Bushfire Mitigation ALARP Risk Assessment

UNITED ENERGY

Document № UE PR 2511

Electricity Network EDPR Summary Report

This report assesses how United Energy meets its obligations to minimise bushfire risk to As Low As Reasonably Practical.

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Table of Contents

List of Tables

Table of Figures

1. Executive Summary

Faults on overhead powerlines can cause ground fires, and result in major bushfires leading to loss of life, property and livestock. Every distribution business with electricity assets in a hazardous bushfire risk area (HBRA) has a statutory obligation to implement programs to reduce the number of fires started from its assets.

Consistent with its obligations under Section 83B(1) and Section 98 of the Electricity Safety Act 1998, United Energy (UE) is required to "design, construct, operate, maintain and decommission an at-risk electric line to minimise as far as practicable the bushfire danger arising from that line." Consistent with United Energy's corporate risk appetite statement, such risk shall be reduced to a level that is as low as reasonably practical (ALARP).

Within the framework of UE's risk management policy, UE has assessed options that have the potential to reduce the likelihood of a powerline causing a bushfire. A total of 75 options have been identified and each of these has been assessed in terms of their effectiveness in reducing bushfire risk to ALARP. The assessment was based on the latest available fire loss consequence mapping data. UE's systematic assessment approach ensures that its proposed actions satisfy ALARP at minimum efficient cost.

Of the 75 initiatives that were examined:

- 27 were found not to be effective, and were rejected; and
- 48 initiatives were found to promote the achievement of ALARP. Of these 48 initiatives:
    - 20 have either already been implemented or will be implemented through our business-as -usual expenditure plans;
    - 26 require more detailed assessment through trials or further analysis before a decision is made on the extent to which these initiatives should be adopted; and
    - 2 initiatives – being REFCL and Light Detection and Ranging (LiDAR) implementation – are recommended as new initiatives.

The REFCL and LiDAR initiatives are justified on the basis that:

- The value of the bushfire risk reduction provided by REFCL technologies is comparable to the capital cost of the program. The implementation of REFCL therefore satisfies the ALARP principle.
- The cost of implementing LiDAR exceeds the estimated value of bushfire risk reduction. However, LiDAR will provide other safety outcomes that accord with our obligations to manage safety risk to ALARP, as well as capital expenditure efficiency benefits.
- Both REFCL and LiDAR compare favourably with the other initiatives examined in this bushfire mitigation assessment.

It is recommended that:

- The installation of active REFCLs at Mornington (MTN) and Dromana (DMA) zone substations proceed within the next regulatory period (2016-2020).
- A survey using LiDAR technology mounted on vehicles be conducted, focusing on UE poles and lines in HBRA, should commence in 2016.

2. Bushfire Background

Victoria is one of the most fire-prone regions in the world with a long history of bushfires. Some of the most serious bushfires include 7 February 2009, 16 February 1983, 12 February 1977 and 8 January 1969. These fires have resulted in considerable loss of life, property and livestock. Smaller bushfires occur more regularly and require enormous resources to manage.

Evidence shows that faults on distribution network powerlines are a significant cause of fire starts on days of extreme bushfire risk when temperatures and wind speeds soar, fuel is dry and humidity is low. In all the major fires listed above more than half were started by powerlines. On 7 February 2009 (Black Saturday), 121 of the 173 deaths were the result of powerline ignited bushfires.

Of all the risks associated with operating the UE network the risk with the largest consequence is a fault on an electricity asset starting a major bushfire. The risk is ever present despite continuing efforts to mitigate it.

Fire loss consequence mapping undertaken for the Victorian Department of Economic Development, Jobs, transport and Resources (DEDJTR) by the CSIRO as an input into the Regulatory Impact Statement (RIS) for Bushfire Mitigation Regulation Amendment, dated 17 November 2015, currently provides the most accurate breakdown of risk by zone substation supply areas. The bushfire risk assessed by the CSIRO fire loss mapping research reveals that the UE network only represents 0.50% of the total state risk.

Within UEs territory, there are some areas considered of higher risk such as areas supplied by Mornington (MTN) and Dromana (DMA) zone substations around Red Hill, Arthurs Seat and Mornington that contain a disproportionate share of the risk. According to this CSIRO data, these areas represent 56% of UE's total fire loss consequence (MTN=29% and DMA=27%) and require special attention.

3. Legislation and Regulatory Frameworks

The following obligations collectively require UE to ensure that the risk of bushfire caused by its distribution system is minimised as low as reasonably practicable (ALARP):

Electricity Safety Act - Duty to minimise bushfire danger as far as practicable

Section 83B(1) of the Electricity Safety Act 1998 requires UE to "design, construct, operate, maintain and decommission an at-risk electric line to **minimise as far as practicable the bushfire danger** arising from that line."

Further, Section 98 of the Electricity Safety Act 1998 requires UE to "design, construct, operate, maintain and decommission its supply network to **minimise as far as practicable** - (a) the hazards and risks to the safety of any person arising from the supply network; and (b) the hazards and risks of damage to the property of any person arising from the supply network; and (c) **the bushfire danger** arising from the supply network."

Occupational Health and Safety Act - Duty to minimise health and safety risks so far as reasonably practicable

Section 4 of the Occupational Health and Safety Act 2004 on the principles of health and safety protection requires "(2) Persons who control or manage matters that give rise or may give rise to **risks to health or safety** are responsible for eliminating or reducing those risks **so far as is reasonably practicable**."

AS 5577 - Electricity network safety management systems - Planning for safe operation

Clause 4.3.2 of AS5577 requires the Network Operator to consider "Risk treatment, including where reasonably practicable the elimination of the source of risk and where elimination is not reasonably practicable, the identification of treatments or controls so that residual risks are **reduced to as low as reasonably practicable (ALARP)**."

Thus, UE interprets these obligations as essentially having the same meaning in practice, and the remainder of this document adopts the term As Low As Reasonably Practical (ALARP) to refer collectively to these obligations.

In order for UE to satisfy these obligations depends on what actions are considered to be 'reasonably practical'. Our approach is summarised below:

- Determining whether risks have been reduced to as low as is reasonably practical involves an assessment of the risk, and an assessment of the sacrifice (in money, time and effort) involved in taking measures to further reduce that risk, and a comparison of the two. The basis on which the comparison is made involves the test of 'gross disproportion'.
- If a measure is practical and it cannot be shown that the cost of the measure is grossly disproportionate to the benefit gained; then the measure is considered reasonably practical and should be implemented. The criterion is reasonably practical, not reasonably affordable - justifiable cost and effort is not determined by reference to internal budget constraints.

4. Risk Management

4.1 Risk Management Framework

The UE Risk Management Framework outlines policies, standards, procedures, and a process for the identification, assessment, treatment, monitoring, review, communication, and reporting of electricity network risks. It includes a Risk Appetite Statement, prepared by the United Energy Board outlining the degree of risk that the organisation is prepared to take in pursuit of its objectives.

The Risk Appetite Statement has been aligned with the objectives outlined in the Corporate Plan and provides overarching guidance on the parameters for decision making in the areas of finance, operations, health, safety and business sustainability and is consistent with managing to ALARP principles in areas of bushfire mitigation and managing the risk of a death or serious injury.

Figure 1 Risk Management Framework

4.2 Risk Assessment Framework

United Energy assesses risks in accordance with UE's risk management framework. Risk is quantified by considering the consequence and likelihood of an event.

An extract of United Energy's Consequence table is shown below, together with United Energy's Likelihood table.

Table 1: Extract – UE Consequence table

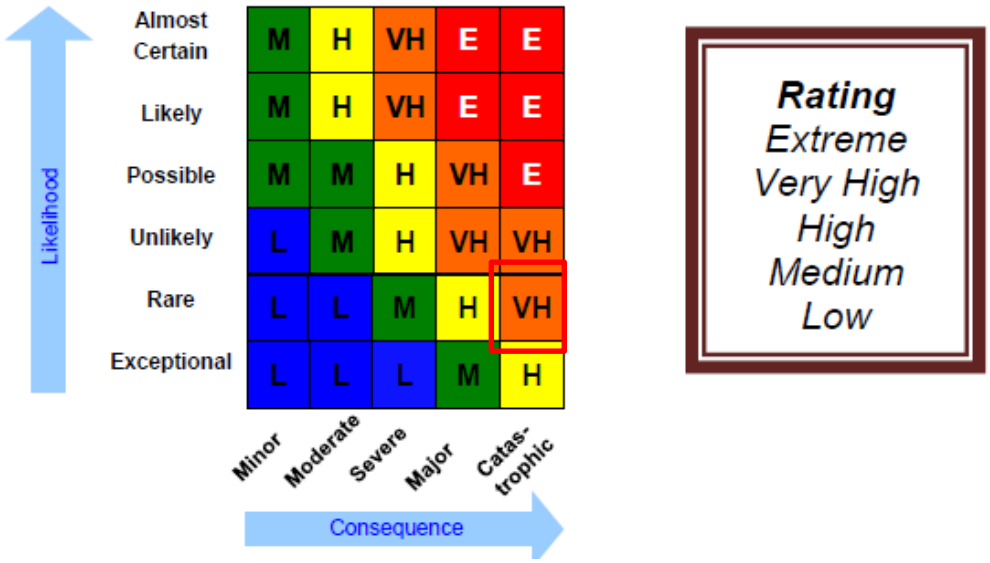
Customer / Reputation	Safety / Human Resources	Financial* / Loss of value by the organisation	Legal / Regulatory / Compliance
Catastrophic *would threaten the survival of UE*			
• Multiple disruptions to service capacity for greater than one month, including failure of supply • Sustained damage to UE brand through widespread publicity and or media coverage resulting in major regulatory or legislative change and or major impact on shareholders.	• Multiple deaths • Multiple serious injuries with greater than 30% permanent disability.	• An event that triggers insolvency • Regulator decision or financial loss > $100m as a once off event, or resulting in > $20m per annum loss for 5 years • Bank(s) requires unscheduled repayment of debt.	• Sustained loss of confidence in the organisation by the investor community • Major class action • Sustained regulatory action including project closure, civil law suit, criminal prosecution and/or significant fines.
Major *would threaten the effective operation of UE for a substantial period* *would have a significant impact on how UE may operate in the future, including its ability to raise capital*			
• Multiple disruptions to service capacity for up to one month, including failure of supply • Substantial damage to UE brand through publicity and or media coverage resulting in significant regulatory or legislative change and or a significant impact on shareholders.	• A death • A serious injury with greater than 30% permanent disability • Unplanned loss of the majority of key senior management.	• Regulator decision or financial loss of $25m < x ≤ $100m as a once off event, or resulting in $5m < x ≤ $20m per annum loss for 5 years • Down grade to non-investment grade rating or equivalent.	• Moderate loss of confidence in the organisation by the investor community • Potential for significant law suit or substantial regulatory detrimental action • Significant enforcement action affecting project operations including operational changes, incurred remediation costs, delays and or fines.

Table 2: UE Likelihood Table

Rating	Likelihood of occurrence (after mitigating effect of existing controls)	Frequency		
		Asset / Operations	Projects	General
Almost Certain	• Greater than 80%	• Every year	• Once every project	• Threat will occur under current work conditions
Likely	• 50% to 80%	• Once every 2 years	• Once every 2 projects	• Threat will probably occur under current work conditions
Possible	• 20% to 50%	• Once every 2 to 5 years	• Once every 2 to 5 projects	• Threat may possibly occur in time
Unlikely	• 5% to 20%	• Once every 5 to 20 years	• Once every 5 to 20 projects	• Threat unlikely to occur
Rare	• 2.5% to 5%	• Once every 20 to 40 years	• Once every 20 to 40 projects	• Threat rarely occurs
Exceptional	• Less than 2.5%	• No more than once every 40 years	• No more than once every 40 projects	• Threat may occur in exceptional circumstances

Based on the matrix below, the product of these likelihood and consequence results in one of 5 risk ratings, from Extreme 'E' through to Low 'L'.

Figure 2: Risk Matrix



4.3 Risk Mitigation Approach

UE has a standardised approach to risk mitigation, which is applied throughout the business to a wide range of circumstances. Following the risk assessment step described above, risk mitigation involves two steps:

- An assessment of whether the risk is acceptable. The acceptability of the risk depends on the effectiveness of the existing controls; the level of residual risk; and the company's risk appetite.
- If the residual risk is not consistent with the company's risk appetite, then further action is required. For risks that are considered too high, will be necessary to introduce more effective controls to further reduce the residual risk. In some instances, it may be appropriate to transfer risk through insurance.

As a matter of policy, further risk mitigation measures must be considered if residual risks are rated as "Extreme" or "Very High". For "Extreme" risks, a decision not to implement specific controls must be authorised by the Chief Executive Officer. For risks that are rated "Very High", it is a requirement to consider whether additional measures can be introduced that will provide a significant net benefit in terms of risk reduction.

4.4 Bushfire Risk Assessment (with existing controls)

UE's existing controls to mitigate bushfire risk are presented in Appendix B.

The application of the risk assessment framework to the inherent bushfire risk and the residual risk with existing controls is as follows:

- The inherent likelihood is Almost Certain and the inherent consequence is Catastrophic, resulting in an inherent risk of Extreme.
- The residual likelihood is Rare and the residual consequence is Catastrophic, resulting in a residual risk of Very High.

As the residual risk is Very High, it is necessary to consider whether additional measures can be introduced that will provide a significant net benefit in terms of risk reduction. In making this assessment, it is important to have regard to United Energy's Risk Appetite Statement in relation to bushfire risk, which states:

> "*We want to manage the risk of bushfires or explosions being caused by failure of our network to as low as is reasonably practical.*"

Chapter 6 summarises the process United Energy has undertaken to assess further controls to meet this obligation.

5. ALARP Principles

United Energy is committed to minimising health and safety and bushfire-related risks to ALARP. As a minimum, the requirements of the following Australian Standards for risk management and ALARP are adopted:

- ISO 31000:2009 – Risk Management – Principles and Guidelines
- AS 5577-2013 Electricity network safety management systems

To achieve this, United Energy has developed processes that meet the requirements of these standards for assessing risks to a level that is ALARP.

5.1 ALARP Process

UE's objective is to reduce the risk to a level that is ALARP. Determining ALARP is essentially a cost benefit analysis. The measure of whether ALARP had been achieved requires an assessment of the cost of reducing residual risk against the benefit to be gained.

5.2 Consideration of Alternatives

The concept of ALARP contains an implicit assumption that there are alternative designs or measures that can reduce the risk but that some of these alternatives may not be 'practical'. Any attempt to demonstrate ALARP that does not consider any alternatives, or at least search for them, is not convincing. An important part of the process of demonstrating ALARP is the identification and evaluation of alternative designs that offer lower risk. The following two questions illustrate the process:

- What else could we do to reduce risk?
- Why have we not done it?

ALARP has been demonstrated when the answer to the second question, for each physically possible alternative, is 'because the cost is grossly disproportionate' to the risk reduction.

The level of analysis required in establishing the relevant costs and safety benefits depends on the severity of the consequences. Where the consequences could include fatalities, there should be an exhaustive search for alternatives, detailed evaluation of the resulting risk reductions (qualitative or numeric), and realistic estimates of the associated cost increments.

6. United Energy's Bushfire Mitigation ALARP Assessment

6.1 United Energy Bushfire Context

There has never been a catastrophic bushfire within the UE distribution area. Furthermore, there have been no "out of control" fire events that could be attributed to UE assets over the 2012-2014 period. The following events are the prime sources of fire ignition (F-factor) emanating from the UE network assets in the period 2012-14.

6.1.1. Hazardous Bushfire Risk Areas

- Pole Fires (11 events - 29% of all HBRA fire starts)
- HV ABCs (6 events - 16%)
- LV Isol/Mains Box/FMB (4 events -10%)
- Street Lights (4 events - 10%)
- Tree/Bark (2 events - 5%)

6.1.2. Low Bushfire Risk Areas

- Pole Fires (227 events - 58.7% of all LBRA fire starts)
- Street Lights (24 events - 6.2%)
- LV Isolators/Mains Box/FMB (22 events - 5.4%)
- HV/LV Connection (18 events - 4.7%)
- Tree/Bark UE (15 events - 3.9%)
- LV Krone Boxes (12 events - 3.1%)

By reducing these events, specifically in HBRA where the residual risk is most significant, UE reduces the risk of igniting a catastrophic bushfire event. UE currently has almost 1140 km of overhead high voltage and subtransmission lines and approximately 470km of low voltage lines in HBRA.

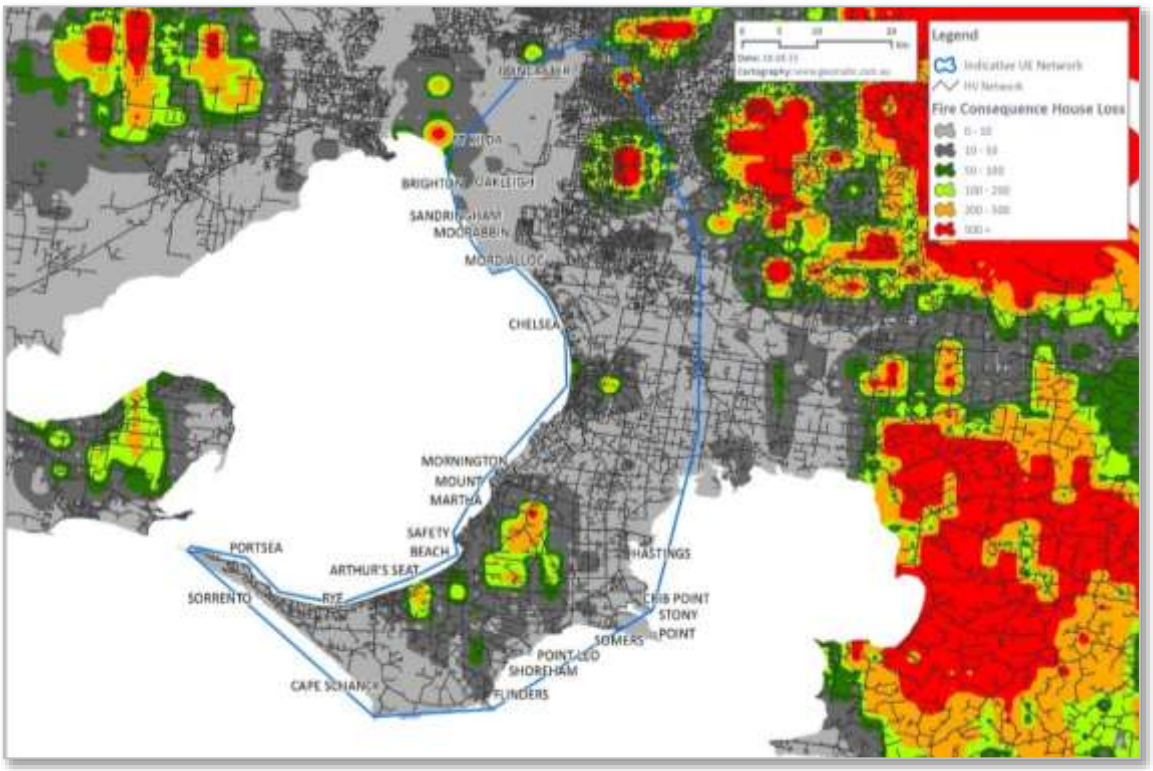
6.2 Bushfire Risk ALARP workshop

An assessment workshop was held on 26 August 2015. As noted above, the current assessment of the Catastrophic Bushfire risk, is a residual risk (with controls) of catastrophic consequence and rare probability resulting in the risk rating of 'Very High'. Given the consequence will likely always remain catastrophic, the focus was primarily on reducing the likelihood.

The assessment workshop included presentations from the Mornington Council, Country Fire Authority and State Government to provide participants with enough information to identify initiatives that could reduce the risk of bushfire using the Arthurs Seat area as a case study.

- Mornington Shire Council presented plans for urban development in and around the Arthurs Seat area and Council readiness for bushfire,
- Country Fire Authority presented the impacts of Bushfire in the Arthurs Seat area on population and urban dwellings,
- Department of Economic Development, Jobs, Transport and Resources presented the Powerline Bushfire Safety Program and consequence mapping for a bushfire in started the Arthurs Seat area (reproduced below). Compared to other parts of Victoria, our scale of consequence is relatively low.

Figure 3: Bushfire Risk map



We focused on catastrophic bushfire in Arthurs Sea for a number of reasons:

- Assessment by Subject Matter Experts (UE, CFA, DSDBI) was that Arthurs Seat area was the greatest risk
- State Government and CFA view was fighting a fire on Arthur's Seat would be more difficult than fighting a fire in Mornington or Glen Waverley

It should be noted however, that risk ratings and controls are independent of location, and applied universally throughout HBRA.

6.3 Initiatives Identified at the Workshop

An exhaustive process identified 75 potential United Energy initiatives which were grouped as follows to facilitate assessment:

- Design (17, such as reducing the high voltage network in HBRA from 22kV to 11kV or 6.6kV)
- Development (8, such as installing REFCLs in HBRA)
- Inspection, Installation, Construction, Maintenance (27, such as improved asset inspection techniques with the use of pole top cameras)
- Operation (16, such as turning the power off on Total Fire Ban days in HBRA)
- Other (7 such as partnering with Universities to research fire prevention technologies)

6.4 First hurdle assessment of initiatives

Following the workshop, each initiative was subject to a high level (or first hurdle) assessment to gauge its appropriateness for mitigating bushfire risk to ALARP.

Of the 75 identified initiatives, 27 were assessed as having a negligible impact on residual risk. These initiatives were rejected.

A total of 48 initiatives satisfied the first hurdle assessment, indicating that they would make, or have the potential to make an effective contribution to mitigating bushfire risk to ALARP. Of these 48 initiatives:

- 20 have either already been implemented or will be implemented through our business-as-usual expenditure plans;
- 26 require more detailed assessment through trials or further analysis before a decision is made on the extent to which these initiatives should be adopted; and
- 2 initiatives – being REFCL and Light Detection and Ranging (LiDAR) implementation – are recommended as new initiatives.

Appendix A provides a brief description of the status of all the initiatives in each group that were assessed as making, or having the potential to make an effective contribution to mitigating bushfire risk to ALARP.

The next section provides an overview of our assessment of some key bushfire mitigation initiatives.

6.5 Bushfire Mitigation ALARP Assessment – Summary of Key Potential Initiatives

The table below provides an overview of UE's assessment of the two additional initiatives recommended (namely, installation of REFCLs and implementation of LiDAR) alongside other major initiatives that were also considered as alternatives.

Table 3: Summary of Key Potential Initiatives

Initiative	Fire start risk reduction	Other benefits	Risks and costs	Cost[1]	Bushfire benefit	Implement?
Install REFCLs at DMA and MTN	Reduces fault current for phase-to-earth faults very quickly. Estimated fire start risk reduction of 48-60%[2].	Reduces duration of outages and the number of customers switched off under catastrophic conditions. Possible longer term reliability benefits. Safety benefits from reduction in electric shocks.	Uncertainty as to its effectiveness in practice. The estimated fire start reduction could be considerably less than currently estimated until operational issues are resolved.	$7.4M	$3.9M	**Yes** Assessed as satisfying ALARP.
Adopt LiDAR in HBRA to assess as conductor clearance issues	Identifies potential for conductor clashing and clearance violations. Assess compliance violations resulting from the vegetation growth. Estimated fire start risk reduction of 5%[3].	Improving network safety by augmenting current physical asset audit processes. Capex efficiencies through: • Increasing planned replacement rather than the more expensive approach of replacement on failure; and • Minimising the need for physical survey work for all planned distribution works	Uncertainty as to how frequently the surveys would be required. Uncertainty regarding the cost of modifying assets identified by the survey as requiring remedial action.	$6M	$300k	**Yes** Apart from the bushfire mitigation benefits, the project is justified on the basis of improving network safety, and capex efficiency benefits.

[1] High level rates assumed of $600/m for bare HV conductor to HV ABC and $900/m for bare HV conductor to underground cable
[2] Department Of Economic Development, Jobs, Transport and Resources, Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment, 17 November 2015, page 11.
[3] Ibid

Initiative	Fire start risk reduction	Other benefits	Risks and costs	Cost[1]	Bushfire benefit	Implement?
Underground all overhead assets in HBRA	Removes almost all fire-start fault modes. Estimated fire start risk reduction of 98-99%[4].	Additional reliability benefits.	Very high costs. Lengthy construction timeframes will result in significant time elapsing before benefits are delivered.	$1030M	$6M	**No**
Insulate Overhead Conductor in HBRA	Removes most fire-start fault modes. Estimated fire start risk reduction 96-98%[5].	Additional reliability benefits.	Very high costs. Lengthy construction timeframes will result in significant time elapsing before benefits are delivered.	$680M	$6M	**No**
SWER replacement for targeted areas	Existing fault rate on SWER is very low, so minimal fire benefit	Converting SWER to single phase permits more sensitive fault detection	Only benefits delivered in conjunction with REFCLs	$18M	Minimal	**No**
Install Remote Area Power Supplies in selected locations and decommission the network	Removes some fire start fault modes in HBRA if the network can be retired.	Reduced maintenance	Only effective if every customer in a section of the network elects to accept RAPs so that the network can be retired	$70M	Minimal	**No**

[4] Ibid.
[5] Department Of Economic Development, Jobs, Transport and Resources, Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment, 17 November 2015, page 11..

Based on the analysis summarised in Table 3, UE has rejected a number of initiatives for the following reasons:

- **Undergrounding the HBRA network - Rejected**

  Rationale: The costs are very high compared to the reduction in fire starts.

- **Insulating the HBRA overhead conductors**

  Rationale: The costs are very high compared to the reduction in fire starts.

- **SWER replacement in targeted areas** –

  Rationale: The existing fault rate on UE's SWER network is very low. The replacement of SWER therefore does not materially reduce the risk of fire starts, but could instead increase it because:

  (i) a greater number of assets are required for singe or three phase construction;

  (ii) available fault level increases (e.g. from approximately 250A to some 1500A); and

  (iii) the likelihood of phase-to-phase faults would be increased (fault values significantly higher e.g. 2500 to 5000A).

  In view of these considerations, UE rejected this option.

- **Install Remote Area Power Supplies and decommission the network**

  Rationale: This initiative involves providing combined diesel/solar/battery storage units at customers' premises in remote areas that are prone to bushfire risk to enable the distribution network to be retired. It is only effective if every customer on the section of network adopts this solution so that the network can be retired. It is a very expensive option with minimal bushfire benefits. UE therefore has rejected this option.

Based on its examination of the key bushfire mitigation initiatives set out in Table 3, UE proposes to implement the following two key initiatives as part of its bushfire risk mitigation strategy:

- Install REFCLs in UE's highest bushfire risk areas (Mornington and Dromana); and
- Undertake a LiDAR survey throughout the HBRA territory.

Implementation of these two initiatives is consistent with UE's obligation to reduce bushfire risk to ALARP. Specifically:

- The installation of active REFCLs at Mornington (MTN) and Dromana (DMA) zone substations within the next regulatory period (2016-2020) is a practical means of reducing bushfire risk and should be part of UE's bushfire mitigation plan.

  MTN and DMA represent 56% of the total UE bushfire risk, which is significantly higher than any other zone substation. Installation of REFCLs at these two locations is practicable because it potentially provides an overall UE network bushfire risk reduction of 35% at a cost which is not disproportionately high compared to the value of the risk reduction.

  UE estimates that the cost of installing REFCLs averages $3.7M per zone substation. This compares with the average forecast cost of $6.26M per REFCL for the rollout of the technology across rural Victoria.

- Utilising LiDAR technology mounted on vehicles to perform site surveys will identify conductor risks to bushfire safety as well as vegetation encroachment to wires (including that from council lands). LiDAR is considered a practical means of reducing bushfire risk.

Further information on these initiatives, including full business case evaluations is contained in the following documents:

- Project Justification document PJ1400, titled "LiDAR Asset Management"; and
- Project Justification document titled "DMA and MTN Zone Substation Rapid Earth Fault Current Limiter (REFCL) Installation".

7. Conclusions and recommendations

UE has a statutory obligation to "design, construct, operate, maintain and decommission an at-risk electric line to minimise as far as practical the bushfire danger arising from that line."

In view of this obligation, UE has explored and assessed a large number of initiatives that have the potential to reduce bushfire risks to a level as low as reasonably practical (ALARP). A total of 75 initiatives have been identified and assessed using the latest available fire loss consequence mapping data.

Of the 75 initiatives that were examined:

- 27 were found not to be effective, and were rejected; and
- 48 initiatives were found to promote the achievement of ALARP. Of these 48 initiatives:
  - 20 have either already been implemented or will be implemented through our business-as-usual expenditure plans;
  - 26 require more detailed assessment through trials or further analysis before a decision is made on the extent to which these initiatives should be adopted; and
  - 2 initiatives – being REFCL and Light Detection and Ranging (LiDAR) implementation – are recommended as new initiatives.

The REFCL and LiDAR initiatives are justified on the following basis:

- The value of the bushfire risk reduction provided by REFCL technologies is comparable to the capital cost of the program. The implementation of REFCL therefore satisfies the ALARP principle.
- The cost of implementing LiDAR exceeds the estimated value of bushfire risk reduction. However, LiDAR will provide other safety outcomes that accord with our obligations to manage safety risk to ALARP, as well as capital expenditure efficiency benefits.
- Both REFCL and LiDAR compare favourably with the other initiatives examined in this bushfire mitigation assessment.

It is recommended that:

- The installation of active REFCLs at Mornington (MTN) and Dromana (DMA) zone substations proceed within the next regulatory period (2016-2020).
- A survey using LiDAR technology mounted on vehicles be conducted, focusing on UE poles and lines in HBRA, should commence in 2016.

Appendix A – Status of bushfire mitigation initiatives

This appendix describes the status of each of the 48 initiatives, by group, that have been identified for implementation, trial or further development.

A1 Design

Ongoing

The following initiatives are already in place, or will be implemented through our business-as-usual expenditure plans:

- Replace HVABC in targeted HBRA areas prioritised based on CFA risk polygons
- Animal proof all at risk overhead assets in HBRA
- Ensure removal of all bird covers in HBRA

To be trialed or for further assessment

The following design initiatives will be trialled or subject to further investigation before a final decision is made regarding their adoption.

- Review overhead line design from bushfire mitigation perspective to identify opportunities to prevent bushfires in HBRA
- Ensure no wooden cross arms or brown insulators remain on sub transmission lines
- Make cycle of inspections more regular (every year/2 years) and have inspections done with pole top camera. Consider other inspection techniques (inspect a designated area).

A2 Development

Ongoing

The following initiatives are already in place:

- Fuse saver trial

Recommended

The following initiatives are recommended:

- Install REFCLS in HBRA
- Undertake pre-Summer LIDAR in HBRA

These initiatives are not in our current business-as-usual plans.

UE has completed sufficient analysis to indicate that proceeding with these initiatives - subject to regulatory approval by the AER and ESV - is consistent with our obligations to mitigate bushfire risk to ALARP

To be trialed or for further assessment

The following design initiatives will be trialled or subject to further investigation before a final decision is made regarding their adoption.

- Roll out more fuses to minimise fault current in HBRA.
- Investigate new technology which would limit fault energy ie, intellirupter
- Improve monitoring for fault signatures on feeders

A3 Inspection, Installation, construction and maintenance

Ongoing

The following initiatives are already in place, or will be implemented through our business-as-usual expenditure plans:

- Add an additional hazard inspection program around Arthurs Seat to occur annually prior to fire season to identify trees that are at risk of coming into contact of our network or failing
- Improve asset inspection techniques with use of pole top camera (to identify mechanical failure of cross arms and potential pole top fire) - in HBRA
- Conduct regular thermal survey work of all HBRA.
- Identify pole tops which are at risk of catching fire which would enable us to better prioritise replacement of at risk pole tops

To be trialed or for further assessment

The following design initiatives will be trialled or subject to further investigation before a final decision is made regarding their adoption:

- Purchase spare critical plant, eg NER to mitigate against critical plant failures (which could result in a fire start).
- Input contingency plans into vegetation management planning (increasing clearance in areas where we have potential sag issues).
- Conduct audits on field crews doing work on TFB days in line with TFB permits.
- Explore what other fire safe equipment/tools could be introduced for Service Provider use.
- Have signage/ interlock system on SP truck showing that truck has required gear to conduct work during summer period
- Have bark (and potentially other signals) patrols done of HBRA during the summer period. Assign a tree champion from UE to identify hazards in HBRA.
- Proactively cut non UE and private trees in HBRA (council trees).
- Review defect priority system to enable us to better target asset defects, focussing on pole tops in HBRA

A4 Operation

Ongoing

The following initiatives are already in place, or will be implemented through our business-as-usual expenditure plans:

- Insource vegetation management function
- Implement vegetation management IT solution
- Improve visibility of bushfire conditions in HBRA, ie winds, Fire Danger Index, temperature.
- Culture shift - from reliability to a fire start impact
- Review/change to the protection settings applied on SWER ACRs on high fire risk days
- Review protection settings on a TFB day and also review when we restore it.
- Increase sensitivity of relay protection settings
- Expand the current fault location monitoring (EFD system)

- Use distance to fault information to reduce feeder patrol time

To be trialed or for further assessment

The following design initiatives will be trialled or subject to further investigation before a final decision is made regarding their adoption:

- Open bus tie circuit breakers on TFB days and bus tie open scheme to reduce fault currents.
- Move open points (reconfigure network) on TFB days
- Use NLM system to look for overloaded low voltage network in HBRA.
- Do not turn on POELS after they have been turned off without remediation or clearance, especially in the high consequence areas
- Implement TFB configurations from midnight one day to midnight next day during TFB days
- Use a fault anticipator to identify fault signature before it turns into a fault.

A5 Other

The following initiatives are considered worthy of further development and likely implementation through our operational bushfire programs:

Ongoing

The following initiatives are already in place, or will be implemented through our business-as-usual expenditure plans:

- Partner with universities to research fire prevention technologies
- Ensure that we are drawing on CFA information - Victorian Bushfire risk register
- Map DELWP polygons over location of our network assets to determine which parts of vegetation and assets are critical to keep under control. Use polygons to inform our bushfire prevention planning.

To be trialed or for further assessment

The following design initiatives will be trialled or subject to further investigation before a final decision is made regarding their adoption.

- Incentivise community to report hazards in HBRA
- Liaise with Council/CFA to assist in the identifying of issues/hazards in HBRA
- Reinvigorate Service Providers to adopt a feeder
- Liaise with utilities in Southern California and France to research fire prevention technologies
- Ensure Tollhurst model is used by Council to reduce fuel load.
- Introduce a fire proofing strategy per feeder (ie we may rate each feeder by risk assessment).

Appendix B - Risk Register: Catastrophic Fire

UE's risk register lists the following controls to mitigate bushfire risk:

Controls (current) Engineering Administration PPE	Control Assurance (describe - programs, process, method, frequency) Reference 'Control ID' Risks register	Desk top ranking of Implemented Control / Assurance
This control involves the GM Electricity Networks (EN) monitoring, auditing, reporting and reviewing the network performance. From this analysis the Electricity Network team develop and maintains approved Policies, Strategies, Plans, and Procedures for the management of the network to prevent fire ignition emanating from all assets. Performance of the network is monitored and documentation revised annually or at least biennially via Asset Management Strategies which are approved by General Manager EN and which are delivered by GM Service Delivery. These documents include but are not limited to the following Plans; • Asset Management; • Fire Prevention; • Electric Line Clearance; • Asset Lifecycle Management and • An approved Electricity Safety Management Scheme.	**TCC001.1** All UE EN strategies and plans are regularly updated and are designed to prevent faults (thus fire ignition) from all sources All of these documents related to fire ignition are summarised and delivered within the Fire Prevention and Electric Line Clearance Plans which are submitted to Energy Safe Victoria (ESV). The two key programs involved in fire prevention are: Asset Inspection program (HBRA 3 years/LBRA 4 years) which include the inspection of Private Overhead Electric Lines (POEL) and; Electric Line Clearance programs (2 year cycle HBRA and LBRA) including a pre-summer inspection of the HBRA	Adequate
Assessment is done annually on the network configuration based on advice from the Phoenix Rapid Fire Model highest consequence areas as provided by ESV. This advice is assessed by head NCC, EN, SD with endorsement by the UE Fire Prevention Committee and executed by the NCC on the electricity network assets. Network is then configured based on the assessment to minimise the chance of fire ignition and improve network safety in accordance with the TFB day contingency report actions.	**TCC001.2** Annually ESV provides advice on the areas that are considered "high consequence" for upcoming fire season. UE considers these areas and may configure the network to minimise the chance of fire ignition in these areas on TFB or Code Red Days. This is done primarily to try to mitigate the chance of fire ignition from the following causes.	Adequate

Controls (current) Engineering Administration PPE	Control Assurance (describe - programs, process, method, frequency) Reference 'Control ID' Risks register	Desk top ranking of Implemented Control / Assurance
UE and UE's Service Providers apply for TFB permits (the permits give instruction on how works are to be carried out on TFB days in a safe manner) every August to allow work crews to undertake essential (make safe) works on TFB/Code Red days (that would normally be banned on such days) on the UE electricity network, generally outdoors. Our permit received from Fire Fighting Agencies (CFA/MFB and DEPI) and endorsed by a Service Provider GM allowing specific works on such days. Service Provider permit monitored and checked by the Fire Prevention Committee	**TCC001.3** This control is designed to mitigate fire ignition from UE crews conducting any works on TFB/Code red days. There is no history of crews being a cause of fire ignition by works conducted on these days however this control is designed to prevent fire ignition from the following sources.	Strong
Service Providers engage in fire prevention practices (vehicles and hot work) , and field crews to carry fire fighting equipment during the pre-summer and summer periods (Nov - March). This practice is reviewed and confirmed by Fire Prevention Committees (both UE and Service Providers) via annual Fire Prevention Committee audit. This control ensures that Fire Fighting equipment is available and "Hot" work is completed safely.	**TCC001.4** This control is designed to mitigate fire ignition from UE crews conducting any works during the fire season and to ensure they carry the correct equipment when operation in the HBRA during the declared fire season. There is no history of crews being a cause of fire ignition during fire season however this control is designed to prevent fire ignition from the following sources.	Strong
On a TFB/ Code Red day, the UE network is configured to minimise the chance of fire ignition, and improve network safety. This is overseen by head of NCC, Service Delivery Managers and in consultation with Service Providers and endorsed by the Fire Prevention Committee. This control is conducted in accordance with the TFB day contingency report actions contained in the Fire Prevention Plan.	**TCC001.5** This control is designed to limit fault energy on TFB and Code Red days primarily in the HBRA or high consequence areas.	Adequate
HBRA Summer vegetation inspections are conducted during the summer period (Dec-March) by an independent contractor to monitor the effectiveness of the Asset Inspection and Vegetation programs. Any decfects that are identified are reported through to the Service Providers and copied to UE Managers for rectification as per UE procedures. On a monthly basis, the results of these inspections are reported up to the Fire Prevention Committee.	**TCC001.6** The annual summer inspection (December - March) is designed to identify any vegetation that has been missed or has grown into the clearance space since the pre summer inspection.	Strong

Controls (current) Engineering Administration PPE	Control Assurance (describe - programs, process, method, frequency) Reference 'Control ID' Risks register	Desk top ranking of Implemented Control / Assurance
Service Providers conduct Pre-summer vegetation inspection and cutting programs in the HBRA in the lead up to fire season to ensure the status of the completion of vegetation programs. The results of these are reported by the Service Providers via UE Managers up to the Fire Prevention Committee on a monthly basis, this information feeds into the UE Fire Performance Index. The Fire Prevention Committee Monitors progress of the pre-summer inspection program.	**TCC001.7** The annual pre- summer inspection (July-November) is designed to identify, and clear any vegetation that is within, or may grow into the clearance space over the fire danger period.	Adequate
Service Providers conduct the UE cyclic asset inspection program within the HBRA in the lead up to fire season to ensure all maintenance defects identified through the inspection are captured in SAP. The results of these are reported by the Service Providers via UE Managers up to the Fire Prevention Committee on a monthly basis, this information feeds into the UE Fire Performance Index. The Fire Prevention Committee Monitors progress of the US asset inspection and maintenance programs.	**TCC001.8** The cyclic asset inspection program is conducted between April-July on a 3 year cyclic basis. Any maintenance identified is completed before the fire danger period	Strong