Bushfire mitigation

PAL RRP BUS 6.11 – Bushfire mitigation - Dec2020 - Public

Revised regulatory proposal 2021–2026

Contents

1 Overview

Business	Powercor
Title	Bushfire mitigation
Project ID	PAL RRP BUS 6.11 - Bushfire mitigation - Dec2020 - Public
Category	Capital expenditure
Identified need	Investments to mitigate the risk of our assets contributing to starting a bushfire
Supporting documents	• PAL RRP MOD 6.17 – FSD model – Dec2020 – public.xlxs • PAL RRP MOD 6.18 – FOLCB model – Dec2020 – public.xlxs • PAL RRP ATT 051 – Victorian communities need power shut off during bushfire threat – Oct2020 – public

1.1 Summary our revised proposal

Our original proposal set out investments to replace assets in electric line construction areas (ELCAs). These areas are considered the highest risk areas where the economic and social consequences of a fire start would have the most devastating impact on our communities.

With the exception of our mitigating rapid earth fault current limiter (REFCL) reliability impact project, the AER did not approve our projects on the basis we had not provided any evidence or justification as to how these investments would reduce the risks as far as reasonably practicable. In this response, we:

- demonstrate the replacement of low voltage fuse switch disconnectors (FSD) and fused overhead line connector boxes (FOLCB) in ELCAs is prudent, efficient and delivers a reduction in risk as demonstrated using a risk monetisation approach
- outline the need for further research and development in new developments, technologies or solutions that may reduce the risk of our assets contributing to a bushfire, including in ELCAs.

Finally, we note that following a recent Victorian Auditor General Report, we have included a contingent project in the event the regulations are changed to increase the pace at which we are replacing assets in ELCAs.

2 Background

We operate a distribution network where the majority of our assets are located in designated hazardous bushfire risk areas (**HBRA**). The unique combination of weather and vegetation that occurs in south-eastern Australia makes it one of the most bushfire prone locations in the world.

As any spark is a potential source of ignition, the consequences of a fault in our overhead electricity sub-transmission or distribution system can be catastrophic. The high temperatures, low humidity and hot gusty northerly winds that occur through summer and autumn produce a volatile fuel source that can ignite easily and burn fiercely. Such fires have caused enormous property, livestock and wildlife losses, together with loss of human life.

For many of our safety initiatives, as outlined in our Bushfire Mitigation Plan (BMP), replacements and trials are prioritised in electric line construction areas over other areas, as ELCAs are considered to be the areas of the highest consequence in the event of a fire start.

2.1 Electric line construction areas

2.1.1 Background

Following the catastrophic Black Saturday bushfires in 2009, the Victorian Government established the Victorian Bushfires Royal Commission (VBRC) to consider how bushfires can be better prevented and managed in the future.

In August 2010, the Powerline Bushfire Safety Taskforce (PBST) was established to oversee the implementation of recommendations from the VBRC relating to powerline replacements and changing the network reclose function. The PBST report, delivered in September 2011, provided options of bushfire mitigation programs which delivered different levels of risk reduction and impacts on electricity bills.

The Victorian Government's response following the PBST's report[1] noted that there will be still be 'black spots' in the electricity distribution network where dangerous poles and wires create an unacceptable bushfire hazard. The Government noted that:[2]

> *A process is required whereby Government, safety agencies and electricity distribution businesses can work together to identify, and replace, the most dangerous power lines. This will require an assessment of local bushfire risk; the condition of existing electricity assets; and a decision as to which replacement technology (insulation, aerial bundling, undergrounding) will yield the best result.*
>
> *The Government will contribute up to $200 million over 10 years for a program of power line conductor replacement. Based on the estimates of the Taskforce, this will replace over 1,000 km, with the final length to be replaced dependent on detailed engineering and geographic assessment. The focus will be on locations with the highest fire loss consequences.*

Sophisticated and detailed analysis was undertaken using the PHOENIX RapidFire bushfire risk analysis program. The program was developed by Professor Tolhurst and his associates at the University of Melbourne as part of the Bushfire Cooperative Research Centre, together with input from the Fire Services Commissioner. The modelling carved up Victoria into tiny 2 square kilometre regions. In each region, a simulation was conducted

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1 Powerline Bushfire Safety Taskforce, *Final Report*, 30 September 2011.

2 Victorian Government, *Power Line Bushfire Safety: Victorian Government Response to the Victorian Bushfires Royal Commission Recommendations 27 and 32*, December 2011, available from: http://www.energyandresources.vic.gov.au/energy/safety-and-emergencies/powerline-bushfire-safety-program/response-to-pbst.

that forecast the consequences of a fire ignition. Those areas where the consequence of a bushfire destroying homes and livelihoods were highest were identified.

2.1.2 Electric line construction areas

On 1 May 2016, the Victorian Government introduced regulations which amended the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (Amended Bushfire Mitigation Regulations)—to implement the PBST's findings.[3]

The Amended Bushfire Mitigation Regulations now require our bushfire mitigation plan (BMP) to include details of the preventative strategies and programs by which we will ensure that within an ELCA, each electric line with a nominal voltage of between 1 kV and 22 kV that is constructed, or is wholly or substantially replaced, in its supply network is a covered or underground electric line.[4]

There are 33 ELCAs across Victoria.[5] In these areas where four or more consecutive spans of an electric line are replaced, those four or more consecutive spans are replaced with covered or underground conductor.

Any new works to be undertaken in ELCAs, including augmentation or connections, must also comply with the higher standards of construction.

2.1.3 Obligations for bushfire mitigation

Our approach to continue to effectively reduce the risk of bushfires from our network is set out in our Bushfire Mitigation Plan, which is accepted by Energy Safe Victoria (ESV).[6] Projects included in our BMP are compliance obligations under the *Electricity Safety Act 1998*.[7]

There are 15 ELCAs in Powercor's distribution area. For many of our safety initiatives as outlined in our BMP, replacements and trials are prioritised in ELCAs over other areas, as ELCAs are considered to be the areas of the highest fire risk.

Projects included in our BMP are compliance obligations under the *Electricity Safety Act 1998* (Vic).[8] The management of bushfire risk by major electricity companies is governed by the Electricity Safety Act. As an electricity distributor we are, by definition, a 'major electricity company'.

Under section 98 of the Electricity Safety Act, we have a general duty to design, construct, operate, maintain and decommission its supply network to minimise *so far as practicable* the hazards and risks to any person arising from the supply network, the hazards and risks to the property of any person arising from the supply network, and the bushfire danger arising from the supply network.[9]

While there is no clear definition, the overarching principles to meet this *as far as practicable* safety obligation which applies to both people and property are:

- is there anything else that could be done to reduce or eliminate the risk?
- is it reasonable to do this?
- do the costs disproportionally outweigh the benefits?

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3 Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016.

4 Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016, Reg. 7(1)(hc)

5 https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/electrical-safety-bushfire-mitigation-further-amendment-regulations-2016/electric-line-declared-energy-maps

6 PAL ATT094: Powercor, *Bushfire Mitigation Plan 2019–2024*, January 2020.

7 *Electricity Safety Act 1998*, clause 113B(2).

8 *Electricity Safety Act 1998*, clause 113B(2).

9 *Electricity Safety Act 1998*, section 98.

We must submit an Electricity Safety Management Scheme (ESMS), which specifies the safety management system by which we will comply with this general duty and other prescribed safety matters including a plan for the mitigation of bushfire danger, periodically to ESV for acceptance.[10] We must comply with an accepted ESMS for the supply network.[11]

We also have an obligation to submit a bushfire mitigation plan (BMP), which specifies our plan for the mitigation of bushfire risk on our supply network, periodically to the ESV for acceptance.[12] The BMP must include the prescribed particulars.[13] We must comply with an accepted BMP for our supply network.[14]

The Amended Bushfire Mitigation Regulations prescribe particulars for BMPs. Therefore our BMP, as accepted by ESV, sets out various initiatives that we will undertake to mitigate bushfire safety risks as required by the Electricity Safety Act 1998 and the amended regulations. Therefore, obligations for works to be undertaken in ELCAs to a higher standard as specified in our BMP is a regulatory obligation.

2.2 Our original proposal

We have obligations under section 98 of the Electricity Safety Act 1998 to continually reduce our bushfire risk as far as practicable. In response to this compliance obligation, we are undertaking a number of targeted programs and initiatives aimed to reduce risk of fire starts on our network. We are committed to replacing assets in high bushfire risk areas and delivering a safe network that mitigates bushfire risk.

In our original proposal, we set out a range of investments to support many of the programs included in our BMP. The investments allocated to our replacement expenditure program are summarised in the table below.

Table 1 Bushfire mitigation program ($million, 2021)

	Bushfire safety programs 2021-2026	Investment
1	Wooden cross arm replacement	3.2
2	Fuse switch disconnector (FSD) replacement in ELCAs	3.7
3	Fused overhead line connector box (FOLCB) replacement in ELCAs	5.0
4	Early fault detection	2.7
5	HV covered conductor and broken conductor detection trials	2.1
6	Mitigating REFCL reliability impacts	13.0
TOTAL INVESTMENT		**29.5**

Source: PAL Regulatory Proposal, January 2020, p. 39.

10 *Electricity Safety Act 1998*, section 99.

11 *Electricity Safety Act 1998*, section 106(2).

12 *Electricity Safety Act 1998*, section 113A.

13 *Electricity Safety Act 1998*, section 113A(2).

14 *Electricity Safety Act 1998*, section 113B(2).

2.3 Draft determination

The draft determination did not accept most of our bushfire mitigation expenditure on the basis we did not provide any evidence or justification as to how the majority of the projects reduce the risks as far as reasonably practicable.[15]

The AER accepted the mitigating REFCL reliability program. After reviewing the business case and the cost-benefit analysis provided, the AER was satisfied that the mitigating REFCL program is prudent and efficient, as it addresses a reliability issue.[16]

For other programs, the AER found we have not established the program is efficient or prudent, given:

- the expenditure seems to be above and beyond what is included in 'base repex'
- the replacement expenditure allowance for overhead conductors and pole top structures repex is sufficient for us to address any cross-arm or overhead conductor expenditure
- no cost-benefit analysis or risk quantification provided to support this expenditure.

2.4 Revised proposal

In this revised proposal, we have:

- accepted the draft determination with respect to wooden cross-arm replacements in ELCAs
- re-proposed the replacement of low voltage fuse switch disconnectors and fused overhead line connector boxes in ELCAs as prudent and efficient, together with risk-monetisation modelling which demonstrates that the expenditures prudently reduce the risks as far as reasonably practicable
- acknowledged the AER's concerns in relation to the proposals to trial and deploy early fault detection technology as well as HV covered conductor and broken conductor detection trials in high risk fire areas
- proposed expenditure for further research and development in technologies to mitigate the risk of our assets contributing to a bushfire, including in ELCAs.

We also note the inclusion of a contingent project should there be a change in regulations or obligations regarding the pace of replacement of assets in ELCAs.

[15] AER, Powercor distribution determination 2021-26, Draft decision, p. 5-45.

[16] AER, Powercor distribution determination 2021-26, Draft decision, p. 5-45.

3 Low voltage assets

This section demonstrates the annualised cost of proactively replacing fuse switch disconnectors (FSDs) and fused overhead line connector boxes (FOLCB) in ELCAs is lower than the annualised risk reduction.

This demonstrates the investment is efficient and prudent and further, contributes to reducing the risk of these assets on our network contributing to a fire start, as far as practicable.

3.1 Summary of our revised proposal position

FSDs and FOLCBs are different models in the same asset class. These assets protect low voltage electrical equipment and mains against overload and short circuit. FOLCBs use fuse links and are more enclosed than FSDs, but effectively serve the same purpose.

An as far as practicable (AFAP) assessment was completed on the FOLCBs and FSDs in our network. The cause of failures identified from the AFAP assessment, consistent with section 83 of the Electricity Safety Act, are below:

- increased current draw resulting in excessive heat build-up which is capable of starting a fire
- poor termination (high resistance) connections including bimetallic thermal expansion coefficient leading to loose connection, which can cause the FSD to ignite
- corrosion of links, hinges and terminations leading to high resistance and greater heat generation (corrosion in electrical connectors can cause voltage drops because of an increase in resistance. High resistance in high current circuits can cause electrical fires.)
- insufficient heat dissipation capacity of the fuses within the box, meaning heat does not drain away properly which causes overheating and can start a fire
- incorrect fuse installed, meaning the fuse will not operate in time to prevent excessive heat build-up which could ignite the unit and start a fire.

In 2018, there were 32 FSD and 963 FOLCB failures on our network, each which represented a material contribution to fire starts.

We consider a proactive program to replace these assets before they fail will meet the AFAP obligations and reduce the risk of these assets contributing to a fire start in the high consequence ELCAs. We have assessed this option against the base case, which is to continue to replace these assets on failure, using a risk-monetisation approach. This is discussed below.

3.2 Assessment approach

3.2.1 Risk monetisation model

The approach taken to determine the net economic benefit of each option includes estimating the annualised value of risk. Our approach to monetising risk is consistent with the method set out in the AER's asset replacement planning note.[17]

The annual risk value of a given option to address the identified need is calculated as the probability of asset failure, multiplied by the likelihood of consequence of the asset failure, multiplied by the consequence cost of the failure event.

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[17] PAL ATT099: AER, *Industry practice application note, Asset replacement planning*, January 2019.

Our modelling assumes one failure mode—the FSD or FOLCB ignites (due to any of the above failure modes) during operation on a total fire ban (**TFB**) day—and one consequence—fire start. The possible consequences are estimated using the following categories:

- value of human life and property
- f-factor penalty.

The probability of failure and consequence are estimated using our actual historical data from fire starts from FSD and FOLCB assets. Based on the historical data, there are around 5 FSD failures per annum in a total population of 121,665 FSDs, a 0.004 per cent failure rate per annum. This total population failure rate is used for FSDs in ELCA areas. For FOLCBs, there are around 17 failures per annum in a total population of 103,585 units, thus a 0.0164 per cent failure rate per annum.

On average over the last 20 years, there are around 13 total fire ban (TFB) days a year in Victoria. This represents 3.6 per cent of days. Between 1969 and 2009 there have been four major fires across Victoria caused by electricity assets. This represents one major electricity asset caused fire in 10 years, which can be equated to one major fire in the Powercor's half of the state each 20 years.[18] We have therefore estimated there is a 5 per cent chance of an unsuppressed fire on a TFB day will cause a catastrophic fire in Powercor's distribution area.

The average cost from a major bushfire has been estimated by the Victorian Government as $330 million ($2014).[19] The costs are driven by loss of life, general insurance claims, damage to telecommunications and other essential utilities.

A disproportionality factor is used to increase the consequence of the annual bushfire risk cost under the AFAP principles. Disproportionality factors are used when identifying practicable or reasonable costs of mitigation, and provide guidance on when to it is not reasonable to invest to reduce safety risk. Where the risk is greatest, a higher investment is warranted to reduce the risk and err on the side of safety. We consider a disproportionality factor of 10 is reasonable for ELCAs, however we have conservatively used a factor of six in this modelling. We also note, consistent with section 98 of the Electricity Safety Act, our AFAP obligations apply to both people and property.

Some of the key assumptions in the risk monetisation assessment are set out in the table below.

18 PAL ATT114, ACIL Allen Consulting, Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment, 17 November 2015, p36.

19 PAL ATT114, ACIL Allen Consulting, Regulatory Impact Statement - Bushfire Mitigation Regulations Amendment, 17 November 2015, p. 35.

Table 2 Key assumptions and sensitivities, per annum

Assumption	FSD metrics	FOLCB metrics
Fire starts from population of assets (based on actuals on our network)	0.004%	0.0164%
Fire starts from asset on TFB day	3.6%	3.6%
Probability of an unsuppressed fire causes a catastrophic fire on a TFB day	5%	5%
Consequence of a catastrophic fire ($2021)	$378 million	$378 million
Disproportionality factor	Range from 1 to 6, depending on the geographical area	
Discount rate	AER real post-tax WACC: 2.75%	

Source: Powercor
Note: further information contained in PAL RRP MOD 6.17 and 6.18

3.2.2 Unit cost

The replacement costs for FSDs and FOLCBs are shown in the table below. They are based on the historic cost of replacing these assets.

Table 3 Unit costs ($2021)

Description	Unit cost
Replacement of FSD	1,259
Replacement of FOLCB	1,248

Source: Powercor

The life of each FSD or FOLCB is assumed to be 51 years, consistent with the standard asset lives for distribution network assets.

3.2.3 Volume of replacements

We propose to replace all FOLCB units in ELCA areas over the next five years, given the higher failure rate. Conversely, we proposed to replace all FSD units in ELCA areas over the next ten years and prioritise those in ELCA areas in the 2021-2026 regulatory period based on geographical factors. We consider this a prudent approach, and consistent with stakeholder expectations.

3.2.4 Assessment of risk reduction

The assessment involves comparing the annual risk cost and probability of failure against the annualised cost of the new assets.

Base case—replace on failure

The base case assumes no change to current practices, where the FSDs and FOLCs are not proactively replaced. Rather they are replaced on failure, and that failure may contribute to a fire start.

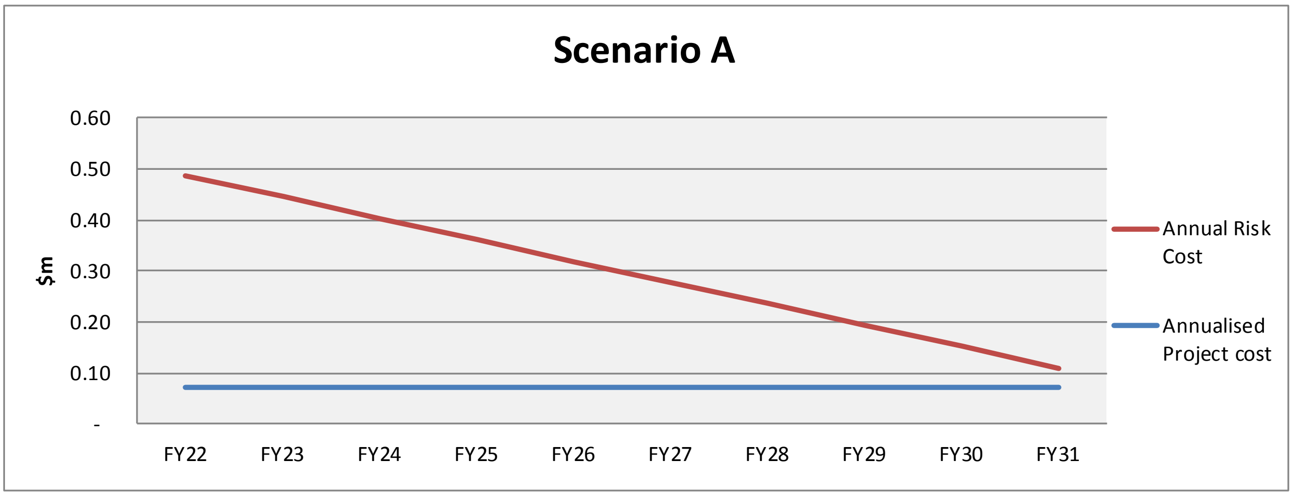
For simplicity, our risk is shown as flat. In reality, the risk of failure of these assets will be increasing over time as the assets age. The modelling is therefore conservative.

Proactive replacement of FSDs and FOLCBs

Under this option, we would proactively replace FSDs and FOLCBs in ELCAs over the 2021–2026 regulatory period.

The total risk decreases as the FSD assets are replaced over a ten year period, and this is shown to be greater than the annualised project cost in the figure below.

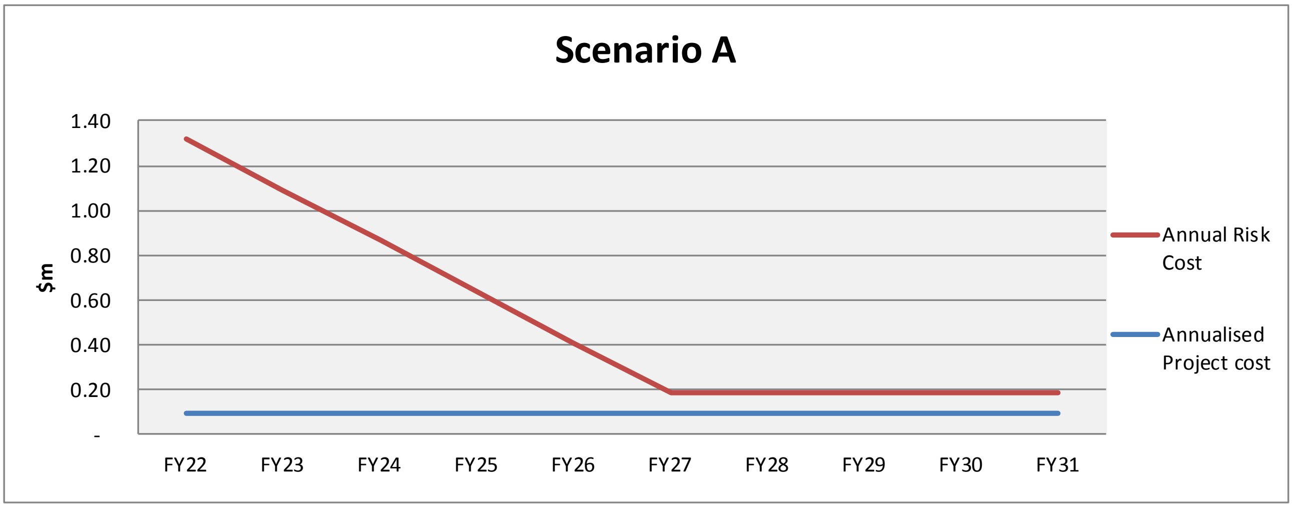
Figure 1 FSDs: Total risk vs annualised cost



Source: PAL RRP MOD 6.17

Similarly, the total risk decreases as the FOLCB assets are replaced over the next five years, and this is greater than the annualised project cost, as shown in the figure below.

Figure 2 FOLCBs: Total risk vs annualised cost



Source: PAL RRP MOD 6.18

A proactive replacement program will reduce risk relative to the baseline case, and the risk monetisation approach supports these investments.

3.3 Sensitivity analysis

We have performed a sensitivity analysis of the impact on changing some of the key assumptions in our model. Specifically, we tested the impact of changing the probability of failure and the consequence of failure by a range from -15 to 75 per cent.

In most scenarios, the annual risk cost exceeds the annualised project cost prior to FY27. However for scenario F, where the probability of failure and consequence of failure are reduced by 75 per cent, then the annualised project costs exceed the annual risk cost. This is an extreme scenario.

3.4 Recommendation

We propose to proactively replace FSDs and FOLCBs in ELCAs, as set out in the table below. As per of our BMP, we propose to implement a proactive replacement program for FSD and FOLCBs in ELCAs.

Table 4 Proposed investment

		2021/22	2022/23	2023/24	2024/25	2025/26	Total
FSD	Investment ($2021)	368,946	368,946	368,946	368,946	368,946	1,844,732
	Volume	293	293	293	293	293	1465
FOLCB	Investment ($2021)	496,365	496,365	496,365	496,365	496,365	2,481,823
	Volume	398	398	398	398	398	1989

Source: Powercor

4 Research and development

We will continue to innovate and identify new ways to make our assets safer across our network. For this reason, we seek additional funding to continue our research and development in ELCAs and other high risk bushfire areas.

4.1 Innovations so far

We continue to innovate in relation to the types of conductor and early detection of potential defects on conductor.

Covered conductor

Covered bare wire conductor reduces the likelihood of a spark occurring if the conductor falls to ground, which may mitigate the risk of our assets causing a bushfire.

As per Regulation 7(1)(hc) of the Amended Bushfire Mitigation Regulations, our BMP must contained details of our preventative strategies and programs to ensure that within an ELCA, each electric line with a nominal voltage of between 1 kV and 22 kV that is constructed, or is wholly or substantially replaced, in its supply network is a *covered* or underground electric line

For multiphase conductor, we have successfully trialled the Hendrix covered conductor.

However, we are still trialling the Amokabel covered conductor on single earth wire return (SWER) lines, and the solution has not been formally endorsed by ESV at this stage. We may have to underground these conductors if the covered conductor trial is unsuccessful

Broken conductor detection trials

We are involved in the development and trial deployment of a broken conductor detection and isolation technology which if successful, will rapidly isolate a broken HV conductor before it hits the ground.

Early fault detection technology

We have invested, and will continue to trial and deploy, the early fault detection (EFD) technology on HV lines in identified high risk fire areas.

An EFD is a device that picks up signals on overhead power lines that are signatures for a particular defect. It has a range of approximately 5 kilometres along the line, and seeks to find deteriorated assets such as broken conductor strands, damaged conductors, damaged pole top equipment and pole top transformer defects.

When the EFD detects an unusual signal, the algorithm of the device determines that there is a potential defect situation along the line. It can determine to about 10 metres accuracy where the defect might be. Then, a fault crew is sent out to investigate.

Installing EFDs will help to monitor our network and enable us to rectify a deteriorated asset before it fails. It is not a condition-based program as there are already programs to replace assets in poor condition.

4.2 Continuing to innovate

We will continue to innovate over the 2021-2026 regulatory period to identify ways to reduce the risk of our assets contributing to a bushfire. We will investigate the SWER covered conductor solutions, broken conductor trials and early fault detection technology. We will also look for other new developments, technologies or solutions in the electricity industry, both domestically and overseas, that may be able to be used in a manner that reduces the risk of our assets contributing to a bushfire and help us continue to meet our AFAP obligations.

We are an active member of the International Wildfire Risk Mitigation Consortium (IWRMC), an industry group consisting of over 40 electrical utilities predominantly across Australia and the United States of America. The objective of the group is to share learnings and experiences with respect to wildfire (bushfire) risk reduction. This will provide the opportunity for members to invest in similar technology trials within their own networks. As with most R&D, many of these opportunities are not yet identified but we will investigate as they arise.

4.3 Contingent project

In October 2020, a Victorian Government auditor-general's report raised concerns about the speed of the reactive replacement of bare-wire conductors in ELCAs. There is currently speculation the Victorian Government may amend the regulations to require distributors to proactive replace bare-wire conductor in these areas.[20]

Given the Victorian Government has expended large amounts of money through the Powerline Replacement Fund requiring Powercor, AusNet and Jemena to install REFCLs, it is probable that a change to the regulations will occur during the 2021-2026 regulatory period.

[20] PAL RRP ATT 051 —ABC News, Victorian communities need power shut off during bushfire threat, energy economist says, 26 October 2020.

5 Summary of revised proposal

This section sets out the expenditure for bushfire mitigation (excluding REFCLs) in our revised proposal.

5.1 Revised proposal forecasts

Table 5 Comparison of regulatory proposal, draft decision and revised regulatory proposal ($m, 2021)

	Regulatory proposal	AER draft decision	Revised proposal
Wooden cross arm replacement	3.2	0	0
Fuse switch disconnector (FSD) replacement in ELCAs	3.7	0	1.8
Fused overhead line connector box (FOLCB) replacement in ELCAs	5.0	0	2.5
Early fault detection	2.7	0	0
HV covered conductor and broken conductor detection trials	2.1	0	0
Bushfire mitigation research and development	-	-	4.1
Mitigating REFCL reliability impacts	13.0	13.0	13.0
TOTAL	**29.5**	**13.0**	**21.4**

Source: PAL RRP MOD 6.09

In addition, we have included a contingent project in the event the regulations are changed to increase the pace at which we are replacing assets in ELCAs.