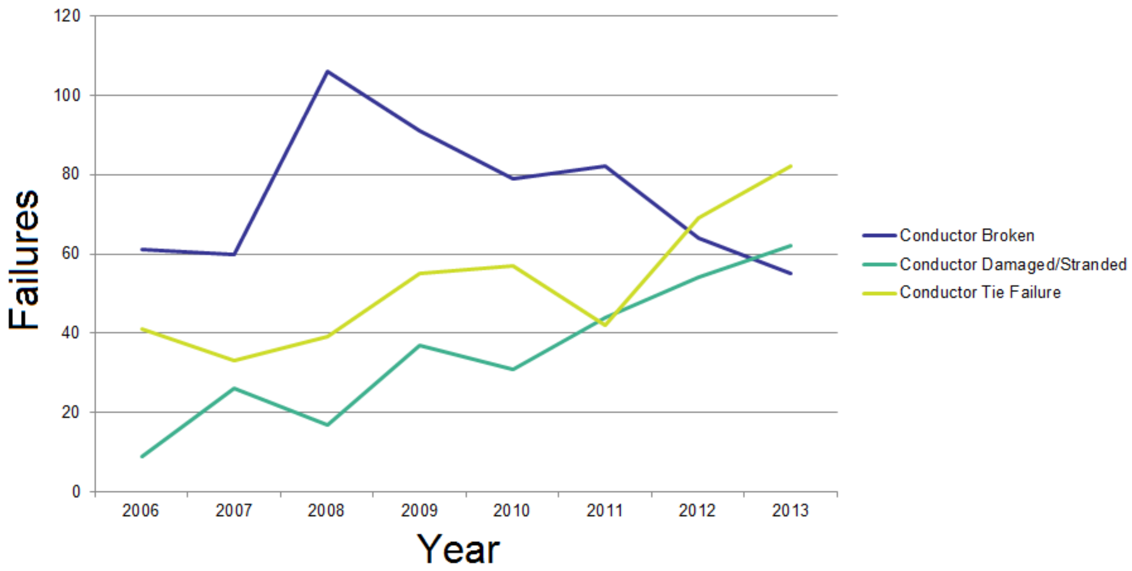

Figure 11 – Conductor failures

Conductor failures continue to be a material cause of asset and ground fires as shown in Figure 12. Conductor failures represent 8% of all asset and ground fires. The number of ground fires caused by conductor failure remains around 10 per annum with the potential for extreme consequences including property damage, loss of life and loss of infrastructure.

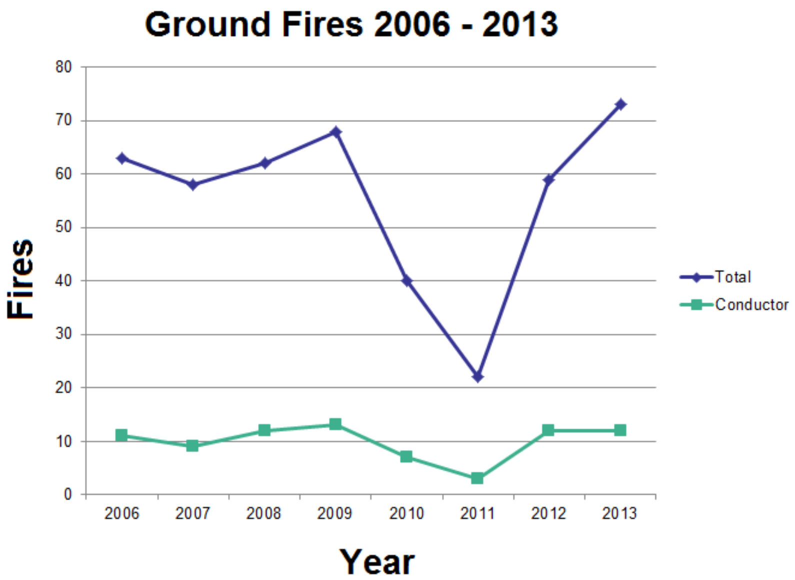

Figure 12 – Ground fires

Analysis has been undertaken which overlays the network onto the FLCM. The map showing fire loss consequence is shown in **Error! Reference source not found.**. The condition of each network span and resulting probability of failure on an extreme fire risk day is used to calculate the risk cost of each span using the consequence costs from the FLCM. This analysis identifies the volume of conductor that should be replaced to reduce the risk of bushfire ignition SFAIP.

C.I.C

Strategy

Continue the program of conductor replacement targeting deteriorated conductor in HBRA to reduce risk SFAIP.

Table 3 - Conductor replacement details for 2016-2020

Details	Units
Total circuit km of conductor replaced due to poor condition	710km
Additional circuit km of conductor replaced to reduce risk of bushfire ignition	1,350km
Proposed conductor replacement 2016-2020	**2,060km**

4.3.2 Vibration Dampers & 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 with 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 will be undertaken in the 2016-20 regulatory period. This will involve the installation at 110,000 structures of dampers and armour rods at a rate of 22,000 per year.

4.3.3 Conductor Spacers & 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 subsequent *Conductor Spacers Plan (AMS 20-52-2)* details the activities required to satisfy the requirements of the Directive which include the following activities.

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.

Medium Voltage Circuit Clearances

The Plan[8] originally submitted to ESV was based upon a requirement to survey an estimated 10,242 multiple MV circuit spans with an estimated exception rate of 0.5% (50 spans). Subsequent to the survey of the first 7,276 spans, an exception rate of 3% has been observed and an additional 4,663 spans identified that require survey. With a revised total 14,905[9] of spans requiring survey and a 3% exceptions rate it is now estimated that a total of 400-500 spans will require some form of augmentation to achieve required circuit clearances.

The plan for completion of the program involves:

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.

[8] AMS 20-52-2 Conductor Spacers Plan (Issue: 1)
[9] AMS 20-52-2 Conductor Spacers Plan (Issue: 2)

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

Table 4 – Circuit clearance details for 2016-2020

Program	2016	2017	2018	2019	2020	Total
MV circuit clearance rectifications (spans)	87	87	87	87	87	435

4.3.4 Overhead Conductor Clearances

Overhead conductor and service cables installed by the former State Electricity Commission were to heights that do not comply with current design standards. AusNet Services maintain a risk management approach, in accordance with its ESMS (refer Section 7, Asset Inspection Manual 30-4111), for the management of overhead conductors and services cables below design standard clearances.

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 5 – Overhead conductor clearance details for 2016-2020

Program	2016	2017	2018	2019	2020	Total
Volumes (pole)	242	242	242	242	242	1,210

4.3.5 Government funded conductor replacement

In 2011 the Victorian Government announced a [C.I.C] 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 [C.I.C] 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 is determined by the Government. Included in the AusNet Services capital forecast is expenditure of [C.I.C] per annum. It is assumed that any work undertaken is fully funded by Government. Further information pertaining to the details can be found in the *Bushfire Mitigation Plan*[10].

4.3.6 HV ABC

Following an escalation in HV ABC failures, some of which resulted in fire ignitions over the 2013/14 summer, AusNet Services established an acceleration of an initially longer-term program for replacement of deteriorated HV ABC. The accelerated program is focussed in the Mt Dandenong area. Analysis of failures, trends and risks were communicated in a paper to ESV and a program to replace 62km of HV ABC included in the Bushfire Mitigation Plan.

[10] BFM 20-21 Bushfire Mitigation Plan

The HV ABC conductor program targeted at bushfire risk areas commenced in 2014 and a large proportion will be complete by the end of the 2011-15 regulatory period. The remaining 10km of conductor will be replaced during 2016. Another program to replace deteriorated HV ABC in areas that do not present a bushfire risk will commence in 2017.

Table 6 – HV ABC replacement details for 2016-2020

Program	2016	2017	2018	2019	2020	Total
Volumes (km) – bushfire areas	10	-	-	-	-	10
Volumes (km) – other areas		9.5	9.5	9.5	9.5	38

4.4 Expulsion Drop Out (EDO) Fuses

4.4.1 Analysis

The *Asset Management Strategy (AMS) – MV Fuse Switch Disconnectors*[11] indicates over 100,000 Fuse Switch Disconnectors (FSDs) are employed in the AusNet Services electricity distribution network. EDO fuses are a specific type of FSD.

EDO fuse failures contribute the greatest proportion (37%) of asset and ground fires. This type of FSD is specifically designed for use in low fault energy locations and fuse element and carrier combinations and fire-chokes are specified to minimise the risk of fire ignition. The EDO fuse population consists of eleven different types and are slowly reducing as units are progressively removed from service. They are being replaced by group fusing systems or by Boric Acid fuses.

In 2000, AusNet Services (formerly TXU) moved from an age based replacement program to a condition based replacement program. The initial change resulted in a reduction in replacement volumes but combined with on-going performance monitoring AusNet Services initiated in 2005, a strategy that targeted EDOs based upon types and location.

High salt pollution areas result in corrosion of the metal fittings and subsequent cracking of the porcelain insulators. 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. Whilst current technology FSDs all demonstrate modes of failure that may result in fire ignition, Boric Acid failure rates are lower than EDOs.

Subsequent to the Powerlines Bushfire Safety Taskforce and its development of a FLCM during 2010-2011, AusNet Services utilised the FLCM model to undertake an economic analysis that resulted in modification to its replacement program in 2011.

4.4.1.1. Fire Loss Consequence Modelling

An outcome of the Powerlines Bushfire Safety Taskforce (PBST) was the development of a fire loss consequence model by Dr K Tolhurst of Melbourne University, referenced in the Final Report dated 30 September 2011. The model was subsequently used by ESV to support their Directive[12] for the suppression of high voltage feeder protection on Total Fire Ban days in those areas designated of highest fire loss consequence. The benefits offered through the new modelling is the provision of a

[11] AMS 20-61 MV Fuse Switch Disconnetors

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

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

Utilising the model, AusNet Services has identified an opportunity to cost effectively reduce community risk through the targeted replacement in high fire loss consequence areas of EDOs over and above previously forecast volumes (10,825) for the 2011-2015 EDPR. Application of a cost benefit analysis has identified the replacement of an additional 9,514 EDO units and 11,246 EDO tubes, which includes an allowance for an overlap of 1,420 sites with the existing program. The program is to replace EDO units with Boric Acid or equivalent technology that has the same or improved performance.

4.4.2 Strategy

The key focus of the EDO strategy is to:

- Replace 9,500 EDO units with Boric Acid, or equivalent, in areas of high fire loss consequence identified through the PBST fire loss consequence model between 2016 and 2020.
- Replace 11,246 EDO tubes in areas of high fire loss consequence identified through the PBST fire loss consequence model by 2016.
- Replace double vented EDOs
- Replace brown and black fuse carriers.
- Maintain condition based replacements (ie. corrosion, cracked insulators).
- Replace EDOs with BA or equivalent where fault current exceeds 1,800 amps.
- Fault crews replace all EDO fuse carriers when attending EDO fuse hang-up.

Table 7 – EDO fuse replacement details for 2016-2020

Capex Program	2016	2017	2018	2019	2020	Total
EDO fuse unit replacements	1,900	1,900	1,900	1,900	1,900	9,500

4.5 Complex High Voltage Structures - Bird & 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 cross-arms 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.

Figure 4, section 3.2 'Risk to Public' indicates bird and animal flashover incidents remain a significant contributor to ground fire ignitions. Accordingly, a review of current initiatives and standards to identify additional opportunities to further reduce this risk SFAIP has been undertaken.

AusNet services will continue to Bird and Animal Proof existing pole top assets in HBRA as a part of the Bushfire Mitigation Program. In the period 2006 to 2013, there were an average of 15 fire ignitions, one of which occurred on a TFB day, associated to Bird and Animal initiated HV flashover arcs per annum.

An assessment has established the implementation of a program to retro-fit existing high voltage complex structures in HBRA at the rate of 1,900 per annum to be an efficient level. This requires the retro-fit of 9,500 installations over the 2016-2020 period. Additionally, insulated leads and covers will be fitted to proposed 11,500 new complex high voltage structures in HBRA areas.

There are approximately 53,000 complex high voltage structures in HBRA areas, 30% of these are bird and animal proofed. The proposed program to retro-fit 9,500 existing installations will have a benefit to cost ratio greater than five. The proposed program is shown below in Table 8.

Table 8 - Bird & Animal Proofing program in HBRA 2016-2020

Complex high voltage structure in HBRAs	Volume
Total HV complex structures in HBRAs	53,000
Total installations requiring bird / animal proofing in HBRAs	37,000
Total proposed retro-fit to existing installations 2016-2020	**9,500**
Total new complex high voltage structures in HBRA	**11,500**

4.6 Enhanced Control & Electrical Protection

Projects to reduce the risk of fire starts using enhanced control and protection techniques commenced in the 2011-15 regulatory period. Replacement of Oil Circuit Reclosers (OCRs) protecting SWER circuits with Automatic Circuit Reclosers (ACRs) enabling the alteration of the reclose function on high fire risk days has been largely completed. Trials of Rapid Earth Fault Current Limiters (REFCLs) have also commenced and are ongoing.

The completed trials and technology development indicate considerable potential for enhanced control and protection systems to economically reduce the risk of bushfire ignition. Further trials and installation of enhanced control and protection systems are planned in the 2016-20 regulatory period.

4.6.1 Automatic Circuit Reclosers

The driver for the replacement of the existing SWER protection scheme with digital protection and SCADA control and targeted three phase ACRs is the community benefit offered through reducing the risk of fire starts on high bushfire days by altering the reclose function or settings on reclosers in HBRA during the fire season either at the start of each fire season or by changing it on high fire risk days.

AusNet Services has replaced 525 Oil Circuit Reclosers (OCRs) that protect SWER circuits and some single-phase circuits with ACRs allowing reclose settings to be changed. Most of these ACRs can be remotely reconfigured via SCADA communications to limit the electrical energy available to a network fault by enabling protection and reclose settings to be remotely adjusted in accordance with the forecast Fire Danger Index (FDI). A project to install satellite based communications services to those ACRs which cannot be reached by other communications technologies is included in the forecast shown in Table 9.

Table 9 – Satellite communication services at ACR sites

Program	2016	2017	2018	2019	2020	Total
Volumes	9	6	6	6	6	33

4.6.2 Feeder Protection & Control

Conductors can be brought to the ground by a number of means such as impact from a falling tree, vehicles hitting poles or asset failure. The safety risks of downed conductors are:

- Fire ignition
- Electrocution of public or employees coming into contact with the live conductor
- Loss of livestock
- Damage to customer equipment due to brownout and voltage variation

Conductors could potentially remain energised on the ground indefinitely as the conventional current-sensitive earth fault protection relay will only provide low-level detection of fault currents. Systems that detect downed conductors or limit fault currents have clear safety benefits through reducing the risks outlined above.

Projects to improve fault detection and reduce fault currents are included in the forecast program. The first program involves replacing Master Earth Fault (MEF) relays. The new MEF relays have the ability to provide current signatures that enable downed conductors to be detected and also provide monitoring and fault recording for Neutral Earth Resistors (NERs). Following detection of a downed conductor, further automated action can be taken such as opening circuit breakers or ACRs to isolate the fault and using Distribution Feeder Automation to restore customers outside the faulted section. MEF relays will be replaced at 31 sites commencing in 2015 and automatic sectionalisation of downed conductors will be implemented at stations where new MEF relays and DFA has been installed.

The second program involves the installation of fault level reducing systems (NERs) at two zone substations, Foster (FTR) and Kinglake (KLK). NERs are already installed at most zone substations. The installations at FTR and KLK will add to the safety of the network by targeting two zone substations which present some bushfire risk and do not currently have an NER installed.

4.6.3 Rapid Earth Fault Current Limiters

Rapid Earth Fault Current Limiters (REFCLs) are a modified Petersen coil, originally developed by W. Petersen in 1917. REFCLs are primarily used in ungrounded 3-phase high voltage distribution networks to limit arcing currents during earth faults.

A REFCL operates when a single phase-to-earth fault occurs. Its operation causes the phase voltage of the faulted phase to be reduced to near earth potential (zero volts), thereby working to eliminate the flow of fault current. To achieve this, the REFCL is tuned to the inductance of the electrical network. The compensation results in altered voltages on the healthy phases in the event of a fault.

REFCL trials have been undertaken at Frankston Zone Substation on the United Energy network and are planned for the Kilmore South Zone Substation on the AusNet Services network in 2015. A further REFCL is being installed at Woori Yallock Zone Substation. These trials are being coordinated by the Victorian Government Department of Economic Development, Jobs, Transport and Resources.

The Government has concluded the Frankston trial confirmed the suitability of technology for the reduction of fire ignition risks associated with distribution network assets. The purpose of Kilmore South and Woori Yallock trials will be to further refine the technology. Accordingly, the Government has commenced the process of preparing a Regulatory Impact Statement (RIS) with the intent of introducing legislation by the end of 2015 to require the Distribution Businesses to install the technology at locations to be determined during 2015. The Government also intends the legislation to require the rollout of REFCL technologies in accordance within set timeframes.

4.6.4 Summary of Enhanced Control and Protection Program

Table 9 – Enhanced Control and Protection details for 2016-2020

Enhanced Control and Protection Program	Volume
Satellite communication services (ACR sites)	33
MEF Relay Installations (zone substations)	31
Automatic sectionalisation of downed conductors (zone substations)	TBD
Installation of NERs (zone substations)	2
Installation of REFCLs (zone substations)	TBD

4.7 No Go Zone

4.7.1 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, as shown in Figure 18. This particular category of regulatory clearance breach has also demonstrated the severe consequences that result in fatalities.

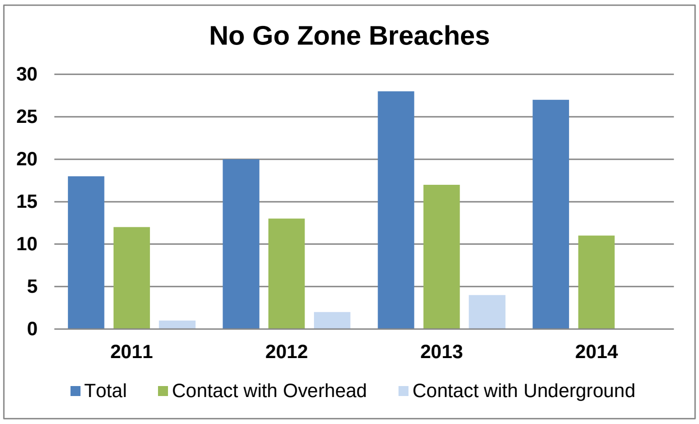

Figure 18 – No Go Zone Breaches

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.

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 a section on its web site that provides information on No Go Zones and links to relevant sites.

4.7.1.1. Infrastructure Security

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.

4.7.2 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.

4.8 Vegetation Management

4.8.1 Background

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.

4.8.1.1. Hazardous Trees

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. Figure 13 indicates trees remain a significant cause of ground fire ignitions.

[13] AMS 20-14 Infrastructure Security

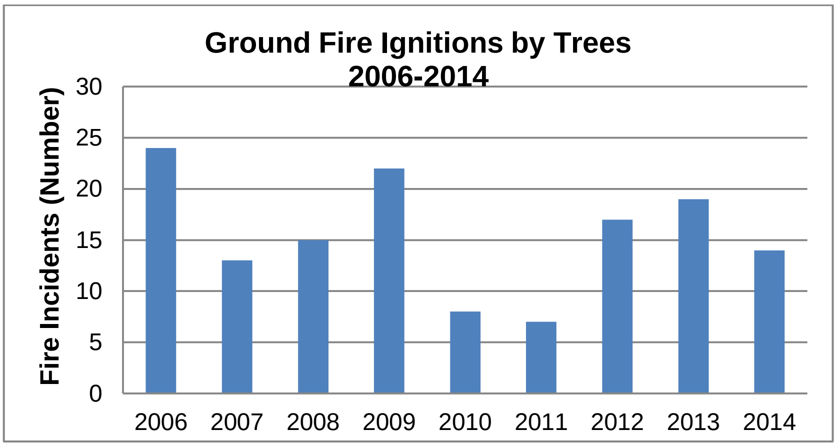

Figure 13 – Ground Fire Ignitions by Trees 2006-2014

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[14] per annum in HBRA. This program was established during the 2011-2015 price review period and remains on-going as shown in Table 10 with no proposed change to Opex requirements.

Table 10 – Hazardous tree removal details for 2016-2020

Program	2016	2017	2018	2019	2020	Total
Volumes (hazard trees)	5,000	5,000	5,000	5,000	5,000	25,000

4.8.1.2. Vegetation Overhangs (56Ms)

The introduction of the *Electricity Safety (Electric Line Clearance) Regulations 2010* removed a previous option to risk manage vegetation overhanging bare overhead powerlines in HBRA.

Under the previous regulations AusNet Services risk managed a small number (approximately 2,000 spans) of significant vegetation, such as Mountain Ash, overhanging overhead bare powerlines. The decision to utilise the option provided under regulation to risk manage these spans was taken due to the impracticalities of either removing or trimming these significant trees to obtain the prescribed clearance space above the powerlines.

Funding was provided within the 2011-2015 Electricity Distribution Price Review (EDPR) period to augment 2,000 spans. Subsequent implementation of the program encountered the following issues;

- The cost per span was under estimated
- The number of 56M spans was under estimated. Actual = 2,275, *and*
- Program deferred, as agreed with ESV, to address new network bushfire risk identified January 2014.

Following a spate of HV ABC cable failures during the 2013/14 fire season that resulted in fire ignitions and in consultation with ESV, a program to replace 63 km of existing HV ABC was commenced in 2014. This resulted in the subsequent deferment of 380 spans of 56Ms into the 2016-2020 EDPR period.

This together with the additional 275 spans now requires the augmentation of 655 56M spans during the 2016-2020 regulatory period, as shown in Table 11, to achieve regulatory compliance.

[14] BFM 10-05 Vegetation Management Plan

Table 11 – Vegetation overhang details for 2016-2020

Program	2016	2017	2018	2019	2020	Total
Volumes (56M span)	655	-	-	-	-	655

4.8.2 Strategy

Whilst legislation in Victoria prescribes **minimum** clearance distances for vegetation to powerlines, AusNet Services proposes embracing sustainable vegetation management practices and policies that seek to minimise disturbance of easements through establishment of appropriate vegetation within easement corridors. AusNet Services consider it prudent to adopt vegetation policies that extend beyond compliance with minimum statutory clearances requirements when incident data indicates possible impacts from climate change may be responsible for an increasing negative trend in performance and safety. The practical application of these policies requires application of the following easement management approaches on an area or case by case basis:

- Establishment of increased easement corridor widths proportional to tree height.
- Removal of hazardous trees/limbs where easement width not achievable.
- Completion of program to eliminate overhangs in HBRA.
- Augmentation of high risk spans where vegetation management not efficient.

4.9 Asbestos

4.9.1 Introduction

AusNet Services has a strategy for the management of asbestos risk that involves actively targeting high risk asbestos and passively targeting medium to low risk installations.

4.9.2 Analysis

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

In accordance with the asbestos strategy AusNet Services proposes addressing Level II risks during the 2016-2020 price review period which involves initiatives that can be undertaken independently of asset replacement projects and are of the nature illustrated in Figure 14. This Figure indicates rope seals around electrical cabinets as the major component together with removal of loose materials, debris and dust.

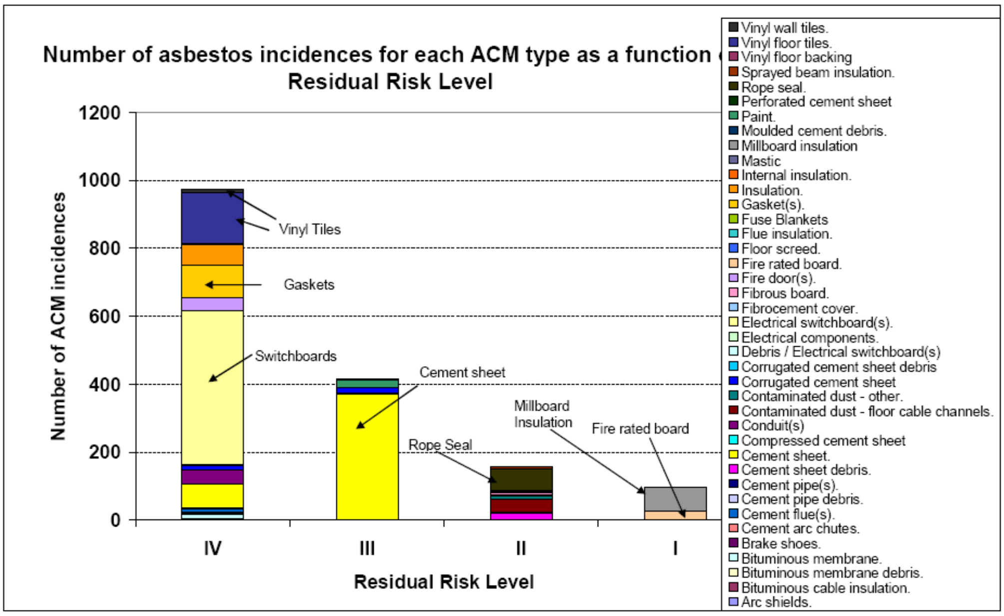

Figure 14 – Asbestos Type

4.9.3 Strategy

AusNet Services will complete Level II asbestos removal as an independent program in accordance with the asbestos 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. During the 2016-2020 price review period, AusNet Services will be targeting asbestos removal in conjunction with proposed station rebuilds at Leongatha, Maffra, Moe, Myrtleford, Seymour, Thomastown and Watsonia. Further details are provided in Table 12.

Table 12 – Associated Asbestos Removal in Conjunction with Proposed Station Rebuild Projects

Station	Asbestos Removal Details
Leongatha	Black asbestos electrical boards in the 66kV yard to be removed as part of replacement of two 66kV Circuit Breakers
Maffra	Panels containing asbestos in the control room to be removed as a new control room is being installed
Moe	Black asbestos electrical boards in the 66kV yard to be removed as part of replacement of two 66kV Circuit Breakers
Myrtleford	Control building to be refurbished to remove external cement sheet containing asbestos
Seymour	Control room roof and walls are cement sheet containing asbestos. Control room floor tiles contain asbestos. Some relay panels in control room also contain asbestos. The amenities building have walls made of cement sheet containing asbestos. Both buildings to be replaced.
Thomastown	Asbestos in the cement sheet cladding of the control building is being replaced as part of a separate project. Black asbestos panels in 22kV switchyard to be removed as part of 22kV bus replacement
Watsonia	Black asbestos panels in 22kV switchyard to be removed as part of 22kV bus replacement

4.10 Occupational Health & Safety

Occupational health & safety risks arise through maintenance and construction activities. These risks include the risk of injury from electric shock, explosive or mechanical failure, falls and exposure to EMF. 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.

4.10.1 Analysis

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.
- 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. With increasing asset age profiles, AusNet Services has identified potential underlying risk to the health and safety of personnel operating in zone substations. Accordingly, AusNet Services has proposed predictive asset replacement strategies for several classes and cohorts of zone substation plant and equipment.

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

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 2 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.

4.10.2 Strategy

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. In addition to this system, specific asset related risks will be addressed.

In zone substations, the asset cohorts that present a risk to personnel operating or working in close vicinity due to the asset condition and risk of failure have been identified. A number of zone substation rebuild projects target the replacement of these assets. Further, several asset classes are identified for planned replacement under specific asset management strategies including:

- Current Transformers – risk of explosive failure;
- Disconnectors mounted on cap and pin type brown and grey porcelain type insulators – mechanical failure risk during operation;
- Station surge arresters (silicon carbide – gapped porcelain).

Identification of asset replacement volumes are identified within individual asset management strategies for respective asset classes and zone substations. A summary of those strategies containing assets considered to have a significant driver due to risk for personnel health and safety include those in Table 13.

Table 13 – Recommended Zone Substation Plant Replacement 2016-2020

Details	Units
Current transformer replacement (Safety & condition based replacement)	17
Disconnector, switches & isolator replacements (Safety & condition based replacement)	144
Station surge arresters (Safety & condition based replacement)	195 sets

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.

4.11 SWER Earths

Testing has identified that a number of SWER earthing systems exceed the Upper Specification Limit (USL). In particular a significant proportion of SWER MV concrete poles exceed the USL. Overall the results are higher in the SWER network compared to previous years. The reasons for the higher results may be attributed to lower than usual annual rainfall and continued deterioration of the steel earth stakes originally used in installations built prior to 1983. The results of SWER Earth tests are shown in Table 14.

Table 14 – SWER Earth Testing Results

EARTH	USL (Ohms)	Population	% Exceeding Upper Specification Limit (USL)		
			2011/12	2012/13	2013/14
SWER ISO MV	30	500	1.2%	0.6%	2.8%
SWER Dist'n MV	40	10,500	0.8%	1.6%	3.2%
SWER Dist'n LV	250	10,500	0.0%	0.0%	0.0%
SWER MV Concrete pole	40	5,000	18.1%	12.7%	13.9%

A program is planned to progressively remediate non-compliant earths on SWER MV concrete poles to less than 3% by 2020. This will result in remediation of 318 SWER earths each year over the 2016-2020 regulatory period.

15 Project 74316513 66kV Towers VFAS Installation – Stage 1