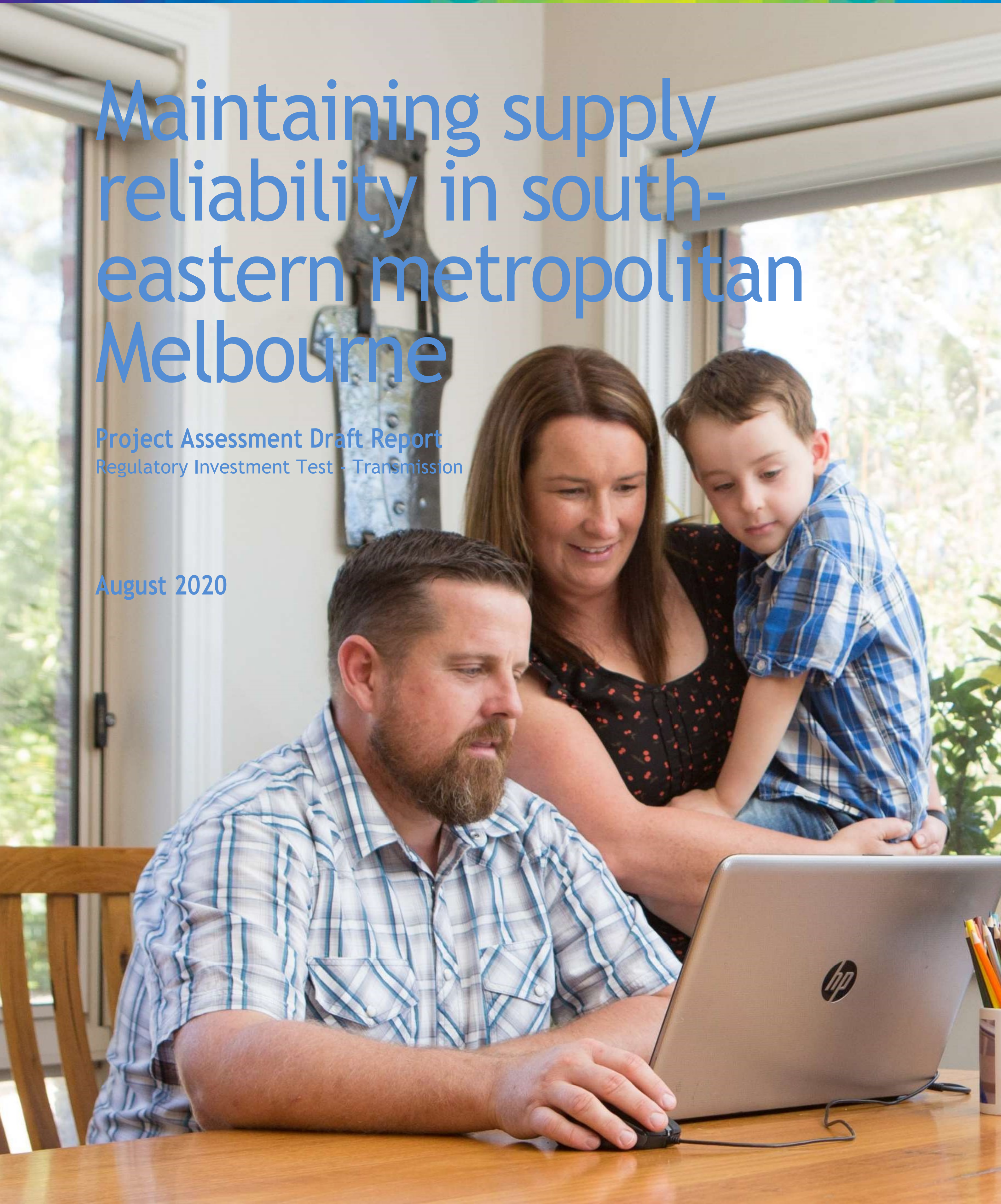

Maintaining supply reliability in south-eastern metropolitan Melbourne

Project Assessment Draft Report

Regulatory Investment Test - Transmission

August 2020

mission zero

AusNet services

Important notice

Purpose

AusNet Services has prepared this document to provide information about potential limitations in Victoria transmission network and options that could address these limitations.

Disclaimer

Executive summary

AusNet Services is undertaking this Regulatory Investment Test for Transmission (RIT-T) to evaluate options for maintaining supply reliability in south-eastern metropolitan Melbourne. Stage 1 of the East Rowville Terminal Station (ERTS) redevelopment project is underway and this RIT-T is for the next phase of that work. Options investigated in this RIT-T will mitigate the residual risks that were not addressed in Stage 1.

The Project Specification Consultation Report (PSCR), which represents the first step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER)[1] and section 4.2 of the RIT-T Application Guidelines[2] was published in December 2019. This report, the Project Assessment Draft Report (PADR), is the second stage of the RIT-T and provides information about the draft conclusions of the RIT-T.

ERTS is owned and operated by AusNet Services and is located in Rowville in Victoria. It was commissioned in the 1960's and serves as the main transmission connection point for distribution of electricity to approximately 128,000 customers. It supplies 1,800 GWh of electric energy per year.

The RIT-T analysis shows that it is no longer economical to continue to provide supply with the existing assets at ERTS as the asset failure risk has increased to a level where investment to replace the selected assets presents a more economical option based on the value that consumers place on supply reliability (VCR).

No non-network proposals were received during the RIT-T PSCR consultation phase.

The preferred option to address the asset failure risk at ERTS is an integrated replacement of two of the four 220/66 kV transformers and selected 66 kV switchgear.

Identified need

As expected of assets that have been in service for a long time, the condition of some of the transformers and circuit breakers at ERTS has deteriorated to a level where there is a material risk of asset failure, which could have an impact on electricity supply reliability, safety, environment, and emergency replacement costs. Therefore, the 'identified need' this RIT-T intends to address is to maintain supply reliability in south-eastern metropolitan Melbourne and mitigate risks from asset failures.

AusNet Services estimates that the present value of the baseline risk costs associated with maintaining the existing assets in service is $24 million – the biggest component of which comes from the supply interruption risks borne by electricity consumers. AusNet Services is therefore proposing investment in asset replacement options that would allow continued delivery of safe and reliable supply of electricity.

Credible options

AusNet Services did not receive any proposals for non-network solutions and did not identify a credible, economical non-network solution for the identified need at ERTS.

The following three network investments were evaluated and will deliver more economical and reliable solutions to maintaining supply reliability in south-eastern metropolitan Melbourne, compared with keeping the existing assets in service:

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[1] Australian Energy Market Commission, *"National Electricity Rule version126,"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 7 November 2019.

[2] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission,"* available at https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf, viewed on 7 November 2019.

- Option 1 – Integrated Replacement
- Option 2 – Staged replacement with one transformer replacement deferred; and
- Option 3 – Staged replacement with the 66 kV circuit breakers deferred.

Assessment approach

AusNet Services followed the AER's Industry practice application note for asset replacement planning to analyse and rank the economic cost and benefits of the investment options considered in this RIT-T.

None of the options considered will have a material impact on wholesale market cost and hence no market simulation studies have been conducted for this RIT-T. Scenario analysis as used in AEMO's Integrated System Plan (ISP) is not required for this RIT-T.

The robustness of the ranking and optimal timing of options have been investigated through sensitivity analysis that involve variations of assumptions around the values used in the base case.

Options assessment and draft conclusion

AusNet Services' cost-benefit assessment confirms that integrated replacement (Option 1) is the most economic option as it provides the highest present value of net economic benefits as illustrated by the results of the sensitivity analysis in Figure 1.

This option will not only maintain supply reliability in south-eastern metropolitan Melbourne, but also mitigates safety, environmental, and emergency replacement risk costs from deteriorating assets at ERTS.

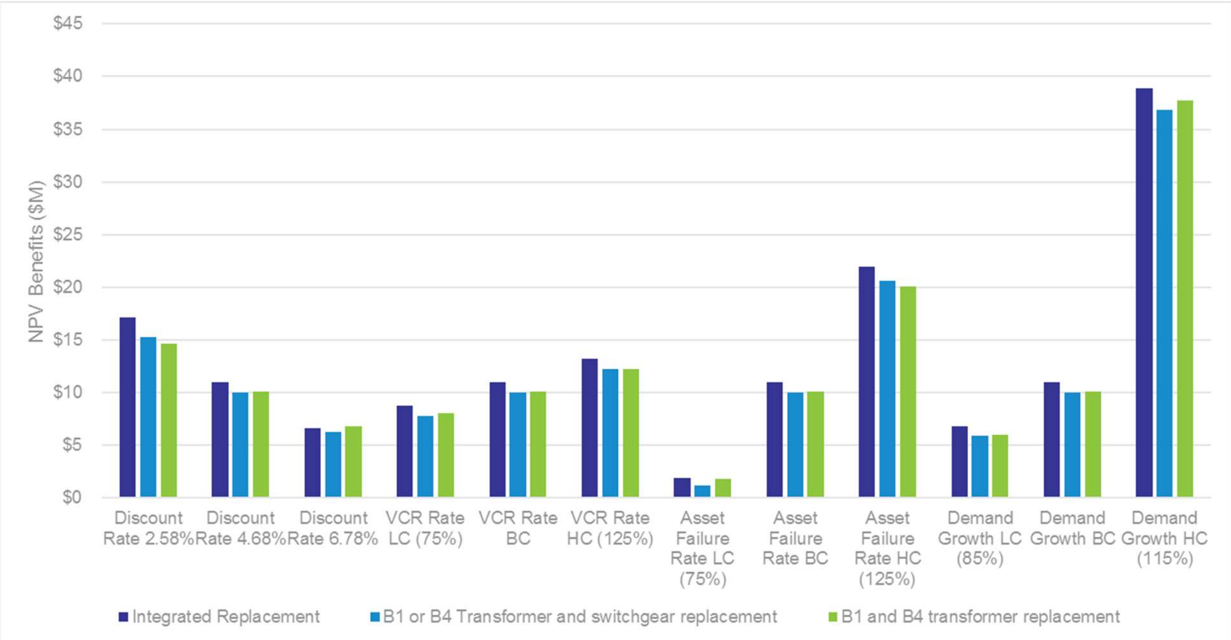

Figure 1 – Option Selection and sensitivity analysis

The optimal timing of Option 1 is 2023 as supported by the sensitivity analysis.

AusNet Services concluded that Option 1 is the most economical option and hence the preferred option to address the identified need and that the project should now proceed to meet the economical timing of 2023.

Submissions

AusNet Services welcomes written submissions on the issues and the credible options presented in this PADR. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 20 October 2020. In the subject field, please reference 'RIT-T PSCR East Rowville Terminal Station.'

Next steps

Assessments of the options and responses to this PADR will be presented in the Project Assessment Conclusions Report (PACR) that is intended to be published before 30 November 2020.

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Figures

Tables

1. Introduction

AusNet Services initiated this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain supply reliability in south-eastern metropolitan Melbourne, in the light of deteriorating assets at East Rowville Terminal Station (ERTS). Stage 1 of the ERTS redevelopment project is underway and this RIT-T is for the next phase of that work. Options investigated in this RIT-T are intended to mitigate the residual risks that were not addressed in Stage 1.

The Project Specification Consultation Report (PSCR) was published in December 2019 in accordance with clause 5.16 of the National Electricity Rules (NER)[3] and section 4.2 of the RIT-T Application Guidelines.[4] Publication of this Project Assessment Draft Report (PADR) represents the second step in the RIT-T process[5].

This document describes:

- the identified need that AusNet Services is seeking to address;
- credible network options that may address the identified need;
- a summary of the submissions to the PSCR;
- the assessment approach and assumptions that AusNet Services has employed for this RIT-T assessment as well as the specific categories of market benefits that are unlikely to be material; and
- the identification of the proposed preferred option.

The need for investment to address risks from the deteriorating assets at ERTS is included in AusNet Services' revenue proposal for the current regulatory control period (2017 to 2022)[6]. This investment need is also presented in AusNet Services Asset Renewal Plan that is published as part of AEMO's 2019 Victorian Transmission Annual Planning Report (VAPR)[7].

1.1. Making submissions

AusNet Services welcomes written submissions on the issues and the credible options presented in this PADR. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 20 October 2020. In the subject field, please reference 'RIT-T PADR East Rowville Terminal Station.'

Submissions will be published on AusNet Services' and AEMO's websites. If you do not wish for your submission to be made public, please clearly stipulate this at the time of lodgment.

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[3] Australian Energy Market Commission, *"National Electricity Rule version126,"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 7 November 2019.

[4] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission,"* available at https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf, viewed on 7 November 2019.

[5] A RIT-T process will assess the economic efficiency and technical feasibility of proposed network and non-network options.

[6] Australian Energy Regulator , *"AusNet Services - Determination 2017–2022,"* p. 42, available at https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/ausnet-services-determination-2017%E2%80%932022/revised-proposal, viewed on 7 November 2019.

[7] Australian Energy Market Operator, *"Victorian Annual Planning Report,"* available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/Victorian-Annual-Planning-Report, viewed on 7 November 2019.

2. Identified need

The role of ERTS in providing electricity supply services and the condition of key assets is discussed in this section. Quantification of the risk costs associated with the deterioration of these assets, and the need for the investments is also presented.

2.1. Supply to south-eastern metropolitan Melbourne

The 220/66 kV ERTS is owned and operated by AusNet Services and is located in Rowville, Victoria. Since it was commissioned the 1960's, ERTS served as the main transmission connection point for distribution of electricity to communities in south-eastern metropolitan Melbourne – from Scoresby to Lyndhurst and Belgrave to Mulgrave.[8]

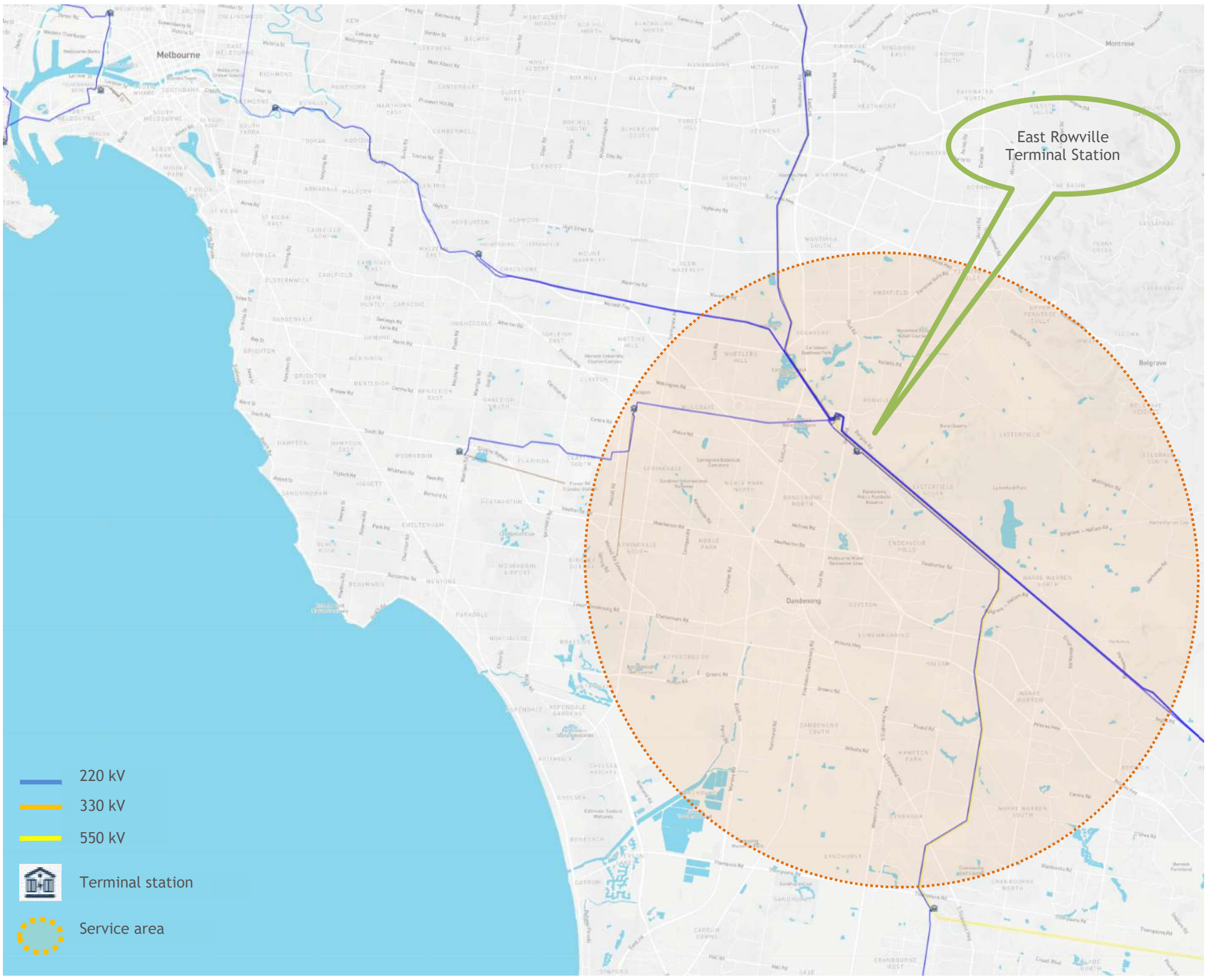

Figure 2 – South-eastern metropolitan Melbourne transmission network and relevant service area

Electricity demand

Approximately 128,000 customers depend on ERTS for their electricity supply. While 92% of these customers are residential, more than 50% of energy supplied by ERTS is consumed by commercial customers – equivalent to 825 GWh[9] per year, see Table 1.

[8] Distribution of electricity to relevant communities is supported by two businesses: United Energy and AusNet Services.

[9] This figure is metered quantity and does not include the appropriate allocation of distribution losses.

Table 1 - Customer number and demand composition

Customer type	Number of customers	Share of consumption (%)
Residential	117,141	31.7
Commercial	9,018	50.4
Industrial	1,168	17.6
Agricultural	445	0.3
Total	127,772	100

Peak demand at ERTS is normally experienced during summer periods. The highest peak demand of 504.9 MW was recorded in the summer of 2008/09 during an extreme weather event. The annual peak demand has not reached that level since 2008/09. The peak demand was 447.60 MW during the summer of 2018/19. The reduction compared to the 2008/09 peak demand is partly due to transfer of electricity demand away from ERTS to other terminal stations.

The Australian Energy Market Operator (AEMO) forecasts[10] that the peak demand at ERTS will remain at the current level over the next ten year period. Figure 3 shows the 10% probability of exceedance (POE10)[11] and the 50% probability of exceedance (POE50)[12] forecasts for peak demand during summer and winter periods.[13]

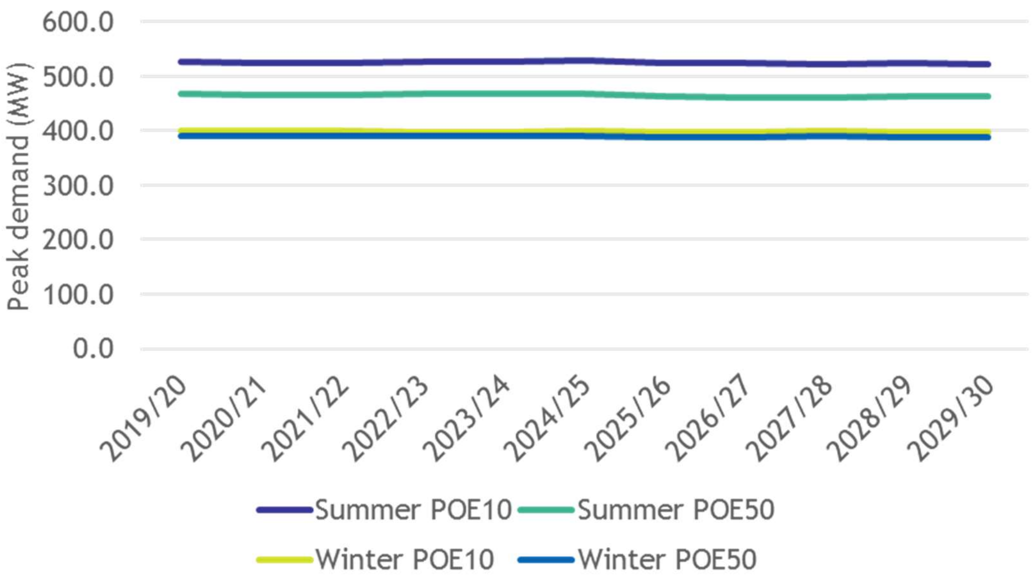

Figure 3 - Demand forecasts for ERTS

AEMO and the relevant Distribution Network Service Providers (DNSPs) recognise that there is an ongoing need for electricity supply services to communities in south-eastern metropolitan Melbourne.

[10] Australian Energy Market Operator (AEMO), *"2018 Transmission Connection Point Forecast for Victoria,"* available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Transmission-Connection-Point-Forecasting/Victoria, viewed on 7 November 2019.

[11] A POE10 forecast indicates a level where there is 10 % likelihood that actual peak demand will be greater.

[12] A POE50 forecast indicates a level where there is 50 % likelihood that actual peak demand will be greater.

[13] Victorian electricity demand is sensitive to ambient temperature, hence, peak demand forecasts are based on expected demand during extreme temperature that could occur once every ten years (POE10) and during average summer condition that could occur every second year (POE50).

Embedded generation

There are five embedded generators greater than 1 MW within the network served by ERTS.

Electricity network

ERTS sources its electricity supply from Rowville and Cranbourne Terminal Stations (ROTS and CBTS). It is part of the outer south-eastern 220 kV corridor in Melbourne, as shown in Figure 1. It supplies eleven 66 kV feeders (six owned by AusNet Electricity Services and five by United Energy) that distribute electricity to customers, as shown in Figure 4.

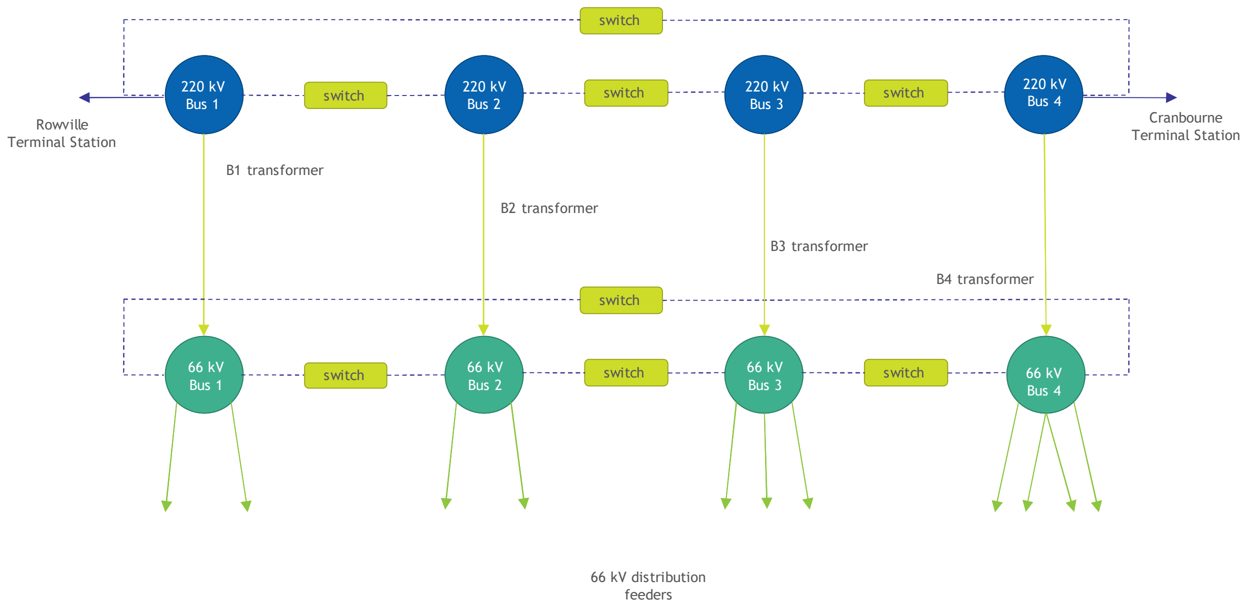

Figure 4 - Representative diagram for ERTS

2.2. Asset condition

Several primary (power transformers and switchgear) and secondary (protection and control) assets at ERTS are in poor condition as expected of assets that have been in service for a long time.

AusNet Services classifies asset conditions using scores that range from C1 (initial service condition) to C5 (very poor condition) – as set out in Appendix C. The latest asset condition assessment for ERTS was conducted in 2019 and reveals that most assets at the terminal station are in poor condition (C4) or very poor condition (C5). For the selected assets, the probability of failure is high, and is likely to increase further if no remedial action is taken. Table 2 provides a summary of the condition of relevant major equipment.

Table 2 - Summary of major equipment condition scores

Asset class	Condition scores				
	C1	C2	C3	C4	C5
Power transformers	2			2	
66 kV circuit breakers				5	7
66 kV instrument transformers				9	3

Power transformers

There are four 150 MVA 220/66 kV transformers at ERTS. The 'B1' and 'B4' transformers were commissioned in late 1960's and a design issue has been found in this type of transformer, which could result in a major transformer failure for close in network faults. The transformers have deteriorated significantly and according to the recent asset condition assessment report, the transformers are in poor condition. Assets in this condition (C4) require remedial action within the next two to ten years.

An investigation of a failure of a similar transformer in AusNet Services network in March 2016 revealed that it was a result of previous buckling – a known issue for transformers of similar brand, type, and make installed in locations where there are high fault levels such as ERTS.

The 'B2' and 'B3' transformers are in very good condition and have a very low risk of failure.

AusNet Services considers that there is a high probability that a winding failure, major tap changer failure or bushing failure of either 'B1' or 'B4' transformer will result in an extended service interruption and a subsequent need for emergency repairs or replacement. The probability of a transformer failure is forecast to increase over time as the condition of these two transformers deteriorates further.

66 kV circuit breakers

Twelve of the twenty five 66 kV circuit breakers, including three bus tie circuit breakers, are in poor condition and are approaching their end of economic and technical life[14]. This is expected of assets that have been in service for a long time.

With condition scores of C4 and C5, these circuit breakers present challenges due to: duty-related deterioration including erosion of arc control devices, bushing oil leakages, and wear of operating mechanisms and drive systems; intensive maintenance; lack of spares and manufacturer support; lack of oil containment bunding; and limited fault level capability requiring restrictive switching configurations.

66 kV instrument transformers

Several instrument transformers at ERTS are assessed to be in poor or very poor condition (C4 and C5). Management of safety risks from potential explosive failures[15] of instrument transformers of this type is costly due to the need for regular oil sampling and partial discharge condition monitoring.

2.3. Description of the identified need

ERTS provides electricity supply to south-eastern metropolitan Melbourne. AusNet Services expects that the services that the terminal station provides will continue to be required as the demand for electricity is forecast to remain at present level over the next ten year period. However, the poor and deteriorating condition of some of the components at the terminal station has increased the likelihood of asset failures. Such failures would result in prolonged substation outages.

Without remedial action, other than ongoing maintenance practice (business-as-usual), some assets are expected to deteriorate further and more rapidly. This will increase the probability of failure, resulting in a higher likelihood of electricity supply interruptions, heightened safety risks due to potential explosive failure of the assets, environmental risks from possible oil spillage, collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs.

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[14] Australian Energy Regulator, *"Industry practice application note for asset replacement planning,"* available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning, viewed on 7 November 2019.

[15] Since 2002, two current transformers of this type have failed explosively in the Victorian network.

Therefore, the 'identified need' this RIT-T intends to address is to maintain supply reliability in south-eastern metropolitan Melbourne and to mitigate risks from asset failures.

The present value of the baseline risk costs is calculated to be $24 million over the forty-five year period from 2019/20. The key elements of the risk costs are shown in Figure 5. The largest component of the baseline risk costs comes from the supply interruption risk, which is borne by electricity consumers, from potential failure of assets.

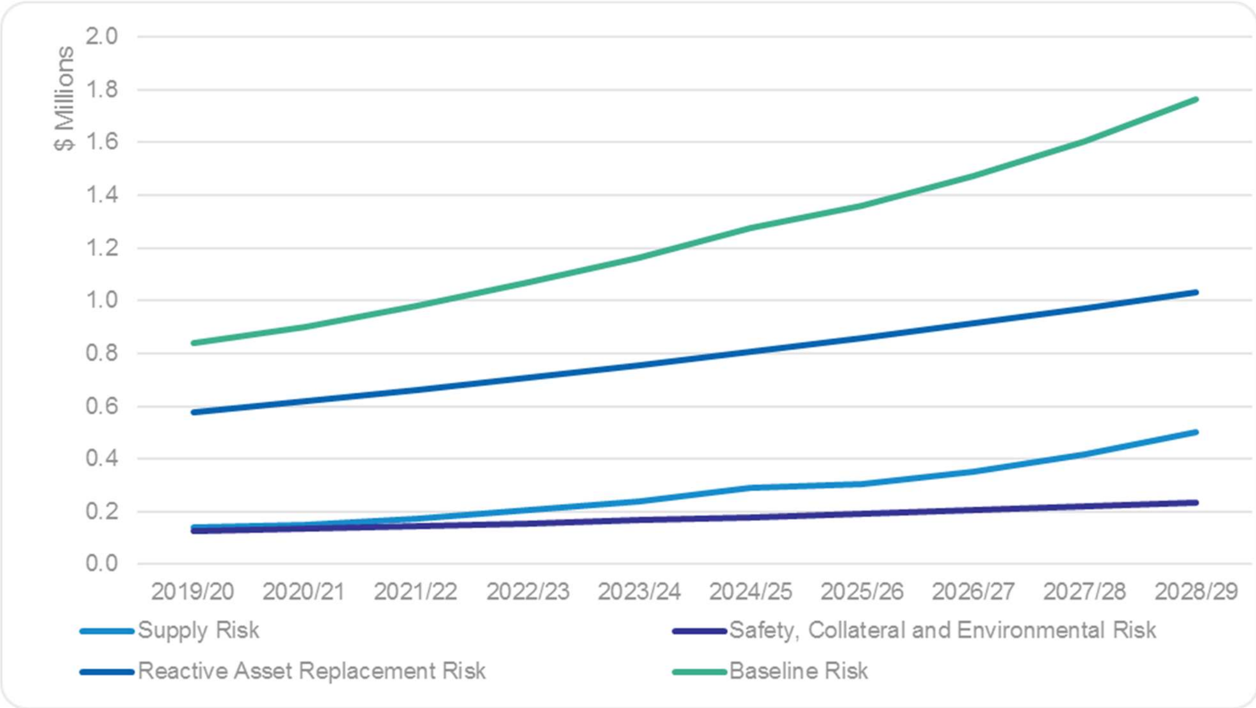

Figure 5 - Baseline risk costs

By undertaking one of the options identified in the RIT-T, AusNet Services will be able to maintain supply reliability in south-eastern metropolitan Melbourne and mitigate safety and environmental risks, as required by the NER and Electricity Safety Act.

2.3.1. Assumptions

Aside from the failure rates (determined by the condition of the assets) and the likelihood of relevant consequences, AusNet Services has adopted a number of assumptions to quantify the risks associated with asset failure. These assumptions are detailed in the following subsections.

Supply risk cost

Supply risk cost has been calculated from the expected unserved energy at ERTS and AEMO's most recent demand forecast for ERTS[16] and has been monetised at a Value of Customer Reliability (VCR)[17] of $40,523/MWh. The VCR rate is based on the AER survey and the load composition at ERTS.

The total supply risk cost is calculated by estimating the community impact of different combinations of forced outages and weighting them by their probabilities of occurrence.

[16] Australian Energy Market Operator (AEMO), *"2018 Transmission Connection Point Forecast for Victoria,"* available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Transmission-Connection-Point-Forecasting/Victoria, viewed on 7 November 2019.

[17] In dollar terms, the Value of Customer Reliability (VCR) represents a customer's willingness to pay for the reliable supply of electricity. The values produced are used as a proxy, and can be applied for use in revenue regulation, planning, and operational purposes in the National Electricity Market (NEM). Australian Energy Market Operator, *"Value of Customer Reliability,"* available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Value-of-Customer-Reliability-review, viewed on 7 November 2019.

Safety risk cost

The Electricity Safety Act 1998[18] requires AusNet Services to design, construct, operate, maintain, and decommission its network to minimise hazards and risks to the safety of any person as far as reasonably practicable or until the costs become disproportionate to the benefits from managing those risks.

In implementing this principle for assessing safety risks from explosive asset failures, AusNet Services uses:

- a value of statistical life[19] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[20]; and
- a disproportionality factor[21].

AusNet Services notes that this approach, including the use of a disproportionality factor, is consistent with practice notes[22] provided by the AER.

Financial risk cost

As there is a lasting need for the services that ERTS provides, the failure rate-weighted cost of replacing failed assets (or undertaking reactive maintenance) is included in the assessment.[23]

Environmental risk cost

Environmental risks from plant that contains large volumes of oil, which may be released in an event of asset failure, is valued at $30,000 per event while risks from transformers with oil containing poly-chlorinated biphenyls (PCB), such as those at ERTS, are valued at $100,000 per event.

[18] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Energy Safe Act 1998,"* available at http://www.legislation.vic.gov.au/domino/Web_Notes/LDMS/LTObject_Store/ltobjst9.nsf/DDE300B846EED9C7CA257616000A3571/1D9C11F63DEBA5E2CA257E70001687F4/%24FILE/98-25aa071%20authorised.pdf, viewed on 7 November 2019.

[19] Department of the Prime Minister and Cabinet, Australian Government, *"Best Practice Regulation Guidance Note: Value of statistical life,"* available at https://www.pmc.gov.au/resource-centre/regulation/best-practice-regulation-guidance-note-value-statistical-life, viewed on 7 November 2019.

[20] Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13," available at https://www.safeworkaustralia.gov.au/system/files/documents/1702/cost-of-work-related-injury-and-disease-2012-13.docx.pdf, viewed on 7 November 2019.

[21] Health and Safety Executive's submission to the1987 Sizewell B Inquiry suggesting that a factor of up to 3 (i.e. costs three times larger than benefits) would apply for risks to workers; for low risks to members of the public a factor of 2, for high risks a factor of 10. The Sizewell B Inquiry was public inquiry conducted between January 1983 and March 1985 into a proposal to construct a nuclear power station in the UK.

[22] Australian Energy Regulator, *"Industry practice application note for asset replacement planning,"* available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning, viewed on 7 November 2019.

[23] The assets are assumed to have survived and their condition-based age increases throughout the analysis period.

3. Credible network options

AusNet Services considered both network and non-network options to address the identified need caused by the deteriorating assets at ERTS but did not find any suitable non-network solution. Since the PSCR publication, AusNet Services refined cost estimates for the network options and the revised estimates are lower than the original estimates.

The network options that AusNet Services has identified are presented below.

3.1. Option 1 –Integrated replacement

Option 1 involves replacement of the two 220/66 kV transformers, selected 66 kV circuit breakers and associated primary and secondary assets in a single integrated project. It includes:

- Sequential replacement of the B1 and B4 transformers; and
- Replacement of twelve 66 kV circuit breakers and associated primary and secondary equipment.

The estimated capital cost of this option is $24.1 million with no material change in operating cost and an estimated delivery lead time of three to four years. Allowing for construction lead time, the earliest commissioning date is in 2024/25.

3.2. Option 2 – Staged replacement with one transformer replacement deferred

Option 2 is a staged replacement option to reduce the asset failure risk at ERTS over two phases. In the first stage, the secondary assets and all deteriorated primary assets except one of the 220/66 kV transformers will be replaced. The remaining 220/66 kV transformer will then be replaced seven years after completion of the first stage.

The estimated capital cost of the first and second stages of this option is $18.6 million and $6.8 million respectively with no material change in operating cost. Allowing for construction lead time, the earliest commissioning date of Stage 1 is in 2024/25 as the delivery lead time is around three to four years. The second stage is seven years after the first stage.

3.3. Option 3 – Staged replacement with the 66 kV circuit breakers deferred

Option 3 is another staged replacement option. In the first stage, the two 220/66 kV transformers will be replaced. The 66 kV circuit breakers will be replaced seven years after completion of the first stage.

The estimated capital cost of the first and second stage of this option is $12.8 million and $12.1 million respectively with no material change in operating cost. Allowing for construction lead time, the earliest commissioning date of Stage 1 is in 2024/24 as the delivery lead time is around three to four years. The second stage is seven years after the first stage.

3.4. Material inter-regional network impact

The ERTS network is electrically radial, and the network impact is confined within the inner suburbs of Melbourne, therefore none of the network options being considered are likely to have a material inter- regional network impact. A ‘material inter- regional network impact’ is defined in the NER as:

"A material impact on another Transmission Network Service Provider's network, which may include (without limitation): (a) the imposition of power transfer constraints within another Transmission Network Service Provider's network; or (b) an adverse impact on the quality of supply in another Transmission Network Service Provider's network."

4. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology[24], AusNet Services undertook a cost-benefit analysis to evaluate and rank the net economic benefits of credible options over a 45-year period.

All options considered were assessed against a business-as-usual case where no proactive capital investment to reduce the increasing baseline risks is made.

Optimal timing of an investment option is the year when the annual benefits from implementing the option become greater than the annualised investment costs.

4.1. Sensitivity analysis

The robustness of the investment decision is tested using a range of input assumptions as described in Table 3. The sensitivity analysis involves variations of assumptions from those used for the base case.

Table 3 - Input assumptions used for the sensitivity studies

Parameter	Lower Bound	Base Case	Higher Bound
Asset failure rate	AusNet Services assessment – 25%	AusNet Services assessment	AusNet Services assessment + 25%
Demand forecast	AEMO 2019 Transmission Connection Point Forecasts - 15%	AEMO 2019 Transmission Connection Point Forecasts	AEMO 2019 Transmission Connection Point Forecasts + 15%
Value of customer reliability	Latest AER VCR figures - 25%	Latest AER VCR figures	Latest AER VCR figures + 25%
Discount rate	2.58% - the WACC rate of a network business	4.68% - the latest commercial discount rate	6.78% - a symmetrical adjustment upwards

4.2. Material classes of market benefits

NER clause 5.16.1(c)(4) formally sets out the classes of market benefits that must be considered in a RIT-T. AusNet Services estimates that the only class of market benefits that is likely to be material is the change in involuntary load shedding that can be achieved when assets with high failure risk are replaced with new assets. AusNet Services' proposed approach to calculate the benefits of reducing the risk of involuntary load shedding is set out in section 2.3.

4.3. Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects material reduction in: safety risks from potential explosive failure of deteriorated assets, environmental risks from possible oil spillage, collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs by implementing any of the options considered in this RIT-T.

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[24] Australian Energy Regulator, *"Industry practice application note for asset replacement planning,"* available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning, viewed on 7 November 2019.

4.4. Classes of market benefits that are not material

AusNet Services estimates that the following classes of market benefits are unlikely to be material for any of the options considered in this RIT-T:

- Changes in fuel consumption arising through different patterns of generation dispatch - as the network is sufficiently radial to the extent that asset failures cannot be remediated by re-dispatch of generation, the wholesale market impact is expected to be the same for all options.
- Changes in costs for parties, other than the RIT-T proponent – there is no other known investment, either generation or transmission, that will be affected by any option considered.
- Changes in ancillary services costs – the options are not expected to impact on the demand for and supply of ancillary services.
- Change in network losses –while changes in network losses are considered in the assessment, they are estimated to be small and unlikely to be a material class of market benefits for any of the credible options.
- Competition benefits – there is no competing generation affected by the limitations and risks being addressed by the options considered for this RIT-T.
- Option value – as the need for and timing of any investment option is driven by asset deterioration, there is no need to incorporate flexibility in response to uncertainty around any other factor.

5. Options assessment

This section presents the results of the economic cost benefit analysis and the economical timing of the preferred option.

All options assessed will deliver a reduction in the following risks: involuntary load shedding, safety, environmental, collateral and emergency asset replacement.

The total risk cost reduction, presented in Figure 6, outweighs the investment cost for all options under most scenarios where input variables are varied one at a time.

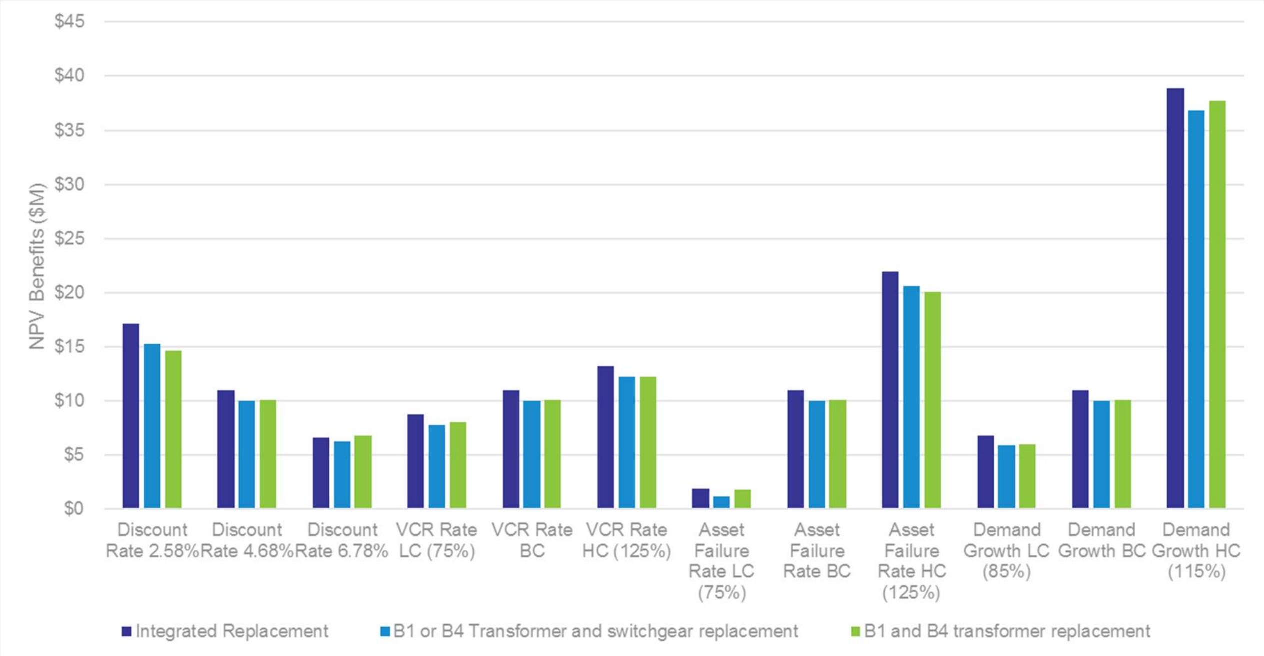

Figure 6 - Option Selection and sensitivity analysis

5.1. Preferred option

Option 1 – Integrated Replacement – delivers the highest net benefit for most of the scenarios considered and is therefore the preferred option.

5.2. Optimal timing of the preferred option

This section describes the optimal timing of the preferred option for different assumptions of key variables. Figure 7 shows that the economical time for the preferred option - Option 1 is 2023/24 for the base case assumptions.

Figure 7 – Optimal timing with respect to variation of key parameters

6. Draft conclusion and next steps

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain supply reliability in south-eastern metropolitan Melbourne and manage safety, environmental and emergency replacement risks at ERTS.

The preferred option involves the following scope of work in a single integrated project:

- Sequential replacement of the B1 and B4 transformers; and
- Replacement of twelve 66 kV circuit breakers and associated primary and secondary equipment.

The estimated capital cost of this option is $24.1 million with no material change to the operating and maintenance cost.

The preferred option will take three to four years to deliver.

Submissions

AusNet Services welcomes written submissions on the topics and the credible options presented in this PADR. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or 20 October 2020. In the subject field, please reference 'RIT-T PADR East Rowville Terminal Station.'

Appendix A - RIT-T assessment and consultation process

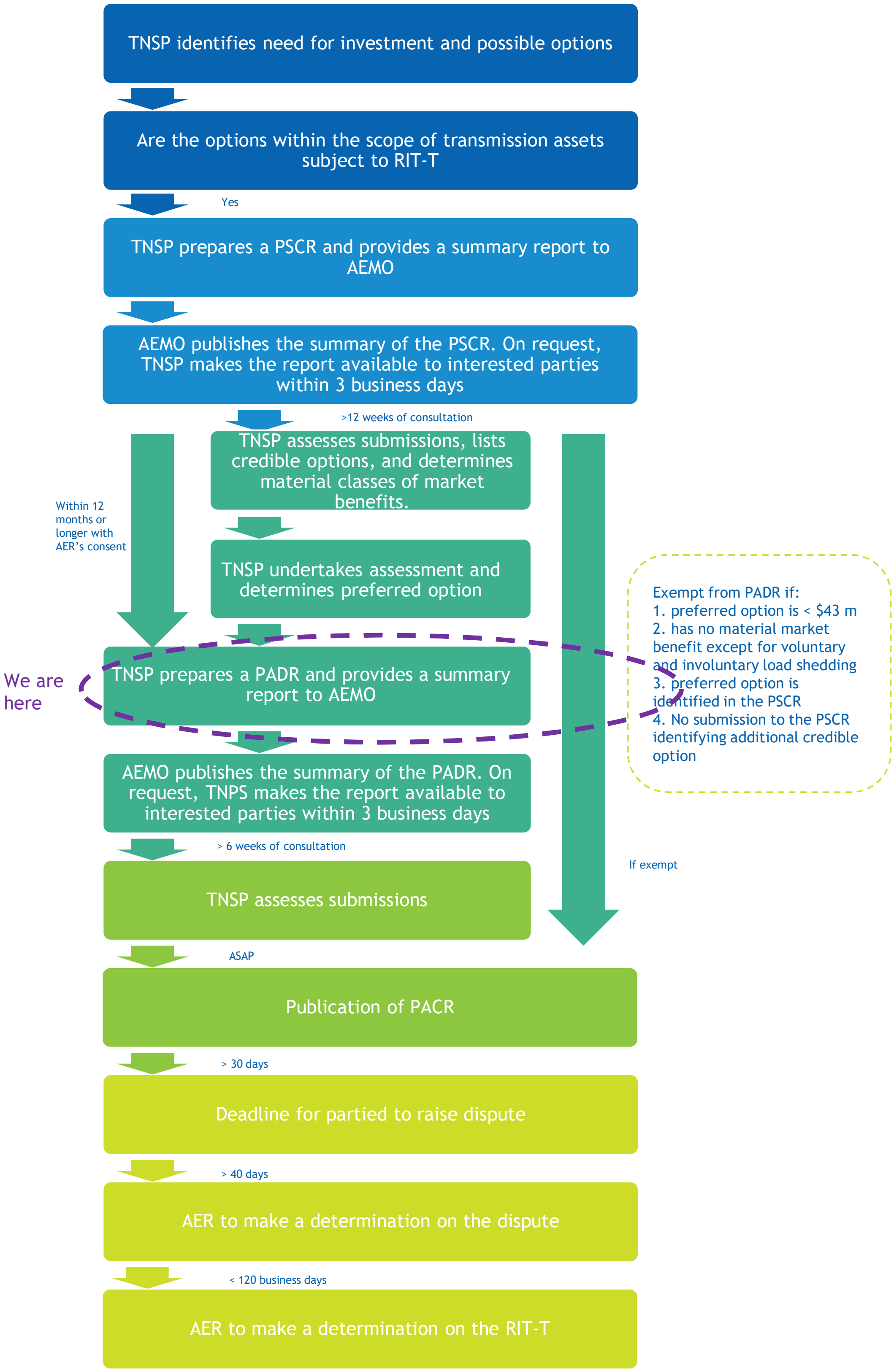

Figure 8 - RIT-T Process

Appendix B - Checklist of compliance clauses

The table below demonstrates the compliance of this PADR with the requirements of clause 5.16.4(k) of the National Electricity Rules version 126[25], which states that a RIT-T proponent must prepare a PADR which must include:

Table 4 - Summary of requirements

Requirement	Relevant section
(1) a description of each credible option assessed;	3
(2) a summary of, and commentary on, the submissions to the project specification consultation report;	3
(3) a quantification of the costs, including a breakdown of operating and capital expenditure, and classes of material market benefit for each credible option;	3 and 4
(4) a detailed description of the methodologies used in quantifying each class of material market benefit and cost;	4
(5) reasons why the RIT-T proponent has determined that a class or classes of market benefit are not material;	4
(6) the identification of any class of market benefit estimated to arise outside the region of the Transmission Network Service Provider affected by the RIT-T project, and quantification of the value of such market benefits (in aggregate across all regions);	4
(7) the results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results;	5
(8) the identification of the proposed preferred option;	6
(9) for the proposed preferred option identified under subparagraph (8), the RIT-T proponent must provide: (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date; (iii) if the proposed preferred option is likely to have a material inter-network impact and if the Transmission Network Service Provider affected by the RIT-T project has received an augmentation technical report, that report; and (iv) a statement and the accompanying detailed analysis that the preferred option satisfies the regulatory investment test for transmission.	3 and 6

25 Australian Energy Market Commission, *"National Electricity Rule version126,"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 7 November 2019.

Appendix C - Asset condition framework

AusNet Services uses an asset health index, on a scale of C1 to C5, to describe asset condition. The condition range is consistent across asset types and relates to the remaining service potential. The table below provides an explanation of the asset condition scores used.

Table 5 - Condition scores framework

Condition score	Likert scale	Condition description	Recommended action	Remaining service potential (%)
C1	Very Good	Initial service condition	No additional specific actions required, continue routine maintenance and condition monitoring	95
C2	Good	Better than normal for age		70
C3	Average	Normal condition for age		45
C4	Poor	Advanced deterioration	Remedial action or replacement within 2-10 years	25
C5	Very Poor	Extreme deterioration and approaching end of life	Remedial action or replacement within 1-5 years	15

Asset failure rates

AusNet Services uses the hazard function of a Weibull two-parameter distribution to estimate the probability of failure of an asset in a given year. The asset condition scores are used to establish a condition-based age which is used to calculate the asset failure rates using a two-parameter Weibull Hazard function (h(t)), as presented below.

$$h(t) = \beta.\frac{t^{\beta-1}}{\eta^{\beta}}$$

Equation 1: Weibull Hazard Function

where:

t = Condition-based age (in years)

η = Characteristic life (Eta)

β = Shape Parameter (Beta)

Hazard functions are defined for the major asset classes including power transformers, circuit breakers, and instrument transformers. All assets in the substation risk-cost model use a Beta (β) value of 3.5 to calculate the failure rates. The characteristic life represents that average asset age at which 63% of the asset class population is expected to have failed.

The condition-based age (t) depends on the specific asset’s condition and characteristic life (η).