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Creating a safer state with electricity and gas

Safety performance report on Victorian electricity networks

October 2018

VICTORIA State Government

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This report has been endorsed by the Director of Energy Safety in Victoria.

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Foreword

In January 2017, the Government announced a review of the state's electricity and gas network safety framework, headed by Dr Paul Grimes, to ensure the effectiveness of the framework in delivering desired safety outcomes for Victorians.

The review included 43 recommendations and there were a further 20 recommendations from a separate assessment of ESV's data strategy and incident data commissioned as part of the review. These recognised many initiatives that ESV was already implementing, and included others that were identified and developed through the dialogue between the review team and ESV.

As part of the final report, the review identified 10 essential elements that underpinned its findings. While ESV has been moving forward with many of the review's recommendations this year, I will talk to four of the elements specifically (in italics below).

The last twelve months has seen ESV *build a stronger and more active ESV presence out 'on the ground'*. We have not just expanded the staff numbers in the Regulatory Assurance and Line Clearance Assurance teams, we have been conducting more and broader inspections and investigations and engaging more with local government and other parties with line clearance and bushfire mitigation responsibilities.

While ESV seeks to work with the businesses it regulates and influence their behaviours to achieve a more effective, long-term electricity safety culture; this has to be balanced with a *preparedness to take strong regulatory action* when required. We are currently prosecuting Powercor in relation to three grass fires and 189 alleged breaches of the regulations. In ESV's view, Powercor's ongoing and systemic failure to manage its vegetation clearance responsibilities appropriately is unacceptable; action had to be taken.

ESV has continued to work with the distribution businesses to ensure safety is embedded within their organisations. Through the implementation of a safety case regime, we are *building and supporting deep safety cultures within the network businesses* with increased engagement of leadership within the businesses. We now have accepted safety cases in place with all the distribution businesses. Our expanded numbers will allow us to better test performance, verify outcomes and fully embed a deeper electricity safety culture.

To target our regulatory activities better and identify emerging risks earlier, we have seen the need to *substantially strengthen ESV's analytical capabilities* and utilise data. As a result, we have significantly expanded the numbers and diversity of expertise within our Data and Analytics team. This now provides us with the core skills and experience we need to build the data lakes, tools and dashboards required to provide robust and timely information to support effective regulatory decision-making. The analyses presented in Section 5 (and elsewhere through this report) demonstrate the enhanced level of analytics that we can now bring to industry regulation.

Over the coming years, we will continue to implement the recommendations of the review. This will ensure that we can more robustly test, challenge and expose the performance of all those parties that we regulate, and thereby maintain the integrity of Victoria's electricity networks and ensure the safety of the Victorian public.

I commend this eighth safety performance report.

Paul Fearon
Director of Energy Safety

Executive summary

This report addresses the financial year from July 2017 to June 2018. The report reviews the performance of the major electricity companies and analyses their performance over time, while looking for common themes and issues the industry faces.

There was one fatality this year involving electrical network infrastructure. The incident involved a tip truck inadvertently making contact with live high voltage powerlines as it raised its trailer while unloading. Our investigation found that there was no fault attributable to the distribution network operator.

Two incidents involving electricity distribution assets resulted in injuries:

- two Zinfra (Jemena) employees received electrical burns due to an incident at a substation in Preston
- a lineworker received an electrical burn from an incident at Newcomb.

WorkSafe Victoria is leading both investigations, with ESV supporting and following up the implementation of corrective actions to prevent recurrence.

The Electricity Safety (Bushfire Mitigation) Regulations require the distribution businesses to reduce the bushfire risk presented by the lines emanating from 45 zone substations. This will be achieved through the deployment of rapid earth fault current limiters (REFCL) and the replacement of bare conductors with underground cables or covered cables in specified areas.

ESV has recruited additional resources to more effectively regulate these activities specifically, and to increase our focus on asset management practices more generally.

As part of these activities, Powercor has commissioned Victoria's first compliant REFCL under the new regulations, and AusNet Services and Powercor are replacing conductors at end of life. Powercor is also on track with its delivery of Automatic Circuit Reclosers; all other distribution businesses have completed their deployments.

Uncertainty around the REFCL operations producing voltages on the network that are non-compliant with the Electricity Distribution Code have now been resolved. This was achieved through amendments to the Code to allow the increased voltages. The Essential Services Commission's expectations of the businesses and their customers are now clear.

As a result of changes to the F-factor Scheme Order implemented this year, ESV now has a role in validating the fire start reports submitted to the Australian Energy Regulator (AER) by the distribution businesses. ESV has worked closely with the AER in developing appropriate reporting templates and in consulting with the businesses to identify areas for improvement in the reporting process.

We have completed our assessment of the detailed safety cases submitted by the distribution businesses and are now working with them to finalise their Electrical Safety Management Schemes. This work continues to proceed in parallel with major investigations (see below). The increased staff numbers in the Regulatory Assurance and Line Clearance Assurance teams have allowed us to pursue such investigations without compromising vital business-as-usual functions.

Last year, I described the work we were undertaking to provide greater clarity of the risks we regulate and the controls available to prevent undesirable events occurring (for example, bushfire ignition). We have continued to pursue a risk-based approach by focusing on how to better target our regulatory activities. Together with increased attention on data collection and analysis, this is starting to yield benefits through ESV being better equipped to address issues with the distribution businesses and, where necessary, take enforcement action.

Asset failures were below the seven-year average in general; March and May were the only months with elevated incidents. Failures were also reduced across all asset types except for connections failures, pole failures (marginal increase), and failures of underground cables and other ground-based assets.

Incidents due to contact with network assets were in line with the seven-year average for the first seven months of the year and well in excess of the average for the remaining five months. There were large increases in miscellaneous contact events (copper theft, vandalism and intrusions into the No Go Zone around overhead conductors) and vehicle impacts. There were also increases in tree and animal contact.

In relation to ground fires from such incidents, fires from asset failures were in line with the seven-year average whereas contact-related fires were significantly greater than the average for six months of the year.

Given the high degree of inter-annual variability due to climate, we considered the fires across the fire season in relation to a comparable year for fire risk — the 2015-2016 fire season. Overall, the total number of fires this year was on track to be fewer than in 2015-2016 until the St Patricks Day weekend; there were 44 network-related fires on that weekend and in the following days. ESV has investigated the fires that occurred; most were due to vegetation blown into the powerlines from outside the clearance space during severe winds that swept through the southwest of the state. There were, however, two fires that ESV is still investigating to determine whether enforcement action is appropriate.

There were also three fires in January attributed to non-compliant vegetation contacting high voltage powerlines. Following investigation of these fires, we identified widespread non-compliances between Shepparton and Mildura. We are prosecuting Powercor for the three ground fires and a further 189 breaches of the electric line clearance regulations; this matter is currently before the courts.

We reported on high levels of non-compliant vegetation reported across the Powercor network last year. This has been repeated this year. There appears to be a systemic issue with the management of vegetation along its powerlines. ESV is currently addressing this with the Powercor CEO.

Hot weather caused numerous outages on Australia Day as fuses operated to protect network assets from high loads. These have been investigated together with the Department of Environment, Land, Water and Planning.

In the early part of the fire season, United Energy approached ESV after it identified 196 non-compliant spans in High Bushfire Risk Areas across its network that it was not aware of prior to the start of the fire season. This arose due the implementation of new light detection and ranging (LiDAR) techniques that identified vegetation at height that could not be readily detected using traditional ground-based visual assessment methods. ESV has worked with United Energy to put a plan in place to address these non-compliant spans before declaration of the 2018-2019 fire danger period.

We also identified an unacceptably high level of non-compliance in Low Bushfire Risk Areas during this year's electric line clearance audits of the Jemena network. Given the low risk posed by the non-compliances observed and Jemena's prompt response and action to satisfy ESV (verified during unannounced audits), we have not pursued this matter further.

With the exception of Powercor, ESV has not observed evidence of systemic failure to operate or maintain the safety of their networks or to mitigate bushfire risk.

With the expansion of the Line Clearance Assurance team, we have also been undertaking more work with the local government in relation to their electric line clearance responsibilities. In addition to ongoing education and consultation activities, we have also issued four councils with Section 86 notices this year. These notices require the relevant councils to clear their non-compliant spans. All four councils responded to the satisfaction of ESV.

In reading the remainder of this report, you will note several other reports referred to in the footnotes. These are worth the time to read as they will provide you with further valuable insights on specific performance issues.

Ian Burgwin
General Manager
Electrical Safety and Technical Regulation

Contents

1. Introduction

On 10 August 2005, Energy Safe Victoria (ESV) was established by the *Energy Safe Victoria Act 2005*. ESV is responsible for the safety and technical regulation of electricity, gas and pipelines in Victoria.

ESV is committed to the safe, efficient supply and use of electricity and gas. This is the eighth year that ESV has reported on the safety performance of the Victorian electricity distribution businesses and the seventh year it has reported on the safety performance of the Victorian electricity transmission businesses. This report informs stakeholders, the community, government and industry of how well these businesses are meeting their safety obligations.

This report also provides transparency of ESV's role in regulating the safety of electricity supply in Victoria and focuses on the key safety indicators reported by each major electricity company:

- incidents on the electricity network
- progress of directions placed on each distribution company to meet the recommendations of the 2009 Victorian Bushfires Royal Commission
- operation of each company's Electricity Safety Management Scheme
- results of audits and inspections of the major electricity companies, including those to assess the readiness of these companies for the bushfire season.

1.1 Aim

The aim of the report is to inform the community, government and industry of how the major electricity companies have performed when delivering their electricity network safety obligations.

This report covers the 2017-2018 financial year, being the 12-month period from 1 July 2017 to 30 June 2018.

1.2 Objective

The objective is to analyse the broad range of safety-related information that ESV acquired during the 2017-2018 financial year to highlight areas of good and bad performance, identify common themes and trends, draw conclusions and make appropriate recommendations.

1.3 Scope

The report assesses data supplied by each major electricity company and examines the safety performance of each major electricity company for 2017-2018 financial year. Some longer-term trends are also discussed.

2. Regulatory context

The *Electricity Safety Act 1998* (the Act) vests ESV with the statutory objective of ensuring electrical safety across Victoria. The responsibility for the safety of Victoria's electricity transmission and distribution networks lies with two groups defined in the Act that ESV regulates — the major electricity companies and other responsible persons. These groups and the regulatory context for ESV's powers are described below.

As they are the primary operators of Victoria's electricity networks, this report predominantly focuses on the performance of the major electricity companies.

2.1 Major electricity companies

2.1.1 Description

Major electricity companies comprise both licenced electricity transmission companies and licenced electricity distribution businesses.

An overview of the major electricity companies is provided in Table 1.[1]

While generally similar in engineering terms, the major electricity companies have evolved differently as various engineering solutions have been adopted in line with the different environments affecting their operations. These differences include geography, topography, customer base and operating environment; all of which have the potential to influence safety performance. As such, care must be taken when comparing the performance of the individual major electricity companies; direct comparisons often may not be possible.

[1] The asset statistics presented are from the Category Analysis Regulatory Information Notice (RIN) data found on the website of the Australian Energy Regulator (AER) (www.aer.gov.au/networks-pipelines/network-performance). These data have been subject to independent audit as part of the RIN reporting process.
The other data are compiled from the websites of the major electricity companies.

2.1.2 Regulatory requirements

The safety performance of the major electricity companies is measured in the context of compliance with the Act as underpinned by subordinate regulations that include:

- Electricity Safety (Management) Regulations 2009

  These establish the requirement for each major electricity company to submit an Electricity Safety Management Scheme (ESMS) to ESV every five years for acceptance. ESV regularly audits each major electricity company for compliance with its ESMS.

  In 2015, ESV introduced the requirement to submit a safety case as a precursor to the preparation of an ESMS.

- Electricity Safety (Bushfire Mitigation) Regulations 2013

  These prescribe the particulars of bushfire mitigation plans, which the major electricity companies are required to submit to ESV every five years for acceptance under the Act. ESV regularly audits each major electricity company for compliance with its plan.

- Electricity Safety (Bushfire Mitigation Duties) Regulations 2017

  These prescribe additional bushfire mitigation requirements applying to major electricity companies under part 10A of the Act. These duties are discussed in more detail in Sections 3.1.1 and 6.2.2.

- Electricity Safety (Electric Line Clearance) Regulations 2015

  These establish the requirement for each major electricity company to submit an electric line clearance management plan to ESV each year for approval and to comply with the Code of Practice for Electric Line Clearance, a schedule to the regulations. ESV regularly audits and inspects each major electricity company for compliance with its approved plan.

Table 1 Electricity network overview

Transmission companies	
AusNet Services	
Voltages:	500kV AC and 220kV AC transmission across Victoria[2] 66kV AC sub-transmission across Victoria 330kV AC on interconnector to New South Wales 275kV AC on interconnector to South Australia
Powerline length:	6,560 km, including 8.5 km of underground cable
No. of towers:	13,300 approx.
Basslink	
Voltages:	500kV AC and 400kV DC link between Loy Yang power station in south east Victoria and George Town in northern Tasmania
Powerline length:	67 km total in Victoria 3.2 km of 500kV AC overhead line 57.4 km of 400kV DC overhead line 6.6 km of 400kV DC underground cable
No. of towers:	142
Transmission Operations Australia	
Voltages:	132kV from Mt Mercer Wind Farm to Elaine Terminal Station
Powerline length:	22 km
No. of towers/poles:	162
Transmission Operations Australia 2	
Voltages:	132kV from Ararat Wind Farm to Ararat Terminal Station
Powerline length:	21 km
No. of towers/poles:	106

Distribution businesses	
AusNet Services	
Customers:	679,000 approx. (90% residential)
Service area:	80,000 km^2
Powerline length:	44,900 km (85% rural, 15% underground)
No. of poles:	335,000 power and 86,600 public lighting approx.
CitiPower	
Customers:	321,000 approx. (85% residential)
Service area:	157 km^2
Powerline length:	5,680 km (25% CBD, 55% underground)
No. of poles:	49,100 power and 9,100 public lighting approx.
Jemena	
Customers:	319,000 approx. (89% residential)
Service area:	950 km^2
Powerline length:	6,340 (86% urban, 30% underground)
No. of poles:	81,200 power and 26,100 public lighting approx.
Powercor	
Customers:	748,000 approx. (85% residential)
Service area:	145,651 km^2
Powerline length:	76,480 km (92% rural, 10% underground)
No. of poles:	488,200 power and 83,600 public lighting approx.
United Energy	
Customers:	640,000 approx. (90% residential)
Service area:	1472 km^2
Powerline length:	12,360 km (25% urban, 26% underground)
No. of poles:	168,700 power and 35,800 public lighting approx.

[2] AC = alternating current. DC = direct current, kV = kilo Volt (or 1000 Volt).

2.2 Other parties identified in the Act

2.2.1 Description

The Act identifies responsible persons in addition to the major electricity companies that have responsibility for electric line clearance. These persons fall into two groups:

- municipal councils whose duties are specified in Section 84C of the Act in relation to declared areas
- other responsible persons specified in Sections 84A, 84B and 84D.

Not all council areas contain declared areas. Of the 79 municipal councils across Victoria, all 31 metropolitan councils and 36 of the 48 regional councils are responsible persons.

The Act also identifies specified operators that are persons that operate a high-voltage overhead electric line in a hazardous bushfire risk area (HBRA) as declared by a fire control authority under Section 80 of the Act. These are a subset of responsible person with additional bushfire mitigation responsibilities.

Specified operators include several wind farms and power stations, the Australian Defence Forces/Defence Estates Victoria, Australian Paper Maryvale, Fosterville Goldmine, Melbourne Water and Coliban Water.

2.2.2 Regulatory requirements

Under the Act, responsible persons are required to maintain vegetation clear of electric lines. For councils, this is the case for all vegetation on public land that they manage within their declared areas. Specified operators are required to clear all vegetation from their electric lines. This is the case for the major electricity companies as well, except for vegetation on public land in declared areas where the municipal council is responsible.

Responsible persons under sections 84 of the Act (distribution companies), 84C (municipal councils) and 84D (electric line owners and operators, which include transmission companies) are required to produce an ELCMP annually. Of these, only the major electricity companies must submit their ELCMP by 31 March of every year for approval.

While responsible municipal councils and specified operators are required to prepare an ELCMP before 31 March every year, they do not have to submit it to ESV for approval each year. Such responsible persons are required to provide a current ELCMP if requested by ESV and ESV may decide to approve these ELCMPs.

2.3 ESV regulatory program

As part of its regulatory program, ESV undertakes the following:

- mandatory safety plan reviews for each major electricity company
  - safety cases
  - Electricity Safety Management Schemes (ESMS)
  - bushfire mitigation plans (BMP)
  - electric line clearance management plans (ELCMP)
- reviews of ELCMPs for other responsible persons (at ESV request)
- audits, inspections and observations
  - planned audits and inspections of safety plan implementation
  - planned and unannounced observations of works practices
  - inspections of vegetation clearance and bushfire mitigation works, including those prior to the fire danger period to ascertain bushfire preparedness.
- safety incidents
  - tracking and analysis of reportable safety incidents
  - investigation of major safety incidents

- directions and exemptions
  - monitoring of major electricity company performance in implementing ESV directions regarding asset safety upgrades
  - assessing requests for temporary exemptions from meeting the regulations, particularly during transitional periods after the declaration of new regulations
  - assessing exemptions related to the installation of electric lines on public lands.

2.3.1 Directions

Following the 2009 Victorian Bushfires Royal Commission, ESV issued directions to all distribution businesses to undertake upgrades of assets that had been identified by the Commission as having the potential to cause bushfires. The two directions issued by ESV related to:

- installation of armour rods and vibration dampers to reduce wind-induced vibration and fatigue
- installation of spacers on high voltage (HV) lines and spreaders on low voltage (LV) lines to prevent clashing of lines in high winds.

These directions required the businesses to complete all works in the hazardous bushfire risk area (HBRA) by 2015 and in the low bushfire risk area (LBRA) by 2020. The progress of the businesses in completing these directions is included in this report.

ESV also issued a direction to Powercor on 11 July 2014 and to AusNet Services on 27 June 2014 on behalf of the Victorian Government's Powerline Replacement Fund. The directions required them to complete certain powerline replacement projects by specified dates and to report progress quarterly. The requirements of the directions were subsequently incorporated into their bushfire mitigation plans and the last of the directions were completed during the 2017-2018 financial year.

2.3.2 Exemptions

The major electricity companies may seek exemptions from regulations from time to time. This may be to allow for additional time to transition to compliance or in specific circumstances where compliance would be impracticable to achieve.

ESV has broad powers to grant exemptions from certain regulatory obligations; however, ESV does not have the power to grant exemptions from the Electricity Safety Act. Exemptions from the Act can only be granted by the Governor in Council on the recommendation of the Minister.[3]

When making decisions regarding exemptions, ESV may seek:

- demonstration that safety risks are reduced or remain the same, or
- commitments from the company regarding works to be undertaken and timetables for achieving compliance.

ESV will then monitor progress towards successful completion and continued operation.

[3] In forming a recommendation regarding such an exemption from the Electricity Safety Act, the Minister will receive a recommendation from the Director of Energy Safety based on advice from ESV staff and, if he so requests, the Powerline Bushfire Safety Committee. The Minister may also take advice from the Department of Environment, Land, Water and Planning.

If the Governor in Council grants an exemption from the Act, ESV subsequently grants an exemption from the associated regulations.

3. Risk management and governance

ESV continues to implement a range of initiatives to improve its risk management and governance processes. The outcome of these improvements will be closer oversight of the major electricity companies, councils and other responsible persons.

3.1 Changes in the regulatory environment

3.1.1 Bushfire mitigation regulations

The Electricity Safety (Bushfire Mitigation Duties) Regulations 2017 commenced on 1 September 2017 to support amendments to the Electricity Safety Act 1998, which introduced civil penalties for major electricity companies that fail to meet their additional bushfire mitigation duties.

ESV is responsible for administering this legislation, and has ensured the necessary resources are available to regulate this activity effectively within the regulatory timeframes.

3.1.2 F-factor scheme

The F-Factor Scheme Order 2016 encourages the distribution businesses to target works (asset replacement, maintenance and operations) to reduce those fire ignitions that pose the greatest risk of harm. The Australian Energy Regulator (AER) manages the Scheme.

Under the Scheme, each distribution business is required to submit a fire start report to the AER by 30 September each year. Where required, the AER can request that ESV review these reports and submit individual draft validation reports to the AER by 30 November each year. These drafts are provided back to the businesses for comment, and final validation reports are to be provided to the AER by ESV by 28 February.

ESV worked with the AER in early 2017 to develop standard templates for the fire start reports and terms of reference for the independent audit that each business will submit with its fire start report.

The first fire start reports under the new Scheme were submitted to the AER by 30 September 2017. These reports covered the period from 1 July 2016 to 30 June 2017. The final fire start reports and validation reports are available through the AER website.[4]

Following the provision of the final validation reports, the AER and ESV consulted with the distribution businesses to provide feedback on, and identify improvements to, the submission and validation processes. ESV subsequently developed an improved reporting template for use in compiling the 2017-2018 fire start reports due by 30 September 2018.

3.1.3 Electricity and Gas Network Safety Framework Review

On 19 January 2017, the Minister for Energy, Environment & Climate Change Lily D'Ambrosio announced an *Independent Review of Victoria's Electricity and Gas Network Safety Framework* (the Review) headed by Dr Paul Grimes. The main objective of the Review was to ensure the effectiveness of the framework in delivering desired safety outcomes for Victorians.

As part of the Review, Dr Grimes commissioned the Centre of Excellence for Biosecurity Risk Analysis (CEBRA) at The University of Melbourne to undertake an assessment and analysis of ESV's electricity and gas incident data and data strategy.[5]

[4] www.aer.gov.au/networks-pipelines/network-performance/victorian-electricity-distribution-businesses-public-fire-start-reports-for-the-july-2016-to-june-2017-reporting-period

[5] Robinson, A., and Lane, S. (2017) *Assessment and Analysis of Incident Data Held by Energy Safe Victoria*, CEBRA report, 21 September 2017.

An interim report was released for public comment on 31 October 2017. The final report of the Review was released on 1 August 2018, together with the Victorian Government's response to its findings.

The final report included 43 recommendations; the CEBRA report included a further twenty recommendations related to building and improving ESV's data analytics capabilities. Many of these were endorsements of works underway or proposed by ESV.

In its response, the Victorian Government fully supported 21 of the report's recommendations and supported, in principle, a further 21 recommendations. One recommendation was not supported. One of the recommendations supported in principle was the recommendation to implement the findings of the CEBRA report.

ESV has been actively implementing all recommendations since the release of the interim Review in October 2017. We will work with government to clarify how the in-principle recommendations can be implemented.

The Review's final report and the Victorian Government response can be found at engage.vic.gov.au/electricity-network-safety-review.

3.2 Improving ESV practice

ESV has continued to improve its regulatory practice to provide better understanding of the industries it regulates and ensure appropriate rigour is applied to its decision-making such that it remains consistent, predictable and defendable.

Safety case and ESMS reviews are now managed through a documented process that leads to the presentation, by the evaluation team, of a case for acceptance to an independent panel of senior executives and managers. The responsible General Manager then accepts the safety case or ESMS. Matters in dispute are escalated to the Director.

This approach ensures:

- sufficient rigour is applied to an assessment
- consistent practice across all ESV divisions
- consistent standards are applied when assessing submissions.

3.2.1 Risk-based regulation

Last year ESV undertook considerable work to better understand the risks ESV regulates and the controls available to prevent undesirable events from occurring. That work has continued with further effort to establish performance standards detailing critical controls identified in risk bow-ties to improve ESV's regulatory targeting. These performance standards document regulatory oversight measures to determine the effectiveness of the available controls.

Whole-of-life, risk-based asset management and risk assessment are two critical controls that ESV will focus on in coming years. During these reviews, safety system audits are to be conducted in order to benchmark the industry and identify if risks are being managed as far as practicable.

This work will assist in strengthening ESV's capability and preparedness to take strong regulatory action.

3.2.2 Audit and inspection practices

ESV has now developed a survey tool to capture electric line clearance field inspection findings electronically. This data is managed through ESV's Geographical Information System. The capture of inspection data in this manner has enabled better analysis of compliance standards and is being used to inform regulatory assurance and targeting.

ESV will continue to develop this tool to see where it can be applied to other aspects of the business. Our Data and Analytics team is already looking to how we can better target audits and inspections, improve the analysis of results and make the reporting process more efficient.

3.3 ESTR growth

The Electrical Safety and Technical Regulation division (ESTR), within ESV, has expanded its capability during the 2017-2018 period. This is driven by a need to secure greater assurance that the major electricity companies and other regulated entities are appropriately delivering their regulatory obligations.

The expansion of ESTR is allowing ESV to better test, challenge and expose the effectiveness of regulated entities in their capacity, and willingness, to comply with the regulations. In turn, this will allow ESV to better manage the network-related risks to the Victorian public.

In 2017-2018, the Data and Analytics team recruited four new data professionals who will implement ESV's Data Management and Analytics Strategy (including effecting the outcomes of the Review and CEBRA report; see Section 3.1.3).

The Line Clearance Assurance team has recruited four Field Officers to add to its existing resource of two Advisors. The principle function of the Field Officers is to confirm compliance with the Code of Practice for Electric Line Clearance through inspection. They will also provide benefit through promoting the ESV safety message on matters relating to electric line clearance to industry and the broader community.

The Regulatory Assurance team has recruited an additional work practices advisor and three new network safety engineers to provide a greater field presence, and enable an increased audit, investigations and safety plan review capability.

3.4 Data capability

ESV has been busy this year building our data capability.

The early part of the year was spent working with CEBRA on its assessment of ESV's data maturity and strategic direction. A key focus of the review was the data strategy and ESV's existing data systems, and whether these help ESV effectively manage the safety risks of Victoria's electricity and gas networks. The review found that, while ESV was heading in the right direction,

> "at this point, ESV is not positioned to make a convincing claim about the effect of network assets upon fire starts, because it is not possible to take account of other sources of variability".

Such sources of variability include weather and climate effects, local fuel loads, fire suppression effects and asset failure rates.

Much work has, therefore, been spent consolidating ESV data capability and building data networks between agencies to focus better on the issue of network-related fires. While this work is ongoing, the new Data and Analytics team has already begun delivering improved fire analyses (see Section 5.1).

As identified in the CEBRA review, there needs to be a common standard of statistically-appropriate analysis of fire incident data across ESV, the Country Fire Authority and Metropolitan Fire Brigade. This will also require common standards for classifying fires across the three agencies. Informal communications between analytics teams within the three agencies on matters of common interest has started. This will be formalised over the next twelve months to address the issues raised in the CEBRA review.

ESV is currently working to ensure the governance structure, modern tools and relevant skills are in place to support the business intelligence function. This is a multi-team collaboration between Information Systems, Data and Analytics, and Risk, Regulatory Planning & Policy.

4. Serious electrical incidents

The safety of the public and energy sector workforce is the highest priority for ESV, and therefore the investigation of serious electrical incidents is a key function of ESV. Serious incidents are defined as those that cause or have the potential to cause the death or injury to a person, significant damage to property or a serious risk to public safety.

One fatality due to electrical infrastructure was reported this year. Before this incident, the last network-related fatality involving the public was in May 2014.

There were also three network employees injured this year from electrical burns in two separate incidents. The last recorded electricity-related serious injuries involving network employees were in October and November 2013.

While performance across most of the year was an improvement over comparable previous years (Section 5.1), several notable fire events occurred that involved the electricity networks.

During January, there were several fires attributed to trees making contact with high voltage overhead powerlines. There was also a spate of fuse failures on the Australia Day long weekend that caused outages on the distribution networks. The St Patricks Day weekend (17-18 March) saw six large bushfires in the south-west of the state that posed a serious threat to public safety and caused considerable property damage.

ESV investigated all these events, and further details are provided below.

4.1 Tip truck fatality

On 6 February 2018, a tip trailer made contact with live high voltage aerial electric line conductors on private property adjacent the Kiewa Valley Highway in Kergunyah. This resulted in the death of the truck driver.

ESV investigated the incident and concluded that the front of the trailer cargo body contacted the 22kV overhead powerlines as the trailer was lifted to dump its load. This caused the body of the truck to become live.

The truck driver likely suffered a fatal electric shock due to either a touch potential (from contacting the truck and the ground at the same time) or a step potential (standing with feet apart near the truck).

The investigation concluded that there was no action to be taken against the distribution network operator, as prevention of the incident was beyond its control.

4.2 Injury of lineworkers

On 7 December 2017, two Zinfra (Jemena) employees received electrical burns that required admission to hospital due an incident at a substation in Blanche Street, Preston. One of the workers was released from hospital after 6-7 days and the other after 10 days. ESV provided support to WorkSafe Victoria in its investigation of this incident. WorkSafe Victoria decided not to proceed with any enforcement action under its regulations. ESV continues to follow up with Zinfra on the implementation of corrective actions to prevent recurrence.

On 22 June 2018, a lineworker received an electrical burn from an incident at Newcomb and was hospitalised. The worker was released from hospital on 30 June 2018. The incident is currently being investigated by WorkSafe Victoria with ESV support.

4.3 January fires

Three fires occurred in January where ignition is attributed to non-compliant vegetation contacting high voltage electric lines. Each of these fires occurred in the Powercor distribution network area.

One of the fires occurred in a HBRA in southwest Victoria; the other two occurred in LBRA in northern Victoria. While the fires in northern Victoria occurred in LBRA these locations are susceptible to bushfire due to changes in land use (see Section 7.2.1).

Following a comprehensive investigation of each of these fire events ESV is prosecuting Powercor for alleged breaches of the Act. These matters are now before the courts.

4.4 Australia Day weekend outages

There were 1,094 outages on the electrical distribution network over the 2018 Australia Day weekend, of which 565 (52 per cent) were due to LV fuse operations. Many of these occurred in the Mornington Peninsula region.

ESV is currently investigating the reasons for such a high number of incidents and found that, on the hot and humid day of 28 January, a large number of customers were using their air conditioners concurrently. This caused the Victorian maximum demand to reach 9,144 MW at 6:30pm, the highest Sunday load ever recorded on this network. This significant load increase caused widespread operation of fuses on the distribution system.

ESV's investigation found that distribution businesses lacked knowledge of their customers total installed air conditioning capacity and the subsequent possible demand created if all were in operation at the same time.

ESV is considering, among other initiatives, the distribution businesses using their smart meter data and implementing "real time monitoring" of the network to better understand the local LV loads, the impact of these loads and where future initiatives such as system improvements and/or load management may be worthwhile to prevent reoccurrence.

Further details can be found in the Post-Event Review available at www.energy.vic.gov.au/safety-and-emergencies/past-energy-emergencies. The Review only covers events on the Sunday, whereas the numbers above are reported for the whole weekend.

4.5 St Patricks Day fires

ESV investigated six separate fire incidents that occurred on the St Patrick's Day weekend in Victoria's south-west. The ignitions of all six fires were associated with electrical network assets. The extent of the fires is shown in Figure 1.

Four of the fires were caused by trees or branches falling onto or being blown onto powerlines during a high wind event on 17 March (St Patrick's Day). These were:

- the Gazette fire at Yatchaw
- the Minjah fire at Minjah
- the Gnotuk fire at Gnotuk
- the Warrnambool-Cobden fire at Laang.

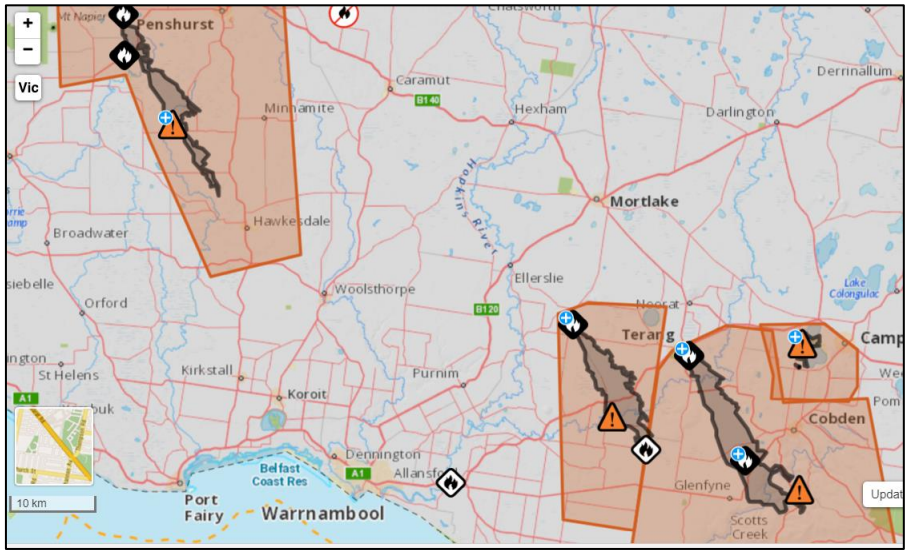

Figure 1 Extent of the St Patrick's Day weekend fires

ESV inspected each of the sites and concluded that, in all four fires, the trees that hit the powerlines were outside the minimum clearance required by electric line clearance regulations. Therefore, ESV did not progress these investigations for legal review or enforcement action.

The two other incidents were:

- the Sisters fire at Garvoc that was found to have resulted from a broken power pole
- the Terang fire at Terang that was due to clashing powerlines.

ESV has commenced a formal legal review of these two incidents to determine whether regulatory enforcement action is appropriate.

Further details of the specific fires can be found at www.esv.vic.gov.au/news/st-patricks-day-fires-technical-reports.

5. Safety trends and analysis

5.1 Fires

This year there were 572 network-related fires, with 284 (50 per cent) resulting in ground fires. Of the latter, 266 occurred during the fire season (1 October 2017 to 30 April 2018) when the risk of a bushfire is highest. During the fire season, the Country Fire Authority (CFA) reports that there were 176 fires larger than 10 hectares across Victoria; of these, fourteen (eight per cent) were due to the electricity networks.

The averages and bounds in Figure 2 show a clear seasonal trend in ground fires due to both asset failures/faults and contact events. Throughout most of the year, there are similar numbers of both types of events; however, the peak in asset-related ground fires is more pronounced historically and has dominated the summer period.

This year, the numbers of asset-related ground fires (blue bars in Figure 2a) were close to the 2010-2017 average. In contrast, Figure 2b shows that the numbers of contact-related fires were well in excess of historic numbers from January to April 2018. Tree contacts were a major contributor and dominated the February and March peaks, and drove the March peak well beyond historic levels in their own right.

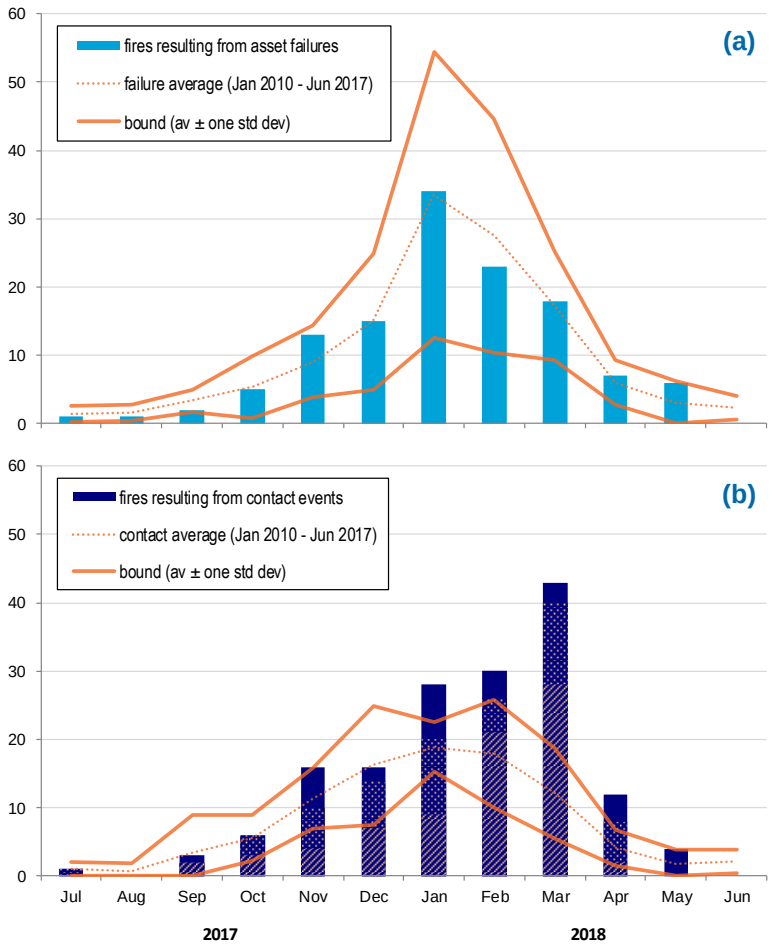

Figure 2 Ground fire incidents due to (a) asset failures and (b) contact events

Hatched area in Figure 2b is the contribution from tree contacts; the dotted area is the contribution from animal contacts

The risk of a fire occurring, and spreading once initiated, depends on a number of variables such as time of year, weather, longer-term climate (e.g. drought), and type and curing of vegetation (among others). Inter-annual variability of these factors can unduly mask or emphasise the numbers of fires involving the electricity networks. Therefore, it is important that we consider data from similar years in making comparisons of performance.

The CFA issues fire declarations for municipalities when ground conditions are conducive to grassfires and bushfires; we can use these declarations as an indicator of fire risk. This allows us to compare inter-annual risks and place this fire season within a historic context.

Data from 1995 to 2017 indicates that, while the 2017-2018 season was not an outlier, it was certainly a higher risk bushfire season than most years of the last quarter century.[6]

As shown in Figure 3, the start of the 2017-2018 fire season was in line with historical averages. The end of the season, however, was prolonged significantly compared to previous years, with ground conditions continuing to be susceptible to late-season fire events. Of the recent years, it was closer in profile to the 2015-2016 fire season so this is the season ESV has used for comparative purposes.

The 2017-2018 fire season was on track to be an improvement on the 2015-2016 season (dashed line in Figure 4). This changed with the fires over the St Patricks Day weekend and in the subsequent week (17-22 March 2018). These fires were primarily associated with severe winds that passed across the state.

These severe winds caused 38 more fires than would have been expected if the winds had not occurred. This, in turn, resulted in fifteen more fires overall than in the 2015-2016 fire season.

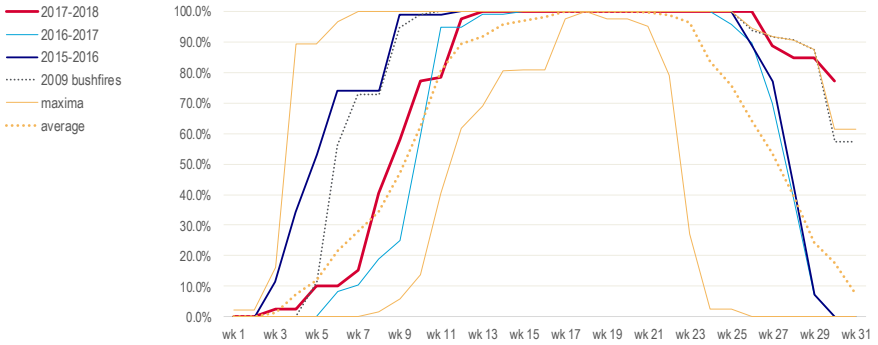

Figure 3 Summary of CFA fire declarations from 1995 to 2018

Blue lines indicate the least and most municipalities declared each week

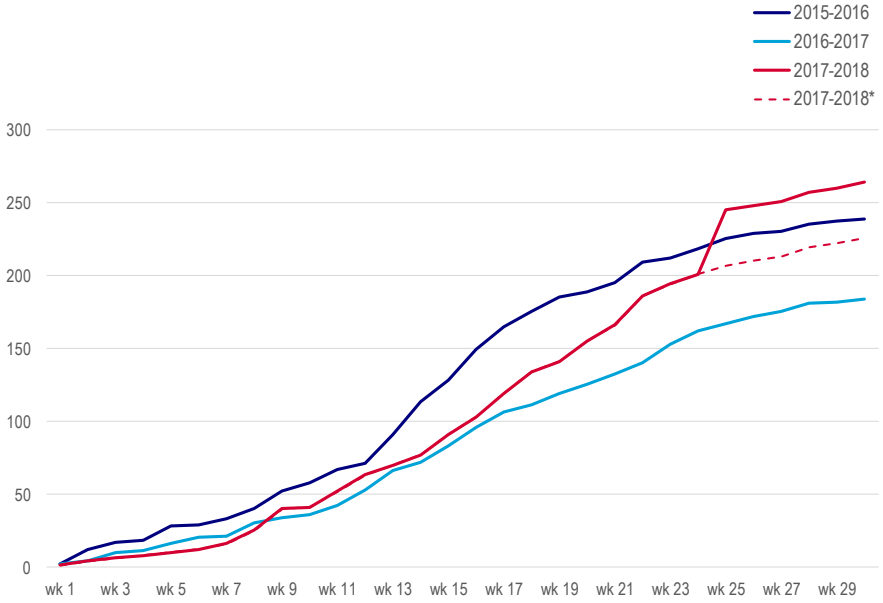

Figure 4 Cumulative fires across the fire season

* dotted line removes the effect of the 17-22 March severe winds

[6] A more detailed analysis of the 2017-2018 fire season can be found in ESV's End of Fire Season Summary (www.esv.vic.gov.au/news/end-of-bushfire-season-report/).

In the End of Fire Season Summary[6] we presented the results of an analysis of the impact of weather on network fire events. Machine learning was used to identify which of 17 separate meteorological factors are most influential in predicting the number of fire events on the electricity networks. In undertaking the analysis, we considered the fires over the three fire seasons between 1 October 2015 and 30 April 2018.

We have extended that analysis to consider all fires reported to ESV between 1 January 2010 and 30 June 2018 regardless of the time of year. We also increased the number of meteorological factors considered from 17 to 22, and considered ground fires due to asset failures (Figure 5) separately from fires due to contact events (Figure 6).

The algorithms predict the number of each type of incident based on daily weather observations from six Bureau of Meteorology stations across Victoria. The actual numbers of ground fires are then aggregated by month and shown as orange bars in each of the figures; the prediction is shown as a blue line.

The blue line also differs between the figures due to variations in the mix of weather factors driving each prediction.

The contributing factors for asset-related fires (Figure 5) are air temperature, wind speed and humidity differential over the preceding three days, with a smaller contribution from maximum temperature. For contact events (Figure 6), the main contributions come from air temperature, maximum wind gust speed, wind speed and, to a lesser degree, humidity.

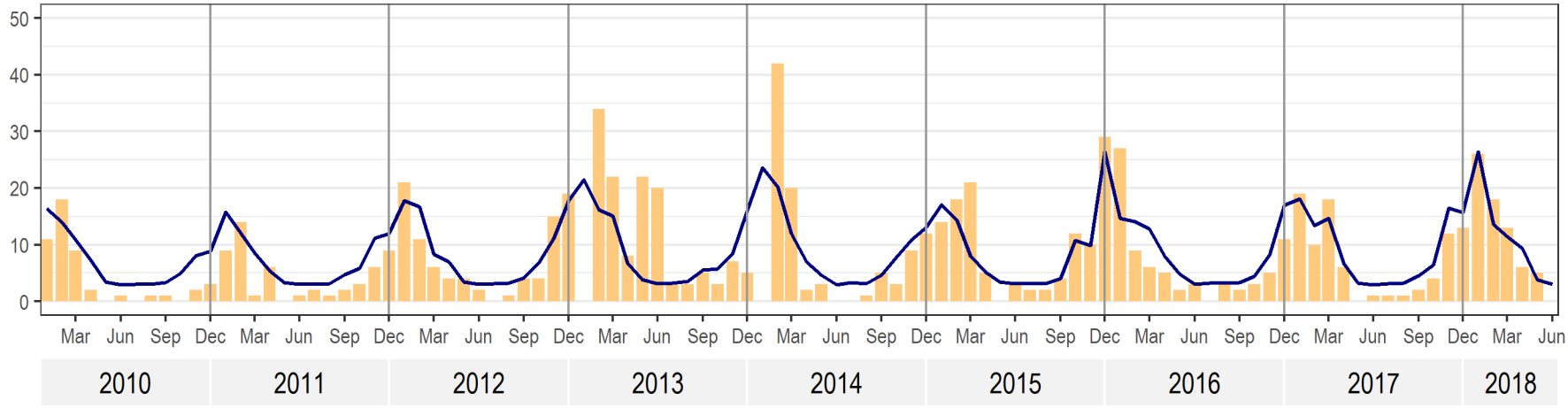

Figure 5 Influence of weather on ground fires due to asset failures

Both figures show a clear seasonal pattern of ground fires with peaks in summer and troughs in winter.

In general, the predictions are close matches with the actual number of asset-related and contact fires. The predictions also reflect the shape and structure of the peaks in the incident data.

While this confirms that weather has a significant impact on network-related ground fires, it is not the cause of these fires but rather a contributing factor. Network asset management practices are the primary controls on asset-related fires, and asset management and electric line clearance practices can influence the number of contact fires. Weather is not an excuse for poor performance. Instead, the distribution businesses should be accounting for weather in the planning of their asset management and vegetation clearance activities.

There are noticeable exceedances across both types of incident in 2012-2013 and 2013-2014, and for contact fires in 2017-2018. These variances may be due, in part or whole, to the practices of one or more of the distribution businesses or to causes other than direct weather influences. This will require further investigation.

While the current analysis is preliminary, the techniques used to derive these predictions can be used to analyse the performance of individual businesses. Such analyses will help us:

- identify areas for further investigation (for instance, ascertain whether particular businesses are more weather-exposed than others)
- target regulatory activities (for instance, the causes of exceedances or targeting safety programs for weather-sensitive assets)
- explore the exposure of the networks to climate change and promote early planning for adaptation.

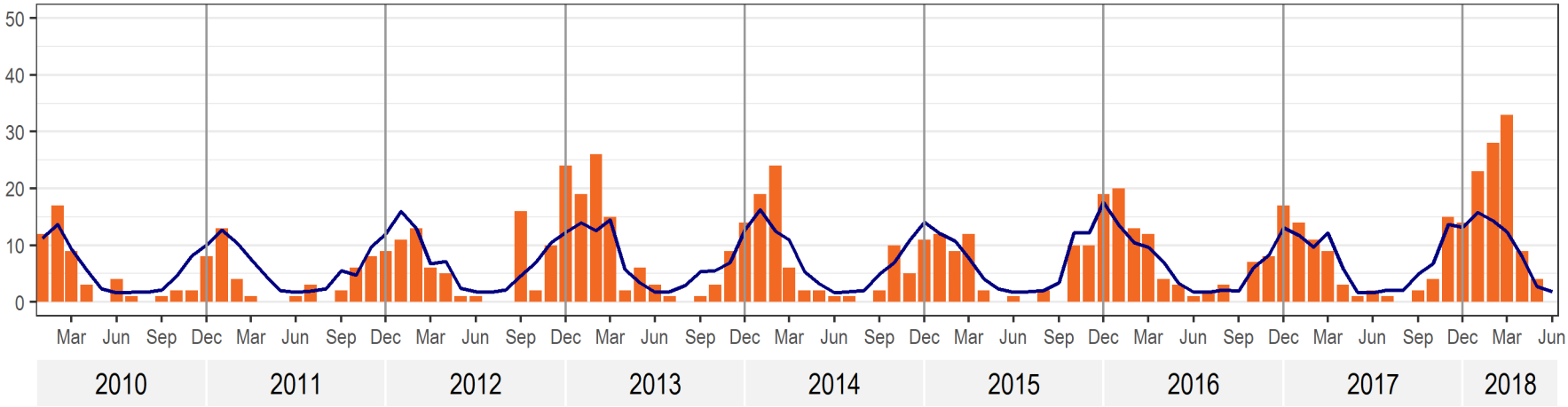

Figure 6 Influence of weather on ground fires due to contact events

Figure 7 shows the number of ground fire events on the Victorian networks from most common to least common. It also shows, in blue, the difference in incidents between 2017-2018 and the long-term average of the 2010-2017 period.

The top four fire events were due to tree contact, animal contact, connection faults and HV fuse failures. All four events are largely within the control of the networks.

When compared to the long-term averages across the period from January 2010 to June 2016, fire numbers in 2017-2018 are elevated in eight categories, stable in one category and reduced in five categories. Of particular note are the significant increases in tree and animal contact and connection faults.

Also of note are the reductions in crossarm failures and other asset failures.

While ground fires from HV fuses increased slightly, the total number of HV fuse failures (regardless of whether a fire resulted) has decreased when compared to the seven-year average (see Figure 11). In short, there have been fewer events but more fires resulted from those fewer events.

Figure 8 shows the trend over the last eight years for the top four fire events above. This indicates that:

- fires from tree contact have increased markedly this year and are now well above the historic peak, warranting the continued attention ESV is applying to vegetation clearance
- while animal contact fires fluctuate, there is a general upward trend
- fires from connection faults have been rising steadily for four years
- fires due to HV fuse failures have increased to historic peak levels after a decline in recent years.

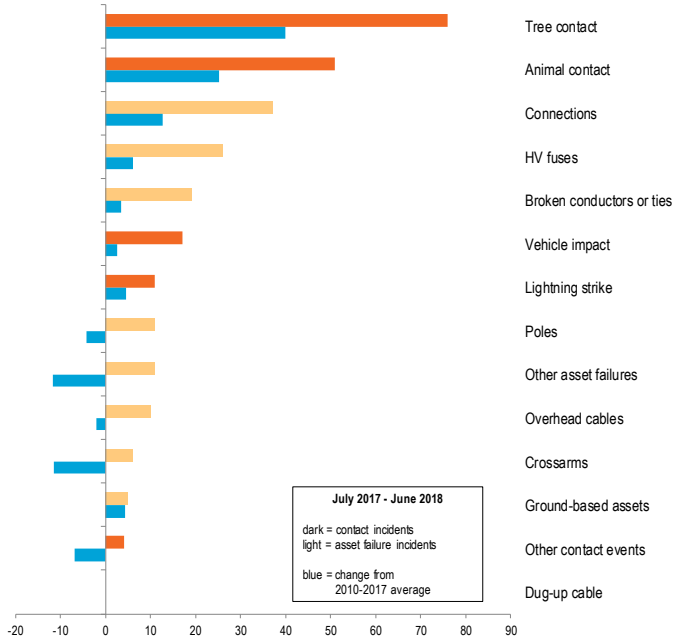

Figure 7 Ground fire-related incidents occurring on Victorian networks

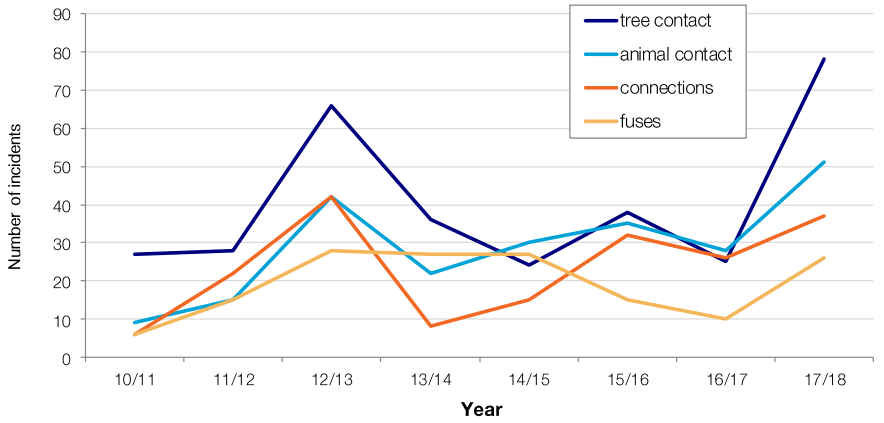

Figure 8 Historic trends for common ground fire events

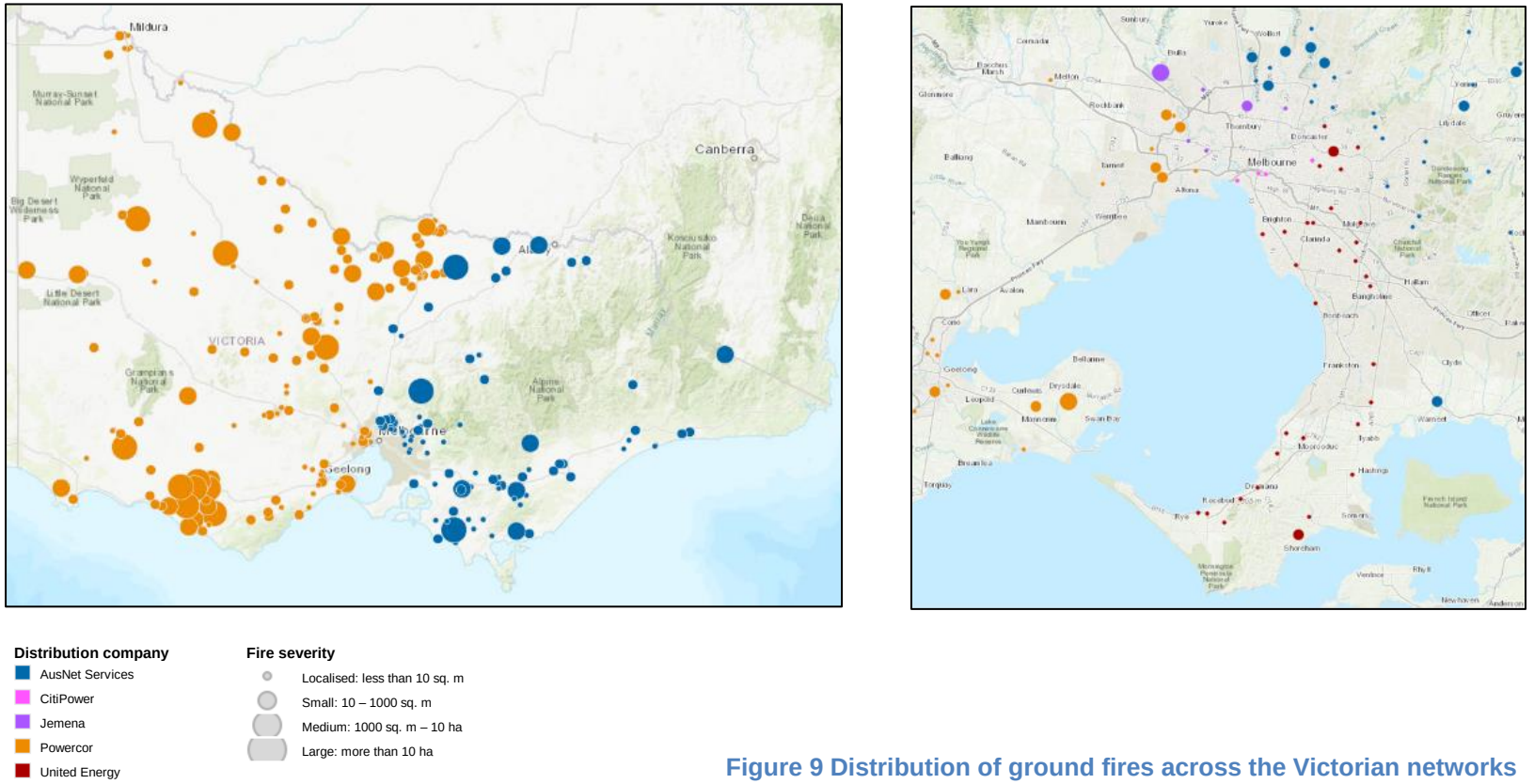

Figure 9 Distribution of ground fires across the Victorian networks

Figure 9 shows where ground fires occurred on the electricity networks across regional Victoria and within the Greater Melbourne region.

Of the 284 ground fires reported in the period, 135 were smaller than 10 m^2 (48%), 107 were between 10 m^2 and 1000 m^2 (38%) and 28 were between 1000 m^2 and 10 ha (10%).

There were fourteen fires larger than 10 ha during the 2017-2018 period (5%). Eleven fires were on the Powercor network and three were on the AusNet Services network.

Nine of the large fires occurred over the St Patricks Day weekend and in the subsequent week (17-22 March 2018). Of these, six of the fires were due to vegetation making contact with overhead powerlines, one was due to the failure of a pole and two were due to conductor clashing. The effect of these extreme winds are discussed further in the End of Fire Season Summary report.[6]

5.2 Network trends

Figure 10 shows the number of network safety incidents on the Victorian networks. The numbers of asset failure incidents and contact events are reported separately.

The historical average for the period January 2010 to June 2017 shows a seasonal trend with increased asset failures over the summer period (Figure 10a). In general, the numbers of asset failures in the last year were well below the average; the annual peak that normally occurs in February was delayed until March. This is possibly due to the extended summer period and/or severe weather events noted previously.

In contrast, the numbers of contact events show less seasonality and more inter-month variability (Figure 10b). Contact events this year showed an even higher degree of variability and were generally in line with the historical average. There were, however, five months where the number of contact events were one standard deviation or higher than the historical average.[7]

While increased tree contacts (the hatched area in Figure 10b) explain the major peaks in February and March, this is not sufficient to explain the August and November peaks. There are four main factors interacting to produce this variability in contact events — tree contact, animal contact, vehicle contact and other contact events (including copper theft, vandalism and intrusions into the No Go Zone around overhead lines).

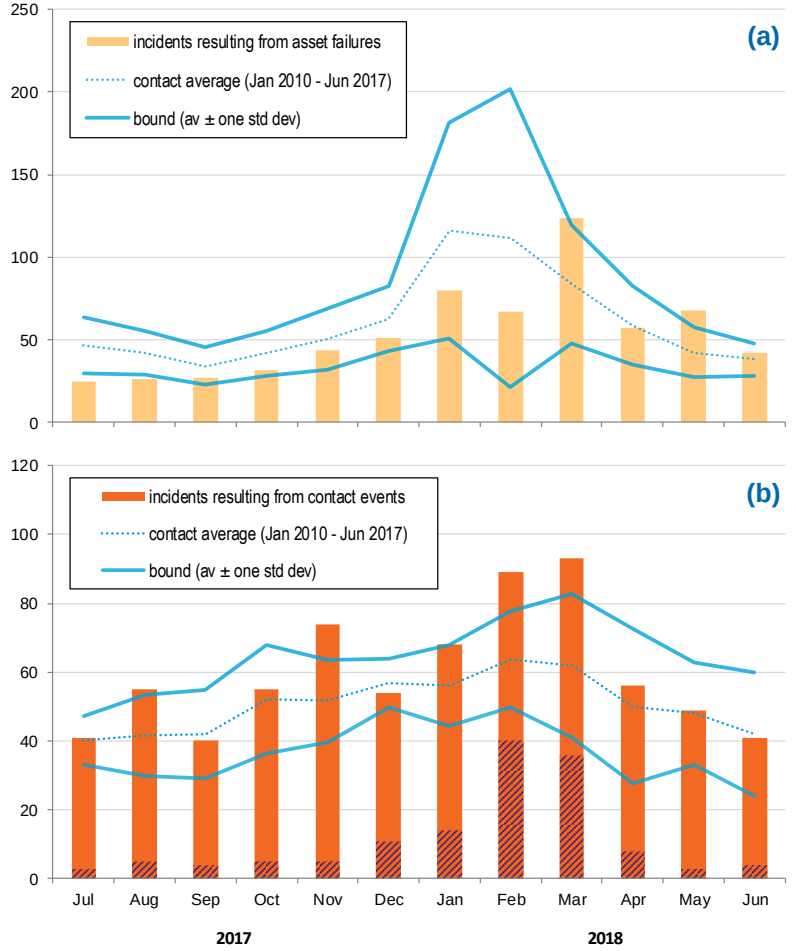

Figure 10 All incidents in the period due to (a) asset failures and (b) contact events

Hatched area in Figure 10b is the contribution from tree contacts

[7] Assuming the likelihood of an incident is normally distributed, 68% of incidents should fall within one standard deviation either side of the average.

Figure 11 shows the number of incidents on the Victorian networks from most common to least common. It also shows, in orange, the difference in incidents between 2017-2018 and the long-term average of the 2010-2017 period.

This year, two of the four most common events were outside the direct control of the networks to manage — other contact events and vehicle impacts. Both of these are discussed in more detail in Section 5.3.

The other two events were within the control of the networks, namely connections failures and, to a degree, tree contact.

When compared to the long-term averages across the period from January 2010 to June 2017, the incidents in 2017-2018 are elevated in eight categories, stable in one category and reduced in five categories. Of particular note are the significant reductions in crossarm failures (for a second year), other asset failures and HV fuse and overhead cable failures. Also of note are the increases in vehicle contacts and other contact events.

Figure 12 shows the trend over the last eight years for the top four events above. This indicates that:

- the downward trend in connections faults has markedly reversed and is almost back at peak levels
- other contact events has dropped this year; however, the decreases on the rural networks are masking increases in the urban networks (see Section 5.3)
- after decreasing and flattening out in 2015-2016, incidences of tree contact have been increasing again over the last two years
- vehicle impacts[8] on overhead lines and poles continue to oscillate and remain an issue for the networks.

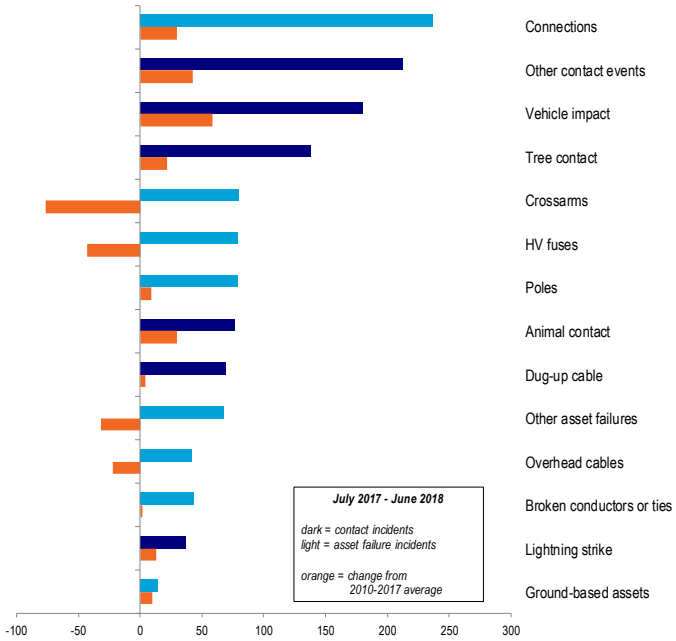

Figure 11 Incidents occurring on Victorian networks

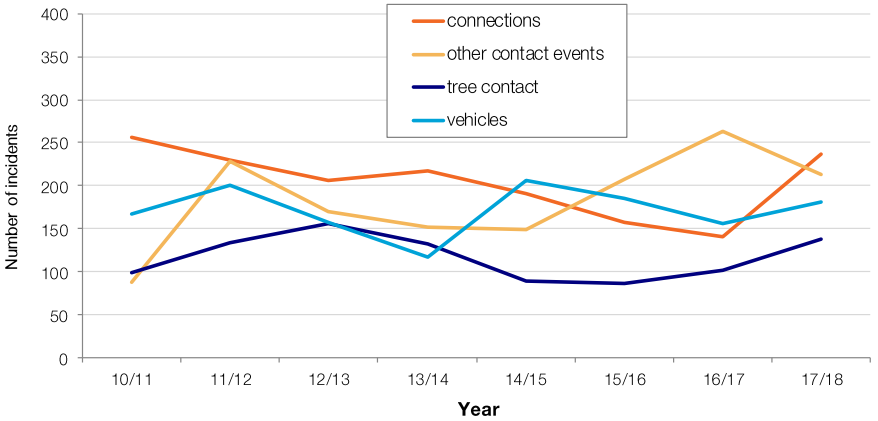

Figure 12 Historic trends for common incident events

[8] Vehicle impacts includes collisions with poles and damage to overhead powerlines from road transport and farming and construction equipment.

5.3 Public safety

ESV continues to monitor public safety and interaction with network electrical assets in three main areas:

- vehicles impacting electrical assets
- encroachment and contact with underground electrical assets
- all other encroachment and contact events, including theft, vandalism, unauthorised access to electric assets and breach of the No Go Zone.

The last of these categories was the most common event placing members of the public at risk last year. Figure 13 shows that the increase in these events from 2014-2015 reversed this year with a drop of 24% from last year's peak of 282 incidents. Figure 14 shows the locations where these incidents were recorded in 2017-2018.

In the Greater Melbourne region, thefts (predominantly copper) are concentrated in the CBD and western suburbs out as far as Melton and Sunbury, with smaller clusters in the northern and inner eastern suburbs. Some thefts were also recorded in Frankston and near Geelong. The incidents correlate with areas with higher levels of commercial/industrial development where electrical assets may be more accessible, potentially with minimal security.

There are only isolated instances of theft of network assets outside the Greater Melbourne and Greater Geelong regions.

Unauthorised access incidents are predominantly concentrated in northern and eastern suburbs.

While vandalism is mainly spread along a band from Sunbury to Clayton, incidents have also been recorded in Werribee, Geelong and east of Bairnsdale.

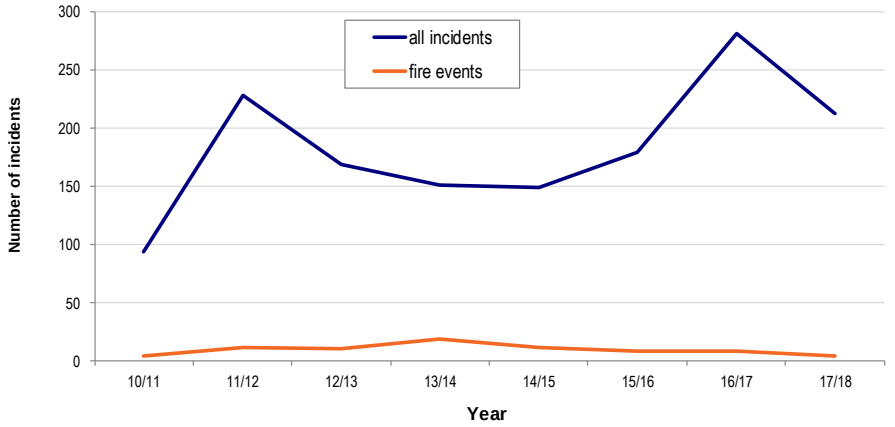

Figure 13 Other encroachment and contact events

These events include copper theft, vandalism, No Go Zone infringements

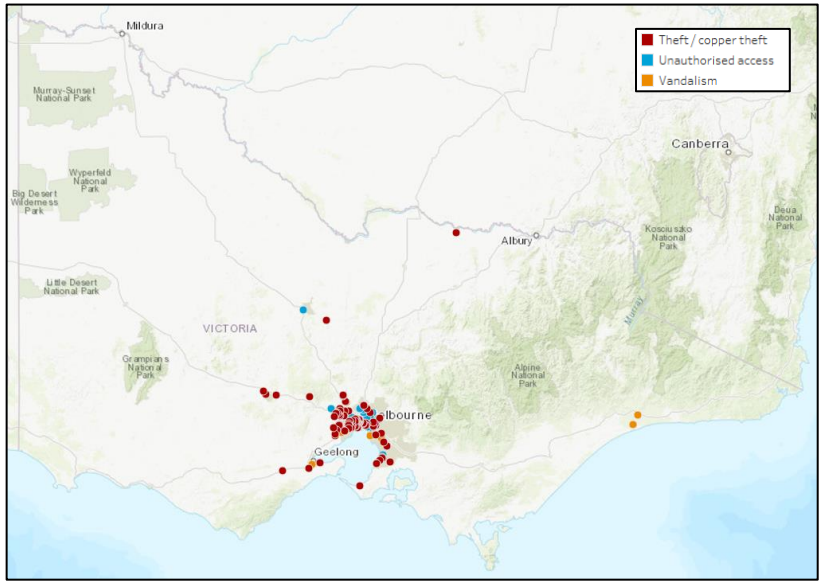

Figure 14 Deliberate contact events across the networks

Infringements of the No Go Zone around overhead and underground cables are generally distributed randomly across the networks, with increased numbers around the Greater Melbourne region where network and construction density are higher (Figure 15). Unlike the deliberate contact events above, No Go Zone infringements are also observed more broadly outside the Greater Melbourne area. Building too close to the No Go Zone is contained to Melbourne, with a cluster through Toorak, Abbotsford and Clifton Hill.

Figure 16 shows that the incidences of underground cables being dug-up or contacted during excavation works has decreased slightly this year, but this is not statistically significant.

Vehicle impacts come from two main sources (Figure 17). The first is impacts from vehicles in transit, being either collisions with poles or large vehicles (trucks, rubbish trucks) snagging overhead lines.[9] The second source is cranes and other farming and construction equipment contacting overhead powerlines.[10] Such impacts have decreased for a second year in a row; the numbers that result in fire events has also decreased this year.

Figure 18 shows concentrations of impacts from transit vehicles within Melbourne's inner suburbs and a band extending down through Werribee and incorporating the Geelong region. There is also a cluster around Frankston. This reflects the higher vehicle densities in these areas. Incidents involving cranes and other farming and construction equipment occur predominantly in Melbourne's inner western and northern suburbs with a band running from the inner eastern suburbs down to Edithvale. This is most probably associated with increased construction in Melbourne. There are only isolated incidents outside the Melbourne and Geelong regions.

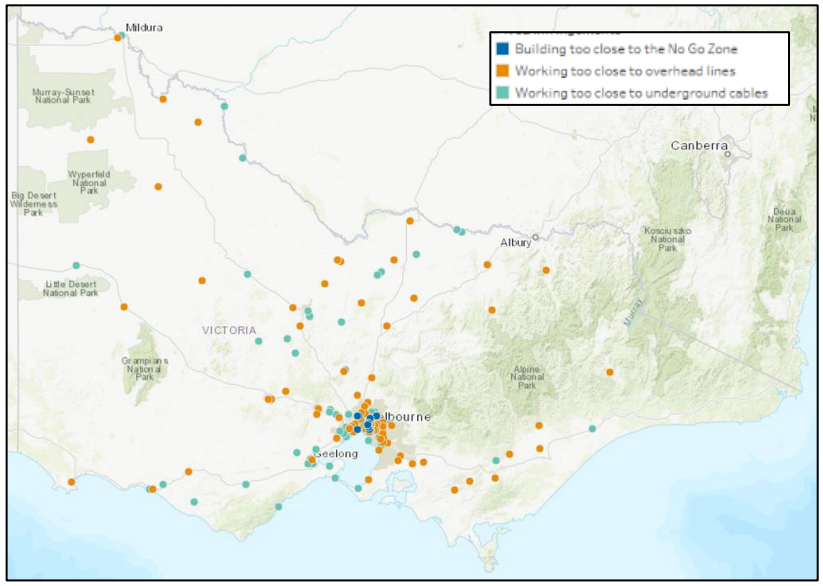

Figure 15 No Go Zone infringements (including dug-up cables)

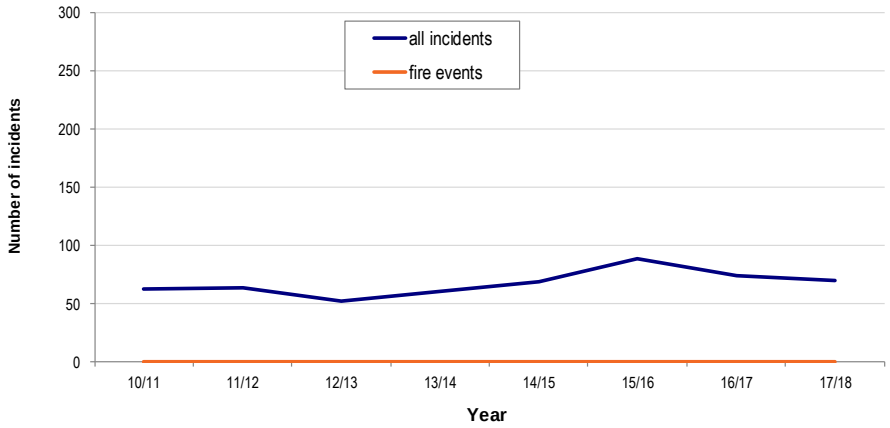

Figure 16 Dug-up cable incidents across the networks

[9] Responsibility for managing and delivering road safety outcomes lies with VicRoads and local government; it is not the responsibility for the major electricity companies.

[10] The major electricity companies are responsible for ensuring overhead lines maintain a minimum ground clearance. It is the responsibility of vehicle and equipment operators to ensure their equipment maintains a safe clearance from the overhead powerlines. Educating the public about these responsibilities has been a focus of ESV's Look Up and Live campaign.

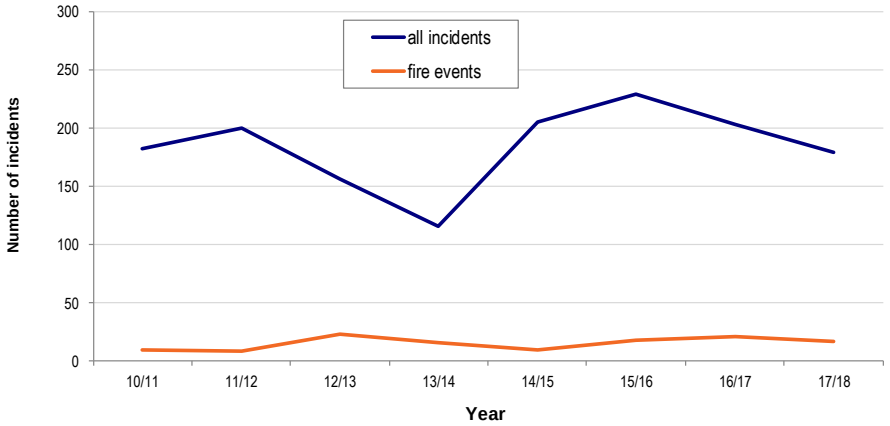

Figure 17 Vehicle impacts on electrical infrastructure

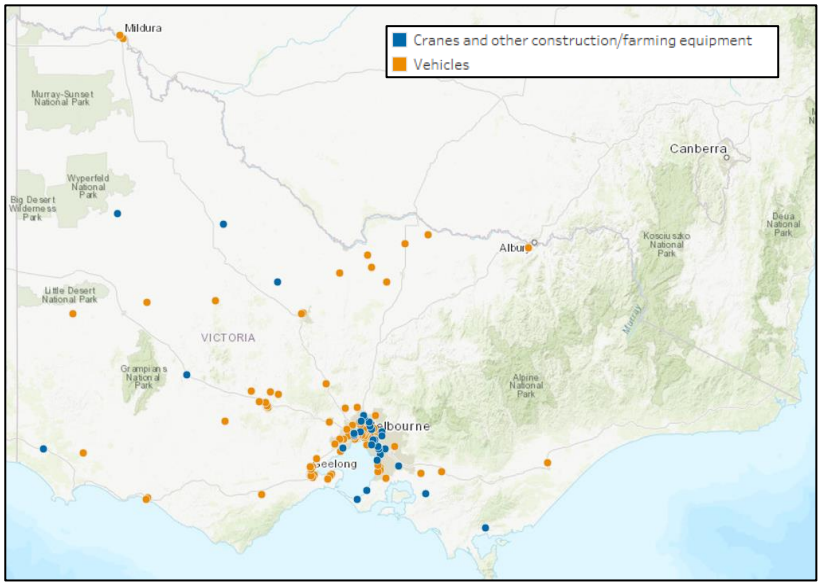

Figure 18 Vehicle impacts on electrical infrastructure across the networks

6. Network infrastructure performance

6.1 Transmission company performance

Detailed information on the performance of the transmission companies is provided in Appendices A, B, F and G for AusNet Services, Basslink, Transmission Operations (Australia) Pty Ltd (TOA) and Transmission Operations (Australia) 2 Pty Ltd (TOA2) respectively.

Transmission networks are critical infrastructure forming the backbone of the national electricity grid. This infrastructure is designed, constructed and maintained to standards appropriate for ensuring a safe and reliable electricity supply for Victoria.

ESV has identified no systemic issues or areas of concern regarding the safety management of the transmission networks.

There were five incidents this year involving transmission assets, namely:

- the explosive internal failure of a 66kV capacitor bank
- a technician contacting a live 240V supply stud while undertaking work in a marshalling cubicle
- a localised fire due to a 500kV conductor coming to ground
- two incidents involving tripping of 66kV busses resulting in loss of supply.

AusNet Services undertook an internal investigation to identify the cause of the 500kV conductor failure. This was completed in July 2018 and provided to ESV.

6.1.1 Safety case evaluation and acceptance

AusNet Services and Basslink have submitted full safety cases that are currently being reviewed by ESV. Until ESV accepts the safety cases and their ESMSs have been revised accordingly and accepted by ESV, these companies will continue to operate under their existing ESMSs.

TOA and TOA2 have accepted ESMSs in place.

On 31 July 2017 the Victorian Essential Services Commission granted a transmission licence to NSW Electricity Networks Operations Pty Ltd (TransGrid) for construction of the Deer Park Terminal Station (DPTS). The granting of the licence defines TransGrid as a transmission company. This, in turn, defines it as a major electricity company and, as such, it is required to have an ESMS, bushfire mitigation plan and electric line clearance management plan. As part of the ESMS acceptance process, TransGrid submitted a safety case to ESV for review on 13 November 2017. ESV accepted the safety case on 15 March 2018. Following acceptance of the safety case, TransGrid submitted an ESMS for acceptance. The TransGrid ESMS is currently under review.

6.2 Distribution company performance

Detailed information on the performance of the distribution businesses is provided in Appendices A, C, D, E and H for AusNet Services, CitiPower, Jemena, Powercor and United Energy respectively.

6.2.1 Safety case evaluation and acceptance

ESV has required the major electricity companies to develop detailed safety cases that require them to clearly explain how they identify and appropriately mitigate the safety risks associated with their operations and other activities. This has required each major electricity company to demonstrate how it identifies the risks it faces, the risks its operations present to the community and how it manages its operations and assets to reduce these risks to an acceptable level.

During the past two years, ESV has utilised its guidance material and assessment tools to determine how effectively each major electricity company has developed and presented to ESV a full and acceptable safety case in advance of submitting its Electricity Safety Management Scheme for approval.

All five distribution business safety cases have been accepted and the businesses are now working to establish acceptable Electricity Safety Management Schemes.

As part of the process to establish accepted ESMSs, ESV has undertaken extensive systems validation audits of all the distribution companies during the 2017-2018 year. The ESMS validation audits identified areas in the ESMSs that require improvement, and the distribution companies are currently working with ESV to achieve a final acceptable ESMS.

6.2.2 Bushfire mitigation regulations

The Electricity Safety (Bushfire Mitigation) Regulations 2013 were amended on 1 May 2016 to require major electricity companies to include additional details in their bushfire mitigation plans:

- All polyphase electric lines originating from 45 prescribed zone substations to meet the required capacity over three tranches by 1 May 2019, 1 May 2021 and 1 May 2023.[11] To achieve this performance target the affected distribution businesses are deploying Rapid Earth Fault Current Limiters (REFCL).
- On and from 1 May 2016, each electric line with a nominal voltage of between 1 kV and 22 kV that is constructed, or is wholly or substantially replaced, within an Electric Line Construction Area is to be a covered or underground electric line (‘extreme’ areas in Figure 19). AusNet Services, United Energy and Powercor are trialling new covered-conductor technologies to achieve this requirement at a lower cost.
- Each distribution business to have installed, by 1 May 2023, an Automatic Circuit Recloser (ACR) in relation to each SWER line in its supply network. Powercor is the only business yet to complete installation of ACRs on its network.

Rapid Earth Fault Current Limiters

AusNet Services and Powercor each have 22 zone substations affected by the REFCL deployment and Jemena has one. REFCLs are designed to minimise the fault current dissipated from phase to ground faults on a 22kV network in order to reduce the risk of fire ignition.

[11] The required capacity relates to the ability to reduce voltages to specified levels within set timeframes in the event of a phase-to-ground fault. These levels and timeframes are specified in the Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016.

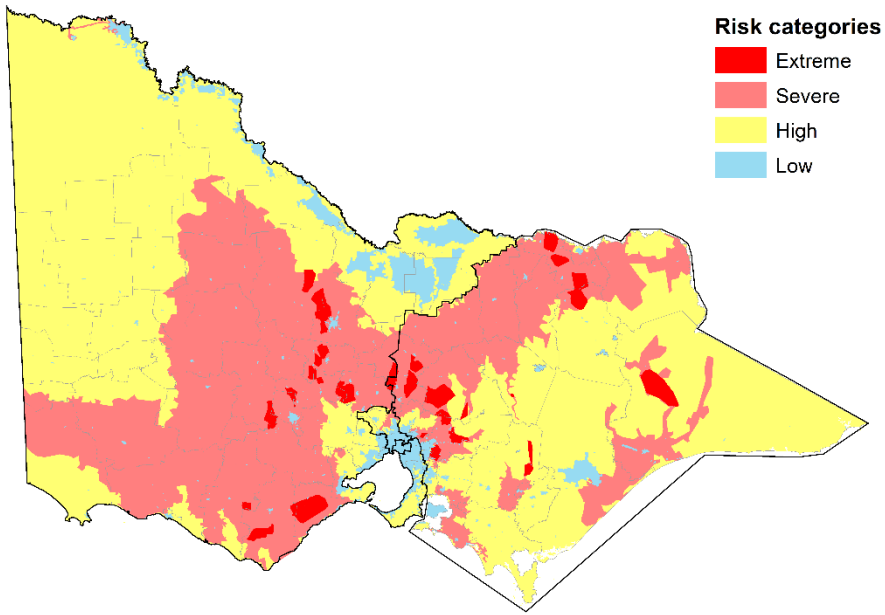

Figure 19 Risk areas across Victoria

On 22 August 2018, ESV accepted Powercor's Gisborne zone substation to be the first compliant substation in Victoria. The acceptance was on the condition that several technical issues be resolved before the bushfire season following 1 May 2019.

In addition to the mandated REFCLs, Jemena has elected to install REFCL protection at Sydenham.

There is no requirement under the regulations for CitiPower and United Energy to install REFCLs on their networks. Despite this, United Energy has elected to install REFCLs at Frankston South, Mornington and Dromana.

When a REFCL unit responds to a single phase-to-earth fault, the voltage on the remaining two unfaulted phases rises. Where equipment is not rated for such voltage excursions, it must be upgraded; this is known as hardening. In some cases, HV customers connected to REFCL-protected networks also need their assets to be hardened or isolated from these effects. In cases where hardening is impracticable, the distribution businesses may seek exemptions to allow the HV customers to be isolated; this is the most common solution for Tranche 1 sites.

On 20 August 2018, the Essential Services Commission revised the Electricity Distribution Code to facilitate the implementation of REFCL technology and placed the responsibility to be REFCL-ready on HV customers. As a result, ESV expects that the number of exemptions will be reduced for subsequent tranches.

For larger networks with high capacitance, sensitivity of the REFCL may be reduced. In cases where the required capacity can no longer be achieved due to excessive capacitance, the network may be split electrically into smaller networks. Where this is no longer practicable, a distribution business may seek exemptions to isolate fully-insulated underground sections of its network where it can be demonstrated that bushfire ignition risk will not be eroded.

Conductor replacement

AusNet Services and Powercor each have approximately 1,600 km of conductor within electric line construction areas. These bare overhead powerlines are to be progressively replaced with insulated or underground solutions. Proactive replacements have been conducted as part of powerline replacement fund activities. As of 30 April 2018, AusNet Services reports that 85 per cent of polyphase electric lines in Electric Line Construction Areas within its network consisted of bare overhead wire. This is expected to reduce to 83 per cent by 30 April 2019. Likewise Powercor reports 81 per cent bare overhead wire remaining; this is expected to reduce to 78 per cent by 30 April 2019.

Automatic Circuit Reclosers

The amended regulations require the distribution businesses to install a new-generation ACR in respect to each SWER line within their distribution network by 2020. With the exception of Powercor, all the businesses had met this obligation prior to enactment of the regulations.

At 31 July 2018, Powercor had installed 391 of the 1062 ACRs to be installed on its network, including 265 installed this year. The schedule was delayed at the end of 2017, but Powercor has since recovered any delays. ESV will continue to closely monitor Powercor's progress to ensure these works are completed by 2020 as outlined in its bushfire mitigation plan.

Covered conductor trial

United Energy successfully trialled Amokabel covered conductor and is now considering the wider application of this conductor on its network. Powercor have indicated that it is also considering the use of this conductor on its network.

Exemptions

AusNet Services and Powercor have sought multiple exemptions over the 2017-2018 period in relation to HV customers and fully-insulated cable network sections supplied from REFCL-protected substations. Further details on these exemptions can be found in Appendix A and Appendix E.

6.2.3 Technology

In addition to the new technologies being deployed to address the requirements of the amended bushfire regulations, there are also two other areas of note where new technologies are being tested by the distribution businesses to improve public safety.

Smart meter analytics

With high penetration of the Advanced Metering Infrastructure (AMI), or smart meters, comes an opportunity for the distribution businesses to utilise the data that is collected for purposes other than general power usage information and billing. The meters collect voltage and current data at regular intervals and, via data analytics, the meter's data can be used to find faults and recognise hazardous situations such as broken neutral conductors and overloaded networks. Once a hazard has been recognised action can be taken before a customer even realises there is a problem (for example, when a neutral is about to break or has just broken). The data analytics and immediate action prevents serious shocks from occurring.

Partial discharge on overhead lines

The distribution businesses are trialling devices that detect small electrical discharges (partial discharges) on a network that can be a pre-indicator of a fault. These small discharges are analysed to look at the 'signature' of the discharge to enable the early warning of pole-top fires, vegetation contact on high voltage lines, pollution build up on insulators, and discharges on transformer and protection equipment. The detection devices are being trialled to remotely monitor overhead lines across many kilometres on a 24/7 basis. If successful, the early detection can warn of potential failures that, when acted on, prevent an electrical fault that may otherwise have resulted in a bushfire.

6.3 Issues for attention

6.3.1 Emerging technologies

The advent of new technologies (particularly energy storage and micro-grids) is likely to significantly shift the electricity supply paradigm in the years to come. This has the potential to impact retailers, distributors and markets as new business models enter the marketplace. Such a paradigm shift is likely to have significant impact on safety regulation as new issues emerge. ESV recognises this and needs to understand how the industry may change and ensure it is prepared and equipped to ensure safety is maintained while this change takes place.

As energy storage and micro grid options for sharing stored energy become more prevalent and evolve, a key concern for network owners is the prospect of stranded assets. This could occur where investment in the networks is undertaken to cater for the current demand and expected

growth, only for energy storage and micro grids to reduce demand on the networks in the not too distant future.

Network investment is generally determined based on a return on investment over several decades; however, the potential of new technologies is creating a level of future market uncertainty for network owners.

The challenge for ESV will be to prepare proactively to respond to any safety concerns arising in this ever-evolving area. These include the impacts on the long-term integrity of the networks and the sustainability of assets.

ESV continues to monitor the potential for ‘New Energy’ to impact on Victoria’s networks. This may manifest through direct impacts of new technologies, changes to network operation or reductions in maintenance should existing business models become unviable. This will allow ESV to best ensure that public safety is considered in discussions about these technologies and that future regulations address any emerging risks.

6.3.2 Asset management

ESV has established two specific roles within Regulatory Assurance to review whether appropriate life-cycle management is being considered, and adopted, to acceptably manage safety risks.

ESV has commenced preliminary work and expects to continue by:

- reviewing the asset management approach of each business
- reviewing critical control effectiveness
- benchmarking safety performance
- establishing what is acceptably safe.

Continuing this work will provide ESV assurance that the distribution businesses are adopting appropriate life cycle management practices.

7. Line clearance performance

Electric line clearance responsibilities are prescribed by the Electricity Safety (Electric Line Clearance) Regulations 2015. The primary purpose of the regulations is to prevent vegetation growing too close to electric lines.

If vegetation grows too close to an electric line it increases risks such as electric shock, fire (including bushfire) and diminished reliability of electricity supply.

7.1 Performance of major electricity companies

7.1.1 ELCMP evaluation and approval

The regulations require all major electricity companies to prepare and submit an electric line clearance management plan (ELCMP) to ESV before 31 March each year.

An ELCMP is used to articulate the company's electric line clearance objectives and the management strategies that will be used to comply with its regulatory obligations.

ESV evaluates the plans against established criteria to validate that the plans meet the minimum expectations of a quality plan and comply with the regulations. Where deficiencies are identified, feedback is provided and the company is then required to submit an amended plan addressing the deficiencies. Resubmitted plans are re-evaluated and, when found to meet the minimum expectations, are referred to the General Manager of Electrical Safety and Technical Regulation for approval.

Each major electricity company submitted its plan for the 2018-2019 period. After some iterations, all of the major electricity companies have an approved ELCMP in place for the 2018-2019 fire season.

7.1.2 Preparedness for the fire danger period

To prevent vegetation coming into contact with powerlines and igniting, it is important that the regulated clearance space is maintained around overhead powerlines. Due to the elevated fire risk, this is critical in HBRA and even more so in areas where the Country Fire Authority has declared a fire danger period to be in place.

Each major electricity company must have management systems in place to ensure that vegetation remains compliant with the Code of Practice for Electric Line Clearance.

ESV completed audits and inspections of all major electricity companies to validate compliance with the regulations. The audit program was completed by a service provider acting on behalf of ESV and required the MEC to submit inspection data to ESV at a minimum of four weeks in advance of commencing the audits.

The audit gauged the preparedness of the companies leading into the 2017-2018 declared fire danger period. The results of the audits and inspections are further described in the individual appendices for each company.

In the majority of cases audited, appropriate clearance standards were observed to have been achieved in the HBRA locations that were inspected.

7.1.3 Reporting over summer season

The major electricity companies were required to report to ESV on their preparedness for 2017-2018 fire danger period. The reporting period for which ESV required reporting commenced on 1 October 2017 and concluded on 30 April 2018.

During the 2017-2018 fire danger period, each company was required to report the total number of non-compliant spans that existed in HBRA leading up to and during the fire danger period.

ESV monitored the progress of vegetation clearing of the major electricity companies to establish an understanding of the performance of their vegetation management programs and the fire danger period preparedness of the businesses.

This formed part of the reports that ESV provided to the Minister for Energy, Environment and Climate Change each week during the fire season.

Performance is described further in the individual appendices for each company.

7.1.4 Exemptions

Under Regulation 11, ESV may exempt a responsible person from any of the requirements of the regulations. Both AusNet Services and Powercor had exemptions in place during the 2017-2018 period.

AusNet Services

The AusNet Services exemption pertains to clause 28(2)(b) of the Code of Practice for Electric Line Clearance (the code). It applies to vegetation clearance distances for electric lines in HBRA, provided that:

- any overhanging branches and the trees supporting the branches do not exhibit any potential hazardous structural defect
- a minimum clearance of 3000 mm is maintained above the powerline to any overhanging tree branch.

The exemption was granted to provide an opportunity to AusNet Services to augment 2284 electric line spans in the Dandenong Ranges and surrounding areas. The augmentation involved replacing uninsulated electric lines with aerial bundled or underground cables.

Granting the exemption and completing the augmentation of these spans would deliver an enhanced, long-term electricity safety outcome. It also meant that extensive clearing of vegetation in an environmentally sensitive area could be avoided.

The augmentation projects being managed under the exemption were completed in early 2018 meaning all associated spans were made compliant.

Powercor

Powercor has two exemptions in place that relate to the management of significant vegetation at:

- 14-16 Armstrong Street, Creswick
- 2 Barley Street, Ballarat East.

The exemptions apply to clause 25 and clause 28 of the code respectively. They are conditional on specific management strategies being employed to mitigate electricity safety risks. The strategies include, but are not limited to:

- increased inspection regimes performed by suitably qualified arborists
- risk assessment
- maintaining specified reduced clearance distances.

These exemptions remain ongoing provided all specified conditions are met.

United Energy

United Energy conducted a LiDAR survey similar to those undertaken by Powercor; both companies are now under the same corporate ownership and United Energy has, therefore, adopted Powercor's vegetation management methodologies.[12]

The LiDAR inspection identified 196 non-compliant spans located in HBRA that involved vegetation at height that had not been identified by United Energy's ground-based visual assessment.

In December 2017, United Energy submitted an application for exemption from the requirement to comply with the Code of Practice for Electric Line Clearance until these spans could be made compliant. After review and consideration ESV rejected the application.

[12] Vegetation management of the CitiPower, Powercor, TOA, TOA2 and United Energy is administered through one business unit servicing all five network companies.

Instead, ESV required that United Energy prepare a plan to achieve compliance on or before the 2018-2019 declared fire danger period and submit the plan to ESV for acceptance. The plan also required that United Energy perform regular hazard assessment of the non-compliant spans to ensure any areas of increased risk to the public could be appropriately identified and addressed.

United Energy submitted an acceptable plan in February 2018. ESV has since been closely monitoring United Energy's progress in making the spans compliant. United Energy appears on track to deliver the plan according to the included schedule of works.

7.1.5 Unannounced inspections

Throughout the 2017-2018 period and over the first quarter of the 2018-2019 period, ESV conducted a schedule of unannounced inspections of line clearance in HBRA and LBRA. These focused on spans that the distribution businesses are responsible for clearing.

Unlike the outcomes audits described in the appendices to this report, ESV provides limited notice to the distribution companies of where or when such field inspections will occur.[13]

Figure 20 depicts the ESV inspection results for the reporting period and the first three months of the 2018-2019 period. This shows that Jemena had the best compliance in HBRA, while Powercor had the worst compliance. AusNet Services had the best compliance in LBRA, while United Energy had the worst.

The high levels of Powercor's non-compliance in both HBRA and LBRA can be viewed within the context of the non-compliance issues discussed in last year's report and in Section 7.2. This is indicative of systemic problems by Powercor in managing its line clearance responsibilities.

[13] Performance results are typically better when the distribution businesses are given advanced notice of ESV regulatory activity such as that given for the outcome audits.

While United Energy performed relatively well in HBRA, the high level of non-compliance in LBRA is of concern. ESV has discussed these results with United Energy (and will continue to do so).

The primary focus is for United Energy to rectify the non-compliances and put in place a plan to ensure the safety of the rest of its network. ESV will closely monitor the rectification actions and consider whether further enforcement action is warranted.

These results, while preliminary, indicate a high level of variance between non-compliance rates for these inspections and the outcomes audits reported in the appendices. ESV will be undertaking further inspections and analysis to ascertain the cause of the variance. We will then engage with the distribution businesses regarding any variations and, where necessary, redesign our audit activities to ensure their efficacy.

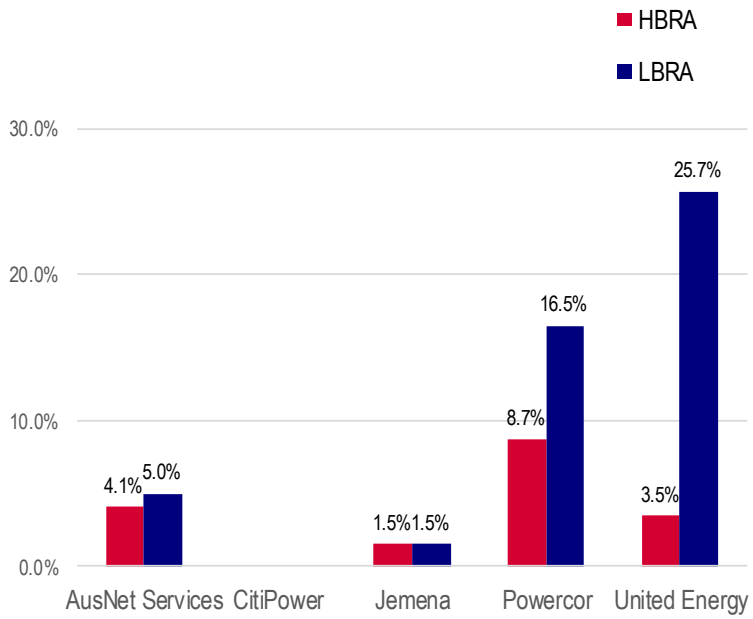

Figure 20 Non-compliance rates by distribution business

7.2 Enforcement actions

7.2.1 Powercor clearing of at-risk LBRA

Powercor is required to maintain the clearance space between vegetation and electric lines in areas of regional Victoria within its distribution area that are classified LBRA (excluding declared areas). Changes to water and land management in some LBRA managed by Powercor have resulted in ground conditions being significantly drier than when last reviewed by the CFA. As a result, the LBRA classification no longer represents the fire risk that exists as local conditions are more consistent with the classification of HBRA.

These areas require reclassification to better reflect the current environmental status. This work is scheduled to commence at the beginning of the 2018-2019 period (see section 7.4.1). The areas of LBRA affected by this issue are highlighted green in Figure 21.

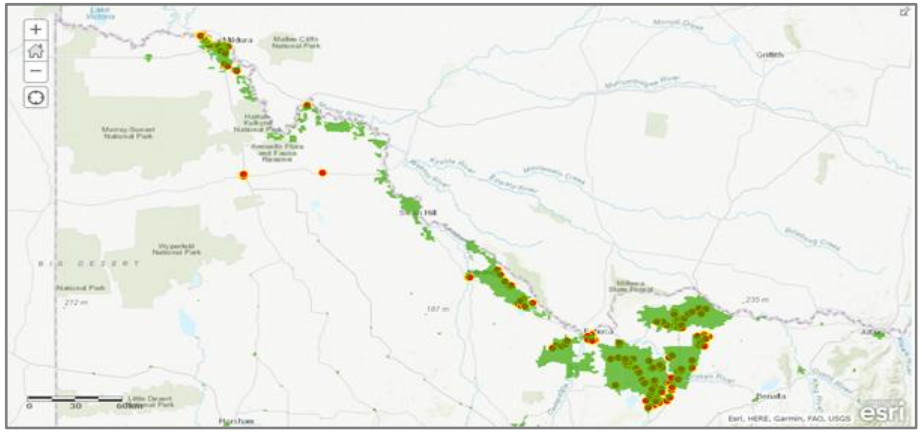

Figure 21 At-risk LBRA

The areas highlighted in green show LBRA areas with elevated risk. The red icons show the locations where ESV identified non-compliant spans in LBRA.

ESV attended two locations during the summer where fires had occurred in a regional LBRA, where an elevated fire risk existed. ESV attributed the ignition of these fires to contact between non-compliant vegetation and high voltage electric lines.

General observations of surrounding areas concluded that Powercor had not cleared vegetation in accordance with the code, regardless of whether it was LBRA or HBRA. Given the bushfire risks this presented to the community, ESV undertook broader inspections across the region.

The inspections identified 248 spans with non-compliant vegetation that ESV deemed unsafe. The distribution of these spans is depicted by the red dots in Figure 21. This confirmed that Powercor's management of vegetation in these areas was poor and electricity safety standards were compromised.

The rate at which non-compliant vegetation was found in this LBRA was much greater than that discovered in HBRA during the ESV pre-summer line clearance audit. This is attributed to Powercor placing greater importance on managing vegetation in HBRA in readiness for fire danger period. It may also be due to formal audit protocols providing several weeks lead notice prior to the audit commencing, allowing time for any necessary clearing to occur.

ESV requested that Powercor clear the unsafe vegetation identified by ESV, and provide additional data and reporting to assure ESV it was managing its electricity safety risks. Additionally, ESV initiated a formal investigation of this matter to determine what, if any, enforcement action should be taken against Powercor.

Powercor notified ESV after it considered it had cleared all of the 248 spans. When ESV re-inspected these, it found that not all had been cleared as reported. During the re-inspection, ESV found additional unsafe sites.

Due to the extent of the non-compliant vegetation observed in LBRA, ESV conducted sample inspections of vegetation in HBRA. These inspections found further sites where non-compliant and unsafe vegetation was affecting electric lines; albeit to a lesser extent than that observed in LBRA.

Pursuant to Section 86 of the Electricity Safety Act (ESA), ESV issued a notice to Powercor. The notice directed Powercor to clear (or confirm clearance of) all 248 previously referred unsafe spans within 14 days, and to advise ESV once that was complete. ESV also required Powercor to clear all other non-compliant and unsafe spans it had identified within 14 days.

Powercor responded to the Section 86 notice and confirmed that it had made all referred spans compliant and safe, including those the subject of the Section 86 notice.

An iterative process of re-inspection and response by Powercor occurred until ESV had confirmed all sites had been cleared of non-compliant vegetation and made safe.

This matter is now the subject of an ESV prosecution that is currently before the Courts.

7.2.2 Fire starts

ESV attended three sites within the Powercor network area during January 2018 where trees were reported to have touched high voltage electric lines and caused fires. Two of these fires occurred in LBRA of elevated risk, as discussed in Section 7.2.1; the other occurred in HBRA.

The location and nature of the fires was:

- Rochester: medium fire that resulted in property damage including fencing, sheds, machinery and hay (1000 m^2 – 10 ha)
- Mywee Road, Strathmerton: medium fire that resulted in fence and irrigation infrastructure damage (1000 m^2 – 10 ha)
- Currells Road, Port Campbell: small fire that resulted in fence damage (10-1000 m^2).

The CFA responded and promptly extinguished each of the fires.

ESV investigated each fire and concluded the cause was consistent with trees making contact with high voltage electric lines.

These fires are now the subject of ESV prosecutions currently before the Courts.

7.3 Performance of other responsible persons

7.3.1 ELCMP evaluation and acceptance

The regulations require all municipal councils and specified operators[14] with electric line clearance responsibilities to prepare an ELCMP before 31 March every year.

Unlike the major electricity companies, these other responsible persons are not required to submit their plan to ESV annually; however, they must do so if requested by ESV. During 2017-2018, ESV evaluated 14 plans submitted by municipal councils and four submitted by specified operators.

The evaluation process indicated a lack of understanding by the relevant organisations of how to prepare a quality plan. Extensive consultation was required to improve the quality of plans to ensure they met the standard expected by ESV.

In 2016, ESV released educational material to assist all councils and specified operators with improving the quality of their plans. The material provided interpretation of the requirements of the regulations and clarified the obligations required of the regulated entities. It also provided insight into ESV's expectations regarding the quality of plans. We continue to work with all parties to educate them on their safety responsibilities.

The General Manager of Electrical Safety and Technical Regulation approved a total of 14 municipal council plans and one specified operator plan in 2017-2018.

[14] Owners or operators of electricity networks that are not a major electricity company.

[15] A span refers to an electric line(s) that exists between any two supporting structures (poles, towers, substations).

7.3.2 Compliance observations

Systems audits

ESV conducted system audits of ten municipal councils throughout 2017-2018 to monitor the effectiveness of their electric line clearance management plans in complying with the regulations.

The local government authorities audited were:

- Baw Baw Shire
- Geelong City
- Hume City
- Moreland City
- Mornington Shire
- Nillumbik Shire
- Queenscliff Borough
- Whittlesea City
- Wyndham City
- Yarra Ranges Shire.

Compliance standards varied significantly between the organisations. It was evident that some organisations lacked the level of knowledge of the regulations that is expected of a regulated entity. ESV educated these organisations to ensure they were capable of managing their electric line clearance risks.

The auditing process included a field inspection component to verify that appropriate clearance standards are achieved. Where non-compliant vegetation is observed, ESV requires the relevant councils to clear the vegetation and restore appropriate safety standards.

Again, compliance varied between organisations as was the time it took to complete the required clearing work. Typically, however, all councils showed a willingness to comply and engaged openly with ESV.

HBRA inspections

Fifty-two municipal councils are responsible for managing tree clearance around electric lines in HBRA. The number of spans[155] for which councils are responsible is limited; some councils are responsible for less than ten spans (for example, Whittlesea Shire Council), while others are responsible for over 100 spans (for example, the Shire of Yarra Ranges).

Generally, councils are less knowledgeable of their compliance responsibilities and have less mature systems for electric line clearance than the distribution businesses. ESV therefore sought to increase its focus on council management of clearance in HBRA as a failure to appropriately manage such vegetation poses a greater risk of bushfire.

ESV inspected all municipalities where local councils are responsible for managing the clearance space in HBRA. We found 359 non-compliant spans across 32 of these municipalities.

Where we identified non-compliant vegetation, we notified the responsible council of the requirement to clear the vegetation to make it compliant and safe. Each council then arranged for clearing of the non-compliant vegetation, and we then confirmed that the works had been completed.

7.3.3 Issue of Section 86 notices to local government authorities

If a responsible person fails to keep the whole or any part of a tree clear of an electric line, Section 86 of the Act provides ESV with powers to require a responsible person to comply. This is to occur by means of a written notice specifying the actions necessary to comply.

If a responsible person is unable or refuses to comply with a Section 86 notice, ESV may direct the relevant distribution company to clear the non-compliant vegetation. The distribution company can then recover the costs of doing so from the responsible person.

When ESV identifies non-compliant vegetation, our preference in the first instance is to consult with the responsible person and have the vegetation cleared and made safe. When this process does not achieve the necessary safety outcome, or the responsible person fails to respond appropriately, ESV may issue a Section 86 notice.

ESV issued four Section 86 notices to the following four local government authorities in 2018:

- Maroondah City
- Port Phillip City
- Boroondara City
- Yarra Ranges Shire.

Since issue of the Section 86 notices, all of the councils have responded to the satisfaction of ESV, despite the actions not always being implemented with an adequate sense of urgency. Where compliance was sought through means other than vegetation clearing (for instance, implementing an engineering solution), ESV has required that compliance plans are put in place and that these are supported by suitable risk management methodologies.

7.3.4 Consultation and education

Electric line clearance has been a long-standing responsibility of organisations such as, but not limited to, municipal councils, Melbourne Water, Yarra Trams and Defence Estates Victoria. Despite the responsibility they bear, these organisations do not always have a mature understanding of their responsibilities, particularly when compared to the major electricity companies.

The reasons for this may include:

- responsibility oversight set at too low within the organisational structure
- lack of electricity network expertise
- preservation of amenity prioritised over electricity safety
- availability of suitable vegetation management resource
- network access constraints.

In the 2017-2018 period, ESV continued to disseminate educational information to help the regulated entities better understand their electric line clearance responsibilities. This material interpreted aspects of the regulations and advised on how to prepare a quality ELCMP.

Additionally ESV has actively consulted with industry to inform it on the electric line clearance regulations and the subsequent obligations. This has occurred both through proactive interaction and in response to requests for advice and clarification.

7.4 Issues for attention

7.4.1 HBRA / LBRA classification by the CFA

The regulations seek to mitigate the risk of electrocution, fire (including bushfire) and loss of electricity supply by excluding vegetation from a predetermined clearance space around electric lines. The required clearance space is prescribed within the Code of Practice for Electric Line Clearance (the code), a schedule to the regulations.

The code makes a distinction between the clearance spaces required in HBRA and LBRA, with required clearances being greater in HBRA due to the greater threat of bushfire. That said, the bushfire risk also exists in certain areas of LBRA throughout regional and peri-urban Victoria.

Section 80 of the Act identifies the CFA as the authority responsible for assigning fire hazard rating for regional Victoria and most of the peri-urban areas of the State.

Historically, the CFA performed regular cyclic review of these boundaries in consultation with the major electricity companies and municipal councils, with funding from the companies. This program ceased in 2013 and boundaries have not been reviewed since then. As a result, there are areas where the assigned fire hazard rating no longer represents the conditions that prevail (see Section 7.2.1 for an example).

Where at risk vegetation has been cleared for urban development, areas defined as HBRA could now be classified LBRA. Conversely, in areas where pasture is no longer irrigated, the LBRA classification no longer represents the fire risks that exist and these areas could be better defined and managed as HBRA.

The former may result in higher levels of management than are warranted. The latter can result in a greater exposure of the public to the risk of bushfire. While the review of fire hazard boundaries is outside of the immediate remit of ESV, we have engaged with the CFA and major electricity companies to reinstate the process of cyclic review (funded by the distribution businesses).

The review process re-commenced in July 2018, with the first year of review to target the high-risk areas along the Murray River identified in Section 7.2.1. Future scheduling of areas will be based on risk profiling, geographical location and efficient use of resources.

7.4.2 Merger of CitiPower/Powercor and United Energy

In April 2017, the principal owners of CitiPower and Powercor purchased a controlling interest in United Energy. This has resulted in centralised operation for various aspects of these businesses; including electric line clearance.

Despite assurances, ESV is concerned that electric line clearance risks may now emerge across the United Energy network similar to those found across the Powercor network during 2017-2018. This may arise as management of United Energy's electric line clearance responsibilities has been transferred to the Powercor business unit that allowed the systemic non-compliance discussed in Section 7.2. This included allowing trees to grow too close and to make contact with high voltage electric lines. This act caused the ignition of the three separate fires discussed in Section 4.3.

ESV will closely monitor compliance standards across United Energy, as it does with all the distribution businesses, to confirm safety standards are appropriately maintained.

Appendix A : AusNet Services

AusNet Services[16] has two shareholders with a significant investment and board representation, being Singapore Power (31.1 per cent) and State Grid of China (19.9 per cent). The remaining 49 per cent is publicly owned. The two major shareholders of AusNet Services also own 100 per cent ownership of Jemena and 34 per cent of United Energy.

AusNet Services has two operating electricity subsidiaries: AusNet Services Transmission (owns and operates the electricity transmission business) and AusNet Services Distribution (owns and operates the electricity distribution business). As the two subsidiaries are managed by the same CEO and Board and use similar procedures, ESV encompasses both subsidiaries into a single entity for reporting purposes. Where the discussion relates to a specific area of the business, this will be identified within the text.

AusNet Services is the only major electricity company in Victoria operating both transmission and distribution networks.[17]

The transmission network services all of Victoria (500kV and 220kV) and also includes interconnections with New South Wales and South Australia (330kV and 275kV respectively). It comprises approximately 6,560 km of transmission lines and 13,300 towers.

The distribution network covers any area of approximately 80,000 km^2, and includes Melbourne's outer-eastern suburbs and runs north to the New South Wales border and south and east to the coast (Figure 22). It comprises approximately 38,300 km of overhead line, 6,600 km of underground cable, 335,000 power poles and 86,600 public lighting poles. Most of this network (85 per cent) is in rural areas.

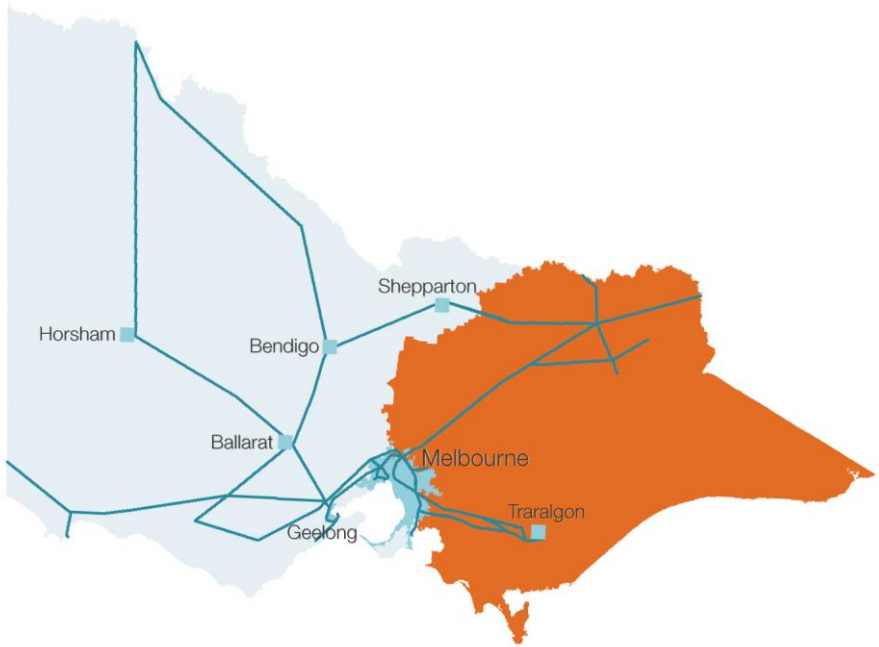

Figure 22 Service area for the AusNet Services distribution network (orange area) and transmission lines (dark blue)

[16] AusNet Transmission Group Pty Ltd and AusNet Electricity Services Pty Ltd are the listed holders of the electricity transmission and distribution licences respectively.

[17] While TOA and TOA2 are closely associated with CitiPower/Powercor, these have been established as separate companies. Their transmission assets are also limited in comparison to those of AusNet Services.

A1 Plans and processes

AusNet Services was scheduled to submit the following documents to ESV for review and acceptance and approval:

- Electricity Safety Management Scheme (ESMS) for distribution network before 3 December 2015
- Electricity Safety Management Scheme (ESMS) for transmission network before 29 March 2016
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revision of the accepted bushfire mitigation plan, although revised plans have been accepted more frequently due to regular changes in the regulations
- Electric line clearance management plan by 31 March each year.

With the new requirement to submit a safety case for acceptance before the review of its ESMS, the timetable for submission of the ESMS was amended to require a preliminary safety case to be submitted before 3 December 2015. This would be seen by ESV to have triggered the ESMS process.

AusNet Services Distribution provided a preliminary safety case in July 2015. After two iterations, ESV accepted the preliminary safety case in May 2016. AusNet Services Distribution submitted its full safety case for assessment in July 2016, and ESV accepted this in December 2016. AusNet Services then submitted its Electricity Safety Management Scheme in May 2017, and ESV is in the process of assessing this scheme.

AusNet Services Transmission submitted its full safety case in July 2017, and this is currently being reviewed by ESV.

AusNet Services submitted its transmission and distribution electric line clearance management plan to ESV in March 2018. ESV approved the plan in August 2018.

A2 Directions

ESV has issued three directions to AusNet Services to:

- install armour rods and vibration dampers in highest risk areas within hazardous bushfire risk areas (HBRA) by 1 November 2015 and in remaining areas of HBRA and in low bushfire risk areas (LBRA) by 1 November 2020
- install spacers on high voltage (HV) lines and spreaders on low voltage (LV) lines in HBRA by 1 November 2015 and in LBRA by 1 November 2020
- undertake powerline replacement projects specified by the Powerline Bushfire Safety Program under the Powerline Replacement Fund.

In April 2017, AusNet Services approached ESV to amend its armour rods and vibration dampers plan for HBRA and LBRA. It proposal was based on Australian Standard AS/NZS 7000 *Overhead line design*, which allows for an engineering assessment to determine if vibration dampers are effective in a given location. ESV reviewed the methodology behind the proposal and the amended installation plan and has accepted both. The AusNet Services program for the installation of armour rods and vibration dampers is ahead of schedule with 66 per cent complete against a target of 43 per cent

The direction to install spacers and spreaders was completed on time in HBRA and AusNet Services has completed the works in LBRA with the exception of two spans.

AusNet Services was also directed to undertake sixteen projects for the Powerline Replacement Fund by 31 December 2015. All sixteen projects have been completed, with four delivered on schedule and 12 delivered late.

These directions arose from Recommendations 27 and 32 of the Victorian Bushfires Royal Commission and the target was to complete these within a 10-year period. While some of the directions were delivered later than AusNet Services had originally proposed, these were completed ahead of the Commission's target date. ESV is satisfied with AusNet Services' progress in delivery of these directions.

A3 Bushfire mitigation regulations programs

To meet its bushfire mitigation obligations, AusNet Services plans to implement REFCL technology at 22 nominated zone substations in three delivery tranches. Consistent with its bushfire mitigation plan, AusNet Services is to address nine zone substations[18] in its first delivery tranche by 30 April 2019.

Over the 2017-2018 period, AusNet Services cautiously progressed its REFCL program, encountering a number of technical issues on the way. Table 2 provides a delivery breakdown for each of the zone substations.

ESV continues its engagement with AusNet Services to develop a consistent compliance testing methodology to ensure that regulatory requirements are achieved, and that its REFCL program delivers the mandated required capacity and, hence, safety outcomes.

A4 Exemptions

AusNet Services sought the following exemptions relating to the supply of HV customers from the following REFCL-protected substations:

- Barnawartha — Nestle Uncle Toby's and Woolworths
- Rubicon-A — Pacific Hydro
- Wonthaggi — Wonthaggi Wind Farm
- Wangaratta — Australian Textile Mills and Pacific Hydro

The Director of Energy Safety made recommendations to the Minister endorsing the exemptions and the Minister has advised her intention to grant the exemptions.

ESV subsequently received an exemption application for the supply of Puckapunyal Army Base from Seymour zone substation. ESV is currently assessing this exemption request.

Table 2 AusNet Services REFCL delivery progress

REFCL delivery milestone	BWA	KLK	KMS	MYT	RUBA	SMR	WN	WGI	WYK
Initiate	●	●	●	●	●	●	●	●	●
Design	●	●	●	●	●	●	●	●	●
Procurement – Ordered	●	●	●	●	●	●	●	●	●
Construction – Lines	●	●	●	●	●	●	●	●	●
Construction – Stations	●	●	●	●	●	●	●	●	●
Construction – Third-party	●	-	-	-	●	●	●	●	●
Testing / Commissioning	●	●	●	●	●	●	●	●	●
Close Out	●	●	●	●	●	●	●	●	●

● Complete ● In progress ● Not commenced - Not required

[18] Barnawartha (BWA), Kinglake (KLK), Kilmore South (KMS), Myrtleford (MYT), Rubicon-A (RUBA), Seymour (SMR), Wangaratta (WN). Wonthaggi (WGI) and Woori Yallock (WYK). AusNet Services started work on Kilmore South this year to ensure sufficient delivery in Tranche 1.

A5 Audit performance

A5.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attention on electric line clearance and bushfire mitigation audits as subsets of the ESMS and key elements of bushfire prevention. The AusNet Services Distribution full safety case was accepted in December 2017.

As part of the process to establish an accepted ESMS, ESV undertook an extensive systems validation audit of the AusNet Services ESMS in March 2018. The validation audit found several areas in the ESMS that required further information and clarification. AusNet Services is currently working with ESV to achieve a final acceptable ESMS.

A5.2 Electric line clearance

Transmission and distribution network system audit

An electric line clearance management system audit was undertaken in August 2017. The audit was used to test if the processes and procedures used by AusNet Services would allow it to effectively manage its electric line clearance risks.

The audit found that AusNet Services has a system in place for managing its electric line clearance program, including establishing objectives, planning to manage line clearance risk, and governance and assurance.

The audit found one opportunity for improvement that related to manual updating of data into the AusNet Services vegetation management system.

Distribution network outcomes audit

An electric line clearance outcomes audit of the AusNet Services distribution network was conducted in November 2017. The focus of the audit was to validate the accuracy of its vegetation management data and to obtain oversight of the electric line clearance standards being achieved.

The associated inspections occurred at randomly selected locations in different regions of the network. Due to the higher bushfire risk on the rural network, particular emphasis was placed on inspecting spans located in HBRA. Spans in LBRA were inspected too, but to a lesser extent.

A total of 764 electricity spans were inspected during the audit, of which 759 were located within HBRA and five in LBRA.

The inspection found the following:

- non-compliant spans
  - HBRA 8
  - LBRA 0
- variance
  - total sample = 8 out of 764 1.0%
  - HBRA = 8 out of 759 1.1%
  - LBRA = 0 out of 5 0%

This information relates specifically to non-compliant spans identified during the audit that were the management responsibility of AusNet Services.

The inspection results indicate that, where AusNet Services is responsible for vegetation management, its processes and clearing activities are implemented according to its approved electric line clearance management plan.

This is most important for HBRA, where the non-compliance rate of 1.1% for 2017-2018 was moderately worse than the 2016-2017 results of 0.8%. While the LBRA result is an improvement from 2016-2017, the sample size is not statistically significant and so any conclusions drawn from this are limited.

Overall the accuracy of the AusNet Services vegetation management data and the line clearance compliance standards was acceptable and compliant with the approved electric line clearance management plan.

The electric line clearance outcome audit recommended that AusNet Services:

- clear the non-compliant vegetation identified by ESV
- develop and use procedures to ensure annual inspection programs are completed efficiently and vegetation clearance activities are undertaken to ensure that clearance standards are maintained.

AusNet Services provided an appropriate response to the recommendations made by ESV.

Transmission network outcomes audit

An electric line clearance outcomes audit of the AusNet Services transmission network was conducted in September 2017, with the same focus as the audit of the distribution network.

A total of 368 electricity spans were inspected during the audit; all of the spans were located in HBRA.

The inspection found the following:

- Non-compliant spans
  - HBRA 8
- variance
  - total sample = 8 out of 368 2.2%

This information relates specifically to non-compliant spans identified during the audit that were the management responsibility of AusNet Services.

For the eight non-compliant spans, the recorded clearance distance ranged from 9.6 m to 12.5 m. While technically non-compliant, the risk presented by this non-compliant vegetation was low.

The electric line clearance outcome audit recommended that AusNet Services Transmission reviews vegetation data recorded in its system to ensure it accurately reflects the conditions in the field.

AusNet Services provided an appropriate response to the recommendation made by ESV.

Overall the accuracy of the AusNet Services vegetation management data and the line clearance compliance standards was acceptable and compliant with the approved electric line clearance management plan.

A5.3 Bushfire mitigation

Transmission network

ESV inspected 120 towers on five transmission lines in the Ballarat, Bendigo and Shepparton areas.

The inspections found no serious issues and thirteen minor issues, including damaged signage and minor tower damage.

The visual inspection found the transmission assets to be generally in very good condition with a low risk of failure. The issues found were very minor in nature and would be repaired as part of routine maintenance. ESV recommended that AusNet Services ensures these issues are addressed.

Overall, AusNet Services was found to have a detailed knowledge of its assets, their condition and the proximity of vegetation to its assets. The easement report provided by AusNet Services included detailed information on the condition of the lines. The AusNet Services system of regular patrols of the network would ensure that its knowledge is regularly updated.

Distribution network

The bushfire mitigation inspection focused on the general condition of the network to prevent fire starts. ESV auditors visited distribution feeders in the Nagambie, Murrindindi, Kinglake, Glenburn, Wandong and Strathewen areas. A total of 526 sites were inspected.

The inspections found the assets in a condition reflective of the data provided at the time of inspection with defect items accurately recorded and coded for action as required. The inspections also found no serious issues and eight minor issues, including:

- one HBRA site had a loose LV spreader
- three sites had low hanging conductor
- two sites had deteriorated HV fuse tubes
- two sites had inadequate clearance to stays.

ESV recommended that AusNet Services rectify the issues found. ESV also recommended that AusNet Services continues to monitor and address the condition of its assets in accordance with its current inspection cycles and practices.

The inspection concluded that systems and processes in place provide AusNet Services with reliable knowledge of the state of its system and assets.

None of the issues identified posed a major safety concern if promptly resolved. AusNet Services has provided a response and action plan to address the inspection findings.

A5.4 Additional pole inspection audit

Following ESV's annual systems and field audits of the distribution businesses' bushfire mitigation plans and procedures, ESV undertook field and systems audits in December 2017 that focused on pole inspection within the AusNet Services network. This was undertaken after concerns were raised by stakeholders about the adequacy of maintenance and asset management.

The pole inspection audit was conducted on the Mansfield 1 (MSD1) feeder between Woods Point and Jamieson. This feeder was chosen by ESV as it is remote and resides within the HBRA

The December 2017 audit focused on two key areas:

- to assess AusNet Services' system for managing its Bushfire Mitigation responsibilities, with emphasis on its asset assessment and reassessment practices and criteria
- to assess the decisions made by the Asset Inspector in the field.

The objective of the audit was to confirm that AusNet Services had appropriate engineering analysis, risk assessment, procedures and processes, and that it followed these procedures and processes in relation to asset inspection and re-inspection.

The systems audit found that AusNet Services had a documented system in place to manage its pole population including maintenance. No instances were found where a pole had been reclassified as serviceable after originally being classified as unserviceable, unless the pole was "staked". The audit also found no recorded failures of poles that had been re-inspected and re-assessed.

Nineteen sites were inspected in the field audit. The audit confirmed that, in many cases, the required maintenance works had already been completed on many of the assets selected as part of the field audit in accordance with AusNet Services' bushfire mitigation program and procedures. The field audit found that, when assessing poles, AusNet Services is applying its asset maintenance criteria consistently and effectively in accordance with industry standards.

The full report can be found at www.esv.vic.gov.au/news/bushfire-mitigation-audit

A5.5 Work practices

In 2017-2018, ESV undertook three observations of AusNet Services' work practices across three sites. The findings of these observations were as follows:

- non-compliances 0
- minor non-compliances 1
- opportunities for improvement 6

These findings were consistent with those of previous observations, where the key areas of concern related to:

- understanding and referencing of safe work method statements
- accuracy of information included on job safety assessments
- checking and use of appropriate personal protective equipment, tools and equipment
- operating and access permit issuing practices.

ESV recognised that AusNet Services has implemented an internal work practices observation program in line with ESV recommendations from previous years. ESV recommended that AusNet Services continues to develop its internal observation program to ensure its work practices specifically focus on ensuring all workers:

- have a detailed understanding of the job safety assessment process and know the contents of relevant safe work method statements
- refer to and use safe working practices
- check the condition of personal protective equipment and equipment prior to use, particularly LV and HV insulating gloves and fall prevention equipment
- are involved in the permit issuing process and:
  - confirm all permit documents are completed to standard
  - ensure all persons involved in the work understand the permit they are signing onto
  - ensure the permit issuing process is to standard with appropriate communication, with strong, effective site leadership.

A6 Safety indicators

Figure 23 shows the annualised number of all serious electrical incidents reported to ESV by AusNet Services, with the data sorted from most frequent to least frequent. Figure 24 shows the same for those incidents that result in a ground or vegetation fire. Both graphs also show the change in incident numbers from 2015-2016, the last year with similar climate to 2017-2018 (see Section 5.1).

All of the four most common incidents and fire-related incidents are within the direct control of AusNet Services to manage.

The most common incidents on the AusNet Services network in 2017-2018 were HV fuse failures, tree contact, other asset failures and connection faults. With the exception of other asset failures, all have decreased in numbers since 2015-2016.

Last year we noted that AusNet Services had the highest level of HV fuse failures of all the distribution businesses. While AusNet Services has reduced the numbers of fuse failures on its network by almost 20 per cent from the 2015-2016 period through its Expulsion Drop Out fuse replacement program, it saw an increase in fuse failures from 2016-2017 and still has the highest number of such events of all the distribution businesses. It had about 40 per cent more fuse failures than Powercor.

Of the four most common fire events, AusNet Services has experienced increases in the number of fires resulting from tree contact, animal contact and HV fuse failures when compared to the 2015-2016 period. There has been no change in the number of fires from connection faults.

HV fuse failures are the most common incident on the AusNet Services network, and 25 per cent of these incidents result in ground fires. The second most common incident, tree contact, is the most common cause of ground fires; two-thirds of these events resulted in a ground fire this year. Animal contact is the sixth-most common incident, but they are the second-most common cause of ground fires, with 74 per cent resulting in a fire.

Of the ground fires on the AusNet Services network this year, 89 per cent were smaller than 1,000 m^2, 7.6 per cent were between 1,000 m^2 and 10 hectares and 3.3 per cent were larger than 10 hectares.

The high likelihood that a tree contact incident will result in a fire is of concern. Given the high tree density close to assets in the AusNet Services and Powercor regions,[19] there is a higher probability of trees growing into the clearance space, trees falling across powerlines from outside the clearance space or branches blowing onto powerline from outside the clearance space. Vegetation management is vital for minimising the bushfire risk from the network. In addition to its line clearance and asset management works (see Section A5), AusNet Services maintains a hazard tree removal program to identify and remove vegetation from outside the prescribed clearance space that may present increased risk to overhead powerlines. It is also progressively replacing bare overhead lines with insulated cables within the highest fire loss consequence areas (see Section 6.2.2).

Continued vigilance and implementation of programs under the amended bushfire mitigation regulations is needed to minimise opportunities for contact events to result in fires.

It is also unfortunate to see that the numbers of fires has increased in all categories since 2015-2016, with the exception of a slight decrease in pole fires.

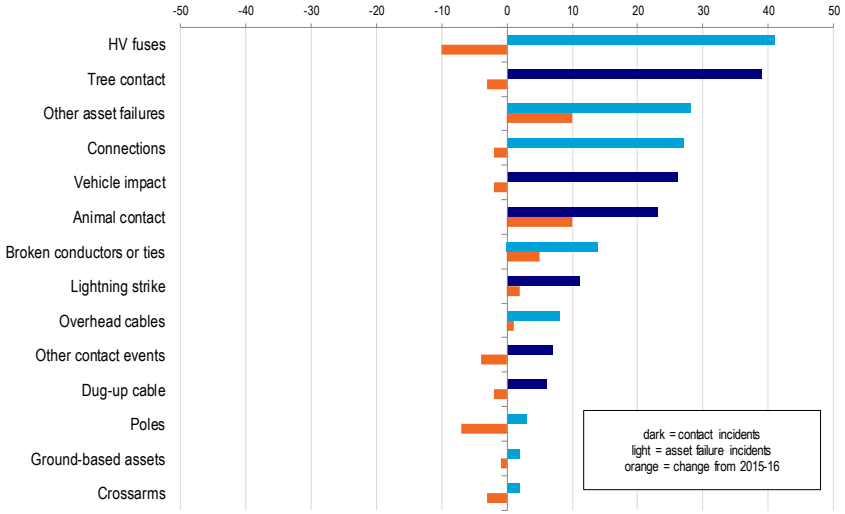

Figure 23 Incidents on the AusNet Services network

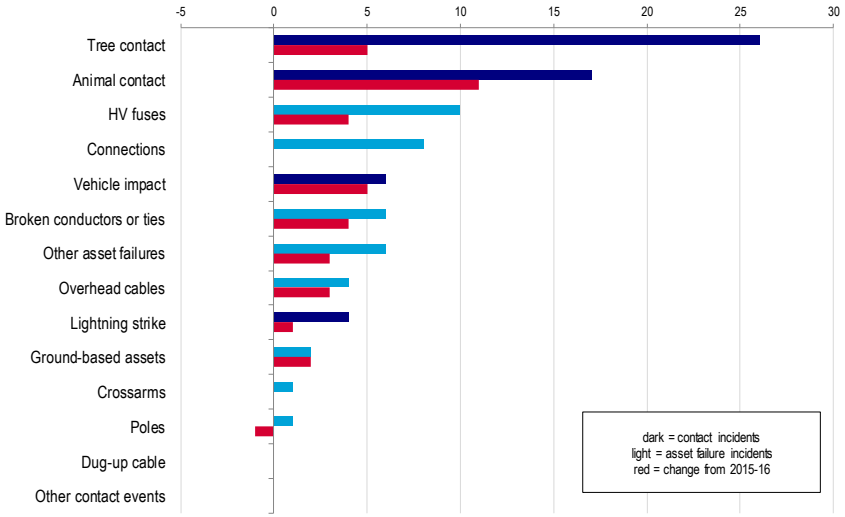

Figure 24 Incidents on the AusNet Services network resulting in ground fires

[19] Tree density across Victoria is shown in Appendix I.

Appendix B : Basslink

Basslink is owned by Keppel Infrastructure Trust, an entity listed on the Singapore stock exchange. Basslink is registered as a Market Network Service Provider.

Basslink owns and operates the HVDC interconnector between Victoria and Tasmania. In Victoria its assets comprise the Loy Yang converter station connected to the 500kV transmission system via 3.2 km of overhead line. From the converter station, 57 km of overhead line and 6.4 km of underground cable connect to the submarine cables that cross Bass Strait to Tasmania (Figure 25). Only the onshore assets in Victoria are subject to regulation by ESV.

The Basslink asset base in Victoria is significantly smaller than that of AusNet Services Transmission; it has only one per cent of the towers that AusNet owns and maintains. Its assets are also newer, having only been commissioned in April 2006.

Figure 25 Location of Basslink transmission assets (dark blue line)

B1 Plans and processes

Basslink was scheduled to submit the following documents to ESV for review and acceptance/approval:

- Electricity Safety Management Scheme (ESMS) before 30 September 2016
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revised bushfire mitigation plan
- Electric line clearance management plan by 31 March each year.

With the new requirement to submit a safety case for acceptance before the review of its ESMS, the timetable for submission of the ESMS was amended to require a preliminary safety case to be submitted before 30 September 2016. This would be seen by ESV to have triggered the ESMS process.

Basslink submitted its preliminary safety case to ESV in September 2016. ESV has assessed the safety case and, in December 2016, requested Basslink to submit its full safety case. The full safety case was submitted to ESV in July 2017.

Basslink submitted its electric line clearance management plan to ESV in March 2018. ESV approved the plan in July 2018.

B2 Directions

ESV has not had cause to issue directions to Basslink.

B3 Exemptions

Basslink has sought no exemptions from regulations.

B4 Audit performance

B4.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attention on electric line clearance and bushfire mitigation audits as subsets of the ESMS and key elements of bushfire prevention.

As part of the process to establish an accepted ESMS, ESV plans to undertake extensive systems validation audits of Basslink during January to March 2019.[20]

B4.2 Electric line clearance

An electric line clearance outcomes audit of the Basslink transmission network was conducted in November 2017. Given the limited size of the Basslink network a sample representing 55 per cent of the entire network was inspected.

The focus of the audit was to validate the accuracy of its vegetation management data and obtain oversight of the electric line clearance standards being achieved.

Associated inspections occurred at randomly selected locations on the easement of the network, which exists entirely in HBRA. A total of 78 electricity spans were inspected during the audit.

All the inspected spans were found to be compliant to the clearance requirements of the electric line clearance regulations. This was consistent with the findings of the most recent line clearance inspection of Basslink, in 2016.

[20] These audits were postponed from January to March 2018 as ESV focused on its attention in 2017-2018 on the higher risk distribution businesses and some of the issues that were emerging with these businesses.

The electric line clearance outcomes audit recommended that Basslink:

- ensure identified hazard trees are scheduled within assigned maintenance time frames
- review manual data entries and correct any errors to ensure a high level of data accuracy is maintained.

Basslink provided appropriate responses to the ESV recommendations.

B4.3 Bushfire mitigation

ESV inspected the 400kV DC powerlines running between the Loy Yang convertor station and the coastal connector station. A total of 84 transmission towers along the route were inspected.

The inspection made the following observations:

- the transmission line is relatively new
- in general, the visual ground inspection of assets along the line route indicate that the line was in good condition, reflecting its most recent line condition inspection conducted in February 2017
- only one item of minor maintenance was noted (rusting bolt) and Basslink will manage this via its maintenance management processes.

The inspection found the transmission assets to be generally in very good condition with a low risk of failure. No safety issues were found regarding asset condition from the inspection.

Overall, Basslink was found to have a detailed knowledge of its assets, their condition and the proximity of vegetation to its assets. The easement report provided by Basslink included detailed information on the condition of the lines. Regular patrols of the system by Basslink would ensure that its knowledge is regularly updated.

Basslink has provided a response to the inspection findings.

B4.4 Work practices

The Basslink transmission line is operational almost continually, with scheduled maintenance occurring every two years.

ESV did not conduct any observations of Basslink works practices this year as there was no planned work undertaken on the Basslink transmission line in the period.

B5 Safety indicators

Transmission infrastructure generally has low levels of incidents due to the nature of the assets and the clearances maintained around these higher voltage assets. Transmission assets are also less dispersed than distribution assets, thereby reducing exposure to environmental threats and third-party impacts. This also makes them easier to maintain.

Compared to the AusNet Services transmission network, Basslink has the further advantage of having a relatively short transmission line in Victoria. Also being a relatively new asset, Basslink has not entered a phase of its life cycle where major maintenance is required.

It is therefore not unexpected that Basslink recorded no incidents on its transmission network during the 2017-2018 period.

Appendix C : CitiPower

CitiPower/Powercor[21] is jointly owned by Cheung Kong Infrastructure, Power Assets Holdings and Spark Infrastructure. Cheung Kong Infrastructure, Power Assets Holdings are both part of the Cheung Kong Group of companies. They jointly own 51 per cent of CitiPower/Powercor, with the remaining 49 per cent held by Spark Infrastructure.

In May 2017, Cheung Kong Infrastructure purchased the DUET Group, thereby giving it majority ownership (66 per cent) of United Energy. This has resulted in some consolidation of activities and processes across the companies Cheung Kong Infrastructure controls. Of most relevance from a safety perspective was the introduction into United Energy of CitiPower/Powercor procedures for vegetation management.

CitiPower and Powercor are managed by a single executive management team using common procedures and systems across the two distribution businesses. As a result, the Electricity Safety Management System (Section C4.1) and the work practices observations audits (Section C4.3) have been undertaken jointly across the two businesses. The remaining sections within this appendix refer to the specific assets within the CitiPower network and have therefore been assessed independently of the Powercor assets.

The CitiPower distribution network covers an area of approximately 157 km^2, and includes Melbourne's central business district and inner suburbs (Figure 26). It comprises approximately 2,580 km of overhead line, 3,100 km of underground cable, 49,100 power poles and 9,100 public lighting poles. Most of this network (75 per cent) is in the central business district.

Figure 26 Service area for the CitiPower distribution network (orange area)

Jemena and United Energy service boundaries are shown in orange

[21] CitiPower Pty Ltd is the listed holder of the electricity distribution licence.

C1 Plans and processes

CitiPower was scheduled to submit the following documents to ESV for review and acceptance and approval:

- Electricity Safety Management Scheme (ESMS) before 14 December 2015
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revision of the accepted bushfire mitigation plan, although revised plans have been accepted annually due to regular changes in the regulations
- Electric line clearance management plan by 31 March each year.

With the new requirement to submit a safety case for acceptance before the review of its ESMS, the timetable for submission of the ESMS was amended to require a preliminary safety case to be submitted before 14 December 2015. This would be seen by ESV to have triggered the ESMS process.

CitiPower provided a preliminary safety case in July 2015. After three iterations, ESV accepted the preliminary safety case in September 2016. CitiPower submitted its full safety case, incorporating feedback from the preliminary safety case assessment, to ESV in December 2016. After two further iterations, ESV accepted the full safety case in August 2017. CitiPower submitted an ESMS in November 2017, which we are currently reviewing.

CitiPower also submitted its electric line clearance management plan to ESV in March 2018. ESV assessed the submitted plan and approved it in August 2018.

C2 Directions

CitiPower has no hazardous bushfire risk areas (HBRA) in its region, so no directions were placed on CitiPower regarding the installation of armour rods and vibration dampers in HBRA.

Two directions have been placed on CitiPower that are yet to commence, namely to:

- install armour rods and vibration dampers in low bushfire risk areas (LBRA)
- install spacers on high voltage (HV) lines and spreaders on low voltage (LV) lines in LBRA.

These directions are not due to be completed until 2020. These directions will be monitored by ESV.

C3 Exemptions

There were no outstanding exemptions applicable to CitiPower. All previous exemptions issued in the last five years have been complied with through the completion of tree clearance works.

C4 Audit performance

C4.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attention on electric line clearance and bushfire mitigation audits as subsets of the ESMS and key elements of bushfire prevention. CitiPower/Powercor had its full safety case accepted in August 2017.

As part of the process to establish an accepted ESMS, we undertook an extensive systems validation audit on CitiPower's ESMS during March 2018. The validation audit found several areas in the ESMS that required further information and clarification. CitiPower is currently working with ESV to achieve a final acceptable ESMS.

C4.2 Electric line clearance

An electric line clearance management system audit was undertaken in August 2017. The audit was used to test if the processes and procedures used by CitiPower would allow it to effectively manage its electric line clearance risks.

The audit found that CitiPower has process and procedures to manage its vegetation clearing responsibilities. Application of the process and procedures should enable CitiPower to, as far as practicable, minimise electricity safety risks such as electric shock or electrocution and fire starts and maintain reliability of electricity supply.

The audit found four opportunities for improvement that related to:

- document control
- training methods
- auditing and analysis of audit findings.

CitiPower network outcomes audit

An electric line clearance inspection of the CitiPower distribution network was conducted in October 2017. The focus of the inspection was to validate the accuracy of its vegetation management data and obtain oversight of the electric line clearance standards being achieved.

The associated inspections occurred at randomly selected locations in different regions of the network. The entire network is LBRA or of an undefined bushfire risk.

A total of 538 electricity spans were inspected. CitiPower was responsible for all spans inspected.

The inspection found the following:

- non-compliant spans in LBRA 27
- variance = 27 out of 538 5.0%

This information relates specifically to non-compliant spans identified during the audit that were the management responsibility of CitiPower.

The inspection results indicate that CitiPower's processes and clearing activities are implemented according to its approved electric line clearance management plan; however, this could be improved. The overall rate of non-compliance of five per cent for 2017-2018 is an improvement from its 11.7 per cent result in 2016-2017.

ESV found that CitiPower vegetation assessment cycle for a significant number of spans exceeded the three-year cycle described in its approved electric line clearance management plan.

The electric line clearance outcome audit recommended that CitiPower:

- clears the non-compliant vegetation identified by ESV
- reviews its database information to ensure it is reflective of their most current span and vegetation assessment information
- reviews assigned codes that indicated vegetation may enter the minimum clearance space earlier than anticipated to ensure the spans remain compliant through future assessment and pruning cycles.

CitiPower responded to the audit proposing how it would resolve the recommendations made by ESV.

C4.3 Work practices

In 2017-2018, ESV undertook two observations of CitiPower work practices across four sites. The findings of these observations were:

- non-compliances 1
- minor non-compliances 4
- opportunities for improvement 5

These findings were consistent with some those of previous observations, where the key areas of concern related to:

- quality of job safety assessments
- checking and use of appropriate personal protective equipment, tools and other equipment
- operating and access permit issuing practices.

Of particular note was that an operator had not completed the operating job safety assessment before starting work. This issue had been identified on three previous work practices observations.

ESV recommended CitiPower's work practices specifically focus on ensuring all workers:

- have a detailed understanding of the job safety assessment process and know the contents of relevant safe work method statements
- check the condition of equipment prior to use, and use appropriate personal protective equipment, particularly LV and HV insulating gloves and fall prevention equipment
- confirm the safety observer is ready to undertake his duties before starting work
- are involved in the permit issuing process and:
  - confirm all permit documents are completed to standard
  - ensure all persons involved in the work understand the permit they are signing onto
  - ensure the permit issuing process is to standard with appropriate communication, with strong, effective site leadership.

C5 Safety indicators

Figure 27 shows the annualised number of all serious electrical incidents reported to ESV by CitiPower, with the data sorted from most frequent to least frequent. Figure 28 shows the same for those incidents that result in a ground or vegetation fire. Both graphs also show the change in incident numbers from 2015-2016, the last year with similar climate to 2017-2018 (see Section 5.1).

Of the four most common incidents, the top three events are largely outside of the direct control of CitiPower.

The most common incident was other contact events, which includes copper theft, vandalism and intrusions into the No Go Zones around overhead lines. These have increased by about 50 per cent since the 2015-2016 period. ESV is currently developing a program of works with Jemena to mitigate the risk from No Go Zone intrusions.

While vehicle incidents have dropped by 43 per cent from 2015-2016, the number this year is double the number reported last year. Dug-up cables are down 22 per cent from 2015-2016, and connection faults are down 14 per cent.

Commendably, the number of fires on the CitiPower network has reduced to zero across all categories except for connection faults, tree contact and dug-up cables. The overall number of ground fires on the CitiPower network is low, with only four fires this year.

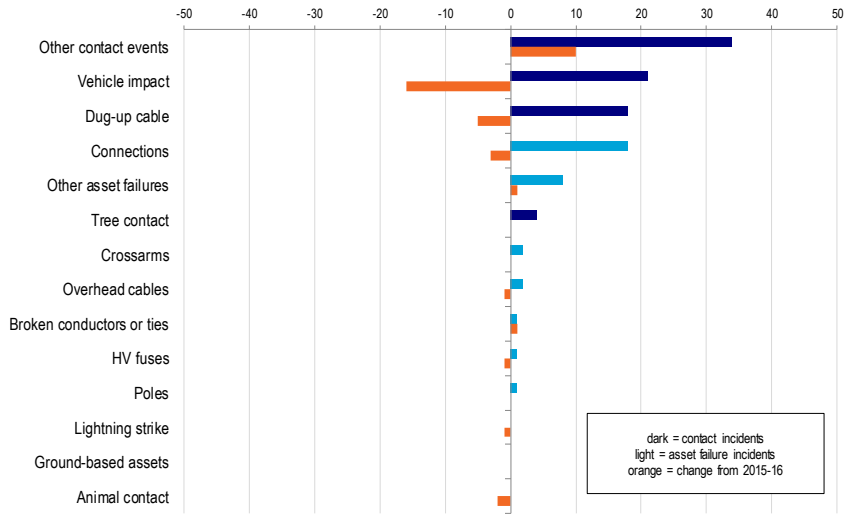

Figure 27 Incidents on the CitiPower network

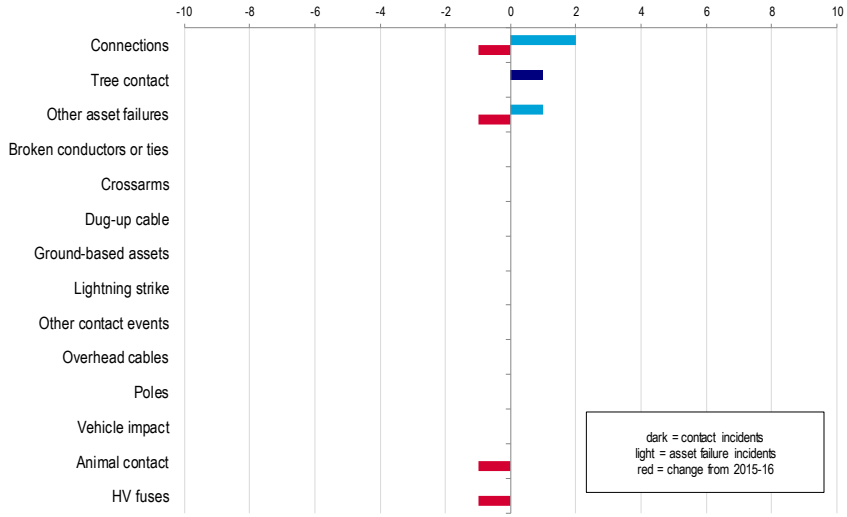

Figure 28 Incidents on the CitiPower network resulting in ground fires

Appendix D : Jemena

Jemena[22] is one of the subsidiaries of SGSP (Australia) Assets Pty Ltd, which is jointly owned by the State Grid International Development Australia Investment Company Limited (SGIDAIC) and Singapore Power International Pte Ltd (SPI). SGIDAIC holds a 60 per cent shareholding in SGSPAA and SPI holds the remaining 40 per cent.

SGIDAIC is owned by the State Grid Corporation of China. SPI is owned by Singapore Power Limited and its ultimate holding company is Temasek Holdings (Private) Limited.

As well as 100 per cent ownership of Jemena, SGSPAA also owns a 34 per cent interest in United Energy Distribution Holdings Pty Ltd, the holding company of United Energy Distribution Pty Ltd. The two companies forming SGSPAA also own 51 per cent of AusNet Services.

The Jemena AC distribution network covers any area of approximately 950 km^2, across Melbourne's northern and western suburbs, including Melbourne International Airport (Figure 29). It comprises approximately 4,450 km of overhead line, 1,880 km of underground cable, 81,200 power poles and 26,100 public lighting poles. Most of this network (86 per cent) is in urban areas.

Figure 29 Service area for the Jemena distribution network (orange area)

CitiPower and United Energy service boundaries are shown in orange

[22] Jemena Electricity Networks (Vic) Ltd is the listed holder of the electricity distribution licence.

D1 Plans and processes

Jemena was scheduled to submit the following documents to ESV for review and acceptance and approval:

- Electricity Safety Management Scheme (ESMS) before 3 December 2015
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revision of the accepted bushfire mitigation plan, although revised plans have been accepted annually due to regular changes in the regulations
- Electric line clearance management plan by 31 March each year.

With the new requirement to submit a safety case for acceptance before the review of its ESMS, the timetable for submission of the ESMS was amended to require a preliminary safety case to be submitted before 3 December 2015. This would be seen by ESV to have triggered the ESMS process.

Jemena provided a preliminary safety case in October 2015. After three iterations, ESV accepted the preliminary safety case in September 2016. Jemena submitted its full safety case to ESV in March 2017, and ESV accepted the full safety case in January 2018. Jemena submitted an ESMS to ESV in January 2018, which ESV is currently reviewing.

Jemena also submitted its electric line clearance management plan to ESV in March 2018, which we approved in August 2018.

D2 Directions

ESV has issued two directions to Jemena:

- install armour rods and vibration dampers in hazardous bushfire risk areas (HBRA) by the end of 2015 and in low bushfire risk areas (LBRA) by the end of 2020
- install spacers on high voltage (HV) lines and spreaders on low voltage (LV) lines in HBRA by the end of 2015 and in LBRA by the end of 2020.

By 31 December 2015, Jemena had only installed 1701 armour rods against a target of 5100. Jemena advised that it had over-estimated the number of armour rods that required installation when the target was developed as part of the 2011-2015 Electricity Distribution Price Review. Jemena also asserted that all spans have been inspected and those requiring armour rods have had them installed. ESV undertook further assessment and accepted Jemena's safety rationale for reporting less than the original estimated target.

Jemena successfully completed the direction to install spacers and spreaders by 31 December 2015.

Jemena is installing armour rods, vibration dampers, spacers and spreaders in the LBRA as part of the routine maintenance program. Jemena estimates that 271 spans will be completed by November 2020, with retrofitting of vibration dampers and armour rods over two years — 135 spans in 2019 and 136 spans in 2020.

D3 Bushfire mitigation regulations programs

To meet its bushfire mitigation obligations, Jemena is mandated to implement REFCL technology at Coolaroo zone substation by 30 April 2023. This work is yet to commence.

Over the 2016-2017 period, Jemena also chose to install an Arc Suppression Coil at Sydenham. Jemena has not placed the Sydenham ASC into service yet as the assets of Metro Trains (a key HV customer) had not yet been hardened and were not capable of withstanding the higher voltages. The ability to undertake this hardening under the electricity rules was unclear. Changes made to the Electricity Distribution Code on 20 August 2018 are not just applicable to mandated REFCLs, they will also assist in resolving Jemena's issue with Metro Trains.

Jemena has plans to install a similar device at Sunbury. While these operate like a REFCL and will provide some level of fire ignition risk reduction, they do not provide the same level of sensitivity and protection as a REFCL. That said, Jemena does not have an obligation to install these devices and is commended for taking this proactive action.

Jemena also plans to establish a new zone substation at Craigieburn to accommodate load growth. It is expected that the existing Jemena feeders supplied from AusNet Services' prescribed substation at Kalkallo will be transferred to Craigieburn. These feeders are mandated and, therefore, the Craigieburn substation needs to be REFCL-capable by the date the feeders were mandated if they are to be tranferred. ESV expects that AusNet Services and Jemena will work collaboratively to ensure the required capacity is achieved on these feeders by the time that AusNet Services is due to deliver the required capacity for the Kalkallo zone substation. While the Craigieburn substation has been deferred beyond 2020, it may need to be brought forward due to Jemena's bushfire mitigation obligations.

D4 Exemptions

There are no exemptions currently applicable to Jemena.

D5 Audit performance

D5.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attention on electric line clearance and bushfire mitigation audits as subsets of the ESMS and key elements of bushfire prevention.

As part of the process to establish an accepted ESMS, ESV undertook an extensive systems validation audit on Jemena's ESMS in June 2018. The validation audit found several areas in the ESMS that requires further information and clarification. Jemena is currently working with ESV to achieve a final acceptable ESMS.

D5.2 Electric line clearance

An electric line clearance outcomes audit of the Jemena distribution network was conducted in September and October 2017. The focus of the audit was to validate the accuracy of its vegetation management data and to obtain oversight of the electric line clearance standards being achieved.

The associated inspections occurred at randomly selected locations in different regions of the network. Due to increased fire threats associated with the network, particular emphasis was placed on inspecting electricity spans located in HBRA. Spans in LBRA were inspected too, but to a lesser extent.

A total of 533 electricity spans were inspected during the audit. Of these spans, 466 were located within HBRA and 67 in LBRA.

The inspection found the following:

- non-compliant spans
  - HBRA 1
  - LBRA 14

- variance
  - total sample = 15 out of 533 2.8%
  - HBRA = 1 out of 466 0.2%
  - LBRA = 14 out of 67 20.9%

This information relates specifically to non-compliant spans identified during the audit that were the management responsibility of Jemena.

The inspection results indicate that, in HBRA where Jemena is responsible for vegetation management, its processes and clearing activities are implemented according to its approved electric line clearance management plan.

This is most important for HBRA, where the non-compliance rate of 0.2 per cent this year was considerably better than the 4.8 per cent result in 2016-2017 and comparable with the 0.0 per cent result in 2015-2016. This was also the best performance of all the distribution businesses.

The results in LBRA were much worse than when last recorded. A non-compliance rate of 1.9 per cent in 2015-2016 has increased to 20.9 per cent this year. LBRA inspections did not occur in 2016-2017.

For HBRA, the overall the accuracy of the Jemena vegetation management data and the line clearance compliance standards was acceptable.

In LBRA, the accuracy of its vegetation management data was acceptable but the compliance standards that were observed were poor. This may have been due to deficient allowance for the growth or regrowth being made at the time the vegetation was last inspected.

The electric line clearance outcome audit recommended that Jemena:

- clears the non-compliant vegetation identified by ESV
- reviews the ESV inspection results in relation to those recorded on its vegetation management system to ensure spans remain compliant and data accurately reflects span conditions
- reviews the data for the spans identified to be non-compliant to confirm the spans will remain compliant via it's ELC management processes, particularly where this relates to making an allowance for vegetation regrowth.

Jemena provided an appropriate response to the recommendations made by ESV.

Given the excellent clearance rate in HBRA and that the poor clearance in LBRA appears to be an isolated occurrence, ESV is not seeking to pursue further action at this time. That said, ESV will be undertaking LBRA inspections in September-October 2018 and will consider any appropriate enforcement actions following the inspections if systemic non-compliance is identified.

D5.3 Bushfire mitigation

The bushfire mitigation field inspection assessed compliance with legislation and internal business process with a focus on the status of assets in the Bulla, Craigieburn, Watsonia, and West Meadows areas. Inspections were carried out at 454 sites randomly selected in these areas.

The inspection found 32 sites with additional defects of a higher priority than Jemena records. Of particular concern was that the inspection identified defects present that Jemena's asset system recorded as having been repaired. This included:

- two concrete pole sites that had short HV insulators without bird covers
- one LV insulator that had detached from the pin
- one span that was missing an LV spreader
- two grey services that were supported by unaccepted clamps.

ESV had some concerns regarding the findings and requested further information from Jemena regarding the inspection requirements in their Asset Inspection Manual. Jemena provided ESV with an updated manual that addressed ESV concerns and reports of field action that adequately rectified all of the inspection findings.

D5.4 Work practices

In 2017-2018, ESV undertook one observation of Jemena work practices on a Jemena work crew. The findings of the observation were as follows:

- non-compliances 1
- minor non-compliances 2
- opportunities for improvement 0

These findings were consistent with those of previous observations, where the key area of concern related to checking and use of appropriate PPE, tools and equipment.

ESV recommended that Jemena's work practices specifically focus on ensuring:

- all workers check the condition of equipment prior to use, and use appropriate Personal Protective Equipment, particularly LV and HV insulating gloves and fall prevention equipment
- all workers including contractors be involved in the on-site Job Safety Assessment process
- the work planning processes ensure adequate pre-site job planning, including consultation with work crew leaders.

D6 Safety indicators

Figure 30 shows the annualised number of all serious electrical incidents reported to ESV by Jemena, with the data sorted from most frequent to least frequent. Figure 31 shows the same for those incidents that result in a ground or vegetation fire. Both graphs also show the change in incident numbers from 2015-2016, the last year with similar climate to 2017-2018 (see Section 5.1).

Of the four most common incidents, other contact events and vehicle impacts are largely outside of the direct control of Jemena to manage. Tree contact is within the control of Jemena except where trees fall or branches are blown onto powerlines from outside the clearance space. Connection faults are within the direct control of Jemena. Of these, all four of these types of incidents increased in numbers since 2015-2016.

Other contact events include copper theft, vandalism and intrusions into the No Go Zone around overhead powerlines. These incidents have increased by a factor of five since 2015-2016. Further analysis of these events is warranted to identify whether there is an underlying cause that needs to be addressed with Jemena or Victoria Police.

The number of ground fires on the Jemena network fell to zero across all categories except for broken conductors, animal contact, crossarm fires and other asset failures. Only one of these, crossarm fires, represents a slight increase on the 2015-2016 period. The overall number of ground fires on the Jemena network is low, with only six fires this year. This is a positive outcome for the year. Jemena is commended for the reduction in fires.

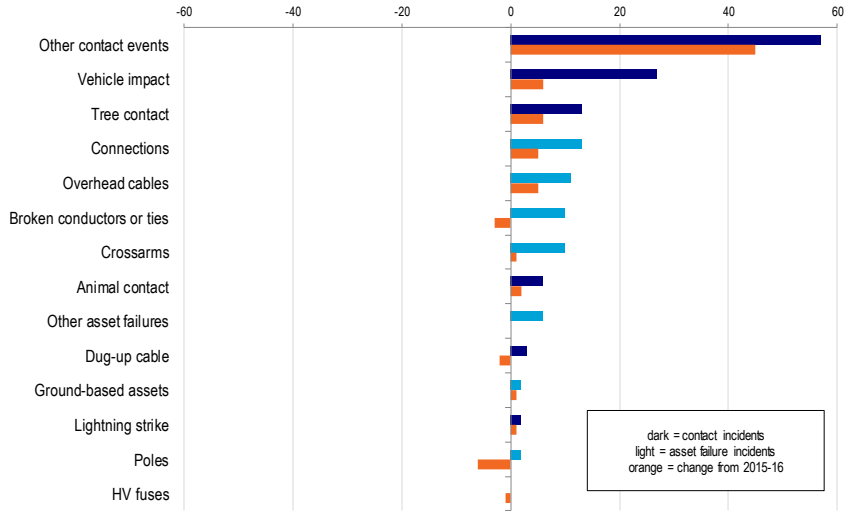

Figure 30 Incidents on the Jemena network

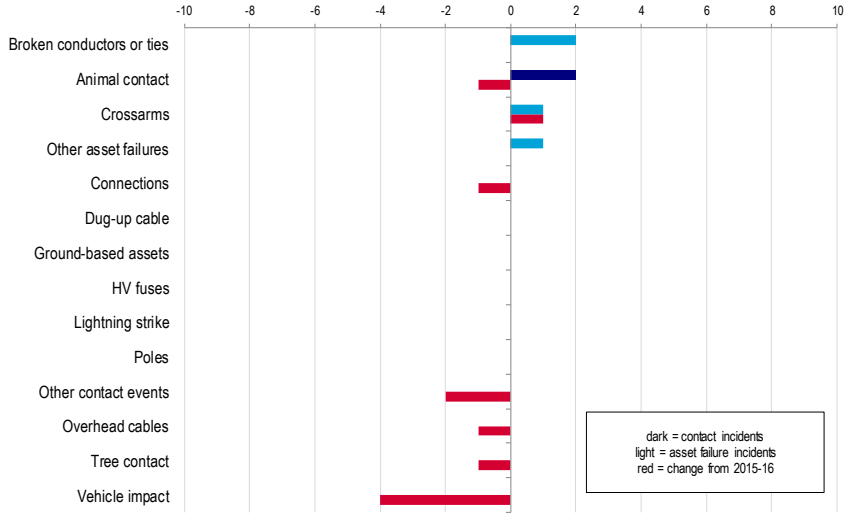

Figure 31 Incidents on the Jemena network resulting in ground fires

Appendix E : Powercor

CitiPower/Powercor[23] is jointly owned by Cheung Kong Infrastructure, Power Assets Holdings and Spark Infrastructure. Cheung Kong Infrastructure and Power Assets Holdings are both part of the Cheung Kong Group of companies. They jointly own 51 per cent of CitiPower/Powercor, with the remaining 49 per cent held by Spark Infrastructure.

In May 2017, Cheung Kong Infrastructure purchased the DUET Group, thereby giving it majority ownership (66 per cent) of United Energy. This has resulted in some consolidation of activities and processes across the companies Cheung Kong Infrastructure controls. Of most relevance from a safety perspective was the introduction into United Energy of CitiPower/Powercor procedures for vegetation management.

CitiPower and Powercor are managed by a single executive management team using common procedures and systems across the two distribution businesses. As a result, the Electricity Safety Management System (Section E5.1) and the work practices observations audits (Section E5.4) have been undertaken jointly across the two businesses. The remaining sections within this appendix refer to the specific assets within the Powercor network and have therefore been assessed independently of the CitiPower assets.

The Powercor distribution network covers any area of approximately 145,700 km^2, and includes Melbourne's Docklands Precinct, west from Williamstown to the South Australian border, north to the Murray and south to the coast (Figure 32). It comprises approximately 68,800 km of overhead line, 7,670 km of underground cable, 488,200 poles and 83,600 public lighting poles. Most of this network (92 per cent) is in rural areas.

Figure 32 Service area for the Powercor distribution network (orange area)

[23] Powercor Australia Ltd is the listed holder of the electricity distribution licence.

E1 Plans and processes

Powercor was scheduled to submit the following documents to ESV for review and acceptance and approval:

- Electricity Safety Management Scheme (ESMS) before 14 December 2015
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revision of the accepted bushfire mitigation plan submitted to ESV although, due to regular changes in the regulations, revised plans have been accepted annually
- Electric line clearance management plan by 31 March each year.

With the new requirement to submit a safety case for acceptance before the review of its ESMS, the timetable for submission of the ESMS was amended to require a preliminary safety case to be submitted before 14 December 2015. This would be seen by ESV to have triggered the ESMS process.

Powercor provided a preliminary safety case on 27 July 2015. After three iterations, ESV accepted the preliminary safety case on 1 September 2016. Powercor submitted its full safety case to ESV on 22 December 2016. After two further iterations, ESV accepted the full safety case on 8 August 2017. Powercor submitted an ESMS on 24 November 2017, which ESV is currently reviewing.

Powercor also submitted its electric line clearance management plan to ESV on 31 March 2018. ESV assessed the plan and approved it on 27 August 2018.

E2 Directions

ESV has issued four directions to Powercor:

- install armour rods and vibration dampers in hazardous bushfire risk areas (HBRA) by 1 November 2015 and in low bushfire risk areas (LBRA) by 1 November 2020
- install spacers on high voltage (HV) lines and spreaders on low voltage (LV) lines in HBRA by 1 November 2015 and LBRA by 1 November 2020
- undertake powerline replacement projects specified by the Powerline Bushfire Safety Program under the Powerline Replacement Fund
- ensure that all SWER ACRs have protection settings and reclose functions that can be controlled by Powercor's SCADA system.

The installation of all armour rods and vibration dampers in HBRA was completed in June 2017 — twenty months after the original completion date.

The installation of spacers and spreaders in HBRA was completed on time, by 1 November 2015.

Powercor has developed a plan to complete the armour rod, vibration dampers and spacer program for installation in the LBRA; however, it has not yet reported on performance against this plan.

Powercor was directed to undertake nineteen projects for the Powerline Replacement Fund with separate completion dates for each project. All projects were completed on time, by December 2015.

For the ACR direction, Powercor submitted an alternative product (FuserSaver) to ESV for acceptance as an ACR. This product was reviewed by ESV and deemed to meet the requirements of the regulation as an ACR. Powercor plans to install 1062 FuseSavers on its network by 2020. This will ensure all SWER lines in the Powercor area have an ACR in accordance with the direction.

ESV will continue to monitor Powercor's implementation of the recommendations and completion of the works in LBRA and installation of FuseSavers to ensure the directions are met.

E3 Bushfire mitigation regulations programs

To meet its bushfire mitigation obligations, Powercor plans to implement REFCL technology at 22 nominated zone substations over three delivery tranches. Consistent with its bushfire mitigation plan, Powercor is to address seven zone substations[24] in its first delivery tranche by 30 April 2019.

Over the 2017-2018 period, Powercor progressed its REFCL program encountering a number of technical issues. Table 3 provides a delivery breakdown for each of the seven zone substations.

On 22 August 2018, ESV accepted Powercor's Gisborne (GSB) zone substation to be the first compliant substation in Victoria. The acceptance was on the condition that several technical issues be resolved before the 2019-2020 bushfire season.

ESV continues its engagement with Powercor to understand and develop pragmatic solutions to the technical challenges being encountered that will provide the greatest bushfire risk reduction to Victorians.

In relation to the SWER ACR program, Powercor experienced some delays at the end of 2017, but has since recovered the shortfall from the 2017 program in the first half of 2018 (Table 4). While this delayed delivery of the 2018 program, Powercor aims to be fully back on schedule by the end of October 2018. ESV has concerns that this may not be achieved; we will continue to closely monitor Powercor's progress to ensure delivery of the overall program by 2020.

Table 3 Powercor REFCL delivery progress

REFCL delivery milestone	CDN	CMN	CLC	GSB	MRO	WIN	WND
Initiate	●	●	●	●	●	●	●
Design	●	●	●	●	●	●	●
Procurement – Ordered	●	●	●	●	●	●	●
Construction – Lines	●	●	●	●	●	●	●
Construction – Stations	●	●	●	●	●	●	●
Construction – Third-party	-	●	●	-	-	-	-
Testing / Commissioning	●	●	●	●	●	●	●
Close Out	●	●	●	●	●	●	●

● Complete ● Not commenced
● In progress - Not required

Table 4 Powercor ACR delivery progress

ACR program	2016	2017	2018	2019	2020	Total
Planned delivery	117	265	265	265	150	1062
Actual installed	117	145	129	-	-	391

[24] Camperdown (CDN), Castlemaine (CMN), Colac (CLC), Gisborne (GSB), Maryborough (MRO), Winchelsea (WIN) and Woodend (WND)

E4 Exemptions

ESV granted two exemptions in 2017 for Powercor to temporarily install SWER bare overhead conductor in electric line construction areas following the failed trial of LoSAG covered conductor. Powercor subsequently replaced the two SWER lines with underground cable prior to the following bushfire risk period, concluding the exemptions.

Powercor submitted the following exemption applications on 7 June 2018 relating to HV customers and underground cable sections supplied from REFCL-protected substations within its network:

- Winchelsea — 2 x network underground cable sections
- Castlemaine — Flowserve, George Western Foods and AGL Hydro
- Eaglehawk — Bendigo Health, Coliban Water, Parmalat, Hoffman Engineering, Thales, Keech Castings and Motherson Elastomers
- Colac — AKD Softwoods (three sites), Australian Lamb, Bulla, Regal Cream

ESV is currently assessing these requests for exemption.

E5 Audit performance

E5.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attention on electric line clearance and bushfire mitigation audits as subsets of the ESMS and key elements of bushfire prevention. ESV accepted the CitiPower/Powercor safety case in August 2017.

As part of the process to establish an accepted ESMS, ESV undertook an extensive systems validation audit on Powercor's ESMS in March 2018. The validation audit found several areas in the ESMS that required further information and clarification. Powercor is currently working with ESV to achieve a final acceptable ESMS.

E5.2 Electric line clearance

Network system audit

An electric line clearance management system audit was undertaken in August 2017. The audit was used to test if the processes and procedures used by Powercor would allow it to effectively manage its electric line clearance risks.

The audit found that Powercor has processes and procedures to manage its vegetation clearing responsibilities. Application of the process and procedures should enable Powercor to, as far as practicable, minimise electricity safety risks such as electric shock or electrocution and fire starts and maintain reliability of electricity supply.

The audit found four opportunities for improvement that related to:

- document control
- training methods
- auditing and analysis of audit findings.

Distribution network outcomes audit

An electric line clearance outcomes audit of the Powercor distribution network was conducted in August and September 2017. The focus of the audit was to validate the accuracy of its vegetation management data and to obtain oversight of the electric line clearance standards being achieved.

The associated inspections occurred at randomly-selected locations in different regions of the network. Due to increased fire threats associated with the network, particular emphasis was placed on inspecting electricity spans located in HBRA, only one LBRA span was assessed during the audit.

A total of 812 electricity spans were inspected during the audit. Of these spans, 811 were located within HBRA and one in LBRA.

The inspection found the following:

- non-compliant spans
  - HBRA 22
- variance
  - total sample = 22 out of 812 2.7%
  - HBRA = 21 out of 811 2.6%

The single span in LBRA was found to be compliant.

This information relates specifically to non-compliant spans identified during the audit that were the management responsibility of Powercor.

The inspection results indicate that, in HBRA where Powercor is responsible for vegetation management, its processes and clearing activities are implemented according to its approved electric line clearance management plan.

This is most important for HBRA, where the non-compliance rate of 2.6 per cent this year was a slight improvement on the 2.8 per cent result in 2016-2017, but an increase on the 0.7 per cent result in 2015-2016.

While the overall accuracy of the Powercor vegetation management data and the line clearance compliance standards was acceptable, performance could be improved. The audit identified that maintenance action data did not always correlate with the cyclic requirements of the Powercor approved electric line clearance management plan.

The electric line clearance outcome audit recommended that Powercor:

- clear the non-compliant vegetation identified by ESV
- review the data contained on its vegetation management system to ensure spans remain compliant and data accurately reflects span conditions
- review the management of its vegetation management data be to identify and rectify why contained inspection dates exceeded documented assessment cycles.

Powercor responded to the audit by proposing how it would address the recommendations made by ESV.

E5.3 Bushfire mitigation

The bushfire mitigation field inspection assessed compliance with legislation and internal business process with a focus on asset condition in the Horsham, Castlemaine, Kyneton, Camperdown and Cobden areas. Inspections were carried out at 620 sites randomly selected in these areas.

The inspection found 19 sites with additional items that were not recorded in the Powercor asset inspection records.

Some of the additional items identified during the inspection included:

- a ruptured EDO fuse tube
- a misaligned thimble on a HV termination
- a missing pole cap
- a deteriorated HV crossarm (found using a pole-top camera)
- a missing LV fuse box cover.

During the electric line clearance inspection (see Section E5.2), the following additional defective asset items were identified:

- a deteriorated HV crossarm
- damage on HV conductor – broken strand
- a fruiting fungus on a crossarm (indicating internal rot of the crossarm)
- a birds nest on a transformer.

The inspection findings showed that Powercor generally had sound processes and procedures in place to adequately manage and check on the state of the assets.

Powercor has provided a response to ESV with actions to address the audit findings.

E5.4 Work practices

In 2017-2018, ESV undertook four observations of the work practices of two of Powercor's service providers across three sites. The findings of these observations were as follows:

- non-compliances 0
- minor non-compliances 0
- opportunities for improvement 15

These findings were consistent with those of previous observations, where the key areas of concern related to:

- quality of job safety assessments (JSAs)
- checking and use of appropriate personal protective equipment (PPE), tools and equipment
- operating and access permit issuing practices.

ESV recommended that Powercor's work practices specifically focus on ensuring all workers (including contractors):

- have a detailed understanding of the JSA process and know the contents of relevant Safe Work Method Statements
- check the condition of equipment prior to use, and use appropriate PPE, particularly LV and HV insulating gloves and fall prevention equipment
- are involved in the permit issuing process and:
  - confirm all permit documents are completed to standard
  - ensure all persons involved in the work understand the permit they are signing onto
  - ensure the permit issuing process is to standard with appropriate communication, with strong, effective site leadership.

E6 Safety indicators

Figure 33 shows the annualised number of all serious electrical incidents reported to ESV by Powercor, with the data sorted from most frequent to least frequent. Figure 34 shows the same for those incidents that result in a ground or vegetation fire. Both graphs also show the change in incident numbers from 2015-2016, the last year with similar climate to 2017-2018 (see Section 5.1).

Of the five most common incidents, two of the events are outside of the direct control of Powercor to manage — vehicle impacts and other contact events (copper theft, vandalism and intrusions into the No Go Zone around overhead power lines). Both of these events have decreased since the 2015-2016 period.

Connection faults, pole faults and tree contact are within the direct control of Powercor. Connection and pole faults have increased since the 2015-2016 period, with the numbers of these events increasing by 25 and 22 per cent respectively.

Of most concern is the increase in tree contact incidents; these have more than tripled since 2015-2016. This is consistent with the findings of our audits, inspections and investigations. It further points to a systemic problem that Powercor has with the management of its line clearance responsibilities. ESV needs to ensure that the level of enforcement is proportionate to the safety risk posed. It is for this reason that ESV is now prosecuting Powercor regarding several matters (see Section 7.2).

Four of the five most common fire-related incidents are within the control of Powercor, the exception being vehicle impacts (the fifth-most common event). Tree contact is within the control of Powercor except where trees fall or branches are blown onto powerlines from outside the clearance space.

The most common cause of ground fires was tree contact. While the numbers of tree contacts have trebled since 2015-2016, the number of these events that result in fires have quadrupled in the same period. Not only are there more events, but a larger proportion are also starting fires. Seventy per cent of tree contact incidents now result in a ground fire.

The high likelihood that a tree contact incident will result in a fire is of concern. Given the high tree density close to assets in the Powercor and AusNet Services regions,[25] there is a higher probability of trees growing into the clearance space or trees failing into or branches being blown in from outside the clearance space. Vegetation management is vital for minimising the bushfire risk from the network. While Powercor is progressively replacing bare overhead lines with insulated cables within the highest fire loss consequence areas (see Section 6.2.2), its management of its electric line clearance responsibilities is troubling.

Ground fires from animal contact and HV fuse failures have increased by 58 and 78 per cent respectively, those from vehicle impacts have remained stable and those from connections have reduced by 36 per cent.

It should be noted that the comparisons above are with a similarly hot year so any increases cannot be attributed to weather effects. This makes the significant increase in fires from tree contact even more troubling.

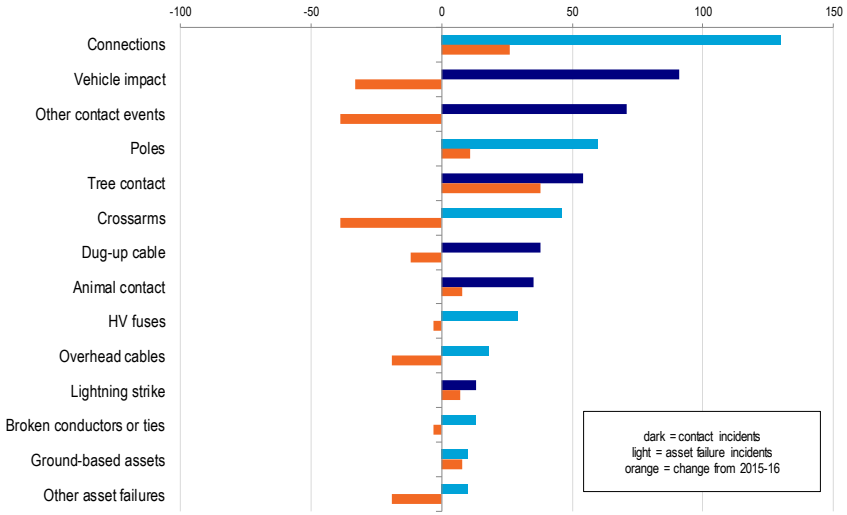

Figure 33 Incidents on the Powercor network

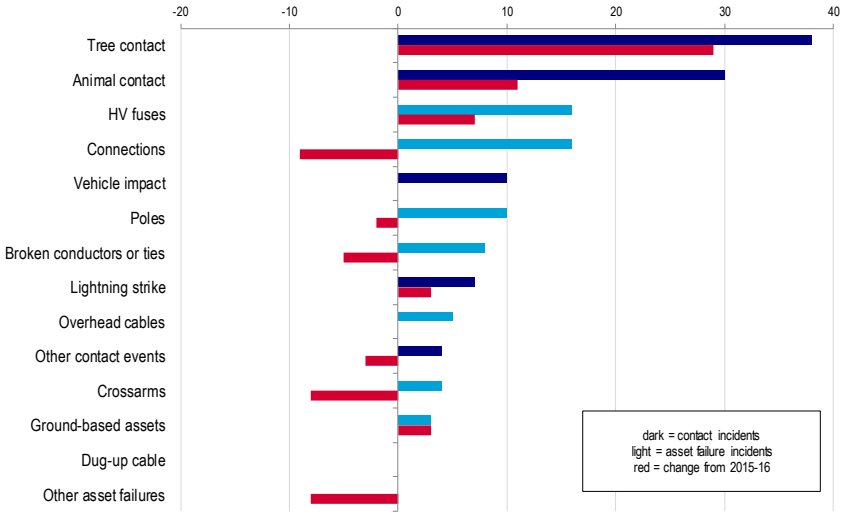

Figure 34 Incidents on the Powercor network resulting in ground fires

[25] Tree density across Victoria is shown in Appendix I.

Appendix F : Transmission Operations Australia

Transmission Operations (Australia)[26] (TOA) is jointly owned by Cheung Kong Infrastructure Holdings Ltd (50 per cent) and Power Assets Holdings Ltd (50 per cent). Both are part of the Cheung Kong Group of companies. Together they hold a majority ownership (51 per cent) of the CitiPower/Powercor Group of companies, which are contracted to provide services in support of ongoing TOA operations. As of May 2017, Cheung Kong Infrastructure also holds majority ownership (66 per cent) of United Energy.

TOA owns and operates the connection from the Mt Mercer Wind Farm to the electrical transmission network (Figure 35). This includes a 22km 132kV powerline and the Elaine Terminal Station, which steps the voltage up from 132kV to 220kV for injection into the AusNet Services transmission network.

The TOA asset base in Victoria is significantly smaller than that of AusNet Services Transmission; it has only 1.2 per cent of the towers and poles that AusNet Services owns and maintains. Its assets are also newer having only been commissioned in November 2013.

Figure 35 Location of TOA transmission assets (orange square)

[26] Transmission Operations (Australia) Pty Ltd is the listed holder of the electricity transmission licence.

F1 Plans and processes

TOA is scheduled to submit the following documents to ESV for review and acceptance/approval:

- Electricity Safety Management Scheme (ESMS) before 2 October 2018
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revised bushfire mitigation plan
- Electric line clearance management plan by 31 March each year.

TOA submitted its electric line clearance management plan to ESV in March 2018, which ESV approved in August 2018.

F2 Directions

ESV has not had cause to issue directions to TOA.

F3 Exemptions

TOA has sought no exemptions from regulations.

F4 Audit performance

F4.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attentions on electric line clearance and bushfire mitigation audits as subsets of the Electricity Safety Management Scheme (ESMS) and key elements of bushfire prevention.

TOA had its ESMS accepted in November 2013.

TOA is a new asset that requires little maintenance at this early stage of its life cycle and is of low risk given its short length. The system TOA utilises is essentially the CitiPower/Powercor system as the entity charged with operating and maintaining the TOA line. Given this and its reduced risk, ESV determined there is greater merit in deploying resources to audits of the CitiPower/Powercor system.

F4.2 Electric line clearance

An electric line clearance inspection of the TOA transmission network was conducted in September 2017. The focus of the inspection was to validate the accuracy of its vegetation management data and to obtain oversight of the electric line clearance standards being achieved.

Given the limited size of the TOA network, most of its 160 electricity spans were inspected. All of the inspected spans were located in HBRA.

The audit found the following:

- non-compliant spans in HBRA 5
- variance = 5 out of 152 3.3%

The non-compliance rate of 3.3 per cent this year was worse than the 2016-2017 result of 1.9 per cent. Due to the nature of the TOA network, the standard of electric line clearance compliance was acceptable.

The electric line clearance outcome audit recommended that TOA:

- clear the identified non-compliant spans
- review its vegetation management data and electric line clearance procedures to determine why vegetation may have entered the minimum clearance space before it was anticipated.

F4.3 Bushfire mitigation

The bushfire mitigation field inspection was coupled with the electric line clearance inspection. The inspection assessed compliance with legislation and internal business process with a focus on asset condition.

The inspection reviewed all 152 spans of the 132kV line, which is situated entirely within HBRA.

A general visual ground inspection of assets along the line route indicates that the line was in good condition and reflective of its relatively young age (commissioned in November 2013). No obvious line defects or maintenance items were identified.

The inspection findings showed that TOA, as a relatively new asset, requires very little maintenance at this stage of its life cycle. TOA generally had sound processes and procedures in place to adequately manage and check on the quality of the assets.

F4.4 Work practices

ESV is yet to undertake a work practice observation of TOA as the transmission line is expected to be operational almost all the time, and is a relatively new asset (commissioned in November 2013) requiring very little maintenance at this stage of its life cycle.

F5 Safety indicators

Transmission infrastructure generally has low levels of incidents due to the nature of the assets and the clearances maintained around these higher voltage assets. Transmission assets are also less dispersed than distribution assets, thereby reducing exposure to environmental threats and third-party impacts. This also makes them easier to maintain.

The risks associated with TOA are reduced by it being a short transmission line and only having been operating for a short time (i.e. four years). Being a relatively new asset, TOA also has not entered a phase of its life cycle where major maintenance is required.

It is, therefore, not unexpected that TOA recorded no incidents on its transmission network during the 2017-2018 period.

Appendix G : Transmission Operations Australia 2

Transmission Operations (Australia) 2[27] (TOA2) is jointly owned by Cheung Kong Infrastructure Holdings Ltd (50 per cent) and Power Assets Holdings Ltd (50 per cent). Both are part of the Cheung Kong Group of companies. Together they hold a majority ownership (51 per cent) of the CitiPower/Powercor Group of companies, which are contracted to provide services in support of ongoing TOA2 operations. As of May 2017, Cheung Kong Infrastructure also holds majority ownership (66 per cent) of United Energy.

TOA2 owns and operates the connection from the Ararat Wind Farm to the electrical transmission network (Figure 36). This includes a 21 km 132kV powerline and the Ararat Terminal Station, which steps the voltage up from 132kV to 220kV for injection into the AusNet Services transmission network.

The TOA2 asset base in Victoria is significantly smaller than that of AusNet Services Transmission; it has less than one per cent of the towers and poles that AusNet Services owns and maintains. Its assets are also newer, having only been commissioned in June 2016.

Figure 36 Location of TOA2 transmission assets (orange square)

[27] Transmission Operations (Australia) 2 Pty Ltd is the listed holder of the electricity transmission licence.

G1 Plans and processes

As part of the requirements for TOA2 to operate the new transmission line, TOA2 was required to have in place an accepted Electricity Safety Management Scheme (ESMS), bushfire mitigation plan and electric line clearance management plan before operations began. ESV reviewed the TOA2 plans and accepted these on the 22 June 2016.

The ESMS and bushfire mitigation plan require resubmission every five years commencing from the date of the most recent acceptance. This resubmission is due on 22 June 2021.

An electric line clearance management plan is to be submitted by 31 March each year. TOA2 submitted its plan to ESV in March 2018, which ESV approved in August 2018.

G2 Directions

ESV has not had cause to issue directions to TOA2.

G3 Exemptions

TOA2 has sought no exemptions from regulations.

G4 Audit performance

G4.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attentions on electric line clearance and bushfire mitigation audits as subsets of the Electricity Safety Management Scheme (ESMS) and key elements of bushfire prevention.

TOA2 submitted a full safety case and ESMS in March 2016. After three iterations, ESV granted approval of the TOA2 full safety case and ESMS in June 2016. The process for validating and accepting the ESMS involved significant ESV system and field audits. Securing this approval allowed TOA2 to commission the new line in the last week of June 2016.

TOA2 is a new asset that requires little maintenance at this early stage of its life cycle and is of low risk given its short length. The system TOA2 utilises is essentially the CitiPower/Powercor system as the entity charged with operating and maintaining the TOA2 line. Given this and its reduced risk, ESV determined there is greater merit in deploying resources to audits of the CitiPower/Powercor system.

G4.2 Electric line clearance

An electric line clearance inspection of the TOA2 transmission network was conducted in September 2017. The focus of the inspection was to validate the accuracy of its vegetation management data and to obtain oversight of the electric line clearance standards being achieved.

Given its limited size, the majority of the TOA2 network was inspected; 77 spans out of a total 107 electricity spans were inspected. All of the spans were located in HBRA.

The inspection found:

- non-compliant spans in HBRA 1
- variance = 1 out of 77 1.3%

The non-compliance rate of 1.3 per cent this year was worse than the 2016-2017 results of 0 per cent. Due to the nature of the TOA2 network, the standard of electric line clearance compliance was acceptable.

The electric line clearance outcome audit recommended that TOA2:

- clear the identified non-compliant spans
- review its vegetation management data and electric line clearance procedures to determine why vegetation may have entered the minimum clearance space before it was expected.

G4.3 Bushfire mitigation

The bushfire mitigation field inspection was coupled with the electric line clearance inspection. The inspection assessed compliance with legislation and internal business process with a focus on asset condition.

The inspection reviewed 77 spans of the 132kV line, which is situated entirely within HBRA.

A general visual ground inspection of assets along the line route indicates that the line was in good condition and reflective of its relatively young age (commissioned in July 2016). No obvious line defects or maintenance items were reported by the field auditor.

The audit findings showed that TOA2, as a relatively new asset, requires very little maintenance at this stage of its life cycle. TOA2 generally had sound processes and procedures in place to adequately manage and check on the quality of the assets.

G4.4 Work practices

As the new TOA2 assets were only commissioned in June 2016, no maintenance work has been required in the last year to afford ESV an opportunity to observe TOA2 works practices.

G5 Safety indicators

Transmission infrastructure generally has low levels of incidents due to the nature of the assets and the clearances maintained around these higher voltage assets. Transmission assets are also less dispersed than distribution assets, thereby reducing exposure to environmental threats and third-party impacts. This also makes them easier to maintain.

The risks associated with TOA2 are reduced by it being a short transmission line and only having been operating for a short time (i.e. one year). Being a relatively new asset, TOA2 also has not entered a phase of its life cycle where major maintenance is required.

It is therefore not unexpected that TOA2 recorded no incidents on its transmission network during the 2017-2018 period.

Appendix H : United Energy

United Energy[28] is jointly owned by Cheung Kong Infrastructure (66 per cent) and SGSP (Australia) Assets Pty Ltd (34 per cent).

Cheung Kong Infrastructure, together with Power Asset Holdings, also owns 51 per cent of CitiPower/Powercor and 50 per cent of Transmission Operations (Australia) and Transmission Operations (Australia) 2.

SGSP (Australia) Assets owns 100 per cent of Jemena. The two companies forming SGSP (Australia) Assets Pty Ltd also own 51 per cent of AusNet Services.

With Cheung Kong Infrastructure purchasing the DUET Group in May 2017 and gaining majority ownership of United Energy, there has been some consolidation of activities and processes across the companies Cheung Kong Infrastructure controls. Of most relevance from a safety perspective was the introduction into United Energy of CitiPower/Powercor procedures for assessing vegetation clearance at height.

At the start of the 2017-2018 period, United Energy engaged EDI Downer and Zinfra as subcontractors to manage aspects of its operations and maintenance services. Towards the end of 2017, United Energy consolidated all these services with Zinfra. Any reference to United Energy within this section also encompasses EDI Downer and Zinfra operations on United Energy assets.

The distribution network covers an area of approximately 1,470 km^2 across Melbourne's eastern and south-eastern suburbs and the Mornington Peninsula (Figure 37). It comprises approximately 9,920 km of overhead line, 3,340 km of underground cable, 168,700 poles and 35,800 public lighting poles. Most of the network is urban and semi-rural.

Figure 37 Service area for the United Energy distribution network (orange area)

Jemena and CitiPower service boundaries are shown in orange

[28] United Energy Distribution Pty Ltd is the listed holder of the electricity distribution licence.

H1 Plans and processes

United Energy was scheduled to submit the following documents to ESV for review and acceptance and approval:

- Electricity Safety Management Scheme (ESMS) before 3 December 2015
- Bushfire mitigation plan every five years commencing from the date of the most recent acceptance of a revision of the accepted bushfire mitigation plan, although revised plans have been accepted annually due to regular changes in the regulations
- Electric line clearance management plan by 31 March each year.

With the new requirement to submit a safety case for acceptance before the review of its ESMS, the timetable for submission of the ESMS was amended to require a preliminary safety case to be submitted before 3 December 2015. This would be seen by ESV to have triggered the ESMS process.

United Energy provided a preliminary safety case in September 2015, and ESV accepted it in March 2016. United Energy submitted its full safety case for assessment in July 2016. After two iterations, the full safety case was accepted by ESV in June 2017. An ESMS was submitted to ESV in June 2017, which is currently being reviewed.

United Energy submitted its electric line clearance management plan to ESV in March 2018. ESV approved the ELCMP in August 2018.

H2 Directions

ESV has issued two directions to United Energy:

- install armour rods and vibration dampers in hazardous bushfire risk areas (HBRA) by the end of 2015 and in low bushfire risk areas (LBRA) by the end of 2020
- install spacers on high voltage (HV) lines and spreaders on low voltage (LV) lines in HBRA by the end of 2015 and in LBRA by the end of 2020.

Both directions were due for completion in HBRA by 31 December 2015. United Energy completed both HBRA directions on time and, in the case of the armour rods and vibration dampers direction, installed a greater number than originally estimated. The LBRA direction is in progress.

H3 Bushfire mitigation regulations programs

H3.1 Rapid Earth Fault Current Limiters

United Energy has no regulatory obligation under the amendments to the Electricity Safety (Bushfire Mitigation) Regulations 2013. Even so, United Energy has elected to install REFCLs at Frankston South, Mornington and Dromana.

The Frankston South REFCL was installed as part of a trial that assisted in the development of the amended regulations. It has been in service for several years at a reduced level of sensitivity. This REFCL is of an earlier model and United Energy has advised ESV of its intention to upgrade this REFCL following completion of the Mornington and Dromana installation program.

The Mornington REFCL is of a similar version as those being installed by AusNet Services and Powercor. Due to the size of the Mornington network, it is unlikely that the capacity specified in the regulations will be achieved; however, this REFCL is not mandated and the specification, therefore, does not apply. That said, United Energy is making its best endeavours to

achieve the highest practicable performance and, thus, bushfire risk reduction. United Energy expects installation of the Mornington REFCL to be completed in November 2018.

The Dromana REFCL program is dependent on the successful completion of the Mornington REFCL. Initial planning is underway.

H3.2 Covered conductor trial

United Energy undertook a trial of two sections of Amokabel covered conductor on their network. The trial was partially funded by a grant from the Victorian Government's Powerline Bushfire Safety Program (PBSP) Research and Development Fund.

During the trial, ESV was made aware that the conductor had failed some tests specified in AS/NZS 3675-2002 and sought resolution of the potential risks. United Energy advised ESV of the controls that had been adopted to minimise the risks. ESV accepts that the controls appear to address the safety concerns. United Energy is now considering the wider application of this conductor on its network.

H4 Exemptions

There are no exemptions currently applicable to United Energy.

H5 Audit performance

H5.1 Electricity Safety Management Scheme (ESMS)

During the 2017-2018 period, ESV continued to focus its attention on electric line clearance and bushfire mitigation audits as subsets of the ESMS and key elements of bushfire prevention. United Energy had its full safety case accepted in June 2017.

As part of the process to establish an accepted ESMS, ESV undertook an extensive systems validation audit of United Energy's ESMS in April 2018. The validation audit found several areas in the ESMS that required further information and clarification. United Energy is currently working with ESV to achieve an acceptable ESMS.

H5.2 Electric line clearance

Network system audit

An electric line clearance management system audit was undertaken in August 2017. The audit was used to test if the processes and procedures used by United Energy would allow it to effectively manage its electric line clearance risks.

The audit found that United Energy has a system in place for managing its electric line clearance program, including establishing objectives, planning to manage line clearance risk, and providing governance and assurance.

The audit identified one opportunity for improvement relating to having a process to analyse and identify the root causes of electric line clearance issues.

Distribution network outcomes audit

An electric line clearance outcomes audit of the United Energy distribution network was conducted in September 2017 The focus of the audit was to validate the accuracy of its vegetation management data and to obtain oversight of the electric line clearance standards being achieved.

The associated inspections occurred at randomly selected locations in different regions of the network. Due to increased fire threats associated with the network, the emphasis was placed on inspecting electricity spans located in HBRA.

A total of 414 electricity spans were inspected during the audit, all of which were located in HBRA.

The inspection found the following:

- non-compliant spans in HBRA 9
- variance in HBRA = 9 out of 414 2.2%

This information relates specifically to non-compliant spans identified during the audit that were the management responsibility of United Energy.

The inspection results indicate that, where United Energy is responsible for vegetation management, its processes and clearing activities are implemented according to its approved electric line clearance management plan.

This is most important for HBRA, where the non-compliance rate of 2.2 per cent this year was comparable to the 2.1 per cent result in 2016-2017, but a marked improvement on the 7.7 per cent result in 2015-2016.

The overall accuracy of the United Energy vegetation management data was adequate; however due to a business ownership transition, the United Energy vegetation management model had changed. This meant seamless analysis of the assessment data submitted to the audit was problematic.

The electric line clearance outcome audit recommended that United Energy:

- clear the non-compliant vegetation identified by ESV
- confirm actions undertaken to ensure non-compliant spans are cleared as per the requirements of its electric line clearance management plan
- ensure appropriate notification of third parties where non-compliant vegetation is not United Energy's responsibility, and ensure said parties undertake the required clearance works
- better manage the transition between vegetation management models brought about by business ownership changes
- review the data contained on its vegetation management system to ensure spans remain compliant and data accurately reflects span conditions.

United Energy responded to the audit by proposing how it would resolve the recommendations made by ESV.

H5.3 Bushfire mitigation

The bushfire mitigation field inspection assessed compliance with legislation and internal business processes, with a focus on asset condition. Field audits were carried out on 261 poles across the United Energy network in the Dromana, Frankston North, Bangholme, Pearcedale, Dandenong South and Lower Plenty areas.

The field inspection found nineteen items that were not recorded in the United Energy records system. Some of the higher priority items identified included:

- one site with a missing LV spreader
- a low hanging LV service cable
- a number of sites with loose hardware
- a damaged LV shackle insulator.

The inspection findings showed that United Energy generally had sound processes and procedures in place to adequately manage and check on the condition of the assets in the field.

The auditor recommended that United Energy review actions in relation to the additional maintenance items observed, determine whether any corrective actions were required and report the findings to ESV.

United Energy has provided a response to ESV with actions to address the inspection findings.

H5.4 Work practices

In 2017-2018, ESV undertook two observations of United Energy work practices across four sites. The findings of these observations were as follows:

- non-compliances 0
- minor non-compliances 3
- opportunities for improvement 6

These findings were consistent with those of previous observations, where the key areas of concern related to:

- checking and use of appropriate PPE, tools and equipment
- conducting metering and servicing activities in compliance with work practices and testing procedures
- appropriate pre-site job planning to consider all variables.

ESV recommended United Energy's work practices specifically focus on ensuring:

- all workers check the condition of equipment prior to use, and use appropriate PPE, particularly LV and HV insulating gloves and fall prevention equipment
- all workers conducting metering and servicing activities apply the correct work practices and testing procedures in the field
- the work planning processes ensure adequate pre-job site planning, including consultation with work crew leaders.

H6 Safety indicators

Figure 38 shows the annualised number of all serious electrical incidents reported to ESV by United Energy, with the data sorted from most frequent to least frequent. Figure 39 shows the same for those incidents that resulted in a ground or vegetation fire. Both graphs also show the change in incident numbers from 2015-2016, the last year with similar climate to 2017-2018 (see Section 5.1).

Of the five most common incidents, only one (other contact events) is outside of the direct control of United Energy to manage. These events include copper theft, vandalism and intrusions into the No Go Zone around overhead powerlines. Since 2015-2016, these events have risen by 91 per cent on the United Energy network.

The other four incident types are within the direct control of United Energy. Connections failures and tree contact have increased by 11 and 8 per cent respectively since 2015-2016. Crossarm failures and other asset failures have decreased by 5 and 20 per cent over the same period.

All of the five most common fire-related incidents are within the control of United Energy. Tree contact is within the control of United Energy except where trees fall or branches are blown onto powerlines from outside the clearance space.

Connection faults and tree contact are the most common causes of fires on the United Energy network. Connections fires have remained stable since 2015-2016 and tree contact fires have risen slightly over the same period. Fires from other asset failures, broken conductors and animal contact have all decreased since 2015-2016.

United Energy should be commended for the drop in fires across all categories, except for the slight increase in tree contact fires.

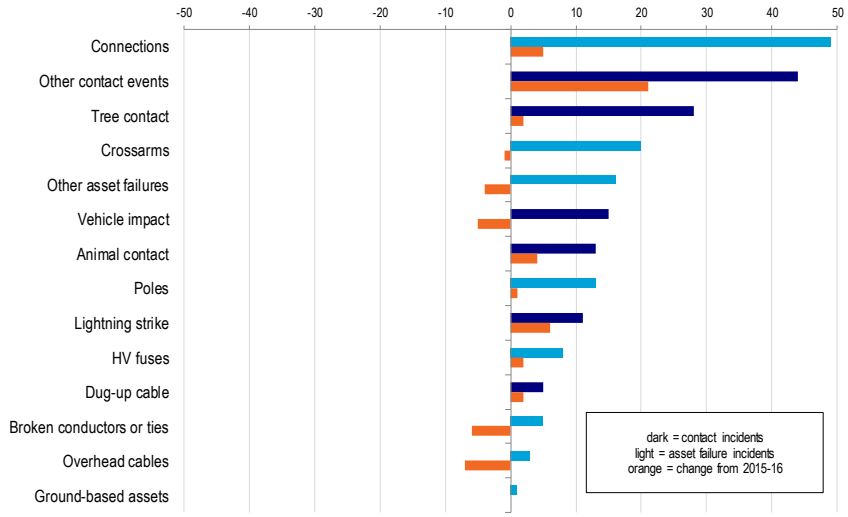

Figure 38 Incidents on the United Energy network

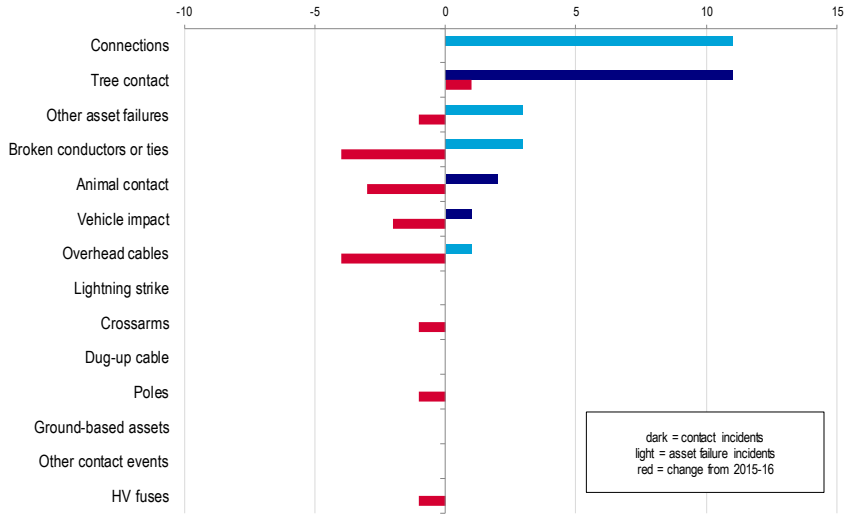

Figure 39 Incidents on the United Energy network resulting in ground fires

Appendix I : Tree density across Victoria

The figure below maps tree density across Victoria with the boundaries of the five distribution businesses in orange. Of the businesses, AusNet Services is most exposed to a high density of tree cover.