EDO fuse replacements

PAL BUS 9.04 - EDO replacement - Jan2020 - Public

Regulatory proposal 2021–2026

Powercor

January 2020

Contents

1 Overview

Business	Powercor
Title	EDO fuse replacements
Project ID	PAL BUS 9.04 - EDO replacement - Jan2020 - Public
Category	Operating expenditure
Identified need	To reduce the risk of EDO fuses starting a bushfire as far as practicable, in accordance with the Electricity Safety Act 1998
Recommended option	Option 3—proactive replacement of all EDO fuses with fault tamers in electric line construction areas (**ELCA**) and replacement of EDO fuses with fault tamers in high bushfire risk areas (**HBRA**) (excluding ELCAs) as part of maintenance and repair
Proposed start date	2021/22
Supporting documents	• PAL ATT094 - Bushfire mitigation plan - Dec2019 - Public • PAL ATT099 - AER - Asset replacement planning - Jan2019 - Public • PAL ATT113 - Electricity safety management - Nov2019 - Public • PAL ATT114 - ACIL Allen - Bushfire regulations amendment RIS - Nov2015 – Public • PAL MOD 9.01 - Step changes - Jan2020 - Public • PAL MOD 9.05 - EDO ELCAs risk - Jan2020 - Public • PAL MOD 9.06 - EDO HBRA risk - Jan2020 - Public

Across our high voltage (**HV**) network we have expulsion dropout (**EDO**) fuses that can, in some cases, start a fire. We can reduce bushfire risk as far as practicable by replacing a large number of EDO fuses with fault tamers in highest consequence bushfire areas. Fault tamers are alternative fuses that have a lower risk of starting a fire.

Fuse replacements are part of our maintenance and repair operating expenditure. Our proposed replacement program would result in a material increase in our operating expenditure not captured in our 2019 base year. The forecast incremental operating expenditure requirements in the 2021–2026 regulatory period, for the preferred option, are outlined in table 1.

Table 1 Expenditure forecasts for preferred option ($million, 2021)

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Operating expenditure	2.18	2.21	2.24	2.26	2.29	11.18

Source: Powercor

Our latest Bushfire Mitigation Plan (**BMP**), accepted by Energy Safe Victoria (**ESV**), establishes the use of fault tamers in lieu of EDO fuses.

2 Background

We maintain the asset on our network to ensure the network operates to our service standards and obligations, including obligations on reliability and safety. Our bushfire safety obligations that are relevant to this step change are described below.

Our maintenance expenditure forms part of our operating expenditure and includes expenditure related to repairing and maintaining network assets to maintain their useful life as well the replacement of HV fuses upon their operation.

2.1 Bushfire safety regulations

We operate and maintain our network in accordance with vegetation and asset management procedures that are consistent with industry best practices and approved by Energy Safe Victoria (**ESV**).

Every five years we submit our Electricity Safety Management Scheme (**ESMS**) to ESV for approval and every year we update our BMP with our updated asset management practices and investment plans to mitigate bushfire risk. ESV reviews and approves our ESMS and BMP, and also monitors our implementation of the plan. ESV accepted the latest version of our ESMS, on 12 December 2018,[1] and our BMP, on 09 December 2019.[2]

Our ESMS and BMP reflect our obligations under the Electricity Safety Act 1998 (**the Act**). Under the Act we have a duty to minimise bushfire risk as far as practicable. Section 98 of the Act requires us 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.*

2.2 Classification of bushfire risk areas

Approximately 51% of our network is classified as Hazardous Bushfire Risk Areas (**HBRA**). HBRAs have a higher risk of bushfire impacts compared to low bushfire risk areas (**LBRA**) due to the area's topography. We are required to inspect assets more often in the HBRAs due to the increased risk of bushfire.

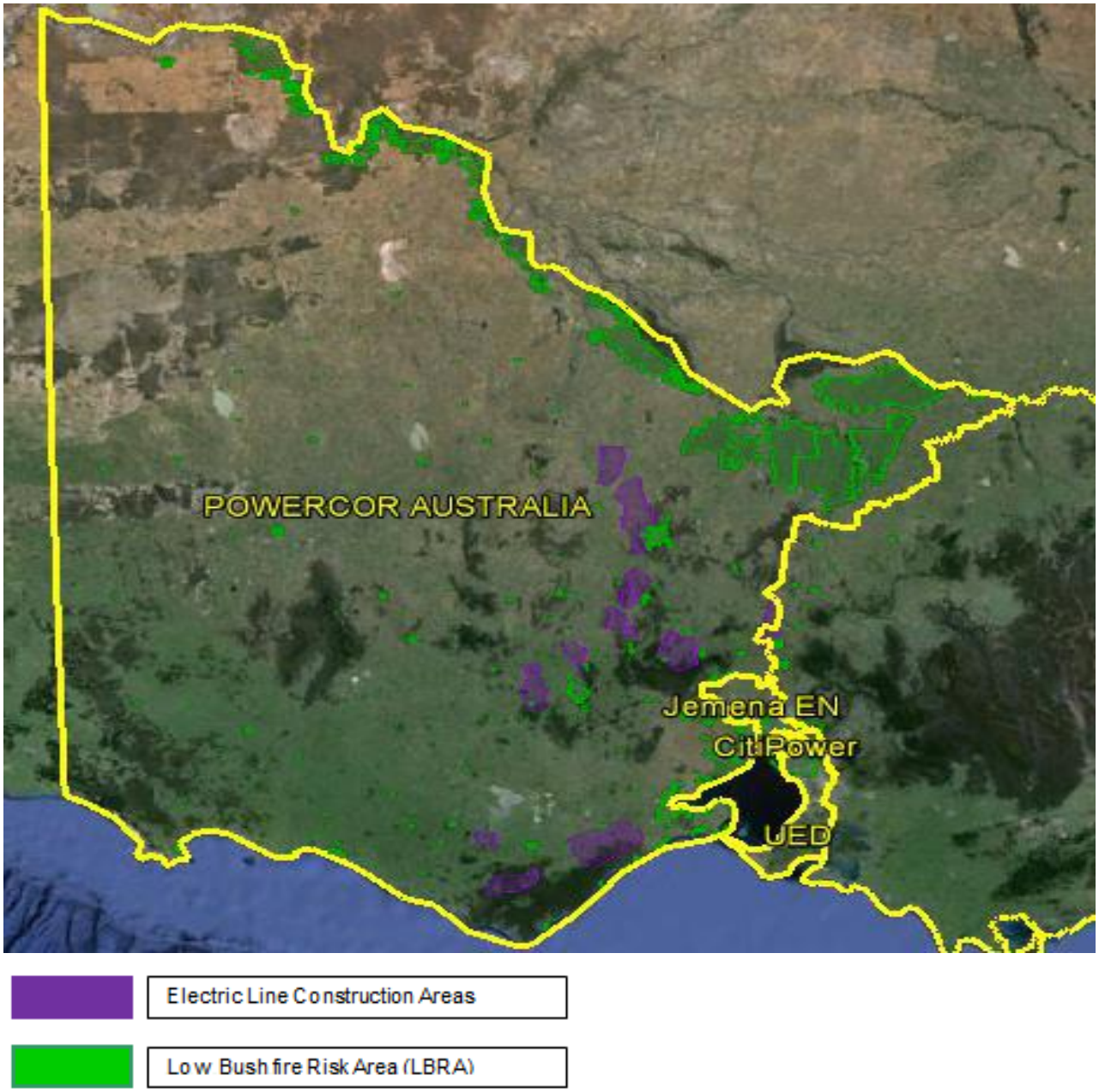
A subset of HBRAs is classified as Electric Line Construction Areas (**ELCA**) in the Electricity Safety (Bushfire Mitigation) Regulations 2013 (**Amended Bushfire Mitigation Regulations**), implemented in Victoria on 1 May 2016. ELCAs are considered to have a higher value of consequence from a potential fire compared to the remainder of HBRA, measured as the value of economic and social cost in an event of a major fire. As such, ELCAs have more stringent standards with regards to the construction of electric lines.

Figure 1 represents the ELCAs on our network.

[1] PAL ATT113 - Electricity safety management - Nov2019 - Public

[2] PAL ATT094 - Bushfire mitigation plan - Dec2019 - Public

Figure 1 ELCAs across our network



Source: Powercor

3 Identified need

The identified need is to reduce the risk of EDO fuses starting a bushfire as far as practicable, in accordance with the Act. We consider it is prudent and practical to reduce bushfire risk in cases where the net economic benefit of doing so is positive. We have identified an opportunity to reduce the risk of EDO fuses causing bushfires with a positive net economic benefit, by replacing a large number of EDO fuses with fault tamers.

3.1 EDO fuses and fault tamers

We currently use HV EDO fuses to protect the network in an event of fault. Table 2 summarised the existing population of EDO fuse sites on our network across HBRAs.

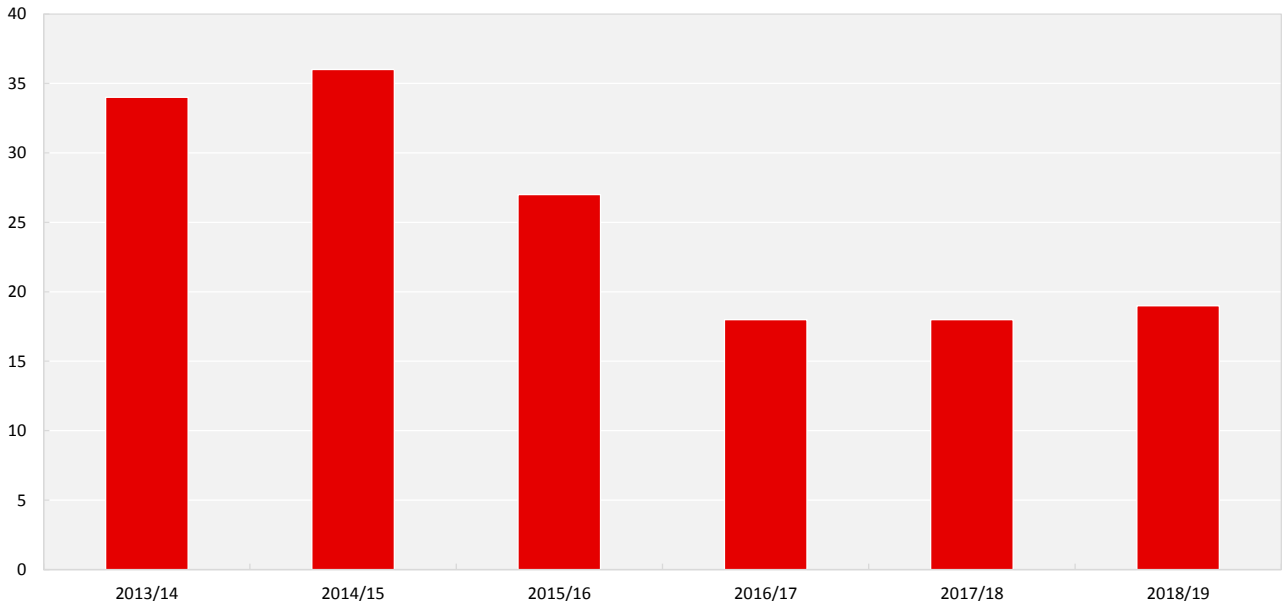
Table 2 Existing population of EDO fuse sites

	ELCAs	HBRAs other than ELCAs
Number of EDO fuse sites in 2019	5,069	60,931

Source: Powercor

When operating, EDOs can cause fire starts due to their inherent design—they can expel sparks upon operation which are in some cases not captured by the fire choke resulting in ground fires. Figure 2 demonstrates the number of fire starts from EDO fuses from July 2013 to June 2019.

Figure 2 Fire starts from EDO fuses, 2013–2019



Source: Powercor

3.1.1 Fault tamers

An alternative to an EDO fuse is a 'fault tamer' fuse. Fault tamers are newer fuse models, designed to operate without expelling hot materials—the fault tamer inherent design consists of a fully contained current limiting fuse element resulting in no expulsion and no spark emissions.

We currently install fault tamers for all new construction in HBRAs. However, we only replace existing EDO fuses with fault tamers on an ad-hoc basis and only a third of existing fuse mounts across the network are compatible with fault tamers. Fuses are generally mounted on poles with mounts that are specific to a certain type of fuse,

with only some mounts compatible with multiple fuse models. To date, we have installed around 3,000 fault tamers across our HBRAs.

3.1.2 Fault tamer application

Both EDO fuses and fault tamers are acceptable protection devices for use in HBRAs and ELCAs. However, use of fault tamers reflects industry best practice due to their superior inherent design and performance. Our latest BMP accepted by ESV establishes the use of superior protection solutions with regard to reducing fire risk, in lieu of EDO fuses.

4 Options analysis

We considered several options to address the identified need. These options address the identified need to varying extents—the preferred option is that which maximises net economic benefit.

As shown in table 3, the option that maximises the net economic benefit is option 3—proactive replacement of EDO fuses with fault tamers in ELCAs and replacement of EDO fuses with fault tamers in HBRAs (excluding ECLAs) as part of maintenance and repair.

Table 3 Options comparison ($ million, 2021)

	Option	Net economic benefit
Do nothing	Maintain status quo	0
2	Proactive replacement of all EDO fuses with fault tamers in ELCAs	116.7
3	Proactive replacement of all EDO fuses with fault tamers in ELCAs (as per option 2) and replacement of EDO fuses with fault tamers in HBRAs as part of maintenance and repair	204.5

Source: Powercor

4.1 Forecast method

4.1.1 Risk monetisation

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.[3]

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.

Our modelling assumes one failure mode—the EDO fuse sparks 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
- unserved energy during the outage caused by the fire
- f-factor penalty.

The probability of failure and consequence are estimated using our actual historical data from fire starts from EDO fuses.

- Some of the key assumptions in the economic assessment are set out in table 4. For more details on all assumptions and sources of information, refer to model PAL MOD 9.05 - EDO ELCAs risk - Jan2020 - Public.

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

Table 4 Key assumptions and sensitivities, per annum

Assumption	Metric
Fire starts from EDOs in ELCAs on TFB day (based on actuals on our network)	0.0007%
Fire starts from EDOs in HBRAs (excluding ELCAs) on TFB day (based on actuals on our network)	0.003%
Probability of an unsuppressed fire causes a catastrophic fire[4]	5%
Consequence of a catastrophic fire[5]	$400 million
Disproportionality factor	Range from 2 to 6, depending on the geographical area
Discount rate	AER real post-tax WACC: 2.75%

Source: Powercor

4.1.2 Unit cost of maintenance

We have forecast the cost of each option using our actual historical costs for labour and materials. Our unit rates are a blended rate of a fuse replacement, including a blend of replacement across single and multiple-phase assets, and a blend of replacement that include or exclude replacement of fuse mounts.

The material cost of the fault tamers is higher than EDO fuses. The installation cost of fault tamers tends to be higher than the installation of EDO fuses as a higher number of fuse mounts need to be replaced. The unit costs used are shown in table 5.

Table 5 Unit costs ($2021)

Description	Unit cost
Installation of EDO fuse	1,553
Installation of fault tamer	1,864

Source: Powercor

4.1.3 F-factor scheme impacts

We have estimated the expected f-factor benefit from each option using our actual f-factor data for 2016–2019. We estimated the potential f-factor penalty savings from removing all bushfire risk associated with existing EDO fuses using the actual penalties during 2016–2019. We then estimated the saving per removal of EDO fuse by dividing the total saving by the number of fuses on the network. Table 6 shows the metrics used in calculating the potential savings from the f-factor scheme.

[4] PAL ATT114

[5] PAL ATT114

Table 6 Assumptions used in calculating potential f-factor savings from each option, ($2021)

Assumption	Value
Total f-factor savings from removing all EDO fuses	$210,994
Total number of EDO fuse sites in all HBRA, including ELCAs	66,000
Potential annual f-factor saving per EDO fuse	$3.2

Source: Powercor

4.2 Assessment of credible options

4.2.1 Option 1—maintain status quo

Option 1 assumes no change to current practices, where the majority of EDO fuses are replaced like-for-like and fault tamers are installed as part of new construction. This option has no material incremental cost and there is no reduction to bushfire risk. This is reflected in zero net economic benefit of the option.

4.2.2 Option 2—proactive replacement of all EDO fuses with fault tamers in ELCAs

Under this option, we would proactively replace all EDO fuses in ELCAs with fault tamers over the 2021–2026 regulatory period.

A summary of the costs and economic benefit of option 2 are shown in table 7. The cost and benefit are measured as the net present value (**NPV**) over a 20 year period. This option has a positive net benefit, where:

- the cost of the option is the incremental operating cost of the replacement of the EDO fuses compared to the cost incurred in the 2019 year
- the benefit is the reduction in monetised risk of bushfires.
- For a detailed analysis of the NPV cost and benefit analysis refer to models PAL MOD 9.05 - EDO ELCAs risk - Jan2020 - Public and PAL MOD 9.01 - Step changes - Jan2020 - Public.

Table 7 Option 2 benefit assessment ($ million, 2021)

Option	NPV costs	NPV benefit	Net benefit
Proactive replacement of all EDO fuses with fault tamers in ELCAs	8.1	124.7	116.6

Source: Powercor

4.2.3 Option 3—option 2 and replacement of EDO fuses with fault tamers in HBRAs as part of maintenance and repair

Under this option, we would replace all EDO fuses in ELCAs and in HBRAs (excluding ELCAs) with fault tamers as part of our maintenance and repair program. This would lead to replacement of around 9,000 EDO fuses over the 2021–2026 regulatory period.

A summary of the costs and economic benefit of option 3 are shown in table 7. This option has a positive net benefit that is larger than the net benefit of option 2. For a detailed analysis of the NPV cost and benefit analysis refer to models PAL MOD 9.05 - EDO ELCAs risk - Jan2020 - Public, PAL MOD 9.06 - EDO HBRA risk - Jan2020 - Public and PAL MOD 9.01 - Step changes - Jan2020 - Public.

Table 8 Option 3 benefit assessment ($ million, 2021)

Option	NPV costs	NPV benefit	Net economic benefit
Proactive replacement of all EDO fuses with fault tamers in ELCAs (as per option 2) and replacement of EDO fuses with fault tamers in HBRAs as part of maintenance and repair	9.7	214.3	204.6

Source: Powercor

4.3 Sensitivity analysis

We have performed a sensitivity analysis of the impact on the ranking of the options from varying the percentage of EDO fuses that are replaced with fault tamers in ELCAs and other HBRAs. Specifically, we tested the impact of changing the probability of failure and the consequence of failure by a range from -15% to 75%.

Option 2 and option 3 delivered a net economic benefit under each of the scenarios and the ranking of the options based on the value of the net benefit remained the same under each scenario, with option 3 providing the highest net economic benefit.

5 Recommendation

We recommend option 3—proactive replacement of all EDO fuses with fault tamers in ELCAs and replacement of EDO fuses with fault tamers in HBRAs. This option delivers the highest net benefit to our customers and will result in the largest reduction in bushfire risk across our network, consistent with our obligations under the Act.

After conducting the options analysis we have updated our program of works to account for the change in maintenance with regard to EDO fuses, which is consistent with our ESV-accepted ESMS and BMP.

Table 9 summarises the incremental operating expenditure of the preferred option.

Table 9 Expenditure forecasts for preferred option ($ million, 2021)

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Incremental operating expenditure under option 3	2.18	2.21	2.24	2.26	2.29	11.18

Source: Powercor