REFCL Tranche 3 Program

Draft Project Assessment Report

July 2020

Contents

1 Overview

This draft project assessment report has been prepared in accordance with the Regulatory Investment Test for Distribution (**RIT-D**) requirements of the National Electricity Rules (**NER**) clause 5.17.4[1].

The purpose of this draft project assessment report is to consult on the credible options to address the identified need—namely, the requirement to comply with the amendments to the Electricity Safety (Bushfire Mitigation) Regulations 2013 (**Amended Bushfire Mitigation Regulations**)[2] which were implemented in Victoria on 1 May 2016 and specifically in relation to the "required capacity"[3] compliance obligation.

This scope of this report is the final Tranche 3 list of zone substations shown in Table 1 where an obligation exists to provide the "required capacity".

Table 1 Zone substations in scope

Tranche 3
• Corio (CRO)[4]
• Koroit (KRT)
• Stawell (STL)
• Hamilton (HTN)
• Merbein (MBN)
• Waurn Ponds (WPD)[4]
• Geelong (GL)[4]

Due to Rapid Earth Fault Current Limiters (**REFCLs**) being the only available technology to meet these requirements, we determined that there are no credible non-network options that could address the identified need. This determination is made under clause 5.17.4(c) and (d) of the NER. This determination was published in accordance with clause 5.17.4(d) on 29 July 2019 and no responses were received regarding this determination. In accordance with these provisions, we will not publish a non-network options report in relation to the proposed network need for Tranche 3 zone substations and will proceed with the draft project assessment.

Each site or group of sites has been separately assessed in this report to allow consideration of specific issues at each location. The preferred option to meet the identified need for each zone substation is summarised in section 5 of this report and the detailed analysis is presented in the relevant appendix.

The preferred option for each site has been selected to maximise net economic benefit in accordance with clause 5.17.1(b) of the NER.

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1 Version 142 of the Rules, clause 5.17.4.

2 Electricity Safety (Bushfire Mitigation) Regulations 2013 (Vic) was amended in 2016 by the Electricity Safety (Bushfire Mitigation) Amendment Regulations, 2016.

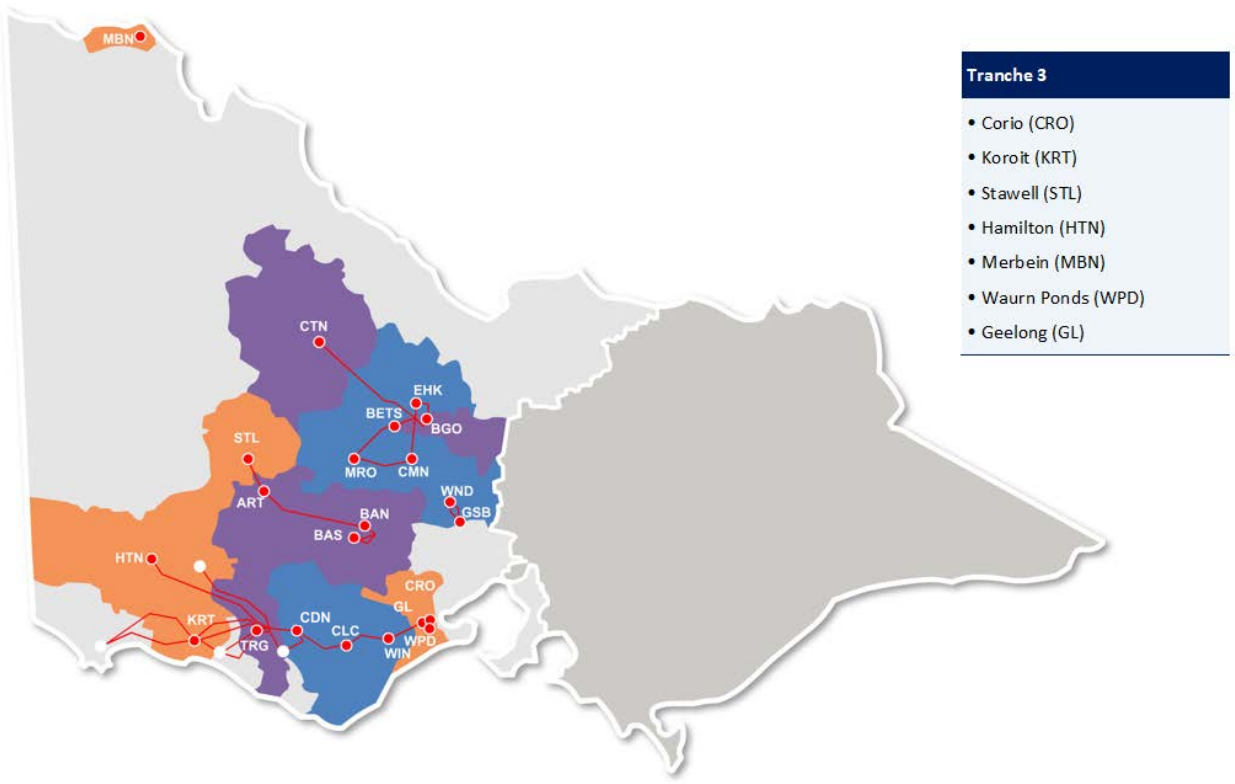
3 Electricity Safety (Bushfire Mitigation) Regulations 2013 (VIC), Definitions

4 Regulatory funding proposals will be included in the 2021-2026 regulatory proposal submission for these sites. The previous approval for Geelong will be adjusted based on the outcome of the AER review of the revised proposal for this site.

We now seek further feedback from stakeholders including registered participants, the Australian Energy Market Operator (**AEMO**), non-network providers, interested parties and persons on our demand side engagement register. Submissions are due by **4 September 2020**.

We will consider all submissions received in response to this draft project assessment report before preparing a final project assessment report.

Figure 1 **Tranche 3 zone substations**



2 Background

2.1 Victorian Bushfire Royal Commission

Following the Black Saturday bushfires in 2009, the Victorian Government established the Victorian Bushfire Royal Commission (**VBRC**) to consider how bushfires can be better prevented and managed in the future. In July 2010, the VBRC's final report was provided to the Victorian Government.

The VBRC's final report made several recommendations, including the following[5]:

> [*t]he State amend the Regulations under Victoria's Electricity Safety Act 1998 and otherwise take such steps as may be required to give effect to the following:*
>
> *– the progressive replacement of all SWER (single-wire earth return) power lines in Victoria with aerial bundled cable, underground cabling or other technology that delivers greatly reduced bushfire risk.*
>
> *– the progressive replacement of all 22-kilovolt distribution feeders with aerial bundled cable, underground cabling or other technology that delivers greatly reduced bushfire risk as the feeders reach the end of their engineering lives.*

2.2 Powerline Bushfire Safety Taskforce

As part of the Victorian Government's consideration of the recommendations made by the VBRC in its final report, the Powerline Bushfire Safety Taskforce (**PBST**) was established. The PBST was required to investigate new cost efficient and effective technologies and operational practices to reduce catastrophic bushfire risk.

The PBST identified REFCLs installed in zone substations as an efficient and effective technology. A REFCL is a network protection device, normally installed in a zone substation, that can reduce the risk of a fallen powerline causing a fire-start. It is capable of detecting when a powerline has fallen to the ground and (almost instantaneously) reduces the voltage on the fallen line to a point where the energy discharge is unlikely to initiate a fire. Further information on REFCLs is provided in section 4 of this report.

A REFCL will not provide a risk mitigation benefit in all scenarios however the PBST estimated the relative reduction in the likelihood of multi-phase powerlines starting bushfires to be approximately 70 per cent with the installation of REFCLs[6].

2.3 Amended Bushfire Mitigation Regulations

On 1 May 2016, the Victorian Government amended the Electricity Safety (Bushfire Mitigation) Regulation 2013 with the introduction of the Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016 (**Amended Bushfire Mitigation Regulations**)—to implement the PBST's findings.

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 each polyphase electric line originating from selected zone substations in our network meets "specified capacity"[7] requirements.

The Amended Bushfire Mitigation Regulations further specify the timeframes by which the selected zone substations must meet these capacity requirements.

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5 2009 Victorian Bushfires Royal Commission, Final Report, Summary, July 2010, recommendation 27

6 Powerline Bushfire Safety Taskforce, Final report, 30 September 2011, p. 5

7 Electricity Safety (Bushfire Mitigation) Regulations 2013 amended by Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016 - Section 5 Definitions for "required capacity"

2.4 Bushfire Mitigation Civil Penalties Scheme

On 16 May 2017, the Victorian Government introduced the Bushfire Mitigation Civil Penalties Scheme via an amendment to the Electricity Safety Act 1998. The scheme includes financial penalties of up to $2 million per point for any difference between the total number of required substation points prescribed in the Amended Bushfire Mitigation Regulations and that achieved. The scheme also includes a daily penalty up to $5,500 per point for each day that a contravention with the Amended Bushfire Mitigation Regulations continues.

3 Project need

3.1 Detailed legislative obligations

The amendments to the Electrical Safety (Bushfire Mitigation) Regulations 2013[8] described in section 2 of this report introduced new technical obligations on the Victorian Distribution Network Service Providers (**DNSPs**) (Powercor, AusNet Services and Jemena) that operate in high risk bushfire areas.

These obligations include:

- each polyphase electric line originating from a listed zone substation must have the "required capacity" specified in the Amended Bushfire Mitigation Regulations
- testing for the "required capacity" must be undertaken before the specified bushfire risk period each year and a report detailing the results of testing submitted to Energy Safe Victoria (**ESV**)
- each new or replaced line with a nominal voltage from 1 kV to 22 kV inclusive must be covered or undergrounded from 1 May 2016 in 33 prescribed electric line construction areas
- each Single Wire Earth Return (**SWER**) line must have an Automatic Circuit Recloser (**ACR**) installed by 1 May 2023.

Schedule 2 of the legislation defines 22 selected zone substations in the Powercor area and assigns a point value to each site based on the level of bushfire risk. Powercor must meet the "required capacity" obligations for selected zone substations where:

- at 1 May 2019, the points set out in schedule two of the Amended Bushfire Mitigation Regulations in relation to each zone substation upgraded, when totalled, are not less than 30
- at 1 May 2021, the points set out in schedule two in relation to each zone substation upgraded, when totalled, are not less than 55
- on and from 1 May 2023, in our supply network, each polyphase electric line originating from every zone substation specified in schedule two has the "required capacity".

The "required capacity" for a polyphase line originating from a selected zone substation is defined by the legislation[9] as:

> *'…in the event of a phase-to-ground fault on a polyphase electric line, the ability—*
>
> *(a) to reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for high impedance fault to 250 volts within 2 seconds; and*
>
> *(b) to reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for low impedance faults to—*
>
> *(i) 1900 volts within 85 milliseconds; and*
>
> *(ii) 750 volts within 500 milliseconds; and*
>
> *(iii) 250 volts within 2 seconds; and*
>
> *(c) during diagnostic tests for high impedance faults, to limit—*
>
> *(i) fault current to 0.5 amps or less; and*
>
> *(ii) the thermal energy on the electric line to a maximum I^2t value of 0.10'*

[8] Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016

[9] Electricity Safety (Bushfire Mitigation) Regulations 2013 (VIC), Definitions

3.2 Program tranches

Three tranches were defined as shown in Figure 2 to meet the three milestone date obligations and associated point requirements as detailed above.

Contingent project funding applications

Each tranche has been included as a contingent project in the 2016-2020 regulatory period due to the uncertainty regarding specific regulatory requirements at the time the determination was made. Separate applications for contingent funding have been made to the Australian Energy Regulator (**AER**) for each tranche.

Figure 2 Contingent Project Application Tranches

Tranche 1	Tranche 2	Tranche 3
• Gisborne (GSB)[10]	• Bendigo TS (BETS)	• Corio (CRO)
• Woodend (WND)[11]	• Charlton (CTN)	• Koroit (KRT)
• Camperdown (CDN)	• Bendigo (BGO)	• Stawell (STL)
• Colac (CLC)	• Ballarat South (BAS)	• Hamilton (HTN)
• Castlemaine (CMN)	• Ballarat North (BAN)	• Merbein (MBN)
• Maryborough (MRO)	• Geelong (GL)	• Waurn Ponds (WPD)[12]
• Winchelsea (WIN)		• Terang (TRG)
• Eaglehawk (EHK)		• Ararat (ART)

Source: Powercor

Powercor made an application for contingent project funding to the AER for Tranche 1 on 28 March 2017. The AER released a final decision on 21 August 2017 and approved the application with modifications to the amounts sought by Powercor.

Powercor made an application for contingent project funding to the AER for Tranche 2 on 2 April 2018. The AER released a final decision on 31 August 2018 and approved the application with modifications to the amounts sought by Powercor.

Powercor made an application for contingent project funding to the AER for Tranche 3 on 22 August 2019. The AER released a final decision on 13 January 2020 and approved the application with modifications to the scope and amounts sought by Powercor. In particular Corio zone substation was excluded from the approval and its funding was deferred for consideration as part of Powercor's 2021-2026 regulatory proposal process.

Amended Delivery Program

The delivery program for the deployment of REFCLs has been amended during the current regulatory period. The planned installation of a REFCL at the Geelong zone substation (which was contained within our second contingent project application) has been delayed and the timeframe for the Terang and Ararat zone substations

[10] Gisborne and Woodend were not included in our first contingent project application to the AER. Rather they were funded as REFCL trial sites through the AER's 2016–2020 distribution determination for Powercor.

[11] See footnote above.

[12] Waurn Ponds zone substation was not included in the Tranche 3 contingent project application and will be included in the 2021-2026 regulatory proposal submission.

accelerated to ensure that we can achieve the requisite points by 1 May 2021, as set out in the Amended Bushfire Mitigation Regulations.

The changes to the prioritisation of the installation of REFCLs in zone substations, as shown below in Figure 3, is reflected in the currently-accepted revision of our bushfire mitigation plan.[13]

The changes in the program reflect our experience with deploying REFCLs to date, efficiencies in delivery and site-specific challenges. The AER's final decision provided us with the flexibility to dynamically adjust our program of work if the locations to be treated were subject to a change in priority over the course of the regulatory period. The AER noted that the mechanism for determining a change in priority is through amendment of the BMP.[14]

Figure 3 Amended delivery program tranches

Tranche 1	Tranche 2	Tranche 3
• Gisborne (GSB)	• Bendigo TS (BETS)	• Corio (CRO)[15]
• Woodend (WND)	• Charlton (CTN)	• Koroit (KRT)
• Camperdown (CDN)	• Bendigo (BGO)	• Stawell (STL)
• Colac (CLC)	• Ballarat South (BAS)	• Hamilton (HTN)
• Castlemaine (CMN)	• Ballarat North (BAN)	• Merbein (MBN)
• Maryborough (MRO)	• Terang (TRG)	• Waurn Ponds (WPD)[15]
• Winchelsea (WIN)	• Ararat (ART)	• Geelong (GL)[15]
• Eaglehawk (EHK)		

Source: Powercor

Work associated with delivery of sites in Tranche 1 is complete. Tranche 2 is under construction and is planned for completion by February 2021.

3.3 RIT-D scope and project need

The scope of this RIT-D Draft Project Assessment Report is the zone substations listed in Tranche 3 of the delivery program and shown in Figure 3.

The project need is to ensure the requirements of the Amended Bushfire Mitigation Regulations are met with the work needed to implement the “required capacity” being complete and operational by 1 May 2023.

This requirement is a mandatory legislated obligation where non-compliance will expose us to penalties as defined in the Bushfire Mitigation Civil Penalties Scheme.

[13] Powercor, Bushfire Mitigation Plan, Revision 8.2 June 2020.

[14] AER, Final decision, Powercor distribution determination 2016 to 2020, Attachment 6 – Capital expenditure, May 2016, p. 6–142.

[15] Regulatory funding proposals will be included in the 2021-2026 regulatory proposal submission for these sites. The previous approval for Geelong will be adjusted based on the outcome of the AER review of the revised proposal for this site.

3.4 Legislated exemption for Corio and Geelong zone substations

In December 2019, we made an application to ESV for an exemption so that Corio and Geelong zone substations would not be required to meet the "required capacity" obligation if nominated bushfire risk feeders are transferred to a new substation that meets the "required capacity" obligation.

The objective of the proposal was to provide scope to implement a more cost-effective solution for our customers over the longer term. In particular, our planning teams had identified demand growth in the north western Geelong region driven by new residential and commercial load. As such, we had earmarked a zone substation in the vicinity of Bannockburn by 2030. An alternative complying zone substation would therefore serve dual purposes – bringing forward future planned work where the driver is demand, and meet our short-term compliance obligations to reduce the risk of our assets contributing to a fire start in high bushfire risk areas.

A conditional exemption was granted through an Order in Council issued under Section 120W of the Electricity Safety Act 1998 and documented in the Victorian Government Gazette on 28 May 2020.[16]

This report includes information on the consideration of options in regard to meeting the project need, with and without application of the exemption, to identify the most efficient option.

[16] Orders in Council Exemption Order Under Section 120W of the Electricity Safety Act 1998 – 1014 G21

4 Rapid Earth Fault Current Limiters

4.1 Overview

The PBST identified REFCLs installed in zone substations as an efficient and effective technology. At present the only way to achieve the "required capacity" technical obligations specified in the Amended Bushfire Mitigation Regulations is by installing a REFCL.[17]

REFCLs can detect single phase-to earth faults almost instantaneously. The voltage on the faulted phase conductor is reduced to nominal earth potential within milliseconds of an earth fault condition limiting the fault current and energy release to below the point where it is likely to start a fire.

A REFCL does not provide protection for overhead line faults in the following situations:

- 22kV phase to phase faults
- faults on Single Wire Earth Return (**SWER**) feeders
- faults on sub-transmission feeders.

Where an earth fault is present on one phase, the phase-to-ground voltage on the remaining two phases will be increased by 73% above normal levels until the circuit is interrupted. Consequently, existing equipment in the network or in a customer's high voltage (HV) installation which is not rated to operate at the elevated voltages will need to be replaced or isolated as part of the REFCL implementation project to ensure the safe and functional operation of the electricity network.

There are a number of aspects that need consideration in the design and implementation of REFCL protection at a zone substation. In addition to the installation of equipment at the zone substation there is also considerable expense associated with configuring and hardening the electricity distribution network to allow effective operation of the REFCL protection. Specific work required to deal with these issues will vary due to specific situations at each location, key issues are detailed in section 4.3 below.

4.2 Implementation experience

The implementation of REFCLs is a new development in Australia and internationally. We continue to develop our understanding in regard to the deployment and operation of REFCLs from our trials at Woodend and Gisborne and the remainder of tranche one and tranche two projects.

This experience has helped demonstrate how operating a REFCL may impact our overall network, with a particular focus on surrounding system resilience, capacitive balancing, and operational matters. Our experience has also highlighted the engineering issues that need to be considered in implementing REFCLs to meet the "required capacity". A summary of important learnings from the initial implementation sites are listed below:

- achieving performance requirements may necessitate multiple REFCL units at particular zone substations
- the capacitive charging current of the network being protected should be kept to within 81 – 108A
- only selected surge arrestor types require replacement
- only selected Automatic Circuit Reclosers (ACRs) require replacement

[17] As acknowledged by the Powerline Bushfire Safety Taskforce (PBST) in the Response to PBST 2011, https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/reports-and-consultationpapers/response-to-pbst

- only selected switchgear requires replacement
- a multi-faceted approach to capacitive balancing is required to ensure a cost-effective means of meeting our performance and fault detection requirements
- the approach to balancing should be more dynamic to maintain the ability to switch and operate the network in a safe, efficient and reliable manner
- a number of existing assets appear resilient to the operation of a REFCL (e.g. high voltage insulators and distribution transformers)
- existing instrumentation transformers are often of insufficient capacity
- network augmentation can pose a risk to REFCL sensitivity
- pre-testing of the resilience of assets to withstand the operation of the REFCL is required
- underground cable specifications need to be reviewed with cable replacement required for cable with insufficient capacity for expected elevated voltages
- the greater the distance from the zone substation to any underground cable increases the damping and total charging current requirements for the zone substation, thereby increasing the number of REFCLs required.

4.3 Engineering implementation works

The implementation of a REFCL generally involves elements of work to be completed at the zone substation, within the distribution network and at HV customer sites.

At the zone substation the work involves installing equipment associated with the REFCL, upgrading existing equipment to support REFCL operation (e.g. station power supply and protection equipment), modifying earthing arrangements and hardening equipment intolerant to overvoltage caused by REFCL operation. Where space limitations exist then reconfiguration of the site or acquiring adjacent land may also be required.

The distribution network requires capacitive balancing, replacement of equipment intolerant to overvoltage and the installation of equipment to support REFCL operation. The cost of this aspect of work is material.

HV customers also require equipment to be replaced or isolated where existing equipment is not rated to the expected higher voltages from REFCL operation. An ACR will also be required for each HV customer connection point to provide a point of isolation. Where a customer has onsite generation then neutral displacement protection is required to avoid islanding.

Each site is subject to detailed analysis and engineering assessment to define a scope of works to ensure the functional outcomes are achieved at the lowest practical cost.

A detailed list of work scope items typically required depending on the site is detailed in Appendix D.

5 Assessment summary

5.1 Waurn Ponds zone substation

The detailed assessment of options to address the identified need for Waurn Ponds Zone Substation is presented in Appendix A.

The preferred option for Waurn Ponds zone substation is shown in table 2 . This option meets the identified need at the lowest cost and maximises the net economic benefit through reliability improvement.

Table 2 Preferred option ($ million, 2021)

Preferred option description	Annual OPEX Cost	PV CAPEX Cost
Install three REFCLs at Waurn Ponds zone substation with six isolating substations, and establish Torquay zone substation with two REFCLs and three isolating substations – Forecast completion date November 2022. The scope of work includes: • install three REFCLs at WPD zone substation • build two 66kV line bays and three new 66kV circuit breakers installed in the bus ring, relocate one 66kV breaker • install six isolating substations on the WPD feeder network • build a new TQY zone substation with two 25/33MVA transformers, four 22kV feeders, 66kV line bays and two REFCLs • install one new four x 3MVar capacitor bank • install three isolating substations on the TQY feeder network • harden 22kV feeders and HV customer sites to allow for REFCL operation To address the reliability issues in the Surf Coast area, load would be transferred from the overloaded WPD zone substation to the new TQY zone substation	$0.74	$73.5

5.2 Corio and Geelong zone substations

The detailed assessment of options to address the identified need for Corio and Geelong zone substations is presented in Appendix B.

The preferred option for Corio and Geelong zone substations is shown in table 3. This option meets the identified need and is the most cost-efficient option.

Table 3 Preferred option ($ million, 2021)

Preferred option description	Annual OPEX Cost	PV CAPEX Cost
Construct new Gheringhap (GHP) zone substation with two 25/33MVA transformers, two REFCLs and one isolating substation – Forecast completion date February 2023. The scope of work includes: • purchase suitable land for the new zone substation • install two new 25/33 MVA transformers along with two 22kV busses, and two REFCLs, at the new GHP zone Substation • extend the 66kV sub-transmission lines to connect GHP into the existing 66kV loop between Geelong Terminal station (**GTS**) and Corio (**CRO**) and Ford Norlane (**FDN**) • reconfigure 22kV feeders to connect the bushfire risk supply areas as specified in the Order in Council onto GHP from the current CRO and GL Zone Substations • network hardening of the 22kV feeder sections transferred from CRO and GL to GHP • construct a 6MVA isolation substation to isolate an underground section of GL021 in the Highton area	$0.53	$52.80

5.3 Koroit - Stawell – Hamilton - Merbein Zone Substations

The detailed assessment of options to address the identified need is presented in Appendix C. The installation of REFCLs was the only identified option with no other option being commercially and technically feasible that could be implemented in sufficient time to meet the identified need. There are no complicating issues or opportunities associated with adjoining zone substations or other reliability or load issues requiring resolution, consequently no other options were identified for consideration.

The preferred option for each site that meets the identified need and is the most efficient option is shown in Table 4 .

Table 4 Preferred option ($ million, 2021)

Preferred Option Description		Annual OPEX Cost	PV CAPEX Cost
Koroit zone Substation	Install one REFCL and complete associated network hardening and REFCL compatibility reconfiguration – Forecast Completion Date February 2021	$0.22	$21.7

Preferred Option	Description	Annual OPEX Cost	PV CAPEX Cost
Stawell zone substation	Install one REFCL and complete associated network hardening and REFCL compatibility reconfiguration – Forecast completion date November 2021	$0.23	$22.83
Hamilton zone substation	Install two REFCLs and complete associated network hardening and REFCL compatibility reconfiguration – Forecast completion date March 2022	$0.31	$31.07
Merbein zone substation	Install one REFCL and complete associated network hardening and REFCL compatibility reconfiguration – Forecast completion date November 2021	$0.25	$24.87

6 Satisfaction of RIT-D

The proposed preferred option for each site as summarised in Section 5, satisfies the RIT-D. This statement is made based on the detailed analysis set out in this report. For each site in Tranche 3, the proposed preferred option is the credible option that meets the project need with the expected highest net economic benefit. Given the mandatory nature of the project need, in some cases the highest net economic benefit is achieved by selecting the option with the lowest overall cost.

7 Lodging a submission

We invite written submissions on the preferred solution identified in this report from any interested parties. Our aim is to develop the distribution network in a manner that maximises net economic benefits to all those who produce, consume and transport electricity in the National Electricity Market. We welcome submissions that may assist in this regard.

Submissions can be provided electronically to the email address provided below:

ritdenquiries@powercor.com.au

Alternatively, submissions may be lodged by mail to the following address:

Andrew Bailey

REFCL Technical Director

CitiPower and Powercor

Locked Bag 14090 Melbourne Vic 8001.

Submissions may be published on our website. If you do not want your submission to be published, please state this at the time of lodgement.

All submissions are due on or before 17:00 on 4 September 2020.

Following our review of any submissions made, the option chosen to address the identified need will be set out in the final project assessment report. That report will represent the final stage of the RIT-D assessment process.

We intend to complete our review of submissions and the selection of the final project assessment report by 31 December 2020.

8 APPENDIX

A Waurn Ponds zone substation Detailed RIT-D Draft Project Assessment

B Corio and Geelong zone substations Detailed RIT-D Draft Project Assessment

C Koroit – Stawell – Hamilton – Merbein zone substations Detailed RIT-D Draft Project Assessment

D Engineering works for RECFL implementation

E Glossary of terms

A Waurn Ponds zone substation

Detailed RIT-D Draft Project Assessment

A.1 Overview

The scope of this section is to present required information for the draft project assessment report that is prepared in accordance with the Regulatory Investment Test for Distribution requirements of the National Electricity Rules for the network need identified at Waurn Ponds zone substation.

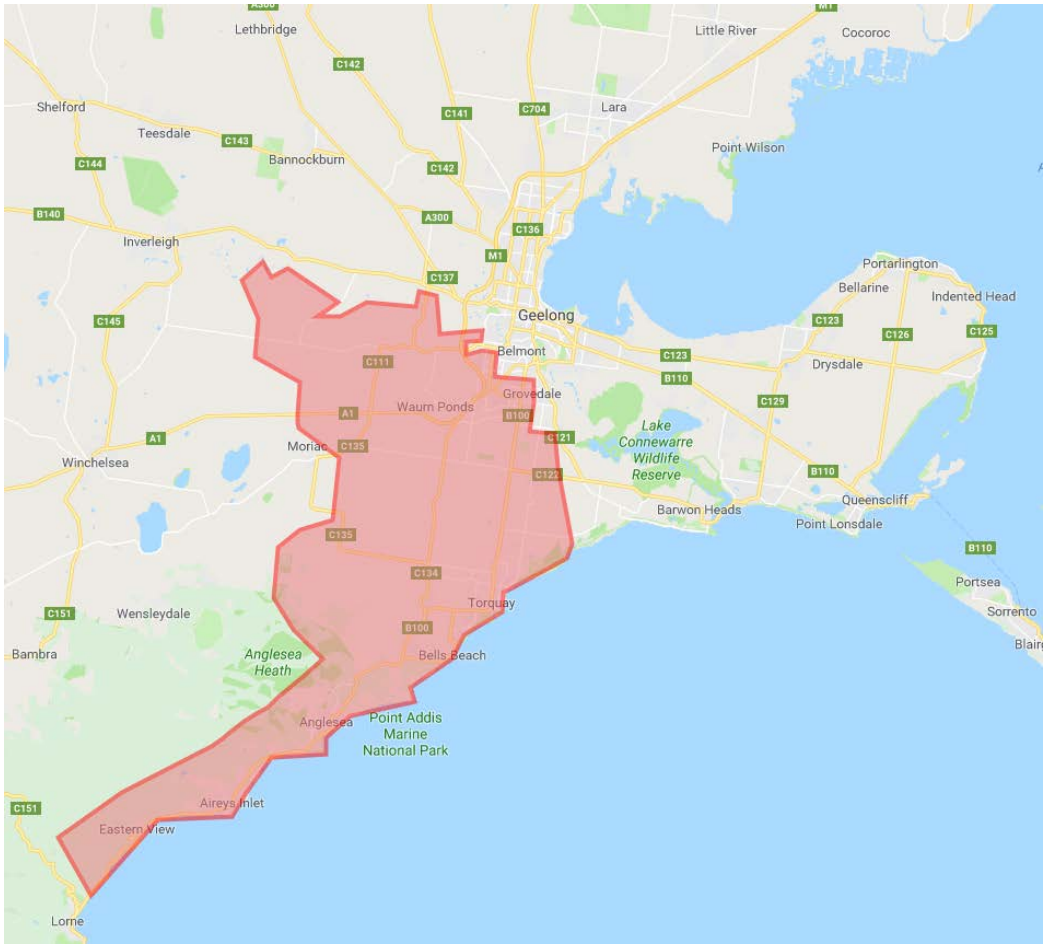
Waurn Ponds zone substation is listed in Schedule 2 of the Amended Bushfire Mitigation Regulations where we must meet the "required capacity" obligations. In addition to meeting this requirement there is also need to consider forecast non-compliance with voltage standards and increasing load at risk due to load growth.

The RIT-D assessment for this site is documented in Appendix A in combination with information contained in the main body of this report.

A.2 Background

Waurn Ponds zone substation supplies electricity to 35,973 customers in the residential, commercial and holiday home areas of Greater Geelong and the Surf Coast Shire. It supplies the southern Geelong suburbs of Waurn Ponds, Grovedale, Belmont and Highton, as well as customers in the towns of Torquay, Jan Juc, Anglesea and Lorne. A map of the WPD supply area is shown in Figure A1.

Figure A1 Waurn Ponds zone substation Supply Area



Source: Powercor

The major high voltage customers supplied from WPD zone substation are Deakin University and Barwon Water. Over the next 20 years, significant new load is also expected to be supplied from WPD zone substation, as 22,000 new land lots are developed in the Armstrong Creek area.

A.2.1 Existing network characteristics

WPD zone substation comprises one 13.5 MVA 66/22kV and two 33 MVA 66/22kV transformers supplying the 22kV buses. The zone substation is a fully switched configuration so that, in the event of a transformer fault, one transformer will be isolated, and the remaining units will continue to supply the station load. WPD zone substation has electrical connectivity (distribution ties) with the four adjacent zone substations of Colac (**CLC**), Geelong (**GL**), Geelong City (**GCY**) and Geelong East (**GLE**).

WPD zone substation supplies ten 22kV distribution feeders. These feeders support a mix of urban and rural residential customers, light industry and commercial loads. Due to the increasing demand on the WPD distribution feeders, only limited transfers are available to provide load relief for WPD zone substation under emergency outage conditions.

A.2.2 Voltage issues at WPD

Clause 4.2 of the Victorian Electricity Distribution Code[18] (**Distribution Code**) prescribes voltage standards that must be met by a distributor. Specifically, clause 4.2.2 relates to allowed variations from the standard nominal voltage level (specified in clause 4.2.1 of the Code) that the distributor is required to maintain at the point of supply to a customer's electrical installation. It is noted that the phase-to-earth voltage variations on the 22kV network do not apply when a REFCL is operating, per clause 4.2.2A of the Distribution Code.

Our analysis shows that, in the absence of mitigating action, the WPD 22kV distribution feeders supplying the Surf Coast areas including Torquay would not meet the above voltage standards from 2025 onwards, based on projected load growth. In addition to meeting our compliance obligations in relation to the installation of REFCLs, we must also ensure that it plans to operate within the voltage variations specified in the Distribution Code.

A.2.3 Forecast demand

The WPD zone substation is a summer critical zone substation. Our maximum demand forecasts indicate an annual average compound growth rate of 3.0% in the WPD supply area up to 2028. Whilst this projected growth is significantly above the average for our network, it is relatively conservative given the characteristics and demographics of the Surf Coast supply area.

In particular, the projected growth in electricity demand is driven primarily by rapid population growth in both the Surf Coast and Armstrong Creek areas. For example, a report by the Surf Coast Shire[19] forecasts annual population growth of over 3.3% during the 2021–2026 period for the Torquay area. Significant new loads are also expected as 22,000 new land lots are developed in the Armstrong Creek urban growth corridor. Our projected growth in electricity demand is in line with historical growth rates, which have substantially exceeded average growth across the State.

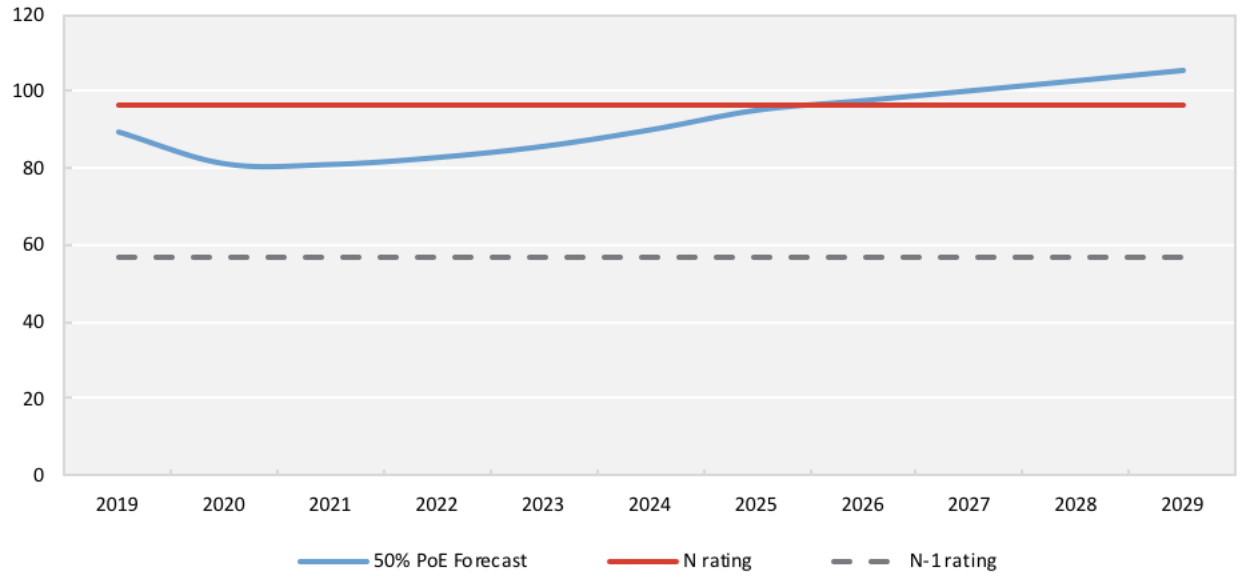
[18] Electricity Distribution Code April 2020 Version 11, Essential Services Commission

[19] PAL ATT242: Surf Coast Shire, Economic Insights, 2018.

Zone substation Maximum Demand

WPD zone substation is currently operating above its (**N-1**) summer cyclic rating. Forecast demand is expected to continue to exceed its summer N-1 cyclic capacity at a 50% probability of exceedance (**PoE**)[20]. By 2026, however, WPD zone substation is forecast to exceed its N cyclic rating, as shown in the Figure A2 below.

Figure A2 Waurn Ponds zone substation maximum demand at 50% probability of exceedance (MVA)



Source: Powercor

In light of this situation, without mitigating action, our customers' load requirements would not be met from 2026 onwards. We note that such an outcome would be inconsistent with our Distribution Code obligations to meet our customers' reasonable expectations of a reliable electricity supply.

As detailed in Table A1 below, our analysis shows the value of expected unserved energy at WPD zone substation in the absence of any mitigating action.

Table A1 Value of expected unserved energy at WPD ($ million, 2021)

	2021	2022	2023	2024	2025	2026	2027
Value of expected unserved energy	0.11	0.26	0.45	0.94	1.72	1.94	2.60

Source: Powercor

The amount of energy at risk for a transformer failure at WPD zone substation is relatively high due to the high demand on the zone substation. WPD has a plant protection scheme in place due to this high demand. Under this scheme, if the load on the WPD zone substation is above the ratings of the other two transformers after a

[20] The 50% PoE demand forecast relates to maximum demand corresponding to an average maximum temperature that will be exceeded, on average, once every two years.

transformer failure, load shedding of distribution feeders will take place. A significant number of connected customers will be without supply until load transfers are established.

When the available load transfer capability is insufficient to supply the total connected demand, the reliability risks increase as the customers will remain without supply until either:

- load transfers become available;
- the total connected demand reduces below the station ratings; or
- a replacement transformer can be installed.

While the probability of a transformer failure is low, the energy at risk for such an event is high because customers may be affected for an extended period of time.

Feeder utilisation

Consistent with our planning policies, we review both thermal and planning capacity constraints when assessing feeder utilisation. Distribution feeders can be operated above their planning capacity, although this reduces operational flexibility as loads cannot be transferred under contingency conditions. Distribution feeders, however, are not designed to exceed their thermal capacity rating.

The thermal ratings of the 22kV distribution feeders to the Surf Coast areas are forecast to approach their thermal ratings by 2025, as shown in Table A2 below.

Table A2 22kV distribution feeder forecasts to the Surf Coast areas in 2025: thermal capacity constraints

Feeder	Forecast Load (50% POE)	Thermal Rating	Load % of Rating
WPD14	286 A	320 A	89%
WPD21	303 A	320 A	95%
WPD22	306 A	320 A	96%
WPD24	311 A	315 A	99%
WPD32	307 A	315 A	98%

Source: Powercor

Each of the 22kV distribution feeders to the Surf Coast areas are forecast to exceed their planning ratings by 2023, and in 2025 are forecast to be more than 110% overloaded as shown below in Table A3.

Table A3 22kV distribution feeder forecasts to the Surf Coast areas in 2025 planning capacity constraints

Feeder	Forecast Load (50% POE)	Planning Rating	Load % of Rating
WPD14	286 A	256 A	112%
WPD21	303 A	256 A	118%
WPD22	306 A	256 A	119%
WPD24	311 A	252 A	123%
WPD32	307 A	252 A	122%

Source: Powercor

A.2.4 Network capacitance forecast

The total network capacitance is a fundamental factor in determining the scope of work required for the installation of REFCLs. At this time REFCLs are the only available technology to meet the the requirements of the Amended Bushfire Mitigation Regulations to implement the "required capacity". Consequently, this forecast is critical to determining the scope of options available to address the identified need.

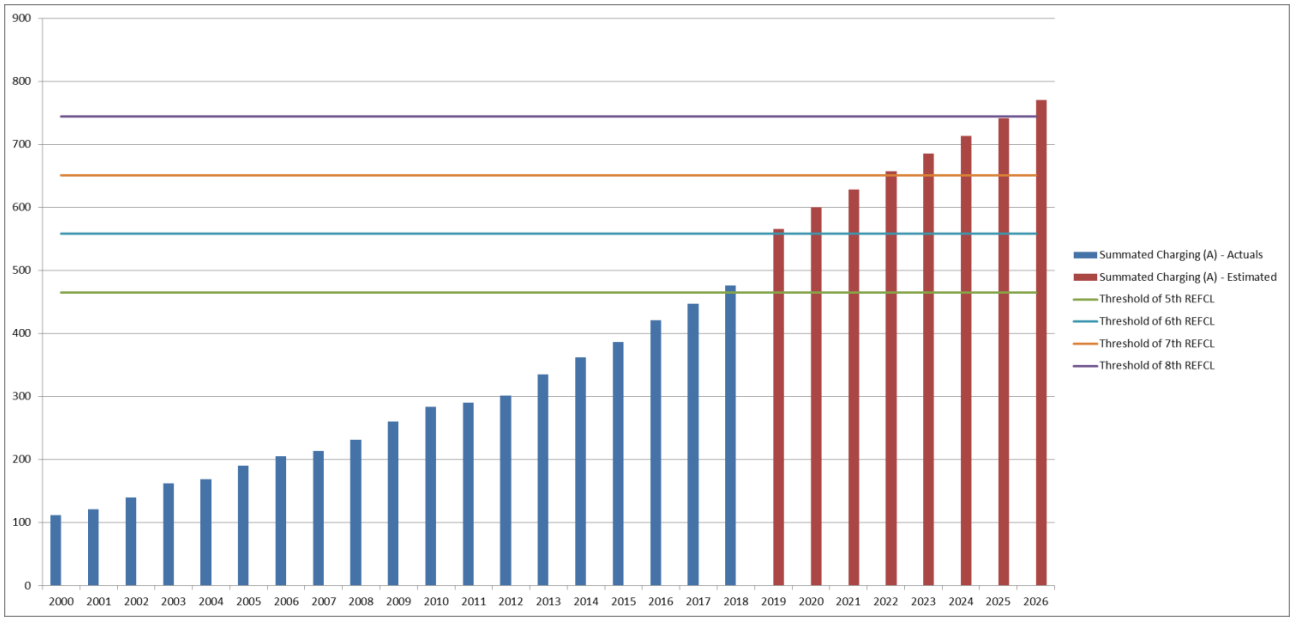
For Waurn Ponds zone substation, there is presently 616km of overhead line and 129km of underground cable for an estimated network capacitance of 494 amps requiring six REFCLs. However, we also need to take account of forecast increases in network capacitance, particularly given the significant underground cable growth, which is driven by development in the Armstrong Creek area.

Network capacitance forecasts have been developed to 2026 by applying a growth rate based on the previous five year's average annual growth in network capacitance. One off programs of work, such as the undergrounding of overhead networks as part of the VBRC Powerline Replacement Program, are removed from the growth rate calculations. Any forecast works for these one-off programs are factored into the network capacitance forecasts to reflect the forecast year of completion. The 2019 network capacitance forecast was developed by using the available actual data for 2019, including all proposed works that have not been completed and adding half of the annual forecast growth rate since the actual data only included just under the first half of the 2019 year's actuals.

This approach to the forecasting of capacitive charging current was presented to the Victorian REFCL Technical Working Group on 9 September 2019. Membership of the REFCL Technical Working Group includes Energy Safe Victoria. The Technical Working Group did not recommend any changes to the methodology, which we regard as a reasonable approach for estimating network capacitance.

Our forecasts show that the network capacitance at WPD is expected be 685 amps in 2023, increasing to 770 amps by the end of the regulatory period in 2026. This significant increase is due to the large amount of underground cable growth being driven by growth in the Armstrong Creek development area. Figure A2 presents the forecast network capacitance, which indicates that nine REFCLs would be required at Waurn Ponds zone substation in the absence of any other measures to reduce the network capacitance.

Figure A2 Waurn Ponds zone substation charging current forecast



Source: Powercor

A.3 Identified need

The project need is to ensure the requirements of the Amended Bushfire Mitigation Regulations are met with the work needed to implement the "required capacity" being complete and operational by 1 May 2023.

The detailed explanation of this requirement is included in the main body of this report in Section 3.

Supplementary to this requirement there is need to consider forecast non-compliance with voltage standards and increasing load at risk due to load growth.

Options have been developed that address all these identified requirements to ensure the most efficient investment is identified.

A.4 Options to meet network need

A.4.1 Options description

Four options have been identified that will meet the network need stated above and are considered to be commercially and technically feasible.

Table A4 below shows the four options that we have examined in response to the identified need for the Surf Coast supply area. A 'do nothing' option was not considered because it would fail to address our compliance obligations.

Table A4 Waurn Ponds zone substation Options ($ million, 2021)

Option	Option Description	Annual OPEX Cost	PV CAPEX Cost
1	**Install nine REFCLs at Waurn Ponds zone substation – Forecast completion date November 2022** The scope of work includes: • install nine REFCLs at WPD zone substation • install 6 transformers, extend 66kV bus with six transformer bays and seven new 66kV breakers • rearrange five existing feeders and construct three new feeders • construct a new indoor switchroom to house 22 new circuit breakers • harden 22kV feeders and HV customer sites to allow for REFCL operation	$1.12	$111.6
2	**Install five REFCLs at Waurn Ponds zone substation with ten isolating substations – Forecast completion date November 2022** The scope of work includes: • install five REFCLs at WPD zone substation • install two new 25/33 MVA transformers • extend the 66kV bus to include two new transformer bays and three new 66kV circuit breakers • rearrange five existing feeders and construct one new feeder • construct a new indoor switchroom to house two buses, five feeders and 11 new circuit breakers • harden 22kV feeders and HV customer sites to allow for REFCL operation • install ten isolating substations	$0.90	$89.9
3	**Install three REFCLs at Waurn Ponds zone substation, establish Torquay (TQY) and Charlemont (CMT) zone substations each with three REFCLs – Forecast completion date November 2022** The scope of work includes: • install three REFCLs at WPD zone substation • build three 66kV line bays and four 66kV circuit breakers installed in the bus ring, relocate one 66kV breaker • build a new TQY substation with three 25/33MVA transformers, five 22kV feeders and, 66kV line bays and three REFCLs	$1.02	$101.5

Option	Option Description	Annual OPEX Cost	PV CAPEX Cost
	• build a new CMT substation with three 10/13MVA transformers, three 22kV feeders and, 66kV line bays and three REFCLs • purchase land for CMT substation • build a 66kV sub-transmission line linking CMT with both WPD and Geelong East (GLE) zone substations • harden 22kV feeders and HV customer sites to allow for REFCL operation To address the reliability issues in the Surf Coast area, load would be transferred from the overloaded WPD zone substations to the new TQY and CMT zone substations		
4	**Install three REFCLs at Waurn Ponds zone substation with six isolating substations, and establish Torquay zone substation with two REFCLs and three isolating substations – Forecast Completion Date November 2022** The scope of work includes: • install three REFCLs at WPD zone substation • build two 66kV line bays, three new 66kV circuit breakers installed in the bus ring and relocate one 66kV breaker • install six isolating substations on the WPD feeder network • build a new TQY substation with two 25/33MVA transformers, four 22kV feeders and, 66kV line bays and two REFCLs • install one new four x 3MVar capacitor bank • install three isolating substations on the TQY feeder network • harden 22kV feeders and HV customer sites to allow for REFCL operation To address the reliability issues in the Surf Coast area, load would be transferred from the overloaded WPD Zone substation to the new TQY zone substation	$0.74	$73.5

A.4.2 Additional considerations

Option 2 and Option 4 include the use of isolating substations. Isolating substations can be used to electrically separate a section of network from other areas of the network to reduce the amount of compensation (i.e. current injected into the transformer neutral to cancel the residual active fault current) that the REFCL must provide to reduce the voltage on the broken conductor to almost zero. However, as the polyphase electric lines portion of the network covered by the isolation substation will not be covered by the REFCL, the required capacity mandated by the Amended Bushfire Mitigation Regulations will not be achieved for these isolated feeder sections. In these circumstances, we would be required to apply to Energy Safe Victoria for an exemption

in accordance with Regulation 13[21]. It is worth noting that the areas of the network where isolating substations may be used are to be wholly underground to ensure that the bushfire risk is negligible.

For Option 1 there is not enough space at the zone substation to house the equipment identified in the scope. In theory, the buffer zone land between the zone substation and adjacent residential housing could be purchased and indicative costs have been included in our assessment. In practice, however, this represents a material risk in regard to costs, timing and option feasibility.

Option 2 also requires additional land due to the extent of the required works and additionally requires sites to be acquired for ten 6 MVA isolating substations on the feeder network. This represents a risk to the delivery of this option. Similarly Option 4 requires sites to be acquired for nine isolating transformers which is a risk to the delivery schedule.

A.4.3 Other options considered but rejected

The following additional options were considered in preliminary planning investigations, but were rejected either because the costs were prohibitive, or the option was unable to meet our compliance obligations:

- Install ten REFCLs at WPD and install four new feeders to supply the Torquay/Surf Coast area. The lack of overhead feeder line route options requires at least 37 km of underground 22kV cable, which makes the cost of this option prohibitive. The long length of underground cable is one of the reasons ten REFCLs are required at WPD.
- Demand management. As already noted, demand management is unable to address our compliance obligations under the Amended Bushfire Mitigation Regulations. This option is therefore not feasible.

A.4.4 Non-network options

Due to REFCLs being the only available technology to meet these requirements, we have determined that there are no credible non-network options that could address the identified need. This determination is made under clause 5.17.4(c) and (d) of the NER. This determination was published in accordance with clause 5.17.4(d) on 29 July 2019 and no responses were received regarding this determination.

A.5 Economic assessment

In this section we present the results of our economic assessment of the four credible options set out in Table A4. The purpose of this assessment is to identify the preferred option.

Each of the credible options would meet the need as identified in Section A3. In identifying the preferred option, the objective is to maximise net economic benefit.

A.5.1 Methodology

The methodology we have applied in this assessment accords with the approach prescribed in the AER documents "Application guidelines - Regulatory investment test for distribution - December 2018"[22].

[21] Electricity Safety (Bushfire Mitigation) Regulations 2013 Clause 13 Exemptions

Under the methodology, the annual value of expected unserved energy is calculated for Waurn Ponds zone substation in the absence of any mitigation measures as a BAU baseline. For each option a residual value of expected unserved energy is also calculated as the risk of an outage is not totally mitigated by implementation of any option. The total benefit is calculated as the total value of expected unserved energy less the residual value of expected unserved energy as calculated for each option.

The present value of the total benefit is compared to the present value of the cost of each option, including all forecast capex and opex costs. The analysis is conducted over a 20-year time period on the basis that reliability improvements are more difficult to forecast for a period of time in excess of 20 years. A net economic value is calculated with projects ranked to maximise this value as required in NER clause 5.17.1(b)

On 20 August 2018, the ESCV revision of the Distribution Code transferred responsibility from distributors to HV customers to ensure their connection is compatible with REFCL installation and pay for any work required. This cost will be equivalent for each option and consequently will not impact the selection of a preferred option. No credible option has been identified that will avoid these costs and for simplicity these costs are not included in the assessment.

A.5.2 Key variables and assumptions

Table A5 below lists the key variables and assumptions applied in the economic assessment.

Table A5 Input Variables and Assumptions

Variable / assumption	Value
Cost of involuntary supply interruption	Value of Customer Reliability (**VCR**) of $38,893 per MWh (weighted average by customer class)
Network operating expenditure	Cost forecast based on 1% of capital project costs incurred
Network capital expenditure	In-house cost estimates using detailed and high-level project scopes
Discount rate (real pre-tax)	2.75% real, being the pre-tax equivalent of the regulated WACC[23]
Asset life	50 years
Weighting of Demand Forecast by PoE Scenario	50% PoE - 70% weighting 10% PoE - 30% weighting

Source: Powercor

[22] Application guidelines, Regulatory investment test for distribution, December 2018 Australian Energy Regulator

[23] NER clause 5.17.1(c)(9)(iii) Paragraphs 16 and 17 of the RIT-D state: "The present value calculations must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector. The discount rate used must be consistent with the cash flows that the RIT-D proponent is discounting."

A.5.3 Economic assessment results

The net present value economic benefit and ranking for each option is calculated according to the methodology described above and summarised in Table A6 below.

Table A6 Option economic assessment results ($ million, 2021)

Option	Option Description	PV Cost	PV Benefit	NPV Economic Benefit	Ranking
1	Install nine REFCLs at WPD	57.3	93.2	35.9	4
2	Install five REFCLs at WPD with ten isolating substations	46.1	93.2	47.0	2
3	Install three REFCLs at WPD, establish Torquay (TQY) and Charlemont (CMT) zone substations each with three REFCLs	52.1	93.1	41.0	3
4	Install three REFCLs at WPD with six isolating substations, and establish TQY zone substation with two REFCLs and three isolating substations	37.7	92.8	55.0	1

Source: Powercor

The analysis indicates Option 4 is ranked as the preferred option.

This option has the highest and a positive net economic benefit. Critically it also meets the requirements defined in the project need to comply with the Amended Bushfire Mitigation Regulations.

A.5.4 Option delivery timing

It is noted that in order to meet the Amended Bushfire Mitigation Regulations , the timing of the works for all options must be completed, including all commissioning and testing, by end of 2022, so that summer 2022/23 is used to prepare the REFCLs for performance compliance by 1 May 2023.

A.5.5 Input assumptions and sensitivity analysis

As each of the options employ a similar mix of capital and operating expenditure and expected delivery cost risk and value of an involuntary supply interruption, the ranking of the options will not change by varying these input assumptions.

The ranking is also unaffected by changes in the cost of capital. It should be noted that the timing of the option is driven by our mandated bushfire obligations, and therefore alternate project timing has not been considered.

Consequently, input assumption scenarios and sensitivity analysis are not presented in this report.

A.6 Preferred option

Clause 5.17.1 (b) of the NER defines the principle that the preferred option is to:

> *"maximise the present value of the net economic benefit to all those that produce, consume and transport electricity in the National Electricity Market"*

and further that

> *"a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is, a net economic cost) where the identified need is for reliability corrective action"*

Option 4 is identified as the preferred option which meets the mandatory requirements of the Amended Bushfire Mitigation Regulations and of the credible and technically feasible options maximises the net economic benefit.

In regard to project timing, the legislated requirement to complete the work by 1 May 2023 does not provide scope to consider delaying the work or consider alternate timing.

A.7 Checklist of regulatory compliance

Table A7 WPD checklist of regulatory compliance

Rules clause	Requirement	Section of this report
5.17.4(j)(1)	Description of the identified need for the investment	Section 3 & Section A3
5.17.4(j)(2)	The assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, reasons that the RIT-D proponent considers reliability corrective action is necessary)	Section 3 & Section A.3
5.17.4(j)(3)	If applicable, a summary of, and commentary on, the submissions on the non-network options report	Section 1
5.17.4(j)(4)	Description of each credible option assessed	Section A.4.1
5.17.4(j)(5)	Where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option	Section A.5.3
5.17.4(j)(6)	A quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	Section A.4.1
5.17.4(j)(7)	A detailed description of the methodologies used in quantifying each class of cost and market benefit	Section A.5.1
5.17.4(j)(8)	Where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	Not applicable
5.17.4(j)(9)	The results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results	Section A.5.3
5.17.4(j)(10)	The identification of the proposed preferred option	Section A.6
5.17.4(j)(11)	For the proposed preferred option, the RIT-D proponent must provide: • details of the technical characteristics • the estimated construction timetable and commissioning date (where relevant) • the indicative capital and operating cost (where relevant) • a statement and accompanying detailed analysis that the proposed preferred option satisfies the regulatory investment test for distribution • if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	 Table A4 Table A4 Table A4 Appendix A & Section 6 Not applicable
5.17.4(j)(12)	Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed	Section 7

B Corio and Geelong zone substations

Detailed RIT-D Draft Project Assessment

B.1 Overview

The scope of this section is to present required information for the draft project assessment report that is prepared in accordance with the Regulatory Investment Test for Distribution requirements of the National Electricity Rules for the network need identified at Geelong and Corio zone substations.

Geelong and Corio zone substations are listed in Schedule 2 of the Amended Bushfire Mitigation Regulations where Powercor must meet the “required capacity” obligations.

The RIT-D assessment for these sites is documented in Appendix B in combination with information contained in the main body of this report.

B.2 Background

Both Geelong and Corio zone substations supply areas of Hazardous Bushfire Risk[24] and Low Bushfire Risk. However, of the

- nine feeders emanating from GL, only two traverse significant Hazardous Bushfire Risk Areas (HBRA)
- ten feeders emanating from CRO, only one traverses significant Hazardous Bushfire Risk Areas (LBRA).

As described Section B3 in this report an Order in Council has been granted to exempt GL and CRO from the Amended Bushfire Mitigation Regulation, subject to conditions. This exemption creates opportunity for alternate options to address the identified need in Section B3.

B.2.1 Network capacitance forecasts

In this situation the characteristic of principle interest in developing and scoping options to meet the network need is the capacitance forecast for the existing zone substation sites and new sites proposed as options.

Network capacitance forecasts have been developed to 2026 by applying a growth rate based on the previous five year's average annual growth in network capacitance. One off programs of work, such as the undergrounding of overhead networks as part of the VBRC Powerline Replacement Program, are removed from the growth rate calculations. Any forecast works for these one-off programs are factored into the network capacitance forecasts to reflect the forecast year of completion. The 2019 network capacitance forecast was developed by using the available actual data for 2019, including all proposed works that have not been completed and adding half of the annual forecast growth rate since the actual data only included just under the first half of the 2019 year's actuals.

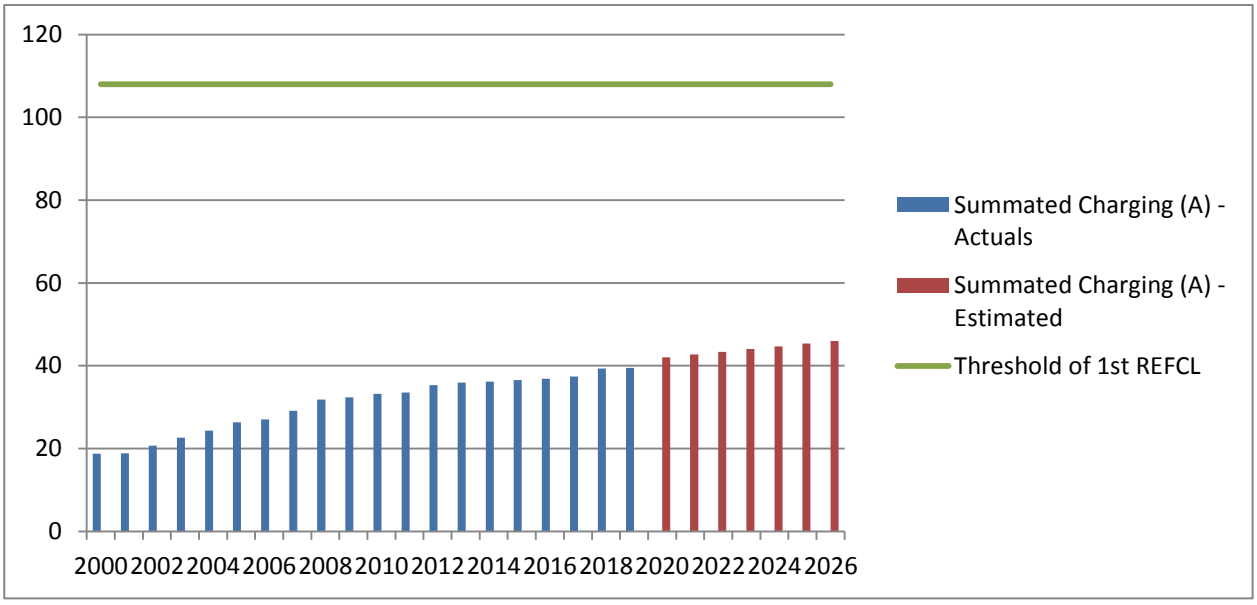
This approach to the forecasting of capacitive charging current was presented to the Victorian REFCL Technical Working Group on 9 September 2019. Membership of the REFCL Technical Working Group includes Energy Safe Victoria. The Technical Working Group did not recommend any changes to the methodology, which we regard as a reasonable approach for estimating network capacitance.

[24] Electricity Safety Act 1998 incorporating amendments at 1 January 2020 Part 1 Clause 3 Definitions

B.2.2 Corio capacitance forecast

For Corio zone substation, there is presently 210km of overhead line and 8.8km of underground cable for an estimated network capacitance of 46 amps. The network area considered includes transfer feeders. The forecast increases in network capacitance is provided in Figure B1.

Figure B1 CRO network charging current forecast per year



Source: Powercor

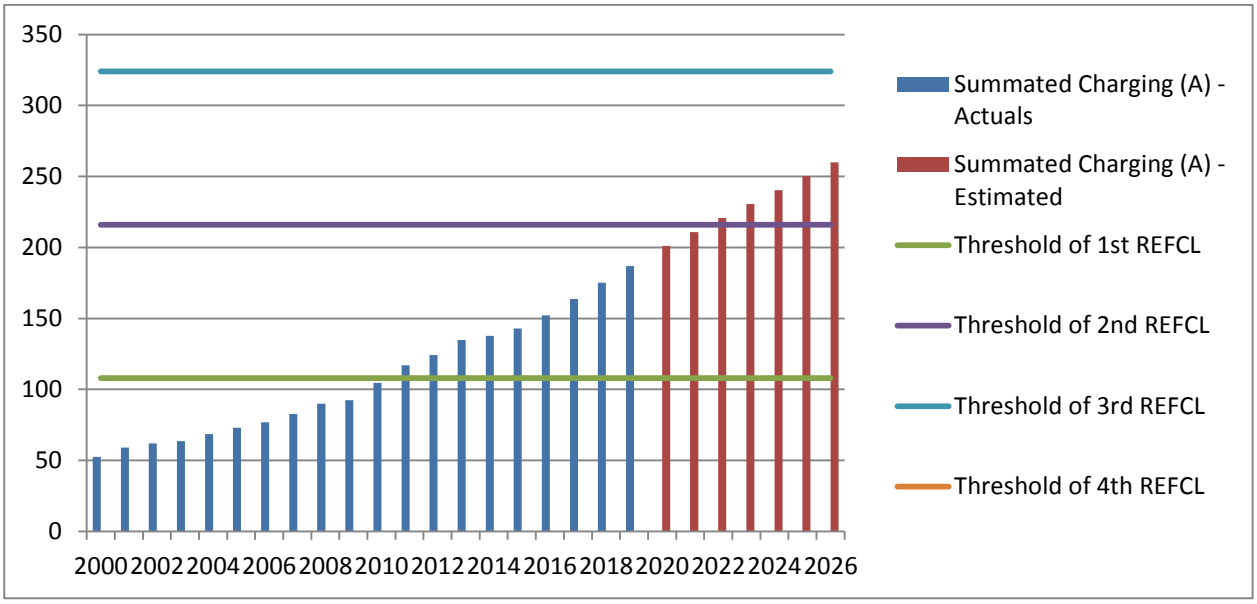
The forecast indicates that for Corio zone substation one REFCL unit is required to meet the immediate and future need in the timeframe under consideration.

B.2.3 Geelong capacitance forecast

For Geelong zone substation, there is presently 51.1km of underground cable and 555km of overhead line for an estimated network capacitance of 200 amps. The network area considered includes transfer feeders. The forecast increases in network capacitance is provided in Figure B2.

Our forecasts show that the network capacitance at Geelong zone substation is expected be 221 amps in 2022, increasing to 260 amps by the end of the regulatory period in 2026.

Figure B2: GL network charging current forecast per year



Source: Powercor

The forecast indicates that for the Geelong zone substation two REFCL units are required to meet the immediate and future need in the timeframe under consideration.

B.2.4 New zone substation option capacitance forecast

Analysis indicates that a new substation would require the installation of two REFCLs to accommodate the feeders transferred from Geelong and Corio zone substations.

B.3 Identified need

The project need is to ensure the requirements of the Amended Bushfire Mitigation Regulations are met with the work needed to implement the "required capacity" being complete and operational by 1 May 2023.

The detailed explanation of this requirement is included in the main body of this report in Section 3.

B.3.1 Order in Council

The Governor in Council, under section 120W of the Electricity Safety Act (1998), has made an Order[25] exempting us from the requirement to ensure that Geelong and Corio are complying substations on the conditions that we:

- establish a new zone substation which is, and remains, a complying substation for purposes of section 120L and 120M(1)(c) of the Electricity Safety Act (1998)

[25] Orders in Council Exemption Order Under Section 120W of the Electricity Safety Act 1998 – 1014 G21

- transfer specified polyphase electric line segments from GL and CRO to that new zone substation
- for particular polyphase electric lines which continue to be served from GL and CRO that are located, or come to be located, in hazardous bushfire risk areas are covered or placed underground or supplied from a complying zone substation.

We sought this exemption to allow for additional and potentially more cost-effective options to be implemented for our customers over the longer term, and to achieve the overall outcome and intent of the Amended Bushfire Mitigation Regulations. Options have been developed to achieve compliance at Corio and Geelong zone substations or alternatively to achieve compliance through application of the exemption order and associated conditions.

B.4 Description of options

Three options have been identified that will meet the network need stated above and are commercially and technically feasible.

The installation of REFCLs is the only technically feasible solution currently available to meet the performance requirements specified in the Amended Bushfire Mitigation Regulations. Consequently the installation of a REFCL is included in the scope of each option. The deployment of a REFCL and associated equipment in the zone substation also requires works to be undertaken on the feeder network and at HV customer sites to enable the REFCL to perform. These works relate to network hardening, capacitive balancing, harmonics and damping. These costs are reflected in the overall option cost.

Table B1 shows the three options that we have examined in response to the identified need for the north western Geelong supply area. A 'do nothing' option was not considered because it would fail to address our compliance obligations.

Table B1 Corio and Geelong zone substations options ($ million, 2021)

Option	Option description	Annual OPEX Cost	CAPEX Cost
1	**Install one REFCL at Corio zone substation, and install two REFCLs at Geelong zone substation, transfer some feeders to Corio zone substation – Forecast completion date February 2023** The scope of work includes: Corio: • install one REFCL with neutral bus and rebuild control room • install a new third transformer and new 22kV 800A circuit breaker for a new feeder • harden 22kV feeders and HV customer sites to allow for REFCL operation Geelong: • install two REFCLs • replace outdoor 22kV switchyard bus with new 22 kV switch room and	$0.53	$53.38

	indoor switchboard • 22kV feeder rearrangements and transfer one feeder to CRO • a new indoor switchroom to be constructed to house 22 new circuit breakers • harden 22kV feeders and HV customer sites to allow for REFCL operation • install one isolating substation on the feeder network		
2	**Construct new Bannockburn (BBN) zone substation with two 25/33MVA transformers, two REFCLs and one isolating substation – Forecast completion date February 2023** The scope of work includes: • purchase suitable land for the new zone substation • install two new 25/33 MVA transformers along with two 22kV buses, and two REFCLs, at the new BBN zone substation • extend the 66kV sub-transmission lines to connect BBN into the existing 66kv loop between Geelong Terminal station (**GTS**) and Corio (**CRO**) and Ford Norlane (**FDN**) • reconfigure 22kV feeders to connect the bushfire risk supply areas as specified in the Order in Council onto BBN from the current CRO and GL zone substations • network hardening of the 22kV feeder sections transferred from CRO and GL to BBN • construct a 6MVA isolation substation to isolate an underground section of GL021 in the Highton area	$0.57	$57.39
3	**Construct new Gheringhap (GHP) zone substation with two 25/33MVA transformers, two REFCLs and one isolating substation – Forecast completion date February 2023** The scope of work includes: • purchase suitable land for the new zone substation • install two new 25/33 MVA transformers along with two 22kV buses, and two REFCLs, at the new GHP zone substation • extend the 66kV sub-transmission lines to connect GHP into the existing 66kv loop between Geelong Terminal station (**GTS**) and CRO and Ford Norlane (**FDN**) • reconfigure 22kV feeders to connect the bushfire risk supply areas as specified in the Order in Council onto GHP from the current CRO and GL zone substations • network hardening of the 22kV feeder sections transferred from CRO and	$0.53	$52.80

GL to GHP

- construct a 6MVA isolation substation to isolate an underground section of GL021 in the Highton area

B.4.1 Additional considerations

For Option 1, the Geelong site requires significant work as there is very limited available space which necessitates significant reconfiguration of existing equipment. There is no available adjacent land for site expansion. There is also a requirement for four distribution augmentation projects (including one new feeder) for Geelong as a result of capacity constraint to the north-west of Geelong. These projects would not be required, and the cost will be avoided if Option 2 or Option 3 is implemented.

In Option 1, the 11 HV customer connection points across CRO and GL are within the REFCL protected area and would require hardening or an isolation transformer to be installed. In options 2 and 3, none of the 11 HV customer connection points across CRO and GL are within the REFCL protected area of BBN or GHP, and no customer hardening or isolation is required.

The costs to be incurred by HV customers is not included for simplicity however the avoidance of these costs for option 2 and 3 provides additional benefit for these options.

During preliminary analysis into the preferred site for a new complying zone substation, we met with Golden Plains Shire to discuss future land use. This discussion identified a proposal for an employment hub in the vicinity of Gheringhap, as opposed to the vicinity of Bannockburn which is earmarked for residential development. Due to the nature of the future land use, Gheringhap is a credible option for a new complying zone substation.

B.4.2 Non-network options

Due to REFCLs being the only available technology to meet these requirements, we have determined that there are no credible non-network options that could address the identified need. This determination is made under clause 5.17.4(c) and (d) of the NER. This determination was published in accordance with clause 5.17.4(d) on 29 July 2019 and no responses were received regarding this determination.

B.5 Economic assessment

B.5.1 Methodology

The methodology we have applied in this assessment accords with the approach prescribed in the AER documents "Application guidelines - Regulatory investment test for distribution - December 2018"[26].

Clause 5.17.1 (b) of the NER defines the principle that the proposed option is to:

> *"maximise the present value of the net economic benefit to all those that produce, consume and transport electricity in the National Electricity Market"*
>
> and further that

[26] Application guidelines, Regulatory investment test for distribution, December 2018 Australian Energy Regulator

"a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is, a net economic cost) where the identified need is for reliability corrective action"

On the basis that it is mandatory to meet the project need to implement the "required capacity" then this report does not calculate the economic benefits which will be materially the same for each option. However, the principle in Clause 5.17.1 (b) of the NER will be met by selecting the lowest cost credible option that meets the project need which in effect maximises the present value of the net economic benefit.

The present value cost of each proposed option is calculated for comparison and includes forecast capex, opex and Powercor costs associated with HV customer sites.

On 20 August 2018, the ESCV revision of the Distribution Code transferred responsibility from distributors to HV customers to ensure their connection is compatible with REFCL installation and pay for any work required. Options 2 and 3 will avoid these costs however this is a cost that would be incurred with Option 1. These costs are not included in the analysis for simplicity and this has an effect of understating the cost and overstating the economic benefit of Option 1. The effect of this is only material where Option 2 and Option 3 are not preferred options.

In regard to project timing, the legislated requirement to complete the work by 1 May 2023 does not provide scope to consider delaying the work or consider alternate timing.

B.5.2 Key variables and assumptions

Table B2 below lists the key variables and assumptions applied in the economic assessment

Table B2 Input variables and assumptions

Variable / assumption	Value
Network operating expenditure	Cost forecast based on 1% of capital project costs incurred
Network capital expenditure	In-house cost estimates using detailed and high-level project scopes
Discount rate (real pre-tax)	2.75% real, being the pre-tax equivalent of the regulated WACC[27]
Asset life	50 years

Source: Powercor

B.5.3 Economic Assessment Results

The present value cost and ranking for each option is calculated according to the methodology described above and summarised in Table B3 below.

Table B3 Option economic assessment results ($ million, 2021)

Option	Option Description	PV Cost	Ranking
1	Install one REFCL at Corio zone substation, and install two REFCLs at Geelong zone substation, transfer some feeder transfers to Corio zone substation	$32.5	3
2	Construct new Bannockburn (BBN) zone substation with two 25/33MVA transformers, two REFCLs and one isolating substation	$29.2	2
3	Construct new Gheringhap (GHP) zone substation with two 25/33MVA transformers, two REFCLs and one isolating substation	$26.7	1

Source: Powercor

The analysis indicates Option 3 is ranked as the preferred option. This option has the lowest PV cost to meet the project need detailed in Section B.3.

[27] NER clause 5.17.1(c)(9)(iii) Paragraphs 16 and 17 of the RIT-D state: "The present value calculations must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector. The discount rate used must be consistent with the cash flows that the RIT-D proponent is discounting."

B.5.4 Option delivery timing

It is noted that in order to meet the Amended Bushfire Mitigation Regulations, the timing of the works for all options must be completed for performance compliance by 1 May 2023.

B.5.5 Input assumptions and sensitivity analysis

As each of the options employ a similar mix of capital and operating expenditure and expected delivery cost risk and value of an involuntary supply interruption, the ranking of the options will not change by varying these input assumptions.

The ranking is also unaffected by changes in the cost of capital. It should be noted that the timing of the option is driven by our mandated bushfire obligations, and therefore alternate project timing has not been considered.

Consequently, input assumption scenarios and sensitivity analysis are not presented in this report.

B.6 Preferred option

Option 3 is identified as the preferred option which meets the mandatory requirements of the Amended Bushfire Mitigation Regulations and of the credible and technically feasible options maximises the net economic benefit.

In regard to project timing, the legislated requirement to complete the work by 1 May 2023 does not provide scope to consider delaying the work or consider alternate timing.

B.7 Checklist of Regulatory Compliance

Table B4 CRO and GL checklist of regulatory compliance

Rules clause	Requirement	Section of this report
5.17.4(j)(1)	Description of the identified need for the investment	Section 3
5.17.4(j)(2)	The assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, reasons that the RIT-D proponent considers reliability corrective action is necessary)	Section 3
5.17.4(j)(3)	If applicable, a summary of, and commentary on, the submissions on the non-network options report	Section 1
5.17.4(j)(4)	Description of each credible option assessed	Section B.4
5.17.4(j)(5)	Where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option	Section B.5
5.17.4(j)(6)	A quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	Table B1
5.17.4(j)(7)	A detailed description of the methodologies used in quantifying each class of cost and market benefit	Section B.5
5.17.4(j)(8)	Where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	Not applicable
5.17.4(j)(9)	The results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results	Section B.5
5.17.4(j)(10)	The identification of the proposed preferred option	Section B.6
5.17.4(j)(11)	For the proposed preferred option, the RIT-D proponent must provide:	
	• details of the technical characteristics	Table B1
	• the estimated construction timetable and commissioning date (where relevant)	Table B1
	• the indicative capital and operating cost (where relevant)	Table B1
	• a statement and accompanying detailed analysis that the proposed preferred option satisfies the regulatory investment test for distribution	Appendix B & Section 6
	• if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	Not applicable
5.17.4(j)(12)	Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed	Section 7

C Koroit – Stawell – Hamilton – Merbein zone substations

Detailed RIT-D Draft Project Assessment

C.1 Overview

The scope of this section is to present required information for the draft project assessment report that is prepared in accordance with the Regulatory Investment Test for Distribution requirements of the National Electricity Rules for the network need identified at Koroit, Stawell, Hamilton and Merbein zone substations.

Koroit, Stawell, Hamilton and Merbein zone substations are listed in Schedule 2 of the Amended Bushfire Mitigation Regulations where Powercor must meet the "required capacity" obligations.

These substations are similar in characteristics and issues requiring consideration. Consequently, a combined assessment for these sites is presented in Appendix C.

The RIT-D assessment for these four sites is documented in Appendix C in combination with information contained in the main body of this report.

C.2 Background

The four substations are in regional locations and supply a similar load type that is typically rural and includes small townships. There is sufficient existing capacity to meet current and forecast load growth for the immediate future.

C.2.1 Zone substation characteristics

Koroit

Koroit 66/22 kV zone substation is a banked station consisting of three 10/13.5 MVA transformers and one capacitor bank of 2 x 3MVar. It is located 6 km east of the Koroit township, on the corner of Conns Lane and Tower Hill Road and supplies the Koroit township and surrounding rural area from the western outskirts of the Warrnambool township to Port Fairy. Port Fairy experiences a high seasonal population during summer and a project in 2014/15 was completed to increase the reliability in the area (NULEC loop auto scheme).

Stawell

Stawell 66/22 kV zone substation is a banked station consisting of two 10/13.5 MVA transformers and two capacitor banks of 1 x 6Mvar and 1 x 3MVar. It is located on the western outskirts of Stawell. It was established in 1964 and supplies the city of Stawell and the rural areas north to Rupanyup, east to Landsborough and south to Halls Gap. The Halls Gap tourist area is the main growth area with some growth occurring in Stawell town.

Hamilton

Hamilton 66/22 kV zone substation is a banked station consisting of three 10/13.5 MVA transformers and two capacitor banks of 4 x 3Mvar and 3 x 3MVar. It supplies customers in Hamilton, Coleraine, Casterton, Macarthur, Branxholme, Penshurst, Cavendish, and Dunkeld. There is adequate zone substation capacity under single contingency for the next ten years.

Merbein

Merbein 66/22 kV zone substation is a partially switched station consisting of two 10/13.5 MVA transformers and one 20/33 MVA transformer. It is located at Merbein and largely supplies along the Murray River between Mildura and Lake Cullulleraine.

General details

General details regarding each of the four zone substations are detailed below and in Table C1.

Table C1 zone substation Characteristics

Zone substation	Koroit zone substation	Stawell zone substation	Hamilton zone substation	Merbein zone substation
Feeders	5	4	6	6
Zone substation transformers	3	2	3	3
22kV buses	3	3	3	3
Capacitor banks	1	2	2	1
Station service transformers	1	1	1	2
22kV circuit breakers (switching configuration)	6 (Banked)	8 (Banked)	8 (Banked)	9 (Partially Switched)

Source: Powercor

C.2.2 Distribution network characteristics

The extent, construction type and components that form the network supplied by the zone substation impact the scope and scale of work for each site.

The network under consideration also includes any feeder from adjacent zone substations that may be transferred in full or part to one of the zone substations being considered in this report. This switching and transfer may occur, for example, to provide access for planned work or in responding to outages that occur on the network.

Details of the volumes of relevant construction type and components associated with the network for each zone substation are shown in Table C2.

Table C2 Network characteristics

	Network Element Volume for each Substation (incl transfer feeders if applicable)			
Network	**Koroit zone substation**	**Stawell zone substation**	**Hamilton zone substation**	**Merbein zone substation**
Total route length (km)	924	581	1,468	449
Underground cable length (km)	16.3	2.8	7.8	40.5
Overhead line length (km)	908	583	1,460	409
Underground network (%)	1.76%	0.47%	0.53%	9.02%
Overhead single phase	316	177	738	11.4
Estimated network capacitance (A)	102.8	46	117	134.0
Distribution transformers	1,807	702	1,704	1,114
HV regulator sites	5	5	6	2
Fuses (per phase)	2,016	794	2,067	1,105
ACRs (number of)	10	12	17	6
Surge arrestor (number of)	4,832	1,115	4,128	4,604
HV customers	4	2	1	2

Source: Powercor

C.2.3 Other network considerations

No material network constraints or related project issues have been identified at the Hamilton, Stawell, Merbein zone substations and the scope of work is solely for the purpose of meeting the network need identified in this assessment.

C.3 Identified need

The project need is to ensure the requirements of the Amended Bushfire Mitigation Regulations are met with the work needed to implement the “required capacity” being complete and operational by 1 May 2023.

The detailed explanation of this requirement is included in the main body of this report in section 3.

C.4 Description of options

At present the only technology available to achieve the "required capacity" technical obligations specified in the amended Electrical Safety (Bushfire Mitigation) Regulations 2013 is a REFCL[28].

The requirement to comply with the amended Electrical Safety (Bushfire Mitigation) Regulations 2013 is mandatory and penalties exist for non-compliance.

Consequently, we have not identified other options or other non-network options to assess. As the requirement is mandatory a "do nothing option" has not been assessed.

Clause 15.2 of the NER specifies the criteria regarding identification of options as:

> *Identification of a credible option*
>
> *(a) A credible option is an option (or group of options) that:*
>
> *(1) addresses the identified need;*
>
> *(2) is (or are) commercially and technically feasible; and*
>
> *(3) can be implemented in sufficient time to meet the identified need*

We have identified an option to install RECLs to meet the project need and this is the only identified option that meets these NER criteria.

The specific characteristics at each site determine the detailed scope of work required. The estimated cost to implement the proposed option at each site is shown in Table C3. Based on experience with Tranche 1 and Tranche 2 sites the engineering design has been optimised to deliver the REFCL installation at the lowest cost.

Table C3 Option description ($ million, 2021)

Network option description		OPEX Cost	CAPEX Cost
Koroit zone substation	**Install one REFCL– Forecast completion date March 2021** The scope of work includes: • install one arc suppression coil and modular building housing REFCL power electronic and interface equipment • associated secondary works and enhanced neutral metering • associated substation work to modify or upgrade earthing, station supply, voltage transformers, surge arrestors • network hardening to facilitate REFCL operation	$0.22	$21.7
Stawell zone substation	**Install one REFCL – Forecast completion date March 2022** The scope of work includes:	$0.23	$22.83

[28] As acknowledged by the Powerline Bushfire Safety Taskforce (PBST) in the Response to PBST 2011, https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/reports-and-consultationpapers/response-to-pbst

Network option description		OPEX Cost	CAPEX Cost
	• install one arc suppression coil and modular building housing REFCL power electronic and interface equipment. • associated secondary works, enhanced neutral metering and install three 3MVar capacitor banks. • associated substation work to modify or upgrade earthing, station supply, current transformers, voltage transformers, surge arrestors • network hardening to facilitate REFCL operation		
Hamilton zone substation	**Install two REFCLs – Forecast completion date November 2021** The scope of work includes: • install two arc suppression coils and modular building housing REFCL power electronic. and interface equipment and associated secondary works including enhanced neutral metering • install new control room, amenities and 22kV switchboard, three 3MVar capacitor banks on Bus No1. and four 3MVar capacitor banks on Bus No.2 • associated substation work to modify or upgrade earthing, station supply, current transformers, voltage transformers, surge arrestors • network hardening to facilitate REFCL operation Due to space limitations work is required as detailed to reconfigure the site to provide required space for new equipment.	$0.31	$31.07
Merbein zone substation	**Install one REFCL – Forecast completion date October 2021** The scope of work includes: • install one arc suppression coil and modular building housing REFCL power electronic and interface equipment. • associated secondary works and enhanced neutral metering • associated substation work to modify or upgrade earthing, station supply, current transformers, voltage transformers, surge arrestors	$0.25	$24.87

C.5 Economic Assessment

C.5.1 Methodology

The methodology we have applied in this assessment accords with the approach prescribed in the AER documents "Application guidelines - Regulatory investment test for distribution - December 2018"[29].

Clause 5.17.1 (b) of the NER defines the principle that the proposed option is to:

> *"maximise the present value of the net economic benefit to all those that produce, consume and transport electricity in the National Electricity Market"*
>
> and further that
>
> *"a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is, a net economic cost) where the identified need is for reliability corrective action"*

On the basis that it is mandatory to meet the project need to implement the "required capacity" then this report does not calculate the economic benefits. However the principle in Clause 5.17.1 (b) of the NER will be met by selecting the lowest cost credible option which in effect maximises the present value of the net economic benefit.

HV Customers will incur costs to be compatible with REFCL installation. No credible option has been identified that will avoid these costs and for simplicity these costs are not included in the assessment and does not impact on preferred option selection.

Given the proposed single option for the sites considered in Appendix C and the mandatory requirement to address the project need it is considered that undertaking scenario and sensitivity analysis is unnecessary as it would provide no additional insight to inform the selection of the proposed approach.

In regard to project timing, the legislated requirement to complete the work by 1 May 2023 does not provide scope to consider delaying the work or considering alternate timing.

C.6 Preferred option

The option described in Table C3 for each zone substation is nominated as the preferred option.

[29] Application guidelines, Regulatory investment test for distribution, December 2018 Australian Energy Regulator

C.7 Checklist of regulatory compliance

Table C4 Checklist of regulatory compliance

Rules clause	Requirement	Section of this report
5.17.4(j)(1)	Description of the identified need for the investment	Section 3
5.17.4(j)(2)	The assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, reasons that the RIT-D proponent considers reliability corrective action is necessary)	Section 3
5.17.4(j)(3)	If applicable, a summary of, and commentary on, the submissions on the non-network options report	Section 1
5.17.4(j)(4)	Description of each credible option assessed	Section C.4
5.17.4(j)(5)	Where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option	Section C5
5.17.4(j)(6)	A quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	Table C2
5.17.4(j)(7)	A detailed description of the methodologies used in quantifying each class of cost and market benefit	Section C5
5.17.4(j)(8)	Where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	Not applicable
5.17.4(j)(9)	The results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results	Section C5
5.17.4(j)(10)	The identification of the proposed preferred option	Section C.6
5.17.4(j)(11)	For the proposed preferred option, the RIT-D proponent must provide: • details of the technical characteristics • the estimated construction timetable and commissioning date (where relevant) • the indicative capital and operating cost (where relevant) • a statement and accompanying detailed analysis that the proposed preferred option satisfies the regulatory investment test for distribution • if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	 Table C2 Table C2 Table C2 Appendix C & Section 6 Not applicable
5.17.4(j)(12)	Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed	Section 7

D Engineering works for RECFL implementation

D.1 Typical work scope elements

The implementation of a REFCL involves installation and reconfiguration of equipment at the zone substation, within the distribution network and at HV customer sites. The general scope of work can include the following items depending on the specific situation at the location for the REFCL installation. The cost of works associated with the distribution network can be significant and comparable to expenditure on zone substation work.

D.1.1 Zone substation work

- installation of one or more Arc Suppression Coil (ASC) in an appropriately bunded enclosure
- install REFCL power electronic and interface equipment in existing or new building housing
- modification of the power transformer earthing arrangement
- installation of transformer neutral isolators, surge arrestors and direct earth switches
- installation of neutral bus systems
- enhanced neutral metering of 22kV feeders
- upgrade 22kV feeder protection relays to IEC compatible units
- upgrade station service supply and associated 415V AC distribution system
- modify capacitor bank earthing arrangement where installed
- install new 22kV VTs and CTs, this may require circuit breaker replacement
- install power quality meters
- upgrade of station surge arrestors
- modification of existing substations communications network configuration
- civil works and building construction for equipment installation.

D.1.2 Distribution network work

- surge diverter replacement
- replacement on failure of transformers intolerant to overvoltage
- replacement of voltage regulators with standard closed-delta three tank arrangement
- capacitive balancing across all 22kV feeders applying a suite of techniques to minimise cost (e.g. single phase network configuration changes, conversion to three phase, capacitive balancing substations, isolation)
- replace ACRs and gas switches or upgrade control boxes to provide required coordination with REFCL functions
- replace 3 phase fuses with ganged fuse-saver to avoid single phase outages
- replace specific ABB and F&G switchgear that is intolerant to overvoltage
- replace underground cable where specification indicates inability to withstand overvoltage

- works as defined above for feeders from adjacent zone substations where these feeders are likely to be supplied from the REFCL substation as part of expected operations when the network is not in its normal state.

D.1.3 High Voltage Customers

- upgrade equipment intolerant to overvoltage consistent with work on distribution network or isolate site with isolation transformer
- install ACR at supply point for isolation
- customers with generation require neutral displacement protection to avoid islanding
- independent site audits are required to confirm compliance for safety and network reliability reasons.

E Glossary of terms

Term	Definition
“required capacity”	Electricity Safety (Bushfire Mitigation) Regulations 2013 amended by Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016 - Section 5 Definitions for “required capacity”
ACR	Automatic Circuit Recloser
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Amended Bushfire Mitigation Regulations	Electricity Safety (Bushfire Mitigation) Regulations 2013 amended by Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016
BMP	Bushfire Mitigation Plan
CRO	Corio zone substation
Distribution Code	Electricity Distribution Code April 2020 Version 11, Essential Services Commission
DNSPs	Distribution Network Service Providers
FDN	Ford Norlane zone substation
GHP	Gheringhap zone substation
GL	Geelong zone substation
GTS	Geelong Terminal Station
HTN	Hamilton zone substation
HV	High Voltage
KRT	Koroit zone substation
MBN	Merbein zone substation
N rating	Capacity available with network operating with all elements in service
N-1 rating	Capacity available with network operating with one element unavailable for service
NER	National Electricity Rules (Version 142)
PBST	Powerline Bushfire Safety Taskforce

Term	Definition
PoE 50	The 50% PoE demand forecast relates to maximum demand corresponding to an average maximum temperature that will be exceeded, on average, once every two years
REFCL	Rapid Earth Fault Current Limiter
RIT-D	Regulatory Investment Test for Distribution
STL	Stawell zone substation
SWER	Single Wire Earth Return
TQY	Torquay zone substation
VBRC	Victorian Bushfire Royal Commission
VCR	Value of customer reliability
WPD	Waurn Ponds zone substation