FINAL Decision
AusNet Services Contingent Project

Installation of Rapid Earth Fault Current Limiters (REFCLs) – tranche three

3 October 2019

AUSTRALIAN ENERGY REGULATOR

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Shortened forms

Shortened form	Extended form
ACR	Automatic Circuit Recloser
AER	Australian Energy Regulator
BN	Benalla Zone Substation
BMP	Bushfire Mitigation Plan
BMR	Electricity Safety (Bushfire Mitigation) Regulations 2013
capex	Capital expenditure
DELWP	Department of Environment, Land, Water and Planning
DNSP	Distribution Network Service Provider
EDPR	Electricity distribution price review
ESCV	Essential Services Commission (VIC)
ESV	Energy Safe Victoria
GFN	Ground Fault Neutraliser
HV	High voltage
KLO	Kalkallo Zone Substation
KLO2	Proposed Kalkallo number 2 Zone Substation
KLN	Proposed Kalkallo North Zone Substation
LLG	Lang Lang Zone Substation
LTIC	Long term interests of consumers
Minister	Victorian Minister for Energy, Environment and Climate Change
MSD	Mansfield Zone Substation
opex	Operating expenditure
REFCL	Rapid Earth Fault Current Limiter

RIN	Regulatory Information Notice
RIS	Regulatory Impact Statement
SCADA	Supervisory Control and Data Acquisition
SLE	Sale Zone Substation
STPIS	Service Target Performance Incentive Scheme
VEDC	Victorian Electricity Distribution Code
WYK	Woori Yallock Zone Substation
ZSS	Zone Substation

About this decision:

Unless specifically identified, we quote all monetary quantities in 2015 dollars for the following reasons:

- This contingent project application was lodged as a part of the current 2016-20 distribution revenue determination, which was made in reference to 2015 dollars. Hence, AusNet Services' application was submitted using real 2015 dollars.
- To enable readers to compare our decision against the Regulatory Impact Statement for REFCL.

The only exceptions where we provide dollar value in current date nominal dollars in this decision is in references to the Post Tax Revenue Model (PTRM) as per the National Electricity Rules

Overview

On 31 May 2019 AusNet Services submitted a contingent project application to the Australian Energy Regulator (AER) seeking an adjustment to its revenue allowance for tranche three of the REFCL program. It sought an additional capital expenditure (capex) and operating expenditure (opex) of $107.3 million[1] and $3.3 million ($real, 2015) respectively.[2] Of these expenditures, $41.9 million capex and $0.03 million opex are for the current 2016-20 period.

Under the National Electricity Rules there is provision for approval and treatment of contingent project capital expenditure that extends into the immediately following regulatory control period.[3] There is no such provision for operating expenditure.

We have determined that the prudent and efficient cost for achieving the tranche three REFCL works is:

- $94.4 million capital expenditure in total, of which $45.8 million to be spent during the current 2016-20 period. The remaining 48.6 million to be spent in the 2021-25 regulatory control period
- operating expenditure $0.03 million in total,[4] to be spent in 2020 the remaining year of the current 2016-20 period.

The key difference between our decision and that of AusNet's proposal is that we do not consider AusNet Services' proposal to build a new KLO2 zone substation represents the least cost option to meet the current legislative requirements for providing REFCL capacity at Kalkallo zone substation. This decision saves $13 million of capex.[5]

Other aspects of its proposal relating to the tranche three works, to install REFCLs and other related capital works, meet the prudency and efficiency criteria of the National Electricity Rules under which this proposal has been assessed.

The impact on customers' electricity bills for 2020 under this Tranche 3 project is about 60 cents for residential users and $1.50 for business customers.

Both AusNet Services and Powercor applied for funding of their respective tranches one and two works. We made decisions on the tranche one application on 21 August 2017 and tranche two on 31 August 2018.

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1 Including the late submission for funding to manage harmonic distortion.

2 All dollar amounts in this document are in real, $2015 in line with the AusNet Services distribution determination unless otherwise stated.

3 National Electricity Rules 6.5.7 (f)-(j)

4 We only review the opex requirement for the reminder of the current 2016-20 regulatory period. The opex requirement for 2021-2025 will be determined as a part of the distribution determination for the next regulatory period.

5 We rejected AusNet Services' proposed solution for KLO zone substation, which reduced the overall cost by $13m. However, this decision will result in a change in expenditure profile and an increase in the expenditure in the 2018-20 period, $4m higher than AusNet Services' original claim.

This tranche three application by AusNet Services

On 31 May 2019 AusNet Services submitted a contingent project application to the Australian Energy Regulator (AER) seeking an adjustment to its revenue allowance for the installation of REFCLs as required by the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (BMR).

The application seeks to recover projected capital expenditure of $105.5 million[6] for tranche three of the REFCL installation program with $41.9 million in the current (2016-20) regulatory period; and the expected operating expenditure of $0.03 million between 2018 and 2020. The proposed expenditure for tranche three is for:

- installation of REFCL devices at five zone substations
- replacement of equipment in the 22kV distribution network that is incompatible with REFCL operation
- other costs associated with the REFCL tranche three implementation
- management of risks associated with HV customer works to ensure the mandated timetable for REFCL implementation can be met.

Following advice by Energy Safe Victoria (ESV) on 12 July 2019 that AusNet Services must manage both the 50 Hz power frequency fault currents as well as other harmonic distortion currents under the BMR. AusNet sought additional funding for upgrade and additional numbers of capacitor banks at MSD, KLO, SLE and LLG.[7] The total cost of the upgrades amounts to $1.8 million.

Contingent project trigger event

Our distribution determination for AusNet Services' 2016-2020 regulatory control period included a trigger for 'Bushfire Mitigation Contingent Project 3 (tranche three of REFCL deployment) once the amended BMR came into effect. To be eligible to seek approval of the funding for the contingent project, AusNet Services is required to demonstrate the specified trigger event has occurred.

As set out in section 3.1, we consider that the requirements that comprise this trigger event have been satisfied.

Extension of time

AusNet Services submitted its application for this expenditure on 31 May 2019. On review we identified that the issues involved in assessing the application were difficult and complex and required further consideration. Accordingly, we issued a notice to AusNet Services on 3 July 2019[8] advising that the AER would extend the time limit to make this decision to 17 October 2019.[9]

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6 AusNet Electricity Services Pty Ltd: *Contingent Project Application, REFCL program, tranche three*, 31 May 2019, p. 6.

7 AusNet Services: email to AER: AusNet REFCL T3 Questions 2.0 23 August 2019

8 AER Letter to AusNet Services NER Extension of time limit under clause 6.6A.2(j). 3 July 2019

9 In accordance with the time limit extension provision of NER clause 6.6A.2(j).

Assessment approach

We detail our assessment approach in section 2. In summary, in reaching our decision we relied on the following information:[10]

- AusNet Services' application
- submissions received from stakeholders
- AusNet Services' responses to our questions and related comments
- our own analysis
- advice and assistance of Energy Safe Victoria (ESV) and the Essential Services Commission of Victoria (ESCV)
- relevant Victorian Government publications
- the revised Victorian Electricity Distribution Code effective 20 August 2018.
- regulatory Information including RIN data.

AER determination

Under the National Electricity Rules there is provision for approval and treatment of contingent project capital expenditure that extends into the immediately following regulatory control period.[11] There is no such provision for operating expenditure.

In accordance with clause 6.6A.2 of the NER, and taking into account stakeholder comments (see section 1.7), our determination is:

- $94.4 million capital expenditure in total, of which $45.8 million to be spent during the current 2016-20 period. This is a reduction of 10.5 per cent on AusNet's proposal.
- operating expenditure $0.03 million in total, to be spent in 2020 the remaining year of the current 2016-20 period; this approves AusNet's proposal.

We consider that:

- the project as described is consistent with the contingent project approved in the 2016-20 distribution determination
- the trigger event specified for this project has occurred
- the capital amount sought exceeds the contingency project threshold specified in rule 6.6A.1(b)(2)(iii)
- an adjusted allowance for works to integrate modified HV customer installations with its networks should be provided

[10] See: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/contingent-projects/ausnet-services-contingent-project-installation-of-rapid-earth-fault-current-limiters-tranche-3

[11] National Electricity Rules 6.5.7 (f)-(j)

- the operating expenditure reasonably required for the purpose of undertaking the project in each remaining year (there is only one year, 2020) of the current regulatory period is $0.03 million in total
- the total capital expenditure reasonably required to complete the project is $94.4 million, a reduction of 10.5 per cent on AusNet's proposal; this reflects the rejection of a second Kalkallo substation
- for the remainder of the current 2016-20 regulatory period, the smoothed annual revenue requirement has increased by around $763 000 to $3.157 billion total ($, nominal)
- this will lead to an increase of 60 cents in average electricity bills for residential customers and $1.50 for small business customers in 2020
- the X-factors should be adjusted as set out in section 4 to maintain the difference in the final year revenue (2020) of not more than 3%, consistent with the AusNet Services revenue determination
- the project has commenced and the likely completion date is 1 May 2023.

Our assessment on the impact on a typical customer's electricity bill is in Appendix C.

In making our determinations we consider the National Electricity Objective, which is to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers (LTIC) of electricity with respect to price, quality, safety, reliability, and security of supply of electricity; and the reliability, safety and security of the national electricity system.

However, the AER has no power to separately assess whether the requirements under the Electricity Safety (Bushfire Mitigation) Regulations (BMR) satisfy the NEO. This is a matter for the jurisdiction.

This decision is made under the National Electricity Rules (NER). The NER requires that we must provide adequate funding to enable distributors to comply with all applicable regulatory obligations.[12] This will enable the REFCL program to be appropriately funded to meet the mandated bushfire mitigation objectives of the Victorian Government, as set out in legislation and regulations. These are designed to reduce the risk of fire starts from falling or damaged assets.

The allowance we approve in this decision will enable AusNet Services to meet its obligations under these legislative provisions, while also ensuring the costs incurred are prudent and efficient to ensure that consumers do not pay more than necessary for the implementation of the REFCL program.

In accordance with clause 6.6A.2 of the NER, and taking into account stakeholder comments, our determination is that the bushfire mitigation tranche three contingent project should be approved, subject to adjustments to the capital and operating expenditure amounts as specified. This will lead to a small increase in required revenues to be recovered from

[12] Under clauses 6.5.6(a) and 6.5.7(a).

customers in the reminder of this current regulatory period and will be included in network charges in 2020.

Structure of this document

This document sets out our determination on the timing and amount of capital and incremental operating expenditure reasonably required within the current regulatory period to undertake this contingent project.

The decision is structured as follows:

- section one provides background, introduces the application and sets out our consultation process
- section two sets out our assessment approach
- section three sets out our assessment of AusNet Services' application
- section four sets out our calculation of the annual revenue requirement
- section five sets out our determination.

1 Introduction

This section sets out the relevant background information to our determination. It covers whether the contingent project trigger has been met and how AusNet Services' revenue allowance should be amended to meet its legal and licence obligations. To arrive at our determination on the application we took into account information provided by AusNet and public submissions received on the application.

1.1 What is a contingent project

Contingent projects are significant network augmentation projects that may arise during a regulatory control period but the need and or timing is uncertain at the time when we make a distribution determination. While the expenditures for such projects do not form part of our assessment of the total forecast capital expenditure that we approve in a determination, the cost of the projects may ultimately be recovered from customers—if:

- pre-defined conditions (trigger events) are met, where these project specific conditions are specified in the service providers' revenue determination
- the service provider submits an application for a contingent project, and we are satisfied that the pre-defined triggers have been meet
- we are satisfied that the proposed project is consistent with the contingent project specified in our revenue determination.
- We are satisfied the costs meet the expenditure criteria of being prudent and efficient to meet the expenditure objectives

1.2 Our role in this process

The Australian Energy Regulator (AER) is the economic regulator for electricity transmission and distribution services in the National Electricity Market (NEM) including Victoria.[13] Our electricity-related powers and functions are set out in the National Electricity Law (NEL) and National Electricity Rules (NER).

When we receive a contingent project application we publish the application and seek public comment. We assess the application to determine whether it contains the information required by the NER.[14] We examine evidence provided to determine if the mandatory pre-defined trigger event has occurred. We also examine whether the project outlined in the application is consistent with the contingent project approved in the distribution determination. We analyse the application to determine if the costs proposed represent a reasonable forecast of the capital and incremental operating expenditure required for the purpose of undertaking the contingent project, both overall and in each year remaining in the regulatory control period. If we are not satisfied that this is the case, we must determine a

[13] In addition to regulating NEM transmission and distribution, we also monitor the wholesale electricity and gas markets to ensure suppliers comply with the legislation and rules, taking enforcement action where necessary, and regulated retail energy markets in Queensland, New South Wales, the ACT, South Australia and Tasmania (electricity only) under the National Energy Retail Law.

[14] NER, clause 6.6A.2(b)(3).

substitute forecast. Where we have departed from the business' application we apply our adjustments to the post-tax revenue model to calculate the revenue the business may charge customers for the remainder of the regulatory period.

1.3 AusNet Services

AusNet Services is one of five DNSPs in Victoria and is responsible for providing electricity distribution services in outer eastern suburbs of Melbourne and eastern Victoria. We regulate the revenues AusNet Services and other electricity DNSPs can recover from their customers through determinations that cover the span of a regulatory control period. AusNet Services' current distribution determination is for the 2016–2020 regulatory control period.

We note that the tranche three works is expected to be completed in the forthcoming regulatory control period. The NER allows for treatment of forecast capital expenditure approved in the contingent project process where projects are expected to be completed in the immediately following control period.[15]

1.4 Other regulators - Energy Safe Victoria (ESV) and the Essential Services Commission of Victoria (ESCV)

ESV is the independent technical regulator responsible for electricity, gas and pipeline safety in Victoria. This includes administration of the *Electricity Safety Act 1998* (VIC) and the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (VIC). Distribution and transmission network service providers are required to submit a bushfire mitigation plan to the ESV for approval before 1 July of each year regarding powerlines identified as 'at risk' of starting fires. Businesses required to upgrade their network to comply with the new bushfire mitigation provisions must also submit annual compliance reports to the ESV regarding their progress.

The ESCV licenses energy retailers and DNSPs to operate in Victoria and administers the Victorian Electricity Distribution Code (VEDC) that all electricity DNSPs must abide by as a condition of their distribution licence. The VEDC includes provisions on quality and reliability of supply.

1.5 Bushfire mitigation reforms

In the wake of the events of 2009's Black Saturday, the Victorian Bushfires Royal Commission (VBRC) published 67 recommendations[16] all of which were subsequently accepted by the Victorian State Government.

On 1 May 2016, the Victorian Parliament passed legislation to implement a number of the recommendations of the VBRC in the form of amendments to the *Electrical Safety (Bushfire Mitigation) Regulations 2013*.[17] The amendments introduced new technical obligations on three Victorian DNSPs that operate in high risk bushfire areas. These obligations include:

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15 National Electricity Rules 6.5.7 (f) - (j)

16 VBRC, *Final Report* (summary), July 2010, http://www.royalcommission.vic.gov.au/finaldocuments/summary/PF/VBRC_Summary_PF.pdf

17 *Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016* (VIC), http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubStatbook.nsf/93eb987ebadd283dca256e92000e4069/9CC083A75311B617CA257FA100148082/$FILE/16-032sra%20authorised.pdf

- each polyphase electric line originating from a selected zone substation must have the "*required capacity*" specified in the BMR
- 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 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.

Further, Schedule 2 of the legislation defines 45 *selected zone substations* and assigns a point value to each one based on the level of bushfire risk. Victorian DNSPs must meet the *required capacity* obligations for *selected zone substations* totalling:

- at least 30 points by 1 May 2019[18]
- at least 55 points by 1 May 2021[19]
- any remaining *selected zone substations* by 1 May 2023.

The *required capacity* for a polyphase line originating from a *selected zone substation* is defined by the legislation 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 faults 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*[20]

[18] Alternatively, DNSPs must meet this obligation for all *selected zone substations* if less than 30 points of a DNSP's substations are defined in Schedule 2.

[19] Alternatively, DNSPs must meet this obligation for all *selected zone substations* if less than 55 points of a DNSP's substations are defined in Schedule 2.

[20] *Electricity Safety (Bushfire Mitigation) Regulations 2013* (VIC), Definitions.

In addition, increased compliance incentives were introduced on 11 May 2017 when the Victorian Parliament passed the *Electricity Safety Amendment (Bushfire Mitigation Civil Penalties Scheme) Act 2017*. The Act introduced civil penalty provisions for the new requirements on DNSPs, including a single fine for individual contraventions and additional fines for each day the contravention remains unresolved.

Installation of REFCLs

The BMR specifies a "required capacity" that the Victorian DNSPs are obligated to meet. REFCLs are the only available technology to meet these requirements. The required capacity is mandated by the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (BMR),[21] distributors' safety management plans and other obligations imposed by Victorian safety legislation

REFCL means "Rapid Earth Fault Current Limiter". This device can detect single phase-to-earth faults almost instantaneously. It then cancels the voltage on the faulted line within milliseconds of detecting it and limits the voltage of the fault to below the point where it can start a fire (the active protection mode).[22]

During the period when REFCL is in active protection mode, the phase to ground voltage of the two remaining phases will be increased by 73 per cent above the normal level. Hence, some of the older equipment will need replacing to ensure safety.

The increase in voltage may also cause damage to the equipment of customers with a high voltage connection.

The key component of REFCLs is called Ground Fault Neutralisers (GFNs). REFCLs are distinguished by the addition of residual current compensation and advanced control technology to a GFN which underpins the high performance REFCL. References to GFN technology in this discussion are generally interchangeable with REFCL technology, unless the context specifies otherwise.

Implementation of the REFCL program

Under the BMR, the 'required capacity', which can only be met by the installation of REFCLs, must be implemented in three tranches:

- Tranche one–to complete the installation of REFCLs in 16 zone substations (8 in AusNet Services area and 8 in Powercor area) and make them operational by May 2019.
- Tranche two–to complete the installation of REFCLs in 15 zone substations (9 in AusNet Services area and 6 in Powercor area) and make them operational by May 2021.

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

22 REFCL cannot provide protection if more than one conductor falls on the ground simultaneously or if a second "cross-country" fault occurs, remote from the first.

A cross-country fault can result when the REFCL is limiting the voltage and current when a line falls to ground. If other assets on the network are not hardened a second fault on one of the healthy phases can occur when an asset fails which can be distant from the original line to ground fault. REFCLs can only handle one fault at a time. In this situation two high current faults can co-exist.

- Tranche three–to complete the installation of REFCLs in 14 zone substations (5 in AusNet Services area, 8 in Powercor area and 1 in Jemena area) and make them operational by May 2023.

1.5.1 Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016 - Regulatory Impact Statement

On 17 November 2015, a Regulatory Impact Statement (RIS) on the *Electricity Safety (Bushfire Mitigation) Amendment Regulations* was released by the Victorian Department of Economic Development, Jobs, Transport and Resources.[23]

The RIS identified that the proposed regulations would impact AusNet Services and Powercor significantly (as the operators of the vast majority of rural powerlines in Victoria), with Jemena impacted to a much smaller degree. Its analysis was based on installation of a REFCL device at each of the 45 selected zone substations.

The RIS acknowledged that some equipment belonging to HV customers directly connected to the 22kV network may need to be replaced as a consequence of REFCL installation at the zone substation. The RIS stated that these costs would be incurred by HV customers. However, in tranche one of the bushfire mitigation contingent project, we found that the effect of the VEDC as it operated at the time was to require the DNSPs to incur this cost.

1.5.2 Previous AER decisions relating to this application

The positive pass through amount of $20.2 million ($2012) approved by the AER for AusNet Services in October 2012 included funding for REFCL trials at the Woori Yallock zone substation that had been approved by ESV.[24]

In the 2016-2020 distribution determination decision for AusNet Services, trigger events were defined for three successive bushfire mitigation contingent projects during the 2016-2020 regulatory period.[25] These contingent projects are specifically for expenses incurred to comply with Victorian bushfire regulations that prescribe the installation of REFCLs and associated works.

1.5.3 REFCL contingent project tranche one

On 31 March 2017, AusNet Services submitted an application to us seeking a determination for funding for a contingent project to be approved, and its maximum allowed revenue to be adjusted in accordance with the NER, to enable it to install REFCLs at designated zone

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[23] See: https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/electrical-safety-bushfire-mitigation-further-amendment-regulations-2016

[24] AER: *Final decision - SP AusNet pass through application,* 19 October 2012: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-pass-throughs/sp-ausnet-cost-pass-through-victorian-bushfire-royal-commission-vbrc-31-july-2012

[25] AER: *Final decision – AusNet Services distribution determination 2016-20, Attachment 6 – Capital expenditure*, p. 126, https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/ausnet-services-sp-ausnet-determination-2016-20/final-decision

substations for tranche one of the REFCL program, as specified by the BMR. The REFCL installations identified in tranche one must be operating by 1 May 2019.

The tranche one application:

- forecast capital expenditure of $108 million ($2016), representing a 5.95% increase on our approved total capital expenditure in its 2016-2020 distribution determination for AusNet Services
- forecast incremental operating expenditure of $2.9 million, representing 0.24% increase on the same distribution determination
- proposed accelerated depreciation of $2.7 million for assets removed before the end of their economic life
- included costs incurred to maintain network reliability
- included costs to isolate or harden customer installations to operate safely with REFCL devices in operation.

Our final decision released on 21 August 2017, approved AusNet Services' application for contingent project funding with modifications to the amounts sought. In particular, it provided for $97.4 million (real, $2016) in total, of capital expenditure for tranche one of the project.

1.5.4 REFCL contingency project tranche two

On 20 April 2018, AusNet Services submitted an application to us seeking a determination for funding for a contingent project to be approved, and its maximum allowed revenue to be adjusted in accordance with the NER, to enable it to install REFCLs at designated zone substations for tranche two of the REFCL program, as specified by the BMR. The REFCL installations identified in tranche two must be operating by 1 May 2021.

The tranche two application:

- forecast capital expenditure of $139.9 million—reduced to $134.4 million after VEDC review, representing a 6.1% increase on our approved total capital expenditure in its 2016-2020 distribution determination for AusNet Services
- forecast incremental operating expenditure of $4.9 million, representing 0.39% increase on the same distribution determination
- proposed accelerated depreciation of $5.1 million for assets removed before the end of their economic life
- included costs incurred to maintain network reliability
- included costs to isolate or harden customer installations to operate safely with REFCL devices in operation.

Our final decision released on 31 August 2018, approved AusNet Services' application for contingent project funding with modifications to the amounts sought. In particular, it provided for $123.5 million in total, of capital expenditure and $872 000 for operating expenditure for

tranche two of the project. This was a reduction of nearly 12% in capital expenditure and 82% in operating expenditure from what AusNet had proposed

Essential Services Commission voltage standards review

A significant matter for tranche one was the Victorian Government's preference that in complying with the BMR, costs to protect HV customer networks during REFCL operation should be borne by the relevant customers. However, the voltage limits specified in the VEDC made DNSPs liable for these costs, which would be passed on to all their customers. Consequently, the ESCV undertook a review of the voltage standards in the VEDC to address this inconsistency. The review was completed and the revised VEDC came into effect on 20 August 2018. It has a direct effect on the allowances we have determined for tranches two and three.

REFCLs are designed to trigger when an abnormal scenario occurs on a network. For example, when a powerline of a 3-phase network falls and comes into contact with the ground, REFCLs operate to rapidly reduce the potential of an electrical spark igniting a fire by redirecting the power from the fallen line to the remaining lines. In doing so it increases the voltage levels of the other two phases of the powerline exceeding the allowable level specified by the version of the VEDC prior to the August 2018 amendment.

To accommodate the voltage variations stemming from REFCL activity, the ESCV has amended the VEDC to allow for voltage variations during REFCL operation in relevant parts of the electricity distribution networks.

The revised VEDC:

- introduces voltage variation limits that apply when REFCLs operate for bushfire risk mitigation
- introduces new obligations for DNSPs to annually publish information on planned REFCL installations
- clarifies the liability of affected parties during REFCL operation, including DNSPs and high voltage (HV) customers
- introduces new definitions to support REFCL operation.

One of the consequences of allowing higher voltages during REFCL operation is that HV customers will need to adopt measures to protect their equipment from high voltage events.

During the ESCV's consultation we provided a submission supporting the proposed changes to voltage standards to the minimum extent necessary to deal with overvoltage events caused by REFCL operation mandated under the BMR. We welcomed the requirement for HV customers to modify their networks to suit REFCL operation, and the removal of phase-to-earth voltage limits when a REFCL is operating. We also supported proposed changes to address customer information, reporting and monitoring requirements.

1.6 AusNet Services' tranche three application

On 31 May 2019, AusNet Services submitted a contingent project application for funding to install REFCLs at five zone substations and associated works.

The expenditure required to install REFCLs was not included in AusNet Services' revenue allowance for the 2016–2020 regulatory control period. Instead, the AER's final decision

specified the installation of REFCLs as three consecutive contingent projects (i.e. a project whereby capital expenditure is probable in the regulatory control period, but either the cost, or the timing of the expenditure is uncertain).

AusNet Services has split its programme of REFCL installations across its 22 named zone substations into three tranches. These tranches align with the three dates provided in the new bushfire legislation by which a certain proportion of the named zone substations must meet the required capacity for phase to ground faults (see section 1.4 above). The third tranche, which is the subject of this contingent project application, is for works to be completed and operating by 1 May 2023.

We published the application for public consultation on 7 June 2019.

We identified that the issues involved appeared difficult or complex. Accordingly, we issued a notice to AusNet Services on 3 July 2019 advising that we would extend the time limit to make this decision by 17 October 2019.

AusNet Services' contingent project application sought revenue requirement for the 2016-2020 regulatory period as shown in **Table 1.1.**

Table 1.1: Contingent project revenue requirement, 2016-20 ($m, nominal)

AusNet Services	2016	2017	2018	2019	2020	Total
Return on capital	-	0.0	0.0	0.0	0.7	0.8
Regulatory depreciation	-	-0.0	-0.0	-0.1	0.1	0.1
Operating expenditure	-	0.0	0.0	0.0	0.0	0.0
Revenue adjustments	-	-	-	-	-	-
Net tax allowance	-	-0.0	-0.0	-0.0	-0.0	-0.1
Annual revenue requirement (unsmoothed)	**-**	**0.01**	**0.01**	**-0.1**	**0.8**	**0.8**
Annual revenue requirement (smoothed)	**-**	**-**	**-**	**-**	**0.8**	**0.8**

Source: AusNet Services, *Contingent project application, REFCL program (tranche three),* 31 May 2019, table 3, p.7.

The contingent project for tranche three relates to REFCL installation works at the following zone substations:

- Benalla (BN)
- Kalkallo (KLO), including the construction of a new KLO2 zone substation
- Lang Lang (LLG)

- Mansfield (MSD)
- Sale (SLE)

The proposed total capital expenditure is nearly $42 million in the current regulatory period for the five REFCL projects. AusNet Services sought to amend to its previously approved expenditure and revenue requirements to levels as shown in **Table 1.2.**

Table 1.2 Proposed revenue requirement, after adding in the tranche three works ($m, nominal)

	2016	2017	2018	2019	2020	Total
Return on capital	217.3	230.9	251.2	268.2	289.7	1,257.4
Regulatory depreciation	103.0	87.6	92.9	96.6	105.6	485.7
Operating expenditure	230.4	240.2	251.8	262.7	275.1	1,260.1
Revenue adjustments	5.3	-6.4	-3.6	16.2	0.1	11.6
Net tax allowance	33.0	26.9	27.5	28.9	28.3	144.7
Annual revenue requirement (unsmoothed)	**589.0**	**579.3**	**619.8**	**672.6**	**698.8**	**3,159.4**
Annual expected revenue (smoothed)	**586.0**	**597.9**	**623.0**	**656.9**	**693.3**	**3,157.1**
X-factor	8.27%	0.30%	-1.84%	-3.01%	-3.13%	n/a

Source: AusNet Services, *Contingent project application, REFCL program (tranche three), 31 May 2019* Table 30, p. 65.

Late submission for new specification capacitor banks

AusNet Services did not include costing for managing harmonic distortion in its original application, as it was waiting for clarification from ESV.

Following advice by ESV on 12 July 2019 that AusNet Services must meet the required capacity in terms of both the 50 Hz power frequency fault currents as well as other harmonic distortion currents under the BMR. AusNet Services advised us that it needed to change its application and sought additional funding for upgrade and additional numbers of capacitor banks at MSD, KLO, SLE and LLG.[26] The total cost of the upgrades amounts to $1.8 million.

[26] AusNet Services: email to AER: AusNet REFCL T3 Questions 2.0 23 August 2019

1.7 Our consultation process

For the purpose of seeking public comment, our practise is to publish applications for a contingent project as soon as practicable after they have been received. Submissions received are considered by us before we make a decision on the application.[27]

1.7.1 Submissions

We received two written submissions from Ms Jill Porter and the Victorian Minister for Energy, Environment and Climate Change. Stakeholder views and our responses are summarised below.

Ms Jill Porter

Ms Porter's questioned the efficacy of REFCL technology in preventing fire starts and expressed concerns that providing funding for the REFCL program is not prudent and efficient, given that:[28]

- REFCL would not have prevented some types of fires caused by powerlines
- reported implementation issues when implementing tranche one installations
- the potential for greater risk and harm to rural communities from REFCL operations via cross country faults.[29]

AER response

The Victorian Government in its *Electricity Safety (Bushfire Mitigation) Regulations 2013* (BMR) mandated a "required capacity" for reduction in fault current in single phase faults and for this to be implemented through a rolling program of works that needs to be completed by 2023 – Tranche one works are to be completed in 2019, tranche two in 2021 and tranche three in 2023. At present the only way to achieve this is by installing a REFCL.[30, 31] Consequently, we do not have the power to prescribe or approve funding for another technology or reject this technology selection, noting that REFCLs are the only available technology that can comply with the requirements of the BMR. The NER prescribes that we must approve an efficient level of funding for AusNet Services to meet the regulatory requirements set out in the BMR.[32] The AER cannot separately assess whether the requirements under the BMR satisfy the NEO. This is a matter for the jurisdiction.

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27 NER, clauses 6.6A.2(c) and (d) also apply.

28 Jill Porter; Submission to AER AusNet Services contingent project tranche three 26 July 2019

29 A cross-country fault can result when the REFCL is limiting the voltage and current when a line falls to ground. If other assets on the network are not hardened a second fault on one of the healthy phases can occur when an asset fails which can be distant from the original line to ground fault. REFCLs can only handle one fault at a time. In this situation two high current faults can co-exist.

30 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-consultation-papers/response-to-pbst

31 See the Victorian Department of Environment, Land, Water and Planning website for further information on the Bushfire mitigation regulations, https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/electrical-safety-bushfire-mitigation-further-amendment-regulations-2016.

32 Under clauses 6.5.6(a) and 6.5.7(a).

The allowance we approve in this decision will enable AusNet Services to meet its obligations under legislation; while also ensuring the costs incurred are prudent and efficient to ensure that consumers do not pay more than necessary for the implementation of the REFCL program.

There was also a concern the costs of this program have proven to be much higher than what had been forecast in the RIS in 2015. The RIS was prepared in 2015 largely based on preliminary costing information provided by the DNSPs and assessments made at the time. We have investigated the reasons for the differences between the preliminary costing and the more detailed scope of works assessments which are now available. These are supported by experience gained by both DNSPs in tranches one and two. More detail is provided in the later sections of this decision dealing with benchmarking of particular asset classes. We are satisfied that the increased volumes of work are well substantiated.

Minister for Energy, Environment and Climate Change

The Victorian Minister for Energy, Environment and Climate Change provided a submission supporting the continued implementation of REFCLs under tranche three. The Minister identified the need to implement the installation program at a fair and reasonable cost to electricity consumers, requesting us to undertake all regulatory, technical and financial due diligence to interrogate all capital and operating expenditure claims from the DNSPs.

In addition, the Minister identified two specific concerns.

1. Unwarranted expenditure associated with the Kalkallo KLO zone substation

   Regarding the two options proposed by AusNet Services to address the high level of capacitance current due to underground cable, the Minister made the following points:

   - the KLO and KLO2 option has considerable uncertainty around cost
   - a new option presented as a late submission by AusNet Services, KLN has changed considerably from the initial KLO2 option
   - the contingent project application associated with KLO and KLO2 does not include a forecast of capital expenditure requirement or project plan identifying the scope of work and proposed costings for each of the proposed capital works forming part of the contingent project; in addition, the options presented by AusNet Services have demonstrated the uncertainty and evolving nature to identify a suitable alternative solution
   - some of the proposed works cannot be directly attributable to the REFCL program and that some portion of the works should be treated as augex and treated in the Electricity distribution price review (EDPR) for the 2021-25 regulatory control period

   AER response

   We share the same concerns as the Minister on AusNet Services' proposal regarding the KLO zone substation. Our analysis and decision on the REFCL obligations for KLO is covered in section 3.5.1.

2. Non-REFCL related costs appear to be included in AusNet's Tranche three contingent project application for the Kalkallo, Benalla, Lang Lang, Mansfield and Sale zone substations

The Minister made the following points:

- There is an overlap between REFCL related capex through the contingent project process and general 'business as usual' capex funded through the EDPR (reset) process and there is no accounting mechanism in place to correct for that overlap in the assessment process for each regulatory control period, in particular:
    - The 22kV switchgear in Lang Lang (LLG) zone substation has suffered major internal damage due to water ingress into the control room where it is housed. This switchgear is due for replacement.
    - AusNet Services' application included installation of new 66kV switchgear at Mansfield zone substation, which is not subject to REFCL regulation's 'required capacity' requirement.

AER response

We acknowledge the Minister's concerns that some of the existing network equipment is old and potentially due for replacement in the near future, but should not be replaced prematurely. We agree that equipment still in serviceable condition should not be replaced as part of this tranche of works unless it is impacted directly by the operation of REFCLs. Information provided by AusNet Services shows this is the case for switchgear at LLG.

While the 22kV switchgear is not in pristine condition, it is still serviceable at present. However, the LLG switchgear will not be able to withstand the higher voltage conditions imposed by the operations of REFCL due to previous major water damage. Such a need is similar to the network hardening cost for replacement of old surge diverters.

A detailed explanation of the need to replace the 22kV switchgear at Land Lang zone substation (LLG) by AusNet Services is available in Appendix A.

Regarding the need for additional 66kV switchgear requirement at Mansfield zone substation (MSD), AusNet Services clarified that:[33]

Merrijig zone substation (MJG) is served as a radial 66kV feeder which is switched via two 66kV circuit breakers at MSD. There are two transformers on MSD fed by two buses. During REFCL testing, maintenance and fault operations, the two buses need to be split. An alternate path through the proposed new 66kV switchgear will be needed otherwise a fault on the Merrijig line would cause outages at both MJG and MSD.

[33] AusNet Services: email to AER AusNet Services REFCL T3 Questions 2.0 attachment Information Request 2.0 REFCL T3, 23 August 2019

2 Assessment approach

Our assessment of the AusNet Services application occurs in two phases. First, we assess the application for compliance as a contingent project with NER clause 6.6A.2(b). Second, we examine the details of the proposal for compliance with the further requirements of NER clause 6.6A.2, particularly in relation to prudent and efficient costs.

We examined AusNet Services tranche three application and assessed it to be compliant under clause 6.6A.2(b) of the NER.

To complete the review of the application we:

- sought further information from AusNet Services and examined its responses
- conducted analysis of their proposed schedule of works identified in the application.

2.1 National Electricity Rules requirement

The NER states a contingent project application must contain the following information:[34]

(i) an explanation that substantiates the occurrence of the trigger event;

(ii) a forecast of the total capital expenditure for the contingent project;

(iii) a forecast of the capital and incremental operating expenditure, for each remaining regulatory year which the Distribution Network Service Provider considers is reasonably required for the purpose of undertaking the contingent project;

(iv) how the forecast of the total capital expenditure for the contingent project meets the threshold as referred to in clause 6.6A.1(b)(2) (iii);

(v) the intended date for commencing the contingent project (which must be during the regulatory control period);

(vi) the anticipated date for completing the contingent project (which may be after the end of the regulatory control period);

(vii) an estimate of the incremental revenue which the Distribution Network Service Provider considers is likely to be required to be earned in each remaining regulatory year of the regulatory control period as a result of the contingent project being undertaken as described in subparagraph (iii);

In assessing applications we must take into account:[35]

(1) the information included in or accompanying the application;

(2) submissions received in the course of consulting on the application;

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[34] NER, clause 6.6A.2(b)(3).

[35] NER, clause 6.6A.2(g).

(3) such analysis as is undertaken by or for us;

(4) the expenditure that would be incurred in respect of a contingent project by an efficient and prudent Distribution Network Service Provider in the circumstances of the Distribution Network Service Provider;

(5) the actual and expected capital expenditure of the Distribution Network Service Provider for contingent projects during any preceding regulatory control periods;

(6) the extent to which the forecast capital expenditure for the contingent project is referrable to arrangements with a person other than the Distribution Network Service Provider that, in the opinion of the AER, do not reflect arm's length terms;

(7) the relative prices of operating and capital inputs in relation to the contingent project;

(8) the substitution possibilities between operating and capital expenditure in relation to the contingent project; and

(9) whether the capital and operating expenditure forecasts for the contingent project are consistent with any incentive scheme or schemes that apply to the Distribution Network Service Provider under clauses 6.5.8, 6.5.8A or 6.6.2 to 6.6.4.

In making this decision we had regard to the requirements of clause 6.6A.2(e)(1), taking into account the factors in clauses 6.6A.2(f) and 6.6A.2(g) and the additional requirements of clause 6.6A.2(h).

2.2 Our approach

To assess AusNet Services' application for a contingent project we followed the process set out in NER clauses 6.6A.2. Specifically we:

- verified that a project trigger event had occurred
- tested that the amount sought exceeded the threshold for a contingent project as set out in rule 6.6A.1(b)(iii)
- reviewed the application and public submissions.

We then investigated the following matters:

- differences between AusNet Services' estimates included in its application and the outturn costs for works undertaken in tranche one (and two) of the project (where available)
- differences between the AusNet Services Tranche three application, and Tranche one and Tranche two applications, and Powercor Tranche one and Tranche two applications
- whether the proposed implementation methods deliver a prudent and efficient outcome
- VEDC compliance

- differences between REFCL driven expenditure and reliability objectives already incentivised under the STPIS program, to ensure there is no conflict between the REFCL modifications and those achieved through reliability incentives
- differences between DNSP obligations and REFCL related statutory compliance obligations
- capex vs opex balance
- costs included in the revenue determination
- treatment of depreciation
- production of estimates
- governance.

We examined these matters and sought further information from AusNet Services where necessary and considered its responses. We also considered its application against the benchmark of a prudent and efficient network business.

It should be noted that although the REFCLs are a new technology and represent a significant part of the overall investment, the program of works also comprises electrical components which are widely used in providing distribution services and whose costs and operation are well known and represent existing technology. Our benchmarking activity compared the following points of reference:

- AusNet Services tranche one decision
- AusNet Services tranche two decision
- Powercor tranche one decision
- Powercor tranche two decision
- the RIS and
- AER benchmarks for common distribution equipment for all DNSPs in Australia.[36]

We concluded that AusNet Services proposed expenditure was efficient in most respects, with the key exception being in relation to the need for new KLO expenditure. We also considered whether a prudent and efficient network business would have structured the project in a similar way to that proposed by AusNet Services, and concluded they would with some exceptions.

During the course of our assessment AusNet Services requested that commercially sensitive information remain confidential. We granted its request on the understanding that:

- the project involves substantial new works that have yet to be put to tender, and that publishing the information will provide price signals to prospective tenderers which may lessen competitive pricing pressure

[36] To benchmark particular components such as conductors, transformers, civil works and buildings, general electrical estimating skills using online and publicly available quantity surveying resources were also used.

- although in general, our preference is to publish all relevant information, on balance we consider that maintaining the confidentiality of the specific estimates in this project will better serve the long term interests of consumers. This approach is also consistent with our confidentiality guideline.

We sought advice from internal technical experts to assist us in making this determination. They examined how estimates were constituted and identified some weaknesses in AusNet Services' application which we addressed in our questions to AusNet Services.

Having determined the required capital and operating expenditure necessary to complete the project, we modified the proposed post tax revenue model (PTRM) to reflect the allowances we consider appropriate. All other parameters remain unchanged.

3 AER Assessment

3.1 Trigger event

In its revised revenue application for the 2016-20 regulatory period submitted to us on 6 January 2016, AusNet Services proposed a three element trigger for the bushfire mitigation contingent project. In our final decision on AusNet Services' 2016-2020 distribution determination published 26 May 2016, we approved bushfire mitigation contingent project three as a contingent project.

The trigger event for bushfire mitigation contingent project 3 was described as follows:[37]

> *In circumstances where a new or changed regulatory obligation or requirement (within the meaning given to that term by section 2D of the National Electricity Law) ("relevant regulatory obligation or requirement") in respect of earth fault standards and/or standards for asset construction and replacement in a prescribed area of the State is imposed on AusNet Services during the 2016–20 regulatory control period, the trigger event in respect of bushfire mitigation contingent project 3 occurs when all of the following occur:*
>
> *i. AusNet Services has identified the proposed capital works forming a part of the project, which must relate to earth fault standards and/or standards for asset construction and replacement in a prescribed area of the State and which are required for complying with the relevant regulatory obligation or requirement. The proposed capital works must be listed for commencement in the 2016–20 regulatory control period in regulations or legislation, or in a project plan or bushfire mitigation plan, accepted or provisionally accepted or determined by Energy Safe Victoria;*
>
> *ii. for each of the proposed capital works forming a part of the project AusNet Services has completed a forecast of capital expenditure required for complying with the relevant regulatory obligation or requirement;*
>
> *iii. for each of the proposed capital works forming a part of the project that relate to earth fault standards, AusNet Services has completed a project scope which identifies the scope of the work and proposed costings;*
>
> *iv. The AER has made a determination under clause 6.6A.2(e)(1) of the National Electricity Rules in respect of bushfire mitigation contingent project 2.*[38]

We determined on 7 June 2019 the trigger has occurred and we had received a compliant application for consideration.

3.2 Extension of time limit

We published the application for public comment on 7 June 2019. We identified that the issues involved in assessing the application were difficult and complex and required

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[37] AER: *Final decision, AusNet Services distribution determination 2016 to 2020, Attachment 6 – Capital expenditure,* May 2016, p. 6–127.

[38] ibid

additional time to consider and consult. Accordingly, we issued a notice to AusNet Services on 3 July 2019 advising that we would extend the time limit to make this decision to 17 October 2019.[39]

3.3 Expenditure threshold

The NER stipulates the capital expenditure threshold[40] for a contingent project is the proposed capital expenditure:[41]

> *exceeds either $30 million or 5% of the value of the maximum allowed revenue for the relevant Distribution Network Service Provider for the first year of the relevant regulatory control period whichever is the larger amount*

3.3.1 AER view

The AusNet Services application is for $41.9 million[42], which exceeds $30 million. Also, 5% of AusNet Services' first year revenue is $29.3 million.[43] Hence, the capital expenditure threshold has been met.

3.4 Cost to protect high voltage (HV) customers

The BMR specify a performance regime for cutting power to a fault in a high voltage line in designated high fire risk zones in Victoria. As REFCL remains the only equipment currently capable of meeting the performance requirements specified by the BMR. Therefore, AusNet Services needs to install and operate REFCLs on its distribution network in order to comply with the BMR.

When a REFCL is in the protection mode, the voltage of two phases of the three phase network is increased by 73 per cent. This higher than normal voltage may cause damages to HV customers' installation.

In the tranche two applications, AusNet Services cited the prospect that financial liability will arise for damage caused by the operation of a REFCL as grounds for funding of additional works to mitigate damage to affected HV customer networks. However, the subsequent ESCV review of voltage standards in the VEDC has resulted in a transfer of responsibility to protect HV customer networks to customers. In practice, this means customers will need to meet the costs of line hardening and installing isolation transformers.

Accordingly, AusNet Services modified its tranche two application to exclude the costs of HV customer isolation, though it included some other HV customer related costs, which are seen as transitional and designed to address other implementation risks for the DNSPs. These customer related works relate to installation of ACRs as well as sensors to detect potential cross-country faults[44] originating at customer premises, portable generators to support HV

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39 AER Extension of time limit under NER, clause 6.6A.2(j).

40 NER, clause 6.6A1 (b) (iii).

41 NER, clause 6.6A.2(e).

42 AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019, p.14.

43 AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019, p.14.

44 A cross-country fault can result when the REFCL is limiting the voltage and current when a line falls to ground. If other assets on the network are not hardened a second fault on one of the healthy phases can occur when an asset fails which

customer load during commissioning, and the employment of an independent consultant to verify the condition of each HV customer connection prior to REFCL operation.

AusNet Services has also excluded the costs of HV customer isolation in its tranche three application. However, it included some other HV customer related costs, which are seen as transitional and designed to address other implementation risks for the DNSP. These customer related works relate to installation of ACRs as well as sensors to detect potential cross-country faults originating at customer premises, and the use of an independent expert to verify the condition of each HV customer connection prior to REFCL operation.

We note that after completion of the three REFCL tranches, the cost of the abovementioned discretionary requirements for connections will be borne by the new HV customers according to the customer connection policy which will be applied consistent with the revised VEDC. However, in relation to existing HV customers we consider it appropriate for the DNSPs to incur these transitional commissioning interface isolation costs. In particular, DNSPs are subject to a mandated timetable (with penalties attached for failure to meet the timetable) for the roll-out of REFCLs. However, there is no equivalent obligation on existing HV customers. Therefore, there is a risk that REFCLs may not be able to be commissioned as required by the mandatory timetable if customer networks are not upgraded in time. To address this, we consider it prudent for the DNSPs to incur these relatively small transitional costs to isolate these customers should their networks not be upgraded in time for REFCL commissioning, so as not to delay the roll out of REFCLs according to the timetable specified in the BMR.

3.5 Capital expenditure

The following table summarises the AusNet Services contingent project application capital expenditure requirements for tranche three.[45]

can be distant from the original line to ground fault. REFCLs can only handle one fault at a time. In this situation two high current faults can co-exist.

[45] AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019, p. 5

Table 3.1: Summary of contingent direct project capital expenditure requirements ($000, in 2015 dollars)

	2016	2017	2018	2019	2020	Total
Zone Substations	-	-	-	6,001	22,153	28,154
Network Balancing	-	-	-	1,392	4,330	5,722
Line Hardening	-	-	226	850	1,457	2,533
Cable replacement (proactive)				126	917	1,043
HV customers	-	-	-	16	299	314
Compatible Equipment	-	-	-	495	990	1,486
Other	-	-	-	215	488	703
Total	-	-	**226**	**9,095**	**30,634**	**39,956**

Source: AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019, p. 49.

3.5.1 Detailed analysis

The installation of REFCLs is a small component of the overall project. Major cost drivers of the projects include:

- Hardening – where components that would fail to withstand the higher voltage conditions applied during REFCL operation are replaced
- Compatibility – where components are upgraded or modified to accommodate REFCLs in order for them to perform and for REFCLs to perform their required function
- Configuration and switching arrangements to enable the REFCL to perform reliably
- emergency and operational power supplies
- protection and control works
- civil, building and infrastructure works to accommodate the above

Our assessment of each of the cost components are explained below.

Zone substation works

AusNet Services is required to install REFCL equipment in a number of zone substations under the BMR. Each zone substation and associated high voltage feeders present a unique capex requirement. We have considered the individual circumstances of AusNet Services for each of the proposed zone substations. Also, where appropriate, we compared the unit rates and volumes against external sources by seeking prices from equipment suppliers, our own consideration of likely costs and volumes for similar works elsewhere and

available benchmarks for unit costs and volumes derived from our recent work reviewing the costs of other regulated DNSPs.

Kalkallo zone substation

AusNet's application proposes construction of a new KLO2 zone substation (zss) to address its perceived technical issues at its Kalkallo (KLO) zss. This approach is unprecedented and represents additional expenditure of $12.7 million compared to what the AER considers the least cost technically acceptable solution.

We identified that the Least Cost Technically Acceptable option for KLO is to install two REFCL units, supported by five isolation transformers as proposed by AusNet and a further four isolation transformers to isolate the predominantly underground feeders. This approach will remove the need for a new KLO2 zss and is a more cost effective way of meeting their tranche three obligations.

Post the public consultation period, AusNet Services proposed another alternative option to address the technical issues caused by REFCLs at KLO, namely the construction of a new Kalkallo North (KLN) zss where REFCLs would be installed to protect all overhead feeders currently originating from KLO plus a Jemena feeder at its zss. AusNet Services claim that the overall long-term cost under this arrangement would be lower and there would be no need for a REFCL installation at KLO. However, AusNet Services has not been able to provide the AER with adequate detailed costing for the KLN solution and requires further work to determine the costs, including securing a sharing agreement with Jemena.[46] Further, we consider that this KLN option will not meet the current legislative requirements reflected in the tranche three works, which prescribe REFCL installations at KLO.

We consider that AusNet Services has not made a compelling case as to why we should approve expenditure above the least cost technically acceptable option to meet tranche three obligations imposed by the BMR.

However, we recognise that AusNet and Jemena may be able to develop an overall lower cost and more effective alternative approach in due course. It is possible the proposed option to build a new KLN zss to provide REFCL protection to the high voltage feeders currently connected to KLO could ultimately be a better option. However, this is not something that can be considered in this process.

AusNet and Jemena can consider this option further and make a joint application in their regulatory proposals for the forthcoming EDPR, which would allow proper stakeholder consultation as well as consideration of necessary amendments to the relevant REFCL obligations by ESV and the Government. Importantly, if an alternative option is found to meet the NER objectives, our approved funding under this tranche three works for providing REFCL installation and isolation transformers at KLO would form part of any funding requirements for the KLN solution, to avoid a double recovery of costs.

Our assessment of the issues associated with AusNet Services' KLO options proposal is shown in Appendix B,

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[46] Email AusNet to AER: REFCL T3 KLO AusNet Questions 2.0 KLO options CONFIDENTIAL

Other zone substation works

The following codes are used by AusNet Services to identify zone substations and these codes will be used in this decision:

Table 3.3: Zone substation codes

Zone substation	Code
Benalla	BN
Kalkallo	KLO
Kalkallo 2	KLO2
Lang Lang	LLG
Mansfield	MSD
Sale	SLE

AusNet Services has proposed $41.2 million[47] for zone substation works to integrate the REFCLs including:

- the REFCL components: Arc Suppression Coil, Residual Current Compensator/Inverter and control panel
- additional power supplies including station service transformers
- modifications to 22kV system including neutral switching bus, AC switchboards and changeover boards
- battery sets and power quality meters
- capacitor bank upgrades
- spatial accommodation issues
- hardening within the zone substation
- civil and ground works
- associated protection and control and SCADA
- PMO (Project Management Office) and community engagement.

The proposed works are considered below.

[47] AusNet Service: *REFCL contingent project application (tranche three),* 31 May 2019. Table 6, p41

Station service transformers

Station service transformers provide power to the systems and machinery that operate within a zone substation. AusNet Services considers that the station service transformers in sizes between 500 kVA and 750 kVA must be upgraded in order to support the additional energy requirements of the new equipment. This is because when a REFCL operates, the associated inverter injects sizeable amounts of energy to counter the faulted phase.

Based on our review of the individual site requirements, we consider that at each site, AusNet Services has adequately scoped the increased energy requirement of the additional equipment. We have also reviewed the proposed equipment costs. We consider these costs are consistent with recent cost benchmarks[48] for similar works carried out by AusNet Services and Powercor.

We note that the unit rate for 750kVA station service transformers has increased by 21%[49] relative to tranche one and tranche two. AusNet points to recent quotes and learnings from tranche two. We do note that the Benalla (BN) and Kalkallo (KLO) each require two 750kVA station service transformers and are the only tranche three substations impacted by this unit rate increase. Because of the loss of economies of scale, there would be no cost savings if AusNet were to replace the two 750kVA transformers with three 500kVA transformers, which have not increased in price. [50]

Therefore, we consider these costs reasonably reflect the capital expenditure criteria (capex criteria) having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Underground Cables

Powercor[51] and AusNet Services[52] are taking a different approach in tranche two and three, also noted by DELWP in its submission[53].

Powercor and AusNet Services have each developed similar strategies for testing and targeting replacement of underground cables. AusNet Services' strategy includes an additional testing and reactive component allocated to other project costs, but achieves a common outcome to Powercor's. We consider both strategies to be appropriate. We note the Marxsen[54] report on which some of the RIS estimates were based, noted the need for testing and pre-emptive replacement of HV underground cables.

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48 Powercor and AusNet Services RIN submissions.

49 AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019. *Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL p5*

50 ibid

51 Powercor: *REFCL contingent project application (tranche two),* 20 April 2018.

52 AusNet Service: *REFCL contingent project application (tranche three),* 31 May 2019.

53 Minister for Energy, Environment and Climate Change: Letter to the AER, 14 June 2018.

54 Marxsen: *HV customer assets and REFCL protected networks: a preliminary risk survey*, June 2017.

AusNet Services presented its Line Hardening Strategy,[55] which presents recent experience from tranche one, two and other underground cable experience. The strategy considers the age and risk profile of particular cable sections.

We considered AusNet Services' application of its strategy in relation to reactive and pro-active cable replacement programs, as there is an additional reactive component for AusNet Services compared with Powercor. AusNet Services' asset register[56] and responses to our questions in tranche two[57] indicate that it has a very large underground component to its network (118.5 km) of which 6.9 km is intended to be proactively replaced and that a further 5.5 km of its network is forecast to be replaced under its reactive program at a cost of $3.0 million.[58] The reactive replacement strategy assumes a requirement to replace 5% of the remaining 118km of underground cable. AusNet's strategy is to assess its assets on the basis of age and criticality. The criteria that AusNet uses is to replace all cables older than 1986 and cables installed between 1986 and 1989 with unknown manufacture date in addition to cables that score 5 on a 1-5 criticality scale. Powercor reported on its experience and published its XPLE (Cross-Linked Polyethylene) cable technical review[59] which presented a similar strategy. Powercor considers replacement of all first generation cables (i.e. those manufactured prior to 1989) will deliver the best reduction in risk.[60]

The Marxsen report[61] recommended replacement of all cables pre 1980 but referred to studies in North America which indicated a much higher rate of failure in REFCL networks than the pre-REFCL cables experience in Victoria. We accept the more conservative approach adopted by AusNet Services in identifying cables manufactured between 1980 and 1986 on the understanding that:

- the reliability network assets impacts a large number of customers
- experience of failures by both Powercor and AusNet in tranche one and tranche two
- potential health and safety risks
- the more conservative approach is reasonable in terms of cost

In accordance with AusNet Services' strategy, it has to perform extensive "prycam" testing on all REFCL cables and Partial Discharge (PD) testing if indicated. If a section fails testing, it needs to be replaced. Also, some cables based on older insulation technology need replacing as experience with REFCL operation shows a high failure rate of similar cables. These cables have been found unsuitable for safe operation with REFCLs. The volumes of the cable to be replaced are derived from the AusNet Services' asset register.

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55 AusNet Services: Attachment 9 *REF 20-07 REFCL Program Line Hardening Strategy v4.0, Attachment 12,* 31 May 2019.

56 AusNet Services: *REFCL contingent project application (tranche three) 31 May 2019. Attachment 26 Cables – Condition and Criticality in Sections.*

57 AusNet Services: 2018_08_8 REFCL – *Response AER question 2.0 – Cables,* August 2018.

58 AusNet Services: *Attachment 26 – Cables – Condition and Criticality in Sections* – CONFIDENTIAL 31 May 2019

59 Powercor: *REFCL contingent project application (tranche two) 20 April 2018, XPLE cable technical review.*

60 Powercor: *REFCL contingent project application (tranche two) 20 April 2018, XPLE cable technical review. p1*

61 Marxsen Consulting Pty Ltd, *Customer assets directly connected to REFCL networks: a preliminary risk survey, 20 June 2017, p16*

The approach is consistent with good engineering practice. We consider the application is sufficiently rigorous in setting out grounds to support this approach. We accept the prediction of underground cable failures in old cables resulting from unanticipated applied voltages is difficult to determine precisely. Both Powercor and AusNet Services are adopting similar strategies. Cable failures may lead to outages, leading to reduced reliability and inconvenience for customers. The consequences of a failure presents a considerable financial risk to the DNSP under the penalty scheme which applies. We therefore consider their proposed approach is prudent and efficient. It is also noted both DNSPs experienced repeated cable failures during commissioning of tranche one.

The performance of tranche one and tranche two underground cables under the respective DNSPs' strategies has provided guidance for further refinement and justification of the approach to identify cables requiring replacement in tranche three.

We note that the unit rate for underground cable replacement has increased since the tranche two to $[redacted] per meter (p/m).[62] AusNet advises the tranche three unit rate is based on actual costs of the removal of pre 1986 steamed cured XLPE cable experienced in Tranche one and two. VicRoads and Council reinstatement requirements has increased the unit rate per/m along with standard rate increases. We conducted an independent analysis of the reasonable costs of undergrounding cables typical of the AusNet Services requirement. 3 core CU XPLE SWA PVC cable 120 sq mm (Copper Cross-Linked Polyethylene Steel Wire Armoured PVC cable typically used in this application) averages $285 p/m using standard estimating methods[63]. HD conduit AS 2053.2 150 mm ID averages $32.50 p/m using standard estimating methods[64]. Excavation costs average $76.50 p/m using standard estimating methods[65] assuming light soil and 10% allowance for soft and hard rock where u/g cable needs to be rerouted from old trenches. Backfilling costs include a mix of sand, 20mm crushed rock and self-levelling material average $88.70 p/m using standard estimating methods[66]. Reinstatement with a 150mm-300mm topsoil and grassing averages $12.13 p/m using standard estimating methods[67]. Traffic management/observer costs of one person full time would average $85.71 p/m using standard estimating methods[68] assuming 7m per day to lay the cable including excavation, conduit laying, cable pulling, filling and reinstatement.

The total is $580.54 ($2019) p/m. Adjusted using the Building Price index 2015: 107.45 and 2019: 116.16 yields $537.54 p/m. This compares favourably with the AusNet Services estimate of $[redacted] p/m.

It should be noted that the above cost estimates do not take into consideration:

- Access and landowner issues
- Travel and accommodation of workforce in rural areas

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62 AusNet Services: *REFCL contingent project application (tranche three), 31 May 2019. Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL p9*

63 Rawlinsons: *Australian Construction Handbook 2019 p528*

64 Rawlinsons: *Australian Construction Handbook 2019 p545*

65 Rawlinsons: *Australian Construction Handbook 2019 p494*

66 Rawlinsons: *Australian Construction Handbook 2019 p495*

67 Rawlinsons: *Australian Construction Handbook 2019 p245*

68 Rawlinsons: *Australian Construction Handbook 2019 p717*

- Extensive rerouting underground cables due to landowner issues and modern standards requirements
- Cultural Heritage issues
- Environmental planning issues

We acknowledge that AusNet Services' recent experience is a valid guidance and independent data in an Australian quantity surveying reference[69] indicates that AusNet's unit rate for undergrounding is reasonable. We note further that The Regulatory Impact Statement (RIS) estimated the cost of putting polyphase powerlines underground at between $284 601 and $706 064 per km.[70] [71]

Altogether, we consider these costs reasonably reflect the capital expenditure criteria (capex criteria), having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Modifications to AC boards

AusNet Services has proposed additional works associated with the AC changeover board based on the additional load requirements of the new REFCL equipment. AusNet Services' approach is broadly comparable with the Powercor approach, however AusNet Services has taken a slightly different design approach. We reviewed the proposed design to satisfy ourselves of the need for this work.

The requirement for additional works including the AC changeover board was not identified in the RIS cost estimates, however we consider that there is a technical requirement for this work, which has only become apparent after more detailed site investigations. The works associated with replacement of AC changeover boards is required because the alternating current (AC) auxiliary supply requirement dramatically increases due to the GFN installation.[72]

There has been an increase in the unit rate[73] for AC changeover boards in tranche three relative to tranche two. AusNet advise that the increase is supported by recent quotes and experience gained in tranche two. Each zone substation requires an AC changeover board and the overall impact on the tranche three project due to the increased unit rate is limited to an uplift of $80 500.

We consider the proposed unit rates and volumes of works associated with the AC changeover boards are reasonable. They are consistent with the benchmarks and independent estimates by our internal engineering experts of the likely scope and cost of similar works. **Table 3.4** below describes tranche three sizing of GFNs.

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69 Rawlinsons: *Australian Construction Handbook 2019*

70 ACIL ALLEN CONSULTING: RIS Regulatory Impact Statement Bushfire Mitigations Regulations Amendment, 17 Nov 2015

71 *Taskforce: Powerline Bushfire Safety Taskforce, Final Report, 30 September 2011, Table 6, escalated by CPI from March 2011 to March 2015, Powerline Replacement Fund: revealed by the electricity distributors through a competitive process.*

72 AusNet Services: *REFCL contingent project application (tranche two),* April 2018 p. 40.

73 AusNet Services: *REFCL contingent project application (tranche three), 31 May 2019. Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL p5*

Therefore, we consider these costs reasonably reflect expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

GFNs and Arc suppression coils

The arc suppression coil cost is based on quotation from a single supplier. The cost of Arc Suppression coils has not changed materially since the tranche two decision[74].The device is a specialised item. AusNet Services has made considerable efforts to identify alternative suppliers but none have a product that can be implemented within the tranche three mandatory timeframe. Therefore, AusNet Services has endeavoured to negotiate an appropriate supply arrangement with the sole supplier to support the contingent project. AusNet Services has endeavoured to address the inherent risks associated with a single source provider of this equipment, which plays a central role in the required works identified in section 3.6.

Table 3.4 outlines the tranche three GFN size requirements. All of the tranche three zone substations require only one GFN except KLO which is larger, more complex and have greater amounts of underground cables, resulting in greater capacitance. We identified that the sizing is in accordance with AusNet Services' Arc Suppression Coil sizing policy[75] which we accept. We note that AusNet Services' sizing policy is similar to Powercor's[76]. However any difference in thresholds does not change the GFN sizing for the tranche three zone substations. Only KLO has been identified as requiring more than one GFN and its capacitive loading is well above the Powercor and AusNet Services thresholds.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Table 3.4: Tranche three GFN sizing

Zone substation	Code	Network Capacitance (A)	GFNs required
Benalla	BN	81	1
Kalkallo	KLO	321	2
Lang Lang	LLG	68	1
Mansfield	MSD	59	1
Sale	SLE	68	1

Source: AusNet Services: *REFCL contingent project application (tranche three) 31 May 2019 Attachments 1,2,3,4,5 REFCL Program MSD, LLG, SLE,BN, KLO functional scopes v1.0 - PUBLIC*.

[74] AusNet Services: *REFCL contingent project application (tranche three), 31 May 2019. Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL p5*

[75] AusNet Services: *REFCL contingent project application (tranche three), May 2019 Attachment 14 REF 30-04 REFCL* Program – Arc Suppression Coil sizing policy issue 3 - PUBLIC

[76] Powercor: *REFCL2.11 Implementation and optimisation of REFCL systems rev 0.4, April 2018. P5*

Capacitor banks

Capacitive balancing is a critical technical factor ensuring a REFCL can operate as intended. This cost item was set out in the RIS and included in the AER's initial assessment[77].The per unit costs are similar to the Powercor estimate[78] and fall within the range of $0–500 000 estimated in the RIS.[79] We think it is unlikely that the standard would be significantly different between the two operators. The major reason for the difference is that the AusNet Services estimates are based on site specific data, whereas Powercor has adopted an average cost approach.

AusNet Services identified a cost uplift in its tranche three application[80]. The cost uplift was within the acceptable range set out in the RIS. It only impacts two zone substations KLO and MSD resulting in a total cost uplift of $316 000.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Late submission for new specification capacitor banks

A late submission was received for upgrade and additional numbers of capacitor banks at MSD, KLO, SLE and LLG. The total of the upgrades amounts to $1.8 million.[81]

AusNet Services presented a new requirement to achieve required capacity. Previously new or upgraded capacitor banks have only been required where:

- capacitor banks are determined to be unable to withstand higher displacement voltages caused by REFCLs during a fault
- earthing and neutral configurations are incompatible with REFCLs

AusNet Services have had difficulty in achieving required capacity due to mismatched 5th and 7th harmonics during REFCL operation. Ideally the electricity supply has a perfect 50 Hz sinusoidal waveform. The REFCL is tuned to cancel the 50 Hz primary frequency fault current. However, due to increased use of electronically controlled machinery and appliances, and power inverters, there are increasing levels of 5th and 7th harmonics current distortion in the distribution network. AusNet Services explored the possibility of receiving an exemption from ESV on the grounds that the fundamental 50 hertz L-G fault component[82] meets required capacity. ESV responded that the BMR does not exclude harmonics and that the required capacity must be achieved regardless of the total harmonic distortion.

AER sought further evidence from AusNet Services:

- evidence from ESV.

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77 AusNet Services: *Total cost model (tranche two), CONFIDENTIAL*, April 2018.

78 Powercor: *REFCL2_MOD.01 Expenditure build up model (tranche two) April 2018*

79 DELWP: *Regulatory Information Statement, Bushfire Mitigation Regulations Amendment, Acil Allen,* 2015*,* p. 69.

80 AusNet Services: *Total cost model (tranche three), CONFIDENTIAL*, 31 May 2019 Attachment 20 Unit Rate Analysis - CONFIDENTIAL.

81 AusNet Services: email to AER: AusNet REFCL T3 Questions 2.0 23 August 2019

82 Fundamental current and voltage measurement with harmonics filtered out

- evidence from AusNet Services
- expert advice.

AusNet argues that the use of capacitor banks to improve the total harmonic distortion will achieve required capacity on the mandated date and over time.

We consider the additional expenditure is reasonable for the following reasons:

- the VEDC specifies voltage and current harmonic distortion limits at points of common coupling
- the VEDC limits are based on Australian and international standards
- customers are allowed to inject harmonics up to the VEDC limit
- the presence of 5th and 7th harmonics can be of the order of 3% of the electrical wave
- the REFCL functions to match the capacitance of the network impacted by the 50 Hz fault current. If there is a significant harmonics current present in the network, the harmonics current may have an energy level that exceeds the required capacity under the BMR
- AusNet Services originally assumed that filtering of harmonics was not necessary because it had independent advice that the i^2t level[83] during a fault was below the threshold to start a fire
- the bushfire mitigation regulations set a voltage at various times during a fault and current and i^2t limit.
- AusNet Services presented their advice to ESV on 11 June 2019[84] in support of an intended application for exemptions from compliance with the BMR at various sites. AusNet Services had proposed ongoing monitoring of harmonics, with no additional costs. AusNet Services considered that harmonic distortion is lower at times of high fire danger and as such, could achieve the required capacity at times of high bushfire danger.
- ESV rejected the applications on the basis that The Act and subordinate legislation requires the required capacity be available at each of the specified zone substations and makes no reference to limiting that performance to a particular time of day.[85]
- AusNet Services advise that they have changed their proposed approach as a result of the views expressed at the PBSC meeting of 11th June 2019[86] and in the documents setting out the requirements for AusNet Services' compliance plan.[87]
- AusNet has provided technical arguments in support of the filtering of the 5th and 7th harmonics using capacitor banks.[88]

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83 i^2t is a measure of the energy of a fault. Current squared multiplied by time in seconds

84 https://esv.vic.gov.au/wp-content/uploads/2019/08PBSC-11-06-2019-Minutes-AusNet.pdf

85 ESV advice to AusNet Services regarding KLK WYK Time Extension Plan Requirements, 12 July 2019

86 ESV: PBSC_11 06 2019_ Minutes meeting dft2

87 ESV advice to AusNet Services regarding KLK WYK Time Extension Plan Requirements, 12th July 2019

88 Emails to AER: AusNet Services REFCL T3 CPA (contingent project application) Questions 2.1 Emails 1&2 6th September 2019

Given the additional information and clarification of technical requirements by ESV, we consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Transformer neutral bus and switchboard

In Tranche three all zone substations require only one neutral bus except Kalkallo (KLO) which has capacitive loading above the threshold for one GFN due to its extensive underground network. AusNet Services identified that additional switching capability beyond the scope of the RIS is required to ensure its protection system continues to operate in accordance with industry standards. The AusNet Services application includes a separate neutral bus and additional protection and interface control systems to address this. We consider that a neutral bus is required at all GFN zone substations. GFNs have a specific capacitive loading capacity. As load growth on a zone substation causes the capacitive loading to exceed this level, a second (and potentially a third) neutral bus is required. The neutral bus configuration is modular so one will serve a single GFN and two transformers and two are required if a zone substation is configured with a third transformer and two 22kV buses. Each neutral bus installation requires a neutral bus controller and corresponding protection.

We note that GFNs can be paralleled and that they can be shared between transformers in a zone substation. However, an earth fault associated with a transformer needs to be cleared automatically. Otherwise a cross-country fault[89] can occur with a REFCL in operation. Further, there is a requirement to fully switch the zone substations to enable segregation. This requires a level of flexibility not currently permitted by the "banked" configuration. We therefore accept that the AusNet Services design is justified.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

REFCL control rooms

There has been increase in the cost of REFCL control rooms and we provide treatment of the benchmarking analysis in our tranche two decision[90].

AusNet Services has identified a need[91] for a tilt slab control room for Benalla zone substation (BN) and presents an options analysis. The justification is on the basis that BN has limited space and there is a requirement to accommodate a new GFN and the new 22kV switchboard. The only viable alternative is to install two urban type 22kV control rooms and a REFCL control room but the cost would be far greater. The tilt slab design has been costed

[89] A cross-country fault can result when the REFCL is limiting the voltage and current when a line falls to ground. If other assets on the network are not hardened a second fault on one of the healthy phases can occur when an asset fails which can be distant from the original line to ground fault. REFCLs can only handle one fault at a time. In this situation two high current faults can co-exist.

[90] AER: Final Decision - AusNet Services contingent project application - tranche two - August 2018

[91] AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 4 REF 70-26 REFCL Program – BN Functional Scope v1.0 PUBLIC p13*

from bottom up and its total cost is materially lower than the cost of a single urban type 22kV control room.[92]

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Battery room upgrades

A battery room upgrade is only required at one zone substation Sale (SLE). REFCLs are integrated into a DC control system that is battery backed. When buses are split to accommodate REFCLs, the DC system must be separated and a new battery is required. In addition, REFCLs need to be battery backed so that service restoration following a zone substation 'Black' event is not jeopardised.

The unit rate for battery room upgrades has not changed from tranche two.[93]

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Dead tank circuit breakers

Four dead tank circuit breakers have been determined to require replacement at Mansfield zone substation (MSD)[94] due to their poor quality and inability to withstand REFCL operations[95].

There has been an increase in the unit rate for dead tank circuit breaker replacements. AusNet Services advises that the increase is supported by recent quotes and experience gained in tranche two. The impact on the tranche three project due to the increased unit rate is an overall uplift of $144 800 dead tank circuit breakers are only required at the Mansfield (MSD) zss. Using a different CB type or switchroom configuration would add complexity and further cost. The capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Other Zone Substation Works that have reduced or have not increased materially in cost[96]

Other zone substation works that have reduced or have not increased materially in cost include:

- Station service transformer 500kVA

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92 AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL*

93 AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL*

94 AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL*

95 AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 1 REF 70-23 REFCL program MSD Functional Scope v1.0 p11*

96 AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 20 Capex Unit Rate Analysis - CONFIDENTIAL*

- ASC footing
- 22kV U/S isolator[97]
- 22kV Voltage transformer
- 22 kV zero sequence CTs
- Neutral bus
- New control building
- Primary cable testing

We accepted the unit rates in each application in tranche two and therefore acknowledge the reduction as a result of learnings in tranche two and recent quotes. We accept the quantities required as detailed in the zone substation scopes[98].

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

SCADA protection, control and communications

The following items represent a proportional deployment to GFN (e.g. 1 to 1) and zone substation capacity:

- Neutral Bus controller - 1 GFN
- Neutral Bus controller - 2 GFNs
- Protection – GFN panels
- GFN interface relay
- Power Quality/Switchgear Interface
- Power Quality Non Standard
- Switchgear Interface Non Standard
- Capacitor Bank Protection & Control (3x3MVAr)[99]
- Capacitor Bank Protection & Control (2x3MVAr)[100]
- Remote Terminal Unit
- SCIMS[101] system – small

All of these items' unit rates[102] have remained the same since the tranche two application.

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97 22kV U/S isolator is a high voltage underslung manual switch

98 AusNet Services: REFCL contingent project application (tranche three) 31 May 2019 Attachments 1,2,3,4,5 REFCL Program MSD, LLG, SLE,BN, KLO functional scopes v1.0 - PUBLIC.

99 Replacing capacitor banks requires protection and control upgrade

100 ibid

101 SCIMS – Survey Control Information Management System

102 AusNet Services: *REFCL contingent project application (tranche three) – May 2019 Attachment 20 Capex Unit Rate Analysis – CONFIDENTIAL p7,8*

We accept the quantities required under the scope of the tranche three project.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Feeder works

AusNet Services has proposed $41.2 million[103] for feeder works to integrate the REFCLs in the tranche three program.

Network balancing

AusNet Services has identified the following cost items for works in its tranche three application.[104]

- Design Labour - internal / external
- Third conductor installation
- Unbonding cable
- Phase rotation
- Balancing capacitors
- Inherent works - various feeder based works
- Phase plate correction
- Fuse review & removal, install solid link

Of these all unit rates have remained the same as tranche two except for:

- Unbonding cable which has increased $[redacted][105] per location however there are only three locations requiring unbonding of cables so the impact is very small.
- Phase rotation which has increased by $[redacted][106] per location or 25%. This increase is based on experiences gained in tranches one and two. The original estimates were conducted by survey and desktop analysis but complexities in the field have driven costs up. There are 224 instances of this totalling $[redacted].

We note that fuse savers[107] were added to the AusNet Services application in tranche three after experience gained in tranches one and two. This was a requirement identified by Powercor. AusNet Services advise that removal of fuses on network segments with excessive capacitive current as single phase fuse operation will cause excessive imbalance causing the GFN to trip the feeder. Therefore, to solve the excessive imbalance, replacement of the existing fuses on the network with solid links is planned. Furthermore, fuse savers are required either where fuses cannot be replaced with solid links because the fault level at a particular location on the network is too high or where fuses are required to

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103 AusNet Service: *REFCL contingent project application (tranche three),* 31 May 2019. Table 6, p41

104 AusNet Service: *REFCL contingent project application (tranche three),* 31 May 2019. Attachment 22 AST Contingent Project Total Cost Model - CONFIDENTIAL

105 AusNet Services Unit Rate Analysis 31 May 2019 - CONFIDENTIAL

106 AusNet Services Unit Rate Analysis 31 May 2019 - CONFIDENTIAL

107 AusNet Services *REFCL tranche (three) Contingent Project Application* 31 May 2019 – PUBLIC p42

provide protection reach for the network. As a result of protection studies performed, it has been concluded that the installation of fuse savers are required for network protection. These costs were not considered in the previous contingent project applications.

The difference between AusNet's and Powercor's cost of implementing fuse savers is less than 1 per cent of the cost.[108] [109]

The network balancing costs are arrived at by multiplying a feeder volumes survey[110] by the unit costs. The feeder volumes comprise:

- Number of feeders
- Transfer feeders
- Spans of third phase
- Unbonding third phase
- Phase rotations
- Single and three phase balancing caps
- RC sections[111]
- Fuse removal-solid link
- Sites for fuse savers
- New ACR installs

These volumes are appropriate for the areas served by the REFCL sites. The volumes are similar per feeder to the previous tranches we have accepted taking into account regional variations such as urban vs rural feeders. There is a one-to one correspondence between a requirement volume and a device or activity requirement.

The AusNet Services Network Balancing Strategy[112] presents arguments for the increased costs of this activity in comparison to the RIS. In particular, the strategy identifies:

- new learning from the Woori Yallock (WYK) REFCL commissioning
- that the RIS was tabled in 2015 before detailed design and site considerations were taken into account. The contingent project application was lodged in 2019
- phase rotation alone as proposed in the RIS is not sufficient to achieve balance. The level of leakage mitigation required to meet the BMR is not possible under that strategy.[113]
- a need for a combination of approaches including:

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108 AusNet Service: *REFCL contingent project application (tranche three),* 31 May 2019. Attachment 22 AST Contingent Project Total Cost Model - CONFIDENTIAL

109 Powercor: *REFCL2_MOD.01 Expenditure build up model (tranche two) April 2018*

110 AusNet Service: *REFCL contingent project application (tranche three),* 31 May 2019. Attachment 22 AST Contingent Project Total Cost Model - CONFIDENTIAL

111 Resistor-Capacitor section – component added to network to balance phases

112 AusNet Services: *Attachment 10 - REF 20-06 REFCL Program Network Balancing Strategy Issue,* 2 April 2018.

113 AusNet Services: Attachment 7 - *20-06 REFCL Program Network Balancing Strategy,* April 2018.

- performing single-phase spur and distribution substation phase transpositions (i.e. where a network section may have more connections to the Red phase in comparison to the Blue phase a transposition can be made converting a Red and White connected spur or asset to the White and Blue phases)
- installing balancing capacitor banks at the beginning of single phase spur sections
- installing LV balancing capacitor banks on the three-phase back bone
- in a small number of cases adding a third conductor to the beginning of a single-phase spur section (practical for cable) and converting that cabled section to three-phase.

During tranche one AER staff conducted site inspections at trial sites operated by AusNet Services and Powercor. We reviewed the arguments advanced for these additional activities against the field experience of operational staff at those locations. We consider the field experience justifies the combined approach as detailed above. We therefore consider the approach taken by AusNet Services is reasonable.

The application outlines a detailed risk and governance strategy.[114] The AusNet Services approach is similar to the Powercor approach.[115] We consider the AusNet Services approach is in accordance with industry norms for complex capital works and is reasonable.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Line hardening

Line hardening works include the major activity of replacing surge arrestors and other items of incompatible equipment.

Surge arrestors

AusNet Services has requested $4.7 million[116] for line hardening works to integrate the REFCLs in tranche three, compared with $7.8 million[117] in tranche two and $12.1 million[118] claimed in tranche one. This estimate is based on the actual surveyed population requirement. It plans to replace 29% of its tranche three surge arrestor population to withstand over-voltages caused by REFCLs which is less than the overall objective of replacing 40% of its total population of surge arrestors.[119]

The RIS[120] proposed that replacement of one in three surge arrestors would reflect an appropriate cost/risk benefit profile. This analysis was based on preliminary data for age and

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114 AusNet Services: *REFCL Program Network Balancing Strategy,* April 2018, p.11 and p. 13.

115 Powercor: *REFCL Program Network Balancing,* April 2018, p. 11 and p. 13.

116 AusNet Services: *Total cost model (tranche three) CONFIDENTIAL,* May 2019.

117 AusNet Services: *Total cost model (tranche two) CONFIDENTIAL,* April 2018.

118 AusNet Services: *Total cost model (tranche one) CONFIDENTIAL,* March 2017.

119 AusNet Services: REFCL contingent project application tranche three 31 May 2019 p43

120 DELWP: *Regulatory Impact Statement, Bushfire Mitigation Regulations Amendment,* ACIL ALLEN, 2015, p. 69.

specification of the surge arrestor population, taking into consideration statistical failure rates. Subsequent work by an independent testing laboratory, commissioned by AusNet Services, identified specific makes and models of existing installed surge diverters which would require replacement.

AusNet Service and Powercor agree closely with the RIS assessment of the percentage of the surge diverter population that requires replacement. The lower percentage is based on a detailed study of GIS data augmented by line inspections in many cases. As such, we accept the AusNet Services estimate of replacement volumes.

These costs reflect surge arrestor costs previously accepted by us in the determination for AusNet Services, the tranches one and two contingent project application and in an earlier pass through application and unit costs have not changed. On this basis, the AER accepts cost per surge arrestor per site as proposed by AusNet Services in the contingent project application.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Compatible equipment

AusNet Services has proposed $2.7 million [121] in tranche three compared with $5.2 million[122] in tranche two and $5.5 million[123] in tranche one. Compatible equipment works to integrate the REFCLs include:

- ACR replacement and upgrades
- Voltage regulator replacement and upgrades.

Compatible equipment in the AusNet Services network comprises the replacement or upgrade of ACRs and voltage regulators. AusNet Services has produced a REFCL Program Automatic Circuit Recloser Strategy.[124] The approach was to produce an options analysis from which the preferred option was to modify ACRs where possible and replace where necessary. We consider the AusNet Services options to be reasonable and the assessment to be robust, leading to a lower cost than the RIS estimate. Overall, the cost claimed per upgrade is has increased by 29%[125] there has been no corresponding change per replacement, which has not changed from tranche two, and also is less than the cost specified in the RIS of $70 000.[126] We note that the costs of upgrades are based on experience gained in tranche one and two and quotes and that the cost of the upgrades is lower than the RIS estimate and is therefore efficient. AusNet Services has allocated a single regulator at Sale (SLE) zone substation in the tranche three program.[127]

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121 AusNet Services: *Attachment 22 – AST Contingent Project 3 Total Cost Model CONFIDENTIAL*, May 2019

122 AusNet Services: *Total cost model (tranche two), CONFIDENTIAL,* April 2018.

123 AusNet Services: *REFCL Contingent Project Application AST Distribution Contingent Project 1 Cost Model CONFIDENTIAL*, March 2017.

124 AusNet Services: *REFCL Program Automatic Circuit Recloser Strategy* 2017.

125 AusNet Services: Unit Rate Analysis, 31 May 2019

126 AusNet Services: *REFCL Program Automatic Circuit Recloser Strategy* 2017, p. 9.

127 AusNet Services: *REFCL contingent project application,* April 2018, p. 47.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Victorian Electricity Distribution Code - HV customers

In its application AusNet Services allocated $0.63 million[128] for VEDC works to integrate REFCLs.

In Section 1.5 we described:

- the treatment of HV customers in tranche one
- the changes to the VEDC as a result of a process conducted by the ESCV
- the treatment of HV customers in tranche two and three.

As outlined in section 1.5, under the revised VEDC effective from 20 August 2018, there is a transfer of risk and obligation to HV customers, which means they need to adopt a strategy at their own cost to make their systems compatible with a network with installed REFCLs.

The application argues that even though the risk and obligation has transferred to the HV customers, there are residual costs, which must be borne by AusNet Services to accommodate these customer works.

These costs average $96 251 per connection.

The residual costs are intended to cover:

- installation of ACRs at some HV customer sites
- protection investigation
- consultant reports to independently verify customer site installations are appropriately hardened or able to be isolated from our network during the operation of a REFCL
- project oversight
- updating schematics for hardening.

These costs relate to five customers, with 7 HV connection points (including three connection points for Jemena feeders connected to KLO).

We consider there is a need for ACRs to isolate a customer where the customer's site is directly connected to the network, as would be the case where a customer chooses to harden its site. This is intended to mitigate a significant risk of a cross-country fault which AusNet Services would wish to detect and isolate.

AusNet Services argues that it does not have a legal basis to charge a customer with an existing connection for an ACR as a connection alteration under its customer connection

[128] AusNet Services: *REFCL contingent project application Total cost model tranche three CONFIDENTIAL,* May 2019.

policy[129] unless the customer applies for a connection alteration. AusNet Services states that new customers who apply for an HV connection would be liable under the connection policy for an ACR where AusNet Services' determines it is necessary, as new customers must design their installation to operate with REFCLs in compliance with the recently amended VEDC.

We consider the requirement for ACRs to be a transitional issue relating only to existing customers. The need for ACRs is driven by uncertainty that all customer installations will be upgraded in time to allow commissioning of REFCLs in accordance with the mandated timetable. If this expenditure were not allowed, the implementation timetable for REFCL operation may be jeopardised by parties outside AusNet Services' control. For this reason, we consider it an acceptable inclusion in the contingent project application.

We also agree that:

- protection investigation is an acceptable inclusion in the tranche three project application for the reasons set out in AusNet Services' revised application.
- costs to independently verify third party reports that HV customers are appropriately hardened or able to be disconnected from the AusNet Services network is an acceptable inclusion in the tranche two project application for the reasons set out in AusNet Services' revised application
- project oversight and updating of schematics for hardening is an acceptable inclusion in the tranche three project application for the reasons set out in the AusNet Services' revised application.

We consider these costs reasonably reflect the capex criteria having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

3.5.2 Other capital expenditure

AusNet Services sought $9.6 million[130] for other works to integrate the REFCLs including Distribution Feeder Automation schemes compatibility and reactive cables replacement, testing and repair. We have treated the cables strategy in section 3.5.1. Distribution Feeder Automation (DFA)

AusNet Services has developed the DFA as a network self-healing system, which detects faults and automatically isolates short sections of feeders so that larger groups of customers are not affected. It should be noted that AusNet Services' investment in DFA is not funded from providing regulated services. It is funded by rewards available under the STPIS for improving reliability.

Under the NER[131], AusNet Services is required to maintain reliability. The Service Target Performances Incentive Scheme (STPIS) is the mechanism providing an incentive for maintaining reliability. However, AusNet Services must also comply with its obligations under

[129] AusNet Services: *Distribution Connection Policy,* 31 March 2017.

[130] AusNet Services*: REFCL Total cost model (tranche three), CONFIDENTIAL,* May 2019.

[131] NER, clause 6.5.6 and 6.5.7.

the BMR to operate REFCLs. We consider this is a more important obligation in high fire danger periods, although it necessarily entails a reduction of reliability on the relevant days, especially where the DFA system is no longer effective.

AusNet Services has allocated $5.1 million in tranche three compared with $15.4 million in tranche two and $7.9 million which was approved in tranche one to Distribution Feeder Automation (DFA).[132]

The integration of a REFCL into the network reduces the effectiveness of the DFA system and will cause a significant loss of reliability in some operating modes. When in operation, REFCLs reduce fault currents to a level below DFA sensing resolution capability. This means that the DFA cannot operate in the manner for which it was designed. In tranche two, AusNet Services modelled the impact on the STPIS under a range of operating conditions and estimated the annual penalty impact to be $4.5 million, leading to a $19.2 million[133] total penalty impact in the next regulatory control period. Had this penalty effect been known at the time of the last regulatory determination, an adjustment mechanism may have been incorporated in the STPIS. However, the operation of the STPIS is set as part of the determination. Consequently, it is not feasible to amend the STPIS scheme to fully address this effect until the next regulatory determination is made (in 2020). This penalty arises because the STPIS scheme operates on five years of historical performance data but lags by two years. We note further that the investment in compatibility is more efficient, therefore it is preferable to upgrade the DFA equipment rather than amending the STPIS scheme to address the effect.

There has been a 12%[134] increase in the cost of DFA sensing units which drive the cost of DFA compatibility. This cost increase is based on experience from tranche one and two and actual quotes for the devices.

We consider these costs reasonably reflect the capex criteria, having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2 (g)(4).

Other program costs

We consider live line equipment, survey costs, annual compliance and tranche three development costs represent reasonable costs in relation to the network size and complexity.

AusNet Services proposes to allocate $4.1 million[135] to undertaking reactive replacement of its underground 22kV cables. See section 3.5.1 for a discussion of this item.

We consider these costs reasonably reflect the capex criteria, having regard to the expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

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132 AusNet Services contingent project application tranche three: *Attachment 12 - REF 20-13 REFCL Program Distribution Feeder Automation Strategy Issue,* 18 April 2018.

133 Email: *AusNet Services to AER $ basis of STPIS figures* 31 August 2018

134 AusNet Services REFCL contingent project application tranche three Unit Rate Analysis – CONFIDENTIAL May 2019

135 AusNet Services: *Total cost model (tranche three) CONFIDENTIAL,* 31 May 2019.

Accelerated Depreciation

We accept AusNet Services' proposal to accelerate the depreciation of certain replaced assets arising from this contingent project decision.[136] Specifically, we agree with the accelerated depreciation of the following assets:

- Protection relays within zone substations
- Surge arrestors
- ACRs
- Sectionalisers
- 22kV HV overhead cables

With respect to the above assets, we assign a collective remaining life of two years for accelerated depreciation purposes. This approach produces a depreciation schedule for these assets that will align with their reduced economic life.[137] We consider this treatment is in line with our final decision for AusNet Services' 2016–20 distribution determination.[138]

The impact of the proposed accelerated depreciation allowance in the current regulatory period is $0.3 million ($, nominal).[139]

[136] Accelerated depreciation does not change the total amount received in depreciation (return of capital), though it does change the timing of the receipt and the consequential return on capital.

[137] NER, clause 6.5.5(b)(1).

[138] AER: *Preliminary decision AusNet distribution determination – Attachment 5 – Regulatory depreciation*, October 2015, pp. 13–17.

[139] AusNet Services: *Total cost model (tranche three) CONFIDENTIAL*, April 201831 May 2019.p57

3.6 Operating expenditure (Opex)

3.6.1 Forecast

Table 3.7: AusNet Services REFCL Contingent Project Application and Operating Expenditure cost summary for tranche three of REFCL installations

Forecast Operating & Maintenance ($000's, in 2015 dollars)[a]						
	2016	2017	2018	2019	2020	Total
Fault response & analysis	-	-	-	-	11.0	11.0
Operating, maintenance and testing instructions	-	-	-	-	-	-
Routine maintenance of zone substation assets	-	-	-	-	-	-
Network Balancing	-	-	-	-	22.3	22.3
Annual Testing	-	-	-	-	-	-
WOTS - (Transmission Charges)	-	-	-	-	-	-
Live line equipment purchases	-	-	-	-	-	-
Training & Change Management	-	-	-	-	-	-
Regulation & Code Changes	-	-	-	-	-	-
Alternative technologies and vendors	-	-	-	-	-	-
Total Opex	-	-	-	-	33.4	33.4

Source: AusNet Services: *REFCL contingent project application (tranche three), Total Cost Model,* 31 May 2019.

a Real $2015 are the basis presented in the application, consistent with the monetary basis of the 2016-20 distribution determination

3.6.2 Analysis

Annual testing and network balancing costs are higher than Powercor reflecting AusNet Services' strategy to test each feeder each year and address the ongoing balancing requirement. The costs have reduced significantly from the tranche one amounts. We consider that the costs reasonably reflect expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

Fault response and analysis costs have reduced in proportion to the complexity and size of the networks in tranche three compared with tranche two. We consider the costs are reasonable to meet industry standards and are based on fault response experience. We consider the costs reasonably reflect expenditure that would be incurred in respect of a contingent project by an efficient and prudent DNSP in the circumstances of that DNSP under the NER, clause 6.6A.2(g)(4).

3.6.3 Operating Expenditure

We approve an amount of $33 400 dollars operating expenditure in accordance with AusNet Services' application for the remaining years of the 2016-2020 regulatory control period.

We note that AusNet services has estimated operating expenditure of $3.3 million[140] in tranche three over the five years of the 2021-25 regulatory control period. The National Electricity Rules only provide for contingent project operating expenses to be approved for the remaining years of the regulatory control period that the contingent project is triggered. As such this amount has not been examined and AusNet Services will need to make a case for the expenditure in its 2021-25 EDPR submission.

[140] AusNet Services: REFCL *contingent project application total cost model (tranche two) CONFIDENTIAL,* 31 May 2019.

4 AER's calculation of the annual revenue requirement

4.1 Capital expenditure

AusNet Services proposed $105.5 million capital expenditure to provide for REFCL installation and supporting works for eight zone substations in tranche three of the REFCL program.[141] AusNet Services provided supporting evidence and detailed cost estimates to make the contingent project application.[142] These costs were not included in the 2016-2020 distribution determination given the assets were not part of the planned replacement program at that time.

We have modified AusNet Services' proposed solution for Kalkallo Zone Substation (KLO), resulting in a $13 million cost saving. We accepted AusNet Services' late submission to include additional $1.8 million cost to manage harmonic current distortion, as discussed in section 3.5.1.

Taking into consideration the above adjustments, we have allocated $94.4 million for capital expenditure for the Tranche 3 works.

As discussed in the following section, to adjust the capex amounts sought by AusNet Services we calculated the adjustment to the inputs in the post-tax revenue model in real, 2015 dollars.

4.2 Operating expenditure

AusNet Services claimed $3.3 million in operating expenditure to provide for REFCL installation and supporting works for five zone substations in tranche three of the REFCL program.[143] AusNet Services provided supporting evidence and detailed cost estimates to make the contingent project application.[144] Of the $3.3 million, $0.03 million applies to the 2016-2020 regulatory control period. The remainder applies to the 2021-2025 regulatory control period and as such was unexamined.

We consider the operating expenditure reasonably required for the purpose of undertaking the project in each year of the regulatory period is $0.03 million in total.

As set out in the next section, to adjust the opex amounts sought by AusNet Services we calculated the adjustment to the inputs into the post-tax revenue model in real, 2015 dollars.

4.3 Time cost of money

Rule 6.6A.2(b)(4)(iii) of the NER requires us to take into account the time cost of money based on the rate of return for the provider. In calculating the total incremental revenue, we have made an allowance for this. The time cost of money is based on the rate of return for

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141 AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019.

142 AusNet Services: *REFCL contingent project application (tranche three), Total Cost Model, CONFIDENTIAL,* 2019.

143 AusNet Services: *REFCL contingent project application (tranche three),* 31 May 2019.

144 AusNet Services: *REFCL contingent project application (tranche three), Total Cost Model, CONFIDENTIAL,* May 2019.

AusNet Services, as set out in the 2016–20 distribution determination.[145] We have also used updated values for X-factor and return on debt in years 2 to 4 under the trailing average methodology applicable to the 2016–20 distribution determination.[146]

The smoothed revenue arising from this contingent project is then calculated by adjusting the X-factor for year 5 to maintain net present value and take account of the time cost of money. We also provide for the final year smoothed revenue to be as close as possible to the unsmoothed revenue for that year.

4.4 Calculation of revenue requirement

Table 4.1: AER Allowance - AusNet Services Contingent Project Revenue Requirement, 2016-2020 ($m, nominal)[a]

	2016	2017	2018	2019	2020
Return on Capital	0.0	0.0	0.0	0.0	0.7
Return on Capital (regulatory depreciation)	0.0	0.0	0.0	0.1	0.1
Operating Expenditure	0.0	0.0	0.0	0.0	0.0
Revenue Adjustments	0.0	0.0	0.0	0.0	0.0
Net Tax Allowance	0.0	0.0	0.1	0.1	0.0
Annual revenue requirement (unsmoothed)	0.0	0.0	0.0	0.1	0.8
Expected revenue (smoothed)	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**
% change to revenue	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.11%**
X-factors	**8.27%**	**0.30%**	**-1.84%**	**-3.01%**	**-3.13%**

a Nominal dollars are used in this section as they are directly quoted from the PTRM model as required under the NER

For this contingent project, revenue is determined by allocating the incremental opex and the incremental capex amounts to distribution services in the post-tax revenue model. The PTRM is updated applying the same WACC parameters as were used in the determination, including the return on debt adjustment noted above.

145 AER: *Final decision, AusNet Services distribution determination 2016 to 2020.*

146 The year 5 return on debt update value is now available and will be separately applied following this contingent project decision. This is to further revise the year 5 X-factor for the purposes of annual pricing.

5 AER determination

5.1 AER determination

We determined that the AusNet Services application for contingent project funding lodged on 31 May 2019 was approved with modifications to the amounts sought. AusNet Services submitted is application in real 2015 dollars. We presented calculations for incremental capital and operating expenditure in each remaining year of the regulatory control period in real 2015 dollars. This is because the PTRM calculation is expressed in real 2015 dollars.

In accordance with clause 6.6A.2(e)(1) of the NER we have determined:

- the amount of capital and incremental operating expenditure for each remaining year of the regulatory control period that we consider is reasonably required for the purpose of undertaking the contingent project in the remaining years of the current regulatory control period is as follows.[147]
- The remainder of the approved capital expenditure in the amount of $48.6 million will be spent in the 2021-25 regulatory control period.

Table 5.1 Capital and incremental operating expenditure ($m, real 2015 dollars)

	2016	2017	2018	2019	2020
Incremental capital expenditure	0.0	0.0	0.2 [a]	9.6 [a]	36.0 [a]
Incremental operating expenditure	0.0	0.0	0.00	0.00	0.03

[a] Our decision to reject AusNet Services' proposal to install KLO2 zone substation results in a change in expenditure profile and an increase in the expenditure in the 2016-20 period at $4m higher than AusNet Services' original claim.

Table 5.1 demonstrates:

- the total capital expenditure we consider is reasonably required for the purpose of undertaking the contingent project is $94.4 million (real, $2015).[148]
- the contingent project has commenced and the likely completion date is 30 April 2023.[149]

On the basis of the capital and incremental operating expenditure stated in **Table 5.1**, and otherwise in accordance with clause 6.6A.2(b)(4),[150] we have calculated the incremental revenue which is likely to be required by AusNet Services for each remaining regulatory year as a result of the contingent project being undertaken to be as follows.[151]

147 NER, clause 6.6A.2(e)(1)(i).

148 NER, clause 6.6A.2(e)(1)(ii).

149 NER, clause 6.6A.2(e)(1)(iii).

150 NER, clause 6.6A.2(e)(2).

151 NER, clause 6.6A.2(e)(1)(iv).

Table 5.2 – Incremental revenue calculation and X-factors ($m, nominal)[a]

	2016	2017	2018	2019	2020
Return on capital	0.0	0.0	0.0	0.0	0.7
Return of capital (regulatory depreciation)	0.0	0.0	0.0	0.1	0.1
Operating expenditure	0.0	0.0	0.0	0.0	0.0
Revenue adjustments	0.0	0.0	0.0	0.0	0.0
Net tax allowance	0.0	0.0	0.1	0.1	0.0
Incremental annual revenue requirement (unsmoothed)	**0.0**	**0.0**	**0.0**	**0.1**	**0.8**
Expected revenue (smoothed)	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**
% change to revenue	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.11%**

a Nominal dollars are used in this section as they are directly quoted from the PTRM model as required under the NER

In accordance with clause 6.6A.2(h), we have used the capital expenditure and incremental operating expenditure determined in accordance with clause 6.6A.2(e)(1)(i) to amend the PTRM to determine the effect of any resultant increase in forecast capital and operating expenditure on:

- the annual revenue requirement for each regulatory year in the remainder of the regulatory control period and
- the X-factor for each regulatory year in the remainder of the regulatory control period.[152]

We determine the effect to be as follows.

Table 5.3 – Annual revenue requirement and X-factors ($m, nominal)[a]

	2016	2017	2018	2019	2020
Annual revenue requirement (unsmoothed)	588.99	579.27	619.78	672.59	698.81
Expected revenue (smoothed)	586.05	597.87	623.02	656.87	693.32
X-factors	8.27%	0.30%	-1.84%	-3.01%	-3.13%

a Nominal dollars are used in this section as they are directly quoted from the PTRM model as required under the NER

[152] NER, clause 6.6A.2(h)(3).

We have determined incremental contingent project unsmoothed revenue amount to be $763 000 ($, nominal). This is the amount that AusNet Services will recover from customers commencing 1 January 2020. This is different from the building block amount of $760 000 ($, nominal) proposed by AusNet Services.

We further determine the smoothed annual revenue requirement should be adjusted to $3.157 billion ($, nominal), based on the revenue requirements and X-factors set out in **Table 5.3.** This corresponds to a total unsmoothed annual revenue requirement of $3.159 billion ($, nominal).

We have not amended the roll-forward model.

This corresponds to an increase in average distribution network prices of 0.11% in 2020.

Appendix A: The need for early replacement of 22kV switchgear at Lang Lang (LLG)

AusNet Services advised the following in response to AER's questions:[153]

Question 1 - If the switchboard at LLG was in good condition, would AusNet Services replace it as part of the REFCL program? Or would AusNet Services install REFCLs and retain the existing Switchboard?

AusNet Services response

- The switchboard design is capable of REFCL operation. We have other switchboards of the same design, which we will accept for use with REFCL equipment. However, the problem at LLG is one of poor condition, which is well advanced in comparison to other equivalent switchboards. Unfortunately, the form of deterioration at LLG can be expected to accelerate with REFCL operation.
- As such, the replacement of the switchboard is required for the installation and safe operation of the REFCL at LLG by 1 May 2023.

Question 2 – What is the extent of water damage to 22kV referred to in the LLG?

AusNet Services response

- Water ingress produced increased building humidity levels, which led to partial discharge deterioration on the switchboard. [redacted]
- We have conducted building repairs to limit water ingress wherever possible, but we will not be able to fully repair potential water leaks behind the switchboard until the switchboard is removed. Therefore, our expectation is that under the existing operational conditions the damage/repair cycle will continue at a similar rate until the switchboard is replaced.
- Under REFCL conditions, the failure rate will accelerate (see response to question 5).

Question 3 - Is this switchgear operating now?

AusNet Services response

- Yes, the 22kV switchboard received a refurbishment in January 2019 and it is operational.

Question 4 - When would the 22kV switchgear need to be replaced if REFCLs were not planned?

AusNet Services response

[153] AusNet Services: email to AER AusNet Services REFCL T3 Questions 2.0 attachment Information Request 2.0 REFCL T3, 23 August 2019

- We consider replacement will be justified within 5-6 years (next regulatory period), on the basis of poor reliability and extensive, ongoing maintenance costs.
- The 2019 refurbishment allows an extension to life and we aim to minimise future risk, through a regime of periodic monitoring/non-invasive tests. Nevertheless, experience from the recent repairs gives us an expectation that there will be a periodic need to instigate more repairs, with an interval of 1-2 years. [redacted]

Question 5 - What justification is there that the switchgear is operable now, but not post REFCL installation?

AusNet Services response

- Our assessment is that insulation levels and therefore long-term reliability is already compromised, [redacted]. However, the higher Phase-Earth stresses associated with REFCL [redacted]. There would therefore be an expectation of more extensive repairs and reduced repair intervals.

Question 6 - Why the switchgear cannot be replaced sequentially?

AusNet Services response

- The 22kV switchgear is all mounted on a single switchboard. There is not sufficient room in the existing demountable switch building to install a new switchboard with the existing board still operational.
- Additionally, it is not operationally viable to swap out the existing switchboard for new panels (of a different design). This would have the following implications:
    - Multiple extended busbar outages to dismantle the bus panel, by panel, plus staged shifting of the switchboard end panel and voltage transformers).
    - Repeated withstand tests with each modification of the existing switchboard, to effectively recommission the switchboard every time. Withstand tests are to be avoided on this switchboard, since insulation has already been compromised.
    - Additional feeder outages to optimise and re-configure existing feeder connections, prior to cutting over swap over feeders on the bus to or bus ties in the form of cables, between the old and new sections.
    - Modification and upgrade of the existing building, adjacent to live, operational switchgear can theoretically be managed in typical switchrooms, but there will inevitably be additional dust, which could settle on internal switchboard

components, in the presence of elevated partial discharge. This would further compound the risk of poor reliability.

- In addition to lead time for special designs plus supply and erection of loose panels, the staged in-situ change out will potentially need to take place over at least 2 seasons, compromising the ability for AusNet Services to deliver within the REFCL completion timeframe.
- In comparison to the above, the AusNet Services plan is to cut over onto a new switchboard, in a new building, which require feeder outages, but the length of outages will be minimal and overall disruption will optimised.

Appendix B: AER consideration of Kalkallo (KLO) proposals

The issues associated with KLO

- This zone substation (zss) is located at the suburban fringe area north of Melbourne. It comprises a substantial amount of new suburban subdivisions with underground networks. The capacitive loading arising from the underground network far exceeds the capacity of two REFCL installations, the currently maximum workable configuration.[154] The sole supplier of REFCL technology does not support more than two REFCLs on a zss and this has implications for zone substations approaching capacitive loading limit.
- Given the technical issues for zss with more than two REFCLs are yet to be resolved, AusNet proposed to build a new KLO2 zss and transfer all underground networks to the new KLO2 zss. After which, only overhead networks will be left in KLO to be protected by REFCLs.
- AusNet is required to achieve the required capacity on its KLO network by 1 May 2023

AusNet's proposal includes the construction of a new KLO2 zone substation (zss) to address its perceived technical issues at its Kalkallo (KLO) zss. This is approach was unprecedented and represent an additional expenditure of $12.7 million above the least cost technically acceptable solution—by using 4 ISOs at a total cost of $4.3 million.

AusNet also argues there is benefit in the bringing forward of a new zone substation KLO2, because

- This would avoid the need for three sets of REFCLs at KLO
- The new KLO2 zss will also provide capacity to meet the future load growth predicted in Melbourne's northern growth corridor, which is expected to be mainly underground networks.

Why we do not accept the KLO2 option

- AusNet has sought $17.0 million for a new zone substation KLO2 because capacitive loading of mostly underground feeders exceeds the capability of REFCL technology at KLO.
- We note that AusNet did not provide details of what will be installed at KLO2, for example the size of the 66/22kV transformer and there is no details on the switchgear and supporting infrastructure to be installed.
- In the initial application, AusNet proposed to transfer 4 predominantly underground feeders to a new KLO2 zss because there is insufficient land space available within the current KLO footprint.
- However, AusNet identified using 5 ISOs to manage the underground sections of the feeders remaining at KLO as a technically credible solution option.

[154] Underground cables introduce 30-45 times more capacitive loading per km than do overhead lines

- We have identified a Least Cost Technically Acceptable option with KLO equipped with 2 REFCLs, 5 ISOs as proposed by AusNet and a further 4 ISOs to isolate underground feeders (removing the need for new zss). ESV has previously approved the use of ISO for this purpose.
- We propose to reject the KLO2 proposal because of the following considerations:
    - It is cheaper to install 4 additional Isolation Transformers (ISO) for $3.9 million
    - The use of ISOs to separate underground networks from overhead networks has previously been adopted and considered an acceptable solution. They were deployed in the earlier REFCL Tranches one and two programs.[155]
    - Regarding AusNet's contention that there is uncertainty about availability of land for ISOs, we consider that
        - Kalkallo has broad acre subdivisions under development
        - Isolation transformers are only 66 sq.m footprint and highly flexible to locate
        - Abundant land is available at $300 000 per residential block or 600 sq.m in the immediate area.[156]
    - We also do not accept AusNet's argument that there is benefit in bringing forward of a new zone substation KLO2 to also meet future demand growth, because
        - KLO has 49.1 MVA firm capacity[157] and the summer 50% POE peak in 2023 is 30MVA[158] with only 2% growth
        - 4 out of 9 feeders on KLO would be transferred to KLO2. AusNet advised that new growth in the area will be in underground networks to be connected to KLO2. Hence, there will not be further material growth for KLO. The remaining capacity would be substantially under-utilised—therefore inefficient use of existing network assets.
        - As expressed in the Minister's submission, capex for meeting demand growth is outside the scope for the contingent project.
- The removal of the KLO2 option would represent a cost reduction of $12.7 million, about 12% of AusNet's initial proposal.

AusNet proposed an alternate option (KLN option) <u>after consultation closed[159]</u>— by linking a new ZSS to Jemena's Coolaroo (COO ZSS)

Following further clarifications regarding the KLO2 option, AusNet advised on 12 August 2019, that:

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[155] ISOs were approved in T1 and T2 in both AusNet's and Powercor's decisions for HV customers and capacitive loading reduction for underground lines. Energy Safe Victoria previously accepted the deployment of ISOs and has granted exemptions for ISO to isolate underground lines and for HV customer sites.

[156] Domain.com 7/8/2019 reported 88 average 600 sq.m vacant land and 363 in surrounding suburbs are currently available.

Price finder reported Apr-Jun 2019 median price for land in Kalkallo $265,000

Core Logic reported 1 July 2018 – 30 Jun 2019 for land in Kalkallo $292,000

[157] AusNet Services: Distribution annual planning report 2019-2023, April 2019, p44

[158] AusNet Services: Distribution annual planning report 2019-2023, April 2019, p44

[159] Submission closed on 26 July 2019.

- Jemena also has an obligation to install REFCLs at its Coolaroo (COO) zss. COO faces similar issues as KLO with significant underground network and further growth in underground networks.
- There is a new and cheaper combined approach (in terms of long-term cost) to provide REFCL protection to the general area, by treating KLO and a feeder from Coolaroo (COO) as a combined project.
- Under this approach, AusNet will construct a new Kalkallo North (KLN) zss. One of the existing overhead feeders on Jemena's COO[160] and three of AusNet's KLO overhead feeders would be transferred to KLN. This will leave only underground networks connected to KLO.
- Hence, there would be no requirement for REFCLs at KLO.
- KLN would be REFCL protected, but would not need ISOs to manage the capacitive loading issues because very little underground cable would be connected.
- AusNet claims this option would result in $10-20 million cost savings over its KLO2 proposal when the life-time cost is considered.

Issues with the KLN option

- The current REFCL legislation prescribes that REFCLs must be physically located at KLO. To implement the KLN option AusNet will need a change to the legislation.
- Without a change in legislation, this option is out of scope for AusNet's tranche three works because it includes additional cost to treat a feeder from COO, which is not a part of AusNet's tranche three obligation. In her submission, the Minister has confirmed that there has been no decision (or agreement) by the relevant regulatory bodies [ESV] regarding a proposal to transfer the REFCL obligations to a new zss.
- AusNet Services and Jemena have not formalised joint agreement on the preferred option. Further, Jemena's REFCL obligation is not a part of the contingent project scope. Jemena's REFCL funding arrangement should be a matter to be considered in the EDPR.
- ESV advised AusNet that ESV could endorse the KLN (or the least cost technical acceptable) option if the option can achieve an equivalent or better safety outcome. However, currently there is insufficient information available for ESV to make an assessment.[161]
- The new proposal is still early in its development and requires extensive work and consultation.
- There is still considerable uncertainty in the projected savings associated with the KLN option. We note the level of projected savings is different each time the proposal was presented to us. This reinforces our view that alternate options for the management of the KLO capacitive loading issue are still at an early stage of development by AusNet and cannot be seen as a fully developed proposal for consideration. The Minister also expressed concern about this aspect of AusNet's KLN proposal.
- Consistent with its advice to AusNet, ESV also advised us that they have not received an application for modifying the regulatory requirements; and the information provided is still insufficient for ESV and the Victorian government to properly consider. This reinforces our view that it is more prudent to approve the

[160] This reduces the capacitive loading to ensure that no more than 2 REFCL for COO.

[161] Email from ESV to AusNet 13 August 2019.

least cost technical acceptable solution and allow AusNet and Jemena time to present a joint solution in the EDPR.

- We cannot approve contingent project works outside of the original scope and approved funding beyond the minimum cost for the technically feasible solution to meet tranche three obligations under the relevant legislation. However, this does not prevent AusNet and Jemena from pursuing a joint option as part of the EDPR which may cost less in overall NPV terms, subject to the relevant legislative amendments. We would consider the validity of alternate options and whether adjustment to costs already approved in this contingent project application will be necessary. This approach is also suggested by the Minister in her submission. Importantly, if such an option was found to meet the NER objectives, our approved funding under this tranche three works for providing REFCL installation and isolation transformers at KLO would be included as a part of any funding requirements for the KLN solution, to avoid a double recovery of costs.

Appendix C – Impact on a typical Customer Bill

Our estimate of the potential impact this decision will have for AusNet Services' residential customers is based on the typical annual electricity usage of around 4,000kWh per annum for a residential customer in Victoria.[162] Therefore, customers with different usage will experience different changes in their bills. We also note that there are other factors, such as transmission network costs, metering, wholesale and retail costs which affect electricity bills. The potential impact on small business customers, however, is estimated differently. We make a pro-rata adjustment to the annual bill for a typical small business customer as calculated in our 2016–20 distribution determination, reflecting the updates made to residential customer bills in this decision. This is due to a limitation in the Victorian Energy Compare comparison tool.[163]

Table A shows the estimated annual average imp act of our determination on AusNet Services' REFCL contingent project tranche three on the average residential and small business customers' annual electricity bills. As explained above, these bill impact estimates are indicative only, and individual customers' actual bills will depend on their usage patterns and the structure of their tariffs.

Table A – Estimated impact of AER's decision on AusNet Services' REFCL contingent project, tranche three on annual electricity bills for 2019 and 2020 ($, nominal).

Impact on Customer Bill	2020
Change to distribution component for contingent project (%)	**0.11%**
Residential Customers	
Distribution component ($)[a]	520
Residential annual electricity bill ($)[b]	1,529
Annual change (%)	0.04%
Annual change ($)	0.6
Small Business Customers	
Distribution component ($)[a]	1,412
Small business annual electricity bill ($)[c]	4,151
Annual change (%)	0.04%
Annual change ($)	1.5

a Distribution network proportions are consistent with the AER's 2016-20 distribution determination.

b Based on average standing offers at June 2017 on Victorian Energy Compare comparison tool (postcode 3134) using annual bill for typical consumption of 4000kWh per year.

c Based on typical small business annual bill as per the AER's 2016-20 distribution determination, using a pro-rata step change reflecting a similar proportion to the residential bill updates.

Source: AER analysis

162 ESC, *Victorian energy market report 2016-17,* November 2017, p. 28.

163 Victorian Energy Compare (AGL standing offer)

Appendix D - List of stakeholder submissions

Submission from	Date
Victorian Minister for Energy, Environment and Climate Change	16 August 2019
Jill Porter	26 July 2019