

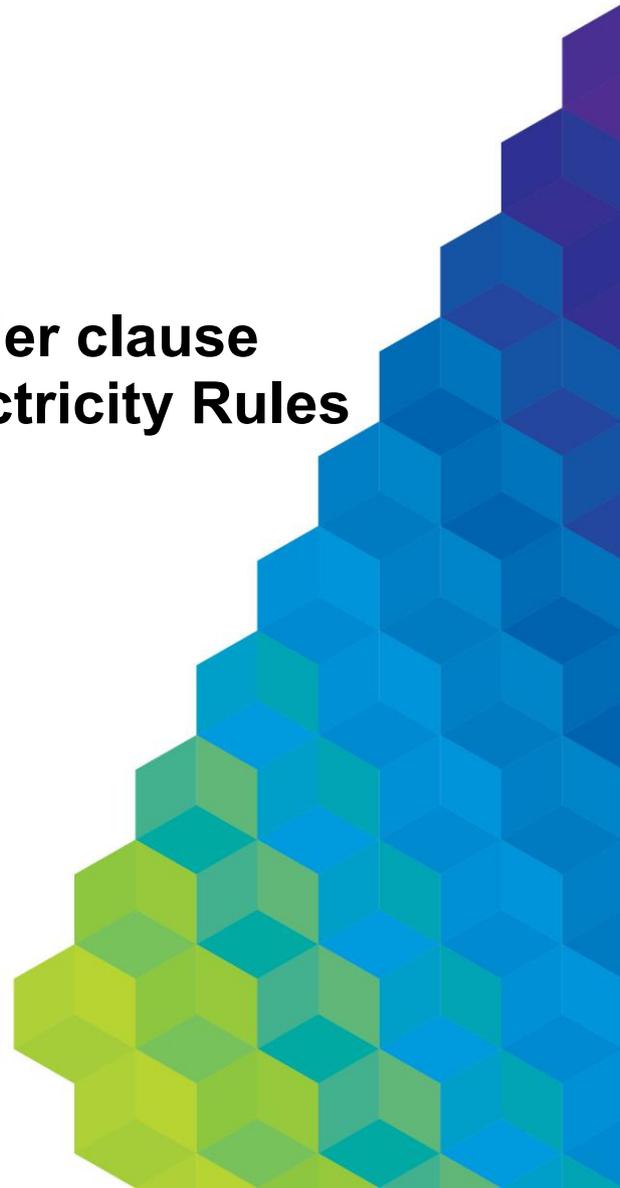


AusNet Electricity Services Pty Ltd

REFCL Tranche 2 - RIT-D

**Notice of Determination under clause
5.17.4(c) of the National Electricity Rules**

October 2018



About AusNet Services

AusNet Services is a major energy network business that owns and operates key regulated electricity transmission and electricity and gas distribution assets located in Victoria, Australia. These assets include:

- A 6,574 kilometre electricity transmission network that services all electricity consumers across Victoria;
- An electricity distribution network delivering electricity to approximately 730,000 customer connection points in an area of more than 80,000 square kilometres of eastern Victoria; and
- A gas distribution network delivering gas to approximately 665,000 customer supply points in an area of more than 60,000 square kilometres in central and western Victoria.

AusNet Services' purpose is 'to provide our customers with superior network and energy solutions.'

For more information visit: www.ausnetservices.com.au

Our AusNet Services Values are the foundation
for how we achieve our objectives



Contact

This document is the responsibility of the Regulated Energy Services business of AusNet Services. Please contact the indicated owner of the document below with any inquiries.

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1 Introduction and overview

This project is a world first rollout of Rapid Earth Fault Current Limiters (REFCL) technology in a manner to deliver considerable bushfire mitigation benefits to Victoria and our customers. A reduction in bushfire risk will improve the safety of the community and is an objective we fully support. The bushfire mitigation regulations (the Regulations), which were amended in 2016, set challenging performance standards (the Required Capacity) for 22 of AusNet Services zone substations and their associated networks. These new standards can only be met by installing REFCLs, which have not previously been implemented for bushfire reduction anywhere in the world. The project is time-critical because the Regulations set establishment dates. Additionally, in the Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017 (the Act), the Victorian Government has reinforced the importance of timely delivery by introducing significant financial penalties if these dates are not met.

The REFCL Program is to be delivered in three Tranches to align with compliance dates of 1 May 2019, 1 May 2021 and 1 May 2023, as set out in the Regulations. This document deals with Tranche 2 of the REFCL installation program. The REFCL installation program is a major network augmentation and as such, it is subject to the regulatory investment test for distribution (RIT-D) in accordance with the Rules. The objective of the RIT-D is to identify the credible option for addressing a network need that maximises the net market benefit. In broad terms, the RIT-D achieves this objective by requiring the distributor:

- to undertake cost benefit analysis in accordance with the Rules and the AER's published RIT-D and guidelines; and
- to consult with Registered Participants, AEMO, interested parties and non-network providers.

A key part of the RIT-D process is the consideration of non-network alternatives. In particular, the Rules require the distributor to publish a "non-network options report" to screen for non-network options, unless the distributor determines that there will be no credible non-network options. In these circumstances, the distributor must publish a notice setting out the reasons for its determination, including any methodologies and assumptions it used in making its determination¹.

AusNet Services has determined that there are no credible non-network options and this document is AusNet Services' notice of determination under clause 5.17.4c of the NER. Therefore, in accordance with clause 5.17.4(d) of the Rules, AusNet Services will not be publishing a non-network options report. Our reasons are set-out in section 4 below.

It should be noted that the REFCL installation program is a 'contingent project' for the purposes of cost recovery. The AER has assessed AusNet Services Contingent Project Application and approved \$123.5 million in capital and operating expenditure to undertake this program. This regulatory process is separate to the RIT-D, although the contingent project application addresses many of the RIT-D requirements. The Contingent Project Application and the AER's decision can be found here:

<https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/contingent-projects/ausnet-services-contingent-project-installation-of-rapid-earth-fault-current-limiters-tranche-2>

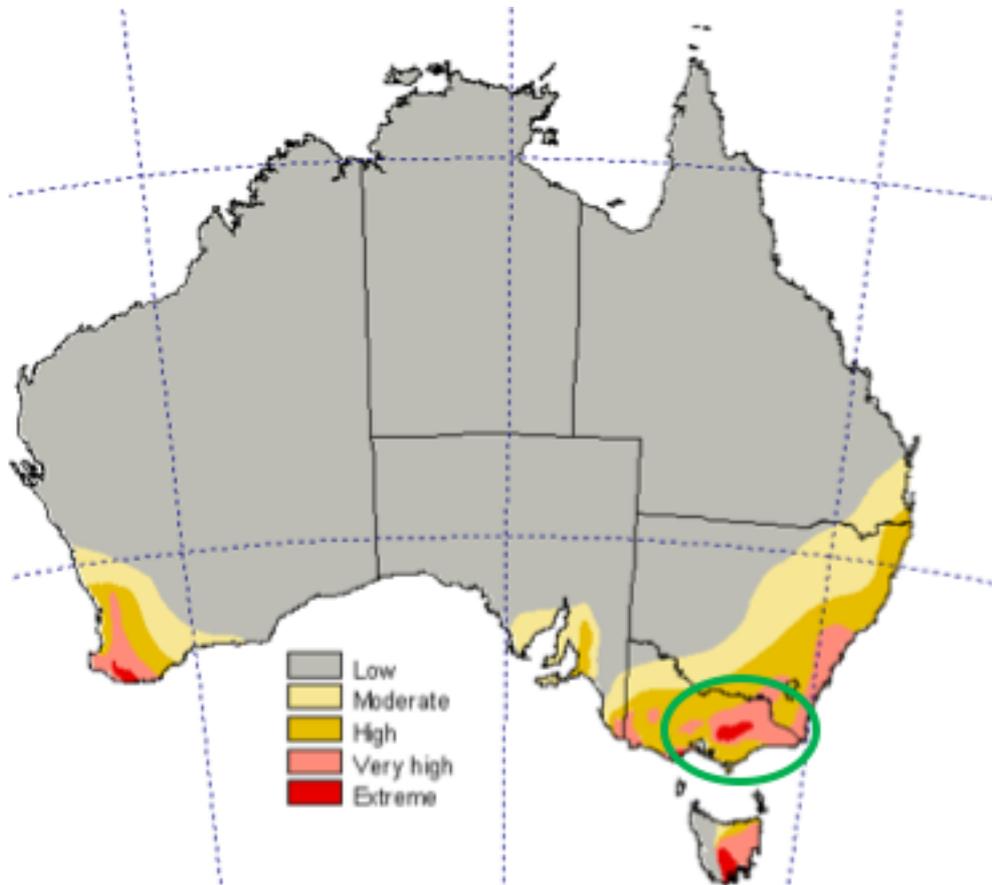
The remainder of this notice provides further background information on the REFCL installation program and the reasons for our determination.

¹ National Electricity Rules, clauses 5.17.4(c) and (d).

2 Background to the REFCL installation program

AusNet Services' network operates in a geographical location which is exposed to extreme bushfire risk. These conditions warrant significant investment to mitigate the bushfire risk.

Figure 1: AusNet Services' extreme bushfire risk



Following the 2009 bushfires, the Victorian Bushfire Royal Commission (**VBRC**) was established and the recommendations made by the VBRC drove changes to the Regulatory Regime (as described below) that ultimately have led to the roll-out of the REFCL technology.

2.1 Regulatory Regime

The AusNet Services REFCL roll-out Program is necessary to comply with the bushfire safety obligations imposed by the Victorian Government (**Government**) and is governed by a number of regulatory instruments. The regulatory framework has evolved and has become increasingly prescriptive over time and strict penalties for non-compliance have been introduced.

Each of the key regulatory instruments is described below.

2.1.1 Victorian Bushfire Royal Commission

The 2009 VBRC made several recommendations with respect to fires originating from electricity networks. Recommendation 27 called for new technology that delivered greatly reduced bushfire risk, being applied to all overhead conductors (Single Wire Earth Return (SWER) and 22kV powerlines) in high bushfire risk areas. The VBRC also suggested an expert taskforce be

established to advise on the best means of achieving the intent of this recommendation. The Powerline Bushfire Safety Taskforce (PBST) was established for this purpose.

2.1.2 Powerline Bushfire Safety Taskforce

The PBST made its report to Government in September 2011. The Taskforce recommended the risk of powerlines starting bushfires could be reduced by:

- Installing fault suppression equipment known as Rapid Earth Fault Current Limiters (REFCLs) on selected 22 kV powerlines to reduce the risk of polyphase powerlines starting fires by automatically reducing the electric current in some types of powerline faults;
- Installing remotely controlled Automatic Circuit Reclosers (ACRs) on SWER lines to reduce the risk of SWER lines starting fires by enabling the devices to be set remotely so that they turn off those powerlines quickly when faults occur; and
- Putting powerlines underground or insulating conductors in the areas of highest bushfire risk.

The Taskforce also indicated the need for further research and development, noting REFCLs had not previously been used for bushfire suppression. In December 2011, the Government accepted the Taskforce's recommendations and established the Powerline Bushfire Safety Program to determine the optimal method for deploying REFCLs for bushfire prevention. This included further investigation of the optimal approach, which included trials of REFCL technology at both Frankston South and Kilmore South zone substations.

2.1.3 REFCL – Regulatory impact statement

A Regulatory Impact Statement (RIS) was prepared by the consulting firm, ACIL Allen, on behalf of the Victorian Department of Economic Development, Jobs, Transport and Resources,² on the Government's proposal to mandate new fault suppression standards through the *Electricity Safety (Bushfire Mitigation) Regulations 2013*. The RIS assessment incorporated a detailed cost-benefit analysis indicating that the estimated costs of deploying REFCLs would be more than outweighed by the reliability and bushfire risk reduction benefits.

The RIS recommended the installation of REFCLs at 45 zone substation across Victoria of which 22 substations form part of AusNet Services' network.

2.1.4 Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016

Following the completion of the RIS process, the Government made the *Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016* which amend the *Electrical Safety (Bushfire Mitigation) Regulations 2013*.

The effect of the amended Regulations was to place three obligations on AusNet Services:

- To install REFCLs (or equivalent technology) at specified zone substations;
- Each electric line, within the Electric Line Construction Area, with a nominal voltage of between 1 kV and 22 kV that is constructed, or is wholly or substantially replaced, is to be a covered or underground electric line; and
- To Install an Automatic Circuit Recloser on each SWER line.

² ACIL Allen Consulting, *Regulatory Impact Statement – Bushfire Mitigation Regulations Amendment*, 17 November 2015. Available at http://www.acilallen.com.au/cms_files/ACILAllen_BushfireMitigationRIS_2015.pdf

Specifically, the amended Regulations required that each polyphase electric line originating from the 45 specified zone substations must have the following capability in the event of a phase to ground fault:

- a) *reduce the voltage on the faulted conductor in relation to the station earth when measured at the corresponding zone substation for high impedance faults to 250 volts within 2 seconds; and*
- b) *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) *1,900 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, 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 0.1.*³

The practical effect of the amendment is to impose an obligation on AusNet Services to install REFCLs at its specified zone substations.

The Regulations use a scoring system to establish milestones for completing the required works. Each zone substation is attributed a point score from 1 to 5, with the highest value attributed to those zone substations where fire mitigation measures would provide the greatest benefit.

AusNet Services is required to complete the works necessary in order to accumulate:

- 30 points by 1 May 2019;
- 55 points by 1 May 2021; and
- 63 points by 1 May 2023.

In total, the Regulations require AusNet Services to install REFCL devices at 22 zone substations by 1 May 2023.

2.1.5 Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017

The Victorian Government subsequently introduced the *Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017 (Amendment Act)*. This Amendment Act amended the *Electricity Safety Act 1998 (Vic) (ESA)* to provide for significant financial penalties if AusNet Services fails to achieve the number of points prescribed by the Regulations by the applicable deadline.

The penalties legislation prescribes a penalty of \$2,000,000 per point that AusNet Services falls short. Each zone substation is assigned a number of points (up to 5) depending on the degree of bushfire risk. Accordingly, penalties of up to \$10 million per zone substation can apply if AusNet Services fails to achieve the Required Capacity by the prescribed dates. Additionally, a daily penalty of \$5,500 can be applied for each day AusNet Services remains non-compliant.

These are significant financial penalties AusNet Services could incur, if it fails to meet its obligations. Additionally, this Amendment Act:

- Requires AusNet Services to prepare annual compliance reporting and associated independent audit; and

³ Other performance requirements are also specified in the definition of 'required capacity' in the *Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016*.

- Empowers ESV to request audits and information.

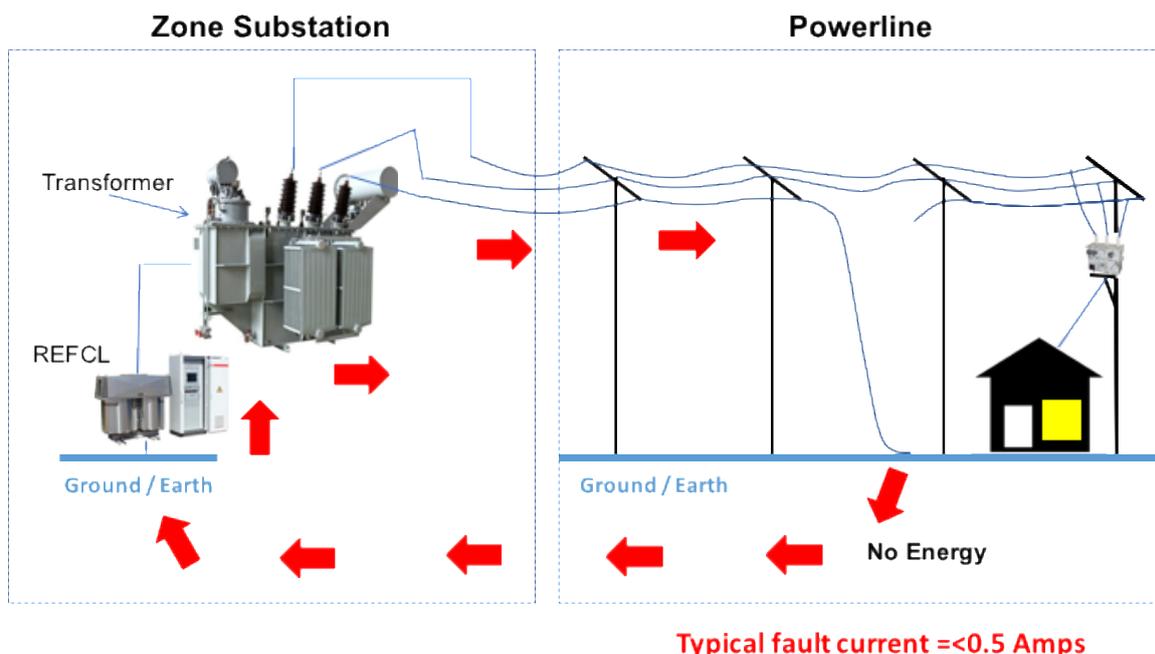
2.1.6 Victorian Electricity Distribution Code

The Electricity Distribution Code (EDC) specifies, in section 4.2.2, the maximum variations from standard nominal voltage for different voltage levels and durations. It is a condition of our Electricity Distribution Licence that AusNet Services comply with all applicable provisions of the EDC. Importantly, On 14 August 2018, the ESC published a final decision on changes to the Code, which allows AusNet Services to operate REFCL protected networks at elevated voltages and places an obligation on HV customers to ensure their installation can safely handle these elevated voltages.

2.2 How does REFCL technology work?

A REFCL is a type of electricity network protection device, which is designed to minimise the fault current (energy) dissipated from phase to earth (wire to ground) faults on the 22kV network in order to reduce the risk of fire ignition associated with network incidents, as shown below.

Figure 2: How does REFCL technology work?



Source: AusNet Services

There are various types of technology that fall under the REFCL umbrella, however the only type of REFCL currently considered suitable by the Victorian Electric Supply Industry (VESI) for bushfire safety is known as the Ground Fault Neutraliser (GFN), a proprietary product by Swedish Neutral. Presently, the GFN is the only device that can meet the performance criteria of the Regulations.

REFCL technology operating at the required performance standard will minimise the risk of fire ignition associated with phase to ground faults on days of heightened fire danger, such as those experienced on Ash Wednesday and Black Saturday. Based upon a sample period of network fault data, analysis undertaken by the Government and CSIRO predict network fire related incidents associated with the nominated zone substations may be reduced by between 50-55%.

A REFCL operates when a single phase-to-earth fault occurs. Its operation causes the phase to ground voltage of the faulted phase to be reduced to near earth potential (zero volts), thereby

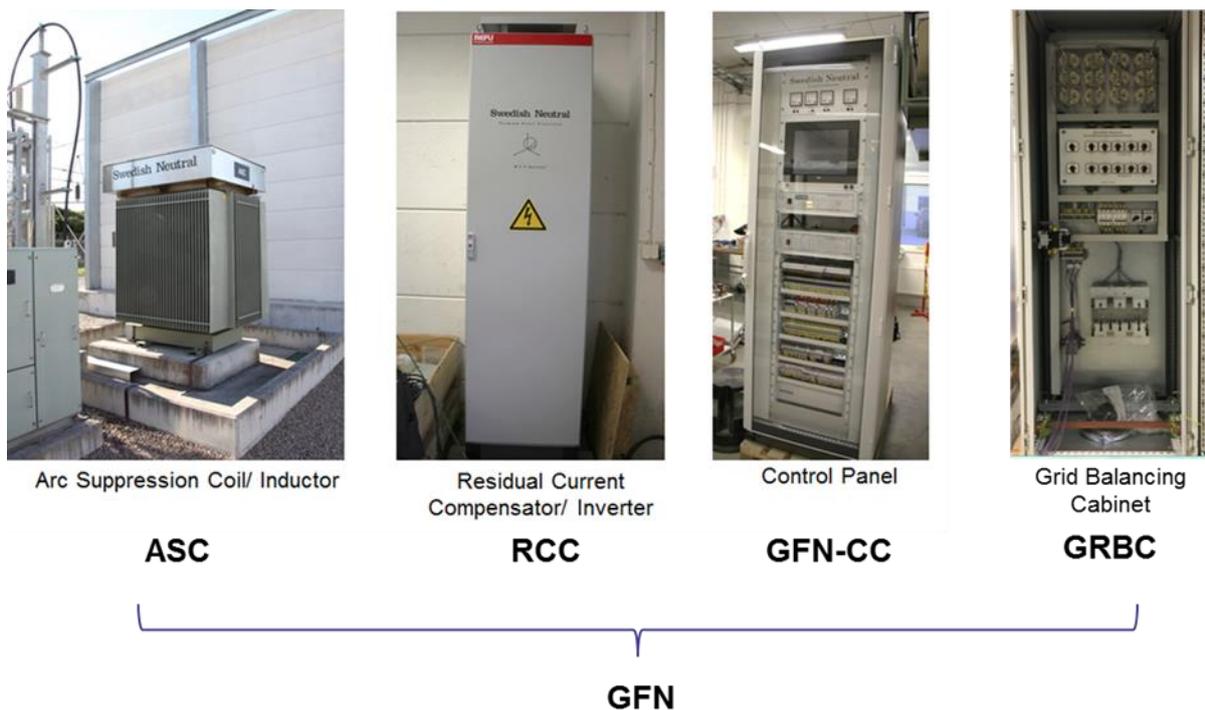
working to eliminate the flow of fault current. To achieve this outcome, the REFCL is tuned to the capacitance of the electrical network and a current injected into the transformer neutral that cancels the residual active fault current. This compensation results in phase to ground voltage on the faulted phase reducing to near 0 volts and the fault current being reduced to a very low value. The healthy phases could rise from 12.7kV to 24.2kV, being 22kV plus 10 per cent.

While the REFCL is compensating for a fault, the healthy phases remain energised and customers remain on supply. However, there remains a risk the energised phases may be in an unsafe condition depending on the nature of the network fault. Accordingly, a maximum compensating period will apply, which may be varied subject to a detailed risk assessment.

The REFCL technology is made up of 4 main components:

- Arc Suppression Coil – also known as a large inductor, which compensates for the leakage current during an earth fault.
- Residual Current Compensator – also referred to as the inverter, which is located in the zone substation control building or switchroom. It is used to reduce fault current by compensating for the active current during an earth fault.
- Control Cubicles, which controls the equipment.
- Grid Balancing Cabinet, which fine tunes capacitive imbalance from the zone substation to achieve better detection sensitivity.

Figure 3: Four components to REFCL technology



Source: AusNet Services

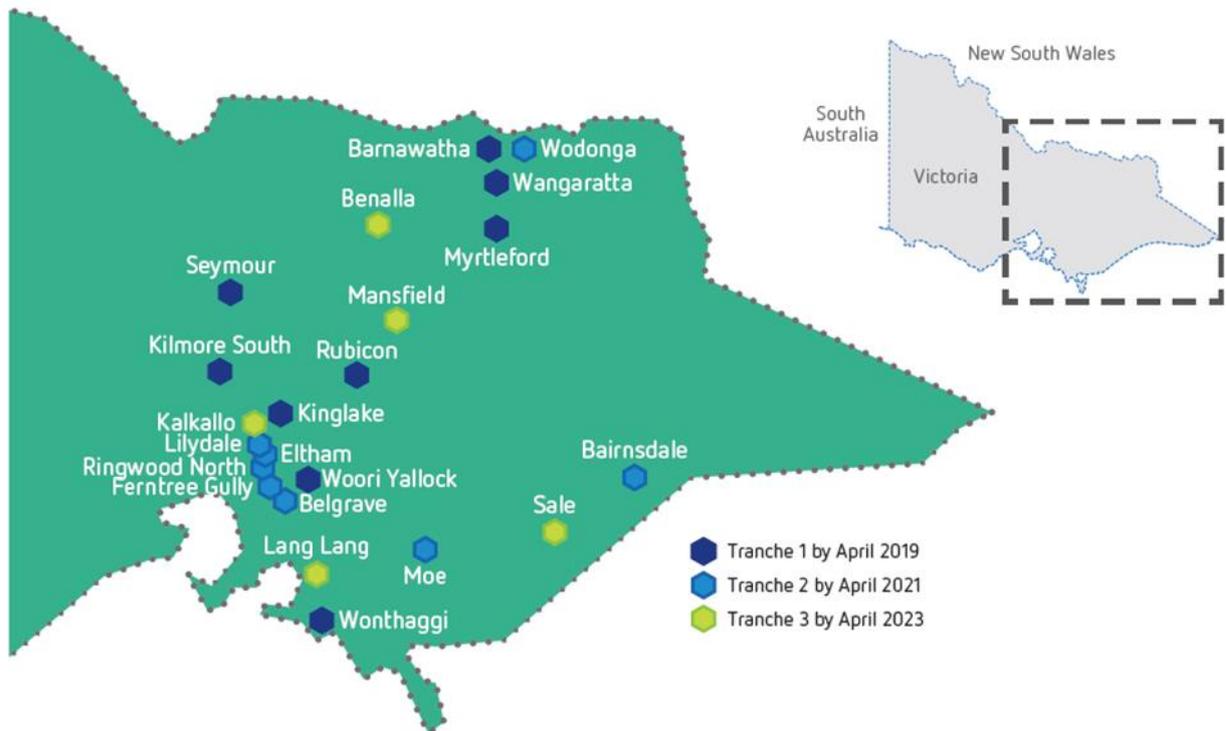
As explained further in our Contingent Project Application, the scope of the required works is much broader than the four components described above. This is because the installation of REFCLs requires a paradigm shift in how our network is designed, operated and maintained. As such, all components of the affected 22kV distribution network need to be reviewed to ensure that the REFCL enabled network continues to operate safely and reliably.

3 Proposed capital works

Each of the three Tranches have different characteristics and challenges. This arises due to the different nature of the substations and their respective supply networks progressed in each Tranche.

In Tranche 2, we are installing REFCLs at 8 zone substations. These zone substations are generally described as peri-urban – the area between urban and rural areas. In Tranche 1, the majority of substations were more rural in nature than those being undertaken as part of Tranche 2. Figure 4 below shows the substations that are being undertaken in each Tranche.

Figure 4 REFCL Program Overview



Source: AusNet Services

The proposed delivery schedule for each Tranche 2 zone substation is set out in Figure 5 below.

Figure 5: REFCL Tranche 2 timeline

Zone Substation	# of GFN's	2018				2019				2020				2021		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Ringwood North (RWN)	1		Design	Design		Construction	Construction	Compliance testing								
Eltham (ELM)*	2			Design	Design	Design		Construction	Construction				Compliance testing			
Ferntree Gully (FGY)	2			Design	Design	Design		Construction	Construction				Compliance testing			
Wodonga (WOTS)	2		Design	Design		Construction	Construction	Construction	Compliance testing							
MOE (MOE)*	2			Design	Design	Design	Design		Construction	Construction			Compliance testing			
Belgrave (BGE)	2			Design	Design	Design		Construction	Construction				Compliance testing			
Lilydale (LDL)	2				Design	Design	Design		Construction	Construction			Compliance testing			
Bairnsdale (BDL)	2			Design	Design	Design		Construction	Construction				Compliance testing			

* Associated rebuild activities not included

** Compliance testing is subject to the HV customer solution being in place & completion of line balancing works



3.1 Necessary works

Significant work is required at each zone substation to accommodate the installation of the REFCL equipment. Additionally, the speed and sensitivity at which the REFCLs operate means traditional protection schemes distributed along a feeder will not operate as they normally would, to detect and isolate a faulted section of the network. Further, the operation of the network with REFCL's in service imposes higher electrical stresses on the network.

As a consequence, capital works extend beyond the immediate confines of the zone substation to ensure that the network continues to operate safely and reliably and AusNet Services maintains compliance with its Distribution Code obligations. The REFCL project therefore involves five capital expenditure workstreams, described below:

- **Zone substation works**

Includes: REFCL installation (being the GFN) and associated equipment within the zone substation. It also includes the replacement of assets that fail during network hardening tests of the relevant high voltage network.

Reason: In addition to installing the REFCL, additional works are required because the REFCL technology is based on a different earthing philosophy. It is essential that the zone substation operates safely and reliably in the new environment.

- **Network Balancing**

Includes: Initial desktop and field modelling work followed by: capacitor bank installations, third phase installations and re-phasing long single phase lines.

Reason: Long single phase (two-wire) spurs teed off three-phase lines can create significant capacitive imbalance. Fire risk reduction relies on minimal capacitive imbalance on switchable sections of the network.

- **Line Hardening**

Includes: Surge Arrestor and underground cable replacements.

Reason: When an earth fault occurs, the REFCL response creates increased voltage stresses (compared to without REFCLs) on line equipment connected to un-faulted phases, which can lead to a second fault. In the absence of line hardening, the REFCL installation would increase fire risk and decrease network reliability.

- **Compatible Equipment**

Includes: Automatic Circuit Reclosers (ACR), Voltage Regulators, sectionalisers and Capacitor Bank replacements.

Reason: Some widely utilised line equipment cannot be used with REFCLs due to the reduced fault currents. This is separate to line hardening, which is solely concerned with the ability of line equipment to withstand over-voltage events.

In addition to these capital works, the project will also entail expenditure for an incremental increase in AusNet Services' operating expenditure.

4 Screening for credible non-network options

The Rules require distributors to apply the regulatory investment test for distribution (RIT-D) to all capital expenditure projects, with the exception of projects that are excluded by clause 5.17.3(a). The REFCL project does not benefit from an exclusion and therefore is subject to the RIT-D.

The purpose of the RIT-D is to identify the credible option for addressing a network need that maximises the net market benefit. It achieves this purpose by requiring the distributor:

- to undertake cost benefit analysis in accordance with the Rules and the AER's published RIT-D and guidelines; and
- to consult with Registered Participants, AEMO, interested parties and non-network providers.

In applying the RIT-D, the distributor is required to publish a 'non-network options report' to screen for lower cost non-network options, unless the distributor reasonably determines that there are no credible non-network options. In this event, the distributor must publish a notice setting out the reasons for its determination. In accordance with this Rule requirement, AusNet Services has determined that there are no non-network options in relation to the Tranche 2 REFCL installations and associated works, namely:

- Zone substation works;
- Network balancing;
- Line hardening; and
- Compatible equipment;

Our reasoning for concluding that there are no feasible non-network solutions are:

1. The installation of REFCLs is the only technically feasible solution currently available that is capable of satisfying the performance requirements specified in the Bushfire Mitigation Regulations.
2. The proposed capital works on AusNet Services' distribution network (and associated operating expenditure) are required to ensure that REFCL operation does not compromise the safety and reliability of AusNet Services' distribution network; and
3. As the proposed capital works address the impact of REFCL operation on our distribution network and its service performance, non-network solutions cannot provide an effective substitute for the proposed capital works.

In accordance with the Rules requirements, we note that these reasons are not dependent on any particular assumptions or methodologies.

In August 2018 the ESC published a final decision on changes to the Code, which allows AusNet Services to operate REFCL protected networks at elevated voltages and places an obligation on HV customers to ensure their installation can safely handle these elevated voltages. The impact of the changes to the EDC is that HV customers will need to manage any

necessary changes to their installations, to ensure that their installation is REFCL compliant. As such, any necessary works are now outside of the scope of our REFCL program and do not need to be considered further here.

4.1 Determination not to publish a non-network options report

For the reasons set out in section 4, there are no credible non-network options in relation to the Tranche 2 project to install REFCLs. Therefore, in accordance with clause 5.17.4(d) of the Rules, AusNet Services will not be publishing a non-network options report.