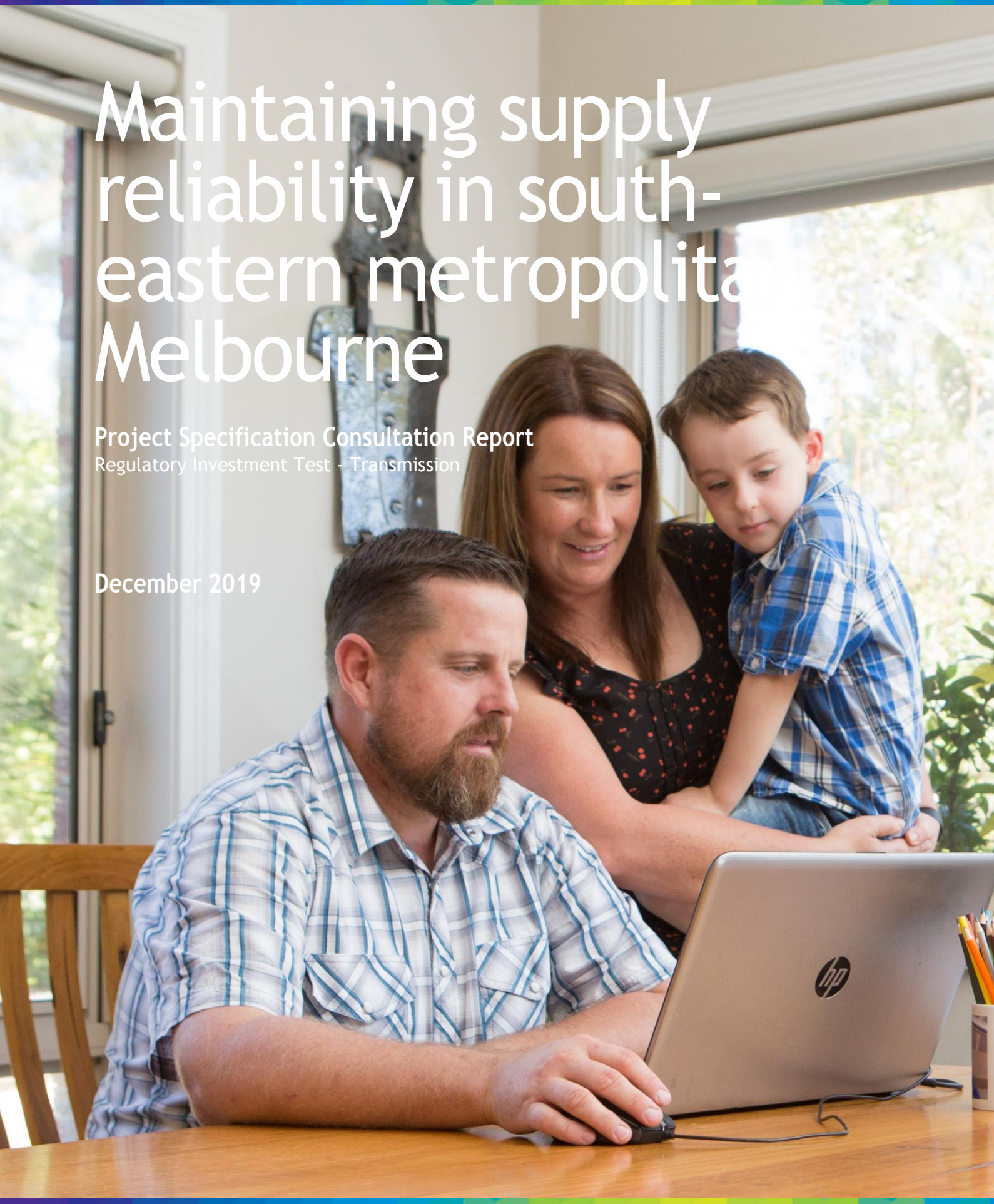
Maintaining supply reliability in south-eastern metropolita Melbourne

Project Specification Consultation Report

Regulatory Investment Test - Transmission

December 2019



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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

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Executive summary

AusNet Services is initiating 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 redevelopment project was delivered in 2019 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 by the first stage.

Publication of this Project Specification Consultation Report (PSCR) 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]. AusNet Services is exploring opportunities to accelerate the RIT-T process as allowed by NER clause 5.16.4(z1).

East Rowville Terminal Station 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.

Identified need

As expected of assets that have been in service for a long time, the condition of the transformers and circuit breakers at East Rowville Terminal Station 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 potential costs of emergency replacements. 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 $120 million – the biggest component of which comes from the supply interruption risks borne by electricity consumers. AusNet Services is therefore investigating options that could allow continued delivery of safe and reliable electricity supply.

Credible options

AusNet Services estimates that network or non-network investments are likely to deliver more economical and reliable solutions to maintaining supply reliability in south-eastern metropolitan Melbourne, compared with keeping the existing assets in service. AusNet Services has identified the following credible network solutions that could meet the identified need:

- Option 1 – Replace B1 transformer, B4 transformer and switchgear in an integrated project;
- Option 2 – Staged replacement, with one transformer replacement deferred; and
- Option 3 – Staged replacement, with the 66 kV circuit breakers deferred.

AusNet Services also welcomes proposals from proponents of non-network options (stand-alone or in conjunction with a network solution), that may meet the identified need, such as:

- options that avoid the need for a 220/66 kV East Rowville Terminal Station and which are of sufficient scale and flexibility to supply 500 MW or more;
- options that defer the need to replace at least one 220/66 kV transformer, by addressing short-term supply shortfalls in an event of a simultaneous outage of two transformers at

[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.

the terminal station; and

- options that allow for one or more of the 66 kV distribution feeders to become self-sufficient in islanded operation by providing local supply or demand curtailment in conjunction with local supply options.

Assessment approach

AusNet Services will investigate the costs, the economic benefits, and the ranking of options in this RIT-T assessment.

The robustness of the ranking and optimal timing of options will be investigated through:

- the use of three scenarios that are selected to explore a wide range of potential benefits: a high-benefit scenario, a central scenario, and a low-benefit scenario; and
- sensitivity analysis which involves variations of assumptions around the relevant variables from those employed under the Central scenario.

Options assessment and draft conclusion

AusNet Services' cost-benefit assessment reveals that the integrated replacement (Option 1) is the most economic option and provides the highest present value of net economic benefits under the Central and High-benefit scenarios, shown in Table 1.

Whilst the present values of the net economic benefits of Option 1 (integrated project) and Option 2 (staged replacement with one transformer replacement deferred) are similar, Option 1 provides additional benefits of fully addressing the residual risks in one integrated project.

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 East Rowville Terminal Station.

Table 1 - Estimated PV of net economic benefits from each option in real 2018/19 $ million

Option	Low-benefit scenario (10%)	Central (80%)	High-benefit scenario (10%)	Weighted value	Rank
Option 1	8.52	79.44	323.32	96.73	1
Option 2	9.59	79.22	319.46	96.28	2
Option 3	4.31	57.69	260.12	72.59	3

AusNet Services' analysis reveals that for the majority of the sensitivities studied, the optimal timing of delivery of the preferred option is as soon as possible.

Therefore, AusNet Services concludes that delivery of Option 1 as soon as possible is the most economical and preferred option to address the identified need.

Submissions

AusNet Services welcomes written submissions on the topics and the credible options presented in this PSCR, and invites proposals from proponents of potential non-network options.

Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 24 March 2020. In the subject field, please reference 'RIT-T PSCR East Rowville Terminal Station.'

Next steps

Should AusNet Services consider that no additional credible options that could deliver a material market benefit were identified during the 12-week consultation period, AusNet Services intends to invoke the benefit of exemption from publication of a Project Assessment Draft Report (PADR) as per NER clause 5.16.4(z1) and produce a Project Assessment Conclusions Report (PACR) before 24 May 2020. Otherwise, in accordance with NER clause 5.16.4(z1)(4), this benefit of exemption will no longer apply, and AusNet Services will aim to produce a PADR before 24 June 2020.

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Tables

1. Introduction

AusNet Services is initiating 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. Stage 1 of the East Rowville Terminal Station redevelopment project was delivered in 2019 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 by the first stage.

Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process[3] in accordance with clause 5.16 of the National Electricity Rules (NER)[4] and section 4.2 of the RIT-T Application Guidelines.[5]

This document describes:

- the identified need that AusNet Services is seeking to address, together with the assumptions used in identifying this need;
- credible network options that may address the identified need;
- the technical characteristics that would be required of a non-network option to address the identified need;
- the assessment approach and scenarios AusNet Services is intending to employ for this RIT-T assessment; and
- the specific categories of market benefits that are unlikely to be material in this RIT-T.

The need for investment to address risks from the deteriorating assets 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 PSCR and invites proposals from proponents of potential non-network options. Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 24 March 2020. In the subject field, please reference 'RIT-T PSCR 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.

[3] A RIT-T process will assess the economic efficiency and technical feasibility of proposed network and non-network options.
[4] 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.
[5] 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.
[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 East Rowville Terminal Station in providing electricity supply services and the condition of key assets is discussed below. 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 East Rowville Terminal Station is owned and operated by AusNet Services and is located in Rowville, Victoria. Since it was commissioned the 1960's, East Rowville Terminal Station has served as the main transmission service connection point for distribution of electricity to communities in south-eastern metropolitan Melbourne – from Scoresby to Lyndhurst and Belgrave to Mulgrave.[8]

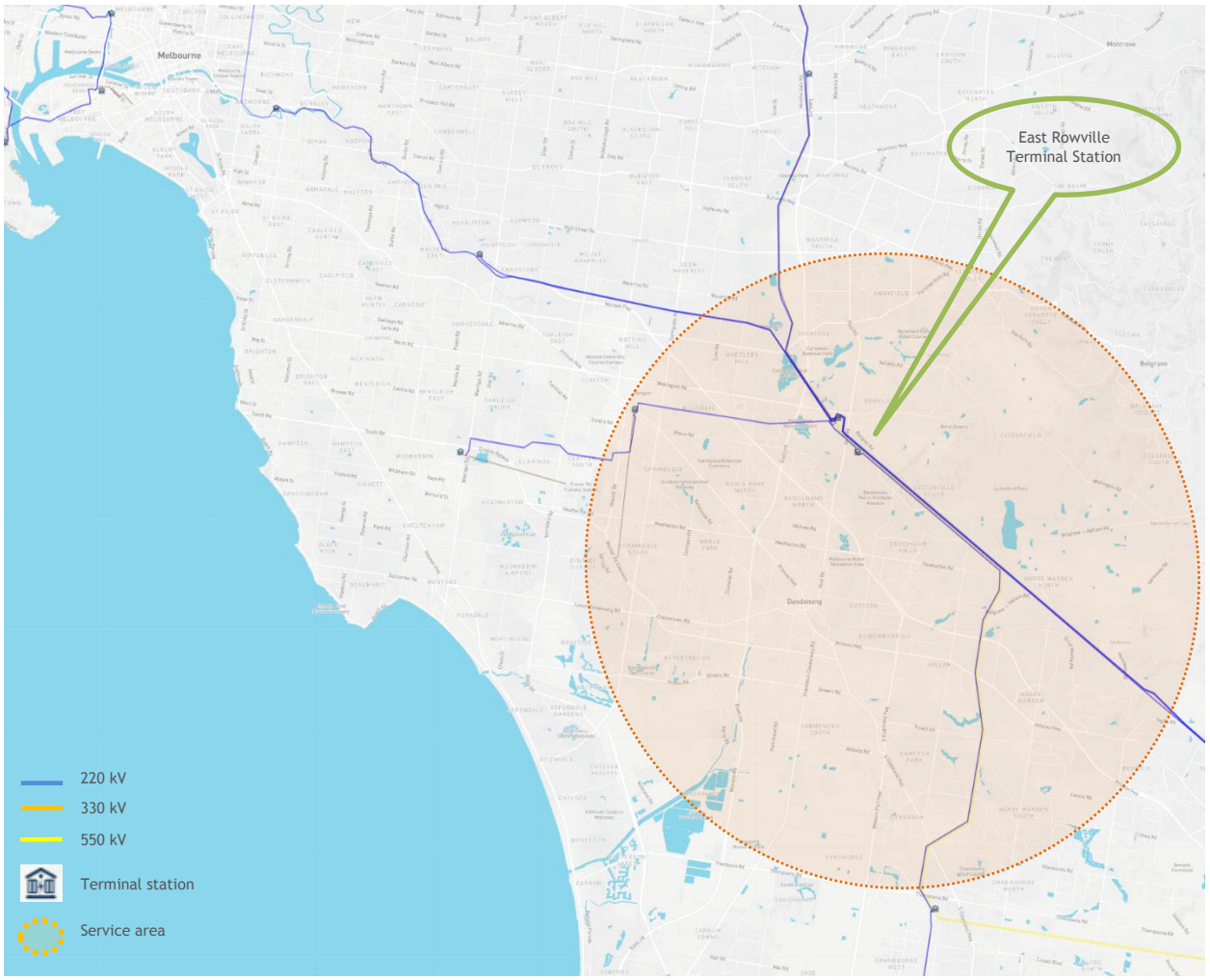

Figure 1 – South-eastern metropolitan Melbourne transmission network and relevant service area

Electricity demand

Around 128,000 customers depend on East Rowville Terminal Station for their electricity supply. While 92% of these customers are residential, more than 50% of energy supplied by East Rowville Terminal Station is consumed by commercial customers– equivalent to 825 GWh[9] per year, see Table 2.

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

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

Table 2 - 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 East Rowville Terminal Station 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, in the summer of 2018/19 peak demand was 447.60 MW. This reduction is partly due to transfer of electricity demand away from East Rowville to other terminal stations.

The Australian Energy Market Operator (AEMO) forecasts[10] that the peak demand at East Rowville Terminal Station will remain at present level over the next ten year period. Figure 2 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]

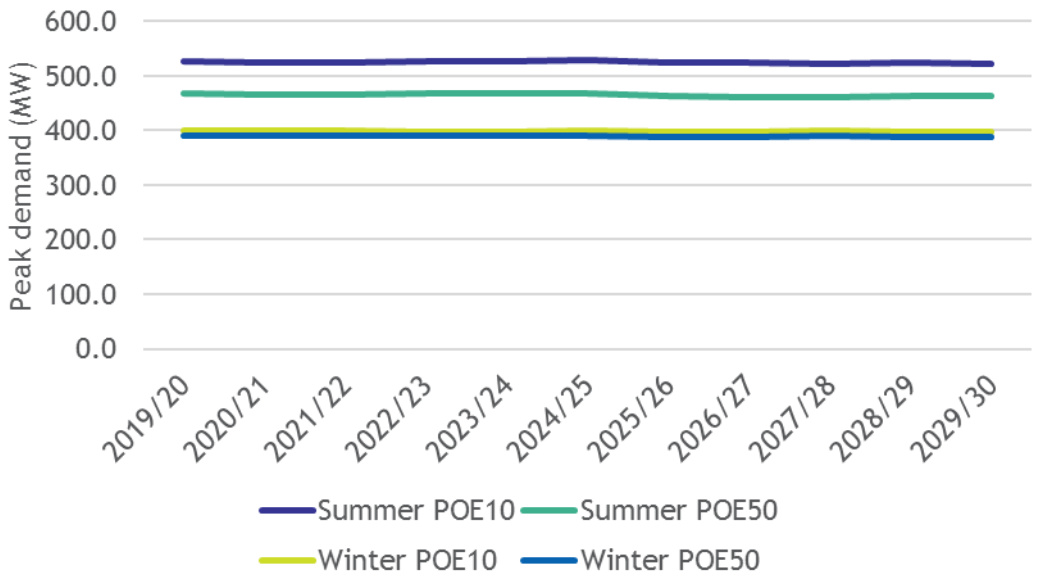

Figure 2 - Demand forecasts for East Rowville Terminal Station

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 East Rowville Terminal Station.

Electricity network

East Rowville Terminal Station sources its electricity supply from Rowville and Cranbourne Terminal Stations. 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 3.

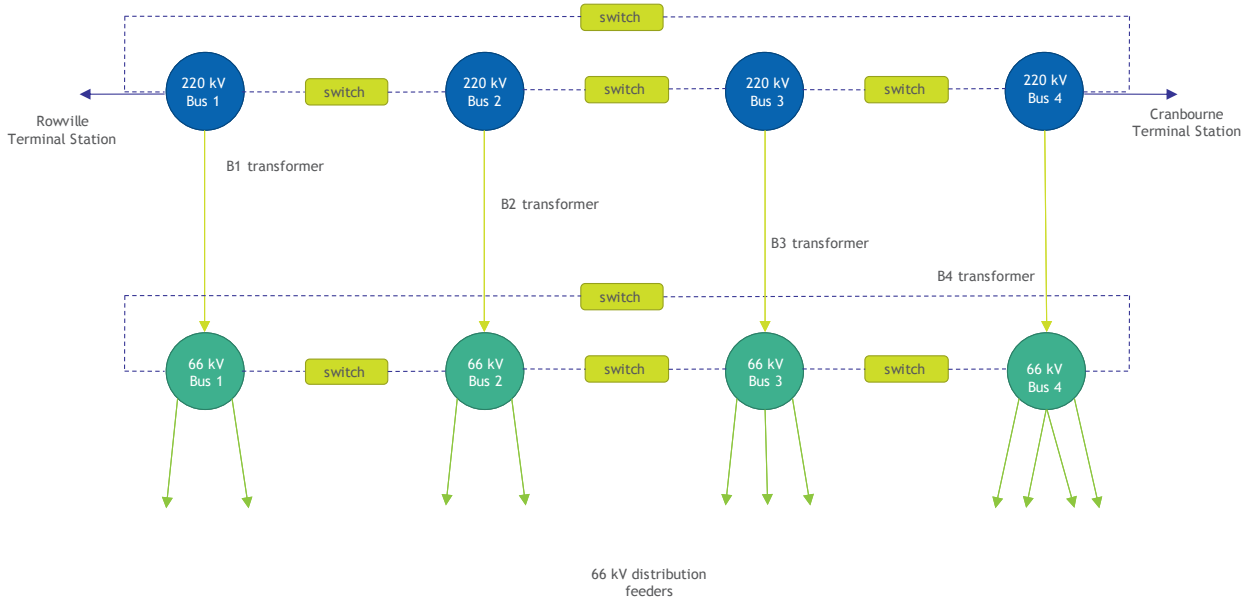

Figure 3 - Representative diagram for East Rowville Terminal Station

2.2. Asset condition

Several primary (power transformers and circuit breakers) and secondary (protection and control) assets at East Rowville Terminal Station are in poor and deteriorating 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 (extreme deterioration) – as set out in Appendix C. The latest asset condition assessment for East Rowville Terminal Station was conducted in 2019 and reveals that most assets at the terminal station are in poor condition (C4) or are rapidly deteriorating (C5). For the affected assets, the probability of failure is high, and is likely to increase further if no remedial action is taken. Table 3 provides a summary of the condition of relevant major equipment.

Table 3 - 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
Instrument transformer				9	3

Power transformers

There are four 150 MVA 220/66 kV transformers at East Rowville Terminal Station. The 'B1' and 'B4' transformers were commissioned in late 1960's and are of a specific make and type that has significant design issues observed in the fleet of similar assets in AusNet Services' network. The transformers have deteriorated significantly and according to the recent asset condition assessment report, the transformers are in poor condition and in advanced deterioration. Assets in this condition (C4) requires remedial action within the next five 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 transformer of similar brand, type, and make installed in locations where there is high fault level such as East Rowville.

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 or have suffered extreme deterioration 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 East Rowville Terminal Station are assessed to be in poor condition and in an advanced deterioration phase (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

East Rowville Terminal Station 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), affected assets are expected to deteriorate further and more rapidly. This will increase the probability of

[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.

failure, resulting in a higher likelihood of electricity supply interruptions, heightened safety risks due to potential explosive failure of the assets, environment 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.

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 relevant asset failures.

AusNet Services calculated the present value of the baseline risk costs to be $120 million over the forty-five year period from 2019/20. The key elements of these risk costs are shown in Figure 4. The largest component of the baseline risk costs comes from the supply interruption risk, borne by electricity consumers, from potential failure of assets.

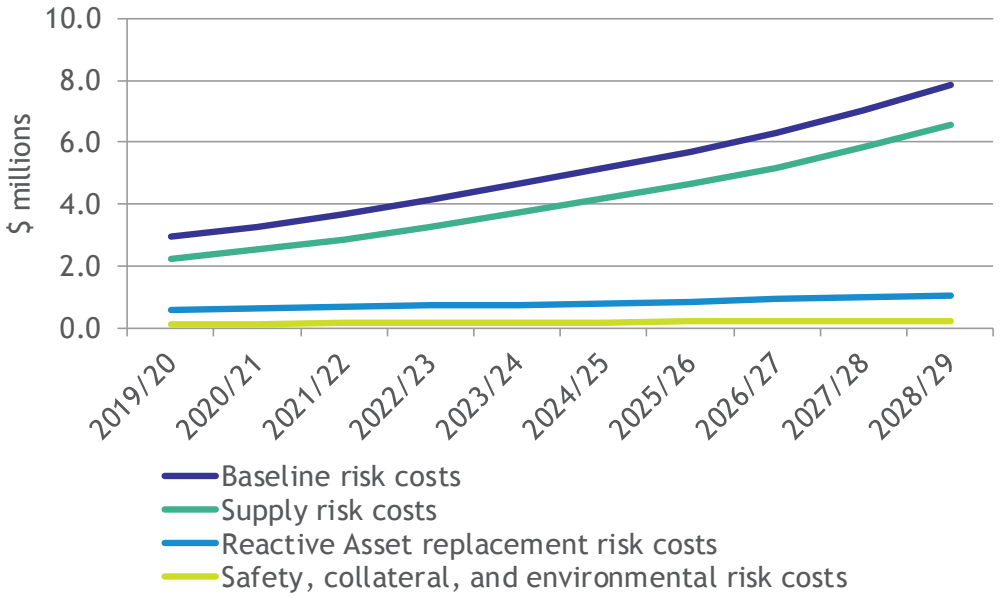

Figure 4 - Baseline risk costs

By undertaking 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 other assumptions to quantify the risks associated with asset failure. These assumptions are detailed in the following subsections.

Supply risk costs

In calculating the supply risk costs, AusNet Services has estimated the unserved energy based on the most recent AEMO demand forecasts for East Rowville Terminal Station,[16] and has valued this expected unserved energy at an appropriate Value of Customer Reliability (VCR)[17]. The choice of VCR

[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.

value is based on those published by AEMO, escalated to 2019/20 values, and the composition of customers supplied by the terminal station. The resulting estimate of the weighted VCR applicable for affected customers is $40,523/MWh.

AusNet Services is aware that the Australian Energy Regulator (AER) is reviewing the Value of Customer Reliability and will update this assumption once the findings are published.

The total supply risk cost is calculated by estimating the impacts of different combinations of relevant outages to reliability of supply in the south-eastern area and weighting them by their probabilities of occurrence.

Safety risk costs

The Electricity Safety Act 1998[18] requires AusNet Services to design, construct, operate, maintain, and decommission its network to minimize 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.

By 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 practice notes[22] provided by the AER.

Financial risk costs

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

Environmental risk costs

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 East Rowville Terminal Station, are valued at $100,000 per event.

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[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 will consider both network and non-network options to address the identified need caused by the deteriorating assets at East Rowville Terminal Station.

The network options that AusNet Services has identified are presented below while the technical requirements that a non-network option would have to provide are detailed in the next chapter.

3.1. Option 1 – Replace B1 transformer, B4 transformer and switchgear in an integrated project

Option 1 involves replacement of the two 220/66 kV transformers, 66 kV circuit breakers, 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 $30.6 million. The estimated operating cost is $2,000 per year.

AusNet Services' preliminary analysis shows that the optimal timing is to deliver a solution as soon as possible. Allowing for construction lead time, the earliest commissioning date is in 2023/24.

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

Option 2 is a staged replacement option to reduce the failure rates of the assets in 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 after the completion of the first stage.

The estimated capital cost of the first and second stage of this option is $22.9 million and $9.3 million respectively. The estimated operating cost is $3,000 per year.

AusNet Services' preliminary analysis shows that the optimal timing to deliver a solution is as soon as possible. Allowing for construction lead time, the earliest commissioning date for the first stage is in 2023/24. The second stage is seven years after.

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 after completion of the first stage.

The estimated capital cost of the first and second stage of this option is $17.6 million and $14.7 million respectively. The estimated operating cost is $2,000 per year.

AusNet Services' preliminary analysis shows that the optimal timing to deliver a solution is as soon as possible. Allowing for construction lead time, the earliest commissioning date for the first stage is in 2023/24. The second stage is seven years after.

3.4. Options considered but not progressed

Retirement of aging plant: Though it may avoid emergency reactive replacement, environment, and safety risk costs, retiring at least one transformer will reduce the terminal station's capacity and will inadvertently increase the supply risk costs. The overload control scheme installed at the terminal station allows for the remaining in-service transformers to be operated at higher ratings, however it is not sufficient to mitigate electricity supply risks caused by asset failure if one transformer was already retired. The expected high annual supply risk cost if a transformer was retired, shown in Figure 5, demonstrates that the service provided by the asset will continue to be required in the future. Consequentially, there would be a requirement to urgently replace the asset should they fail.

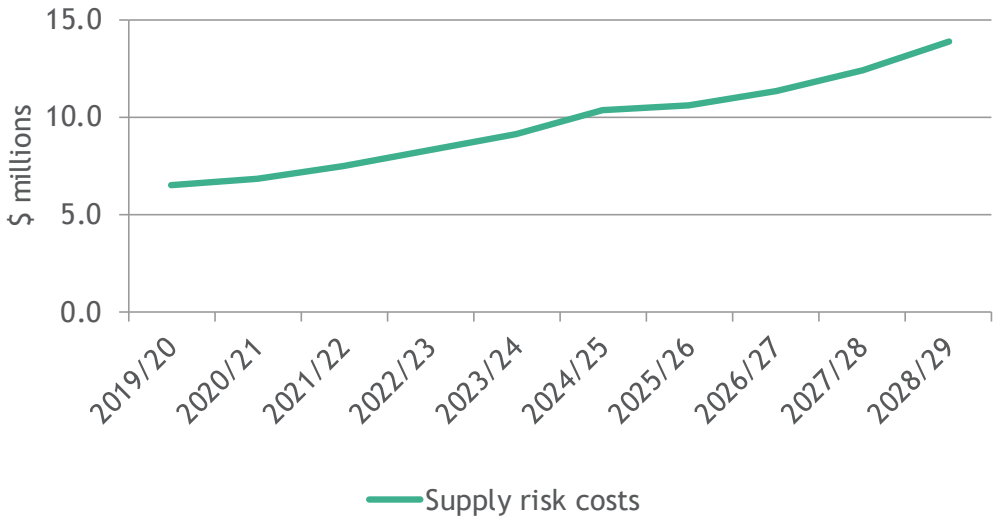

Figure 5 - Supply risk costs if one transformer was retired

Therefore, any option that reduces the terminal stations' capability is not progressed further.

Refurbishment options do not significantly reduce the failure rates and the risks from asset failure and are therefore not progressed further. Hence, refurbishment options are not proposed for this RIT-T.

3.5. Material inter-regional network impact

As the East Rowville Terminal Station network is electrically radial, and the network impact is confined within the inner suburbs of Melbourne, 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."*

AEMO's suggested screening test to indicate that a transmission augmentation has no material inter-network impact is that it satisfies the following[24]

- a decrease in power transfer capability between transmission networks or in another TNSP's

[24] Inter-Regional Planning Committee, *"Final Determination: Criteria for Assessing Material Inter-Network Impact of Transmission Augmentations,"* available at https://www.aemo.com.au/-/media/Files/PDF/170-0035-pdf.pdf, viewed on 7 November 2019.

network of no more than the minimum of 3% of the maximum transfer capability and 50 MW

- an increase in power transfer capability between transmission networks or in another TNSP's network of no more than the minimum of 3% of the maximum transfer capability and 50 MW
- an increase in fault level by less than 10 MVA at any substation in another TNSP's network
- the investment does not involve either a series capacitor or modification in the vicinity of an existing series capacitor.

By reference to AEMO's screening criteria, there is no material inter-regional network impact associated with any options considered.

4. Non-network options

AusNet Services welcomes proposals from proponents of non-network options that could be implemented on a stand-alone basis or in conjunction with a network option to meet or contribute to meeting the identified need for this RIT-T. AusNet Services will evaluate identified non-network options based on their economic and technical feasibility.

Table 4 lists some of the potential non-network services that AusNet Services considers may assist in meeting the identified need:

Table 4 - Potential services that could be provided by non-network options

Non-network option	High-level requirements	Supplementary network requirements
Supply to south-eastern metropolitan Melbourne	Permanent supply that meets a peak demand of about 500 MW and a total annual energy of more than 1,800 GWh. This service must also be expandable to meet forecast growth in the service area.	As this service would avoid the need for the 220/66 kV connection station, transmission lines could bypass East Rowville Terminal Station and the terminal station could be retired.
Back-up supply (combined network and non-network solution)	At least 150 MW of back-up supply for major transformer failure(s).	This service could defer the need for replacement of the 150 MVA 220/66 kV transformers.
Supply to at least one 66 kV feeder that is connected to East Rowville Terminal Station	Supply for the entire service requirement of any of the 66 kV feeders to make it self-sufficient.	This service allows selective-replacement of assets, disconnection of the relevant 66 kV feeder, and retirement of relevant feeder circuit breakers but will require reconfiguration of distribution networks. Depending on the size and which feeder the non-network option is offered at, this service could reduce the scope of replacement needs and allow deferral of investment while mitigating the failure risks from deteriorating assets.

4.1. Required technical characteristics of a non-network option

Up to 150 MW of demand is at risk of being shed during a simultaneous outages of two 220/66 kV transformers to avoid overloading of the remaining transformers. Non-network options could potentially address this risk of supply shortfall, reducing the risk costs associated with such an event.

Figure 6 shows the typical annual demand profile serviced by East Rowville Terminal Station and the supportable demand levels for different network outage configurations. Using this reference demand profile, any non-network option would need to be able to reliably and immediately reduce the loading on the terminal station by at least 150 MW for up to 12 hours per day within 6 hours following failure of one or more transformers.

Whilst this section provides basic information that proponents of non-network solutions could use to evaluate their proposals, AusNet Services invites a collaborative approach and is open for discussions to maximize the potential benefits from non-network options.

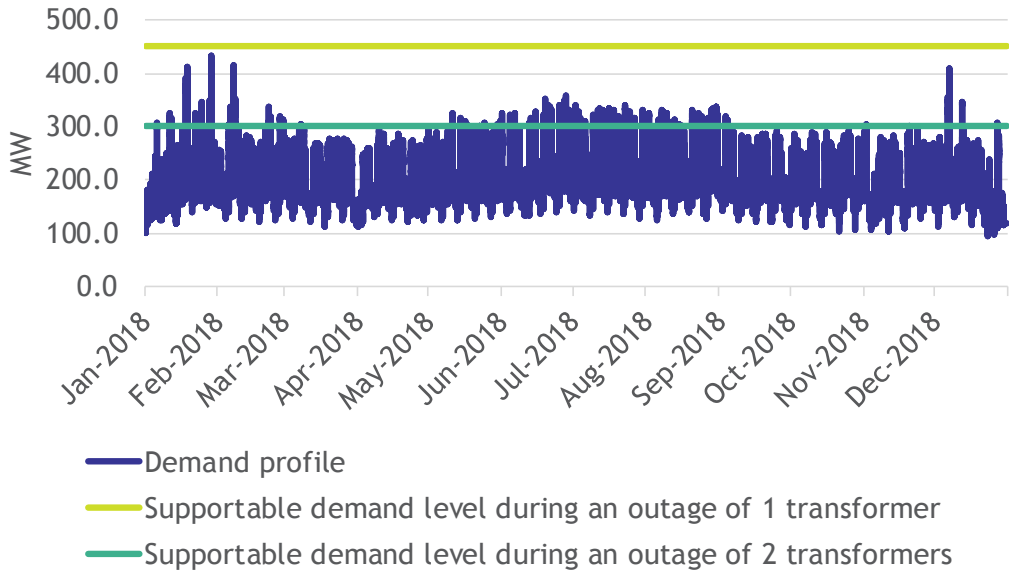

Figure 6 - Typical annual demand profile and supportable demand levels for different network configurations at East Rowville Terminal Station

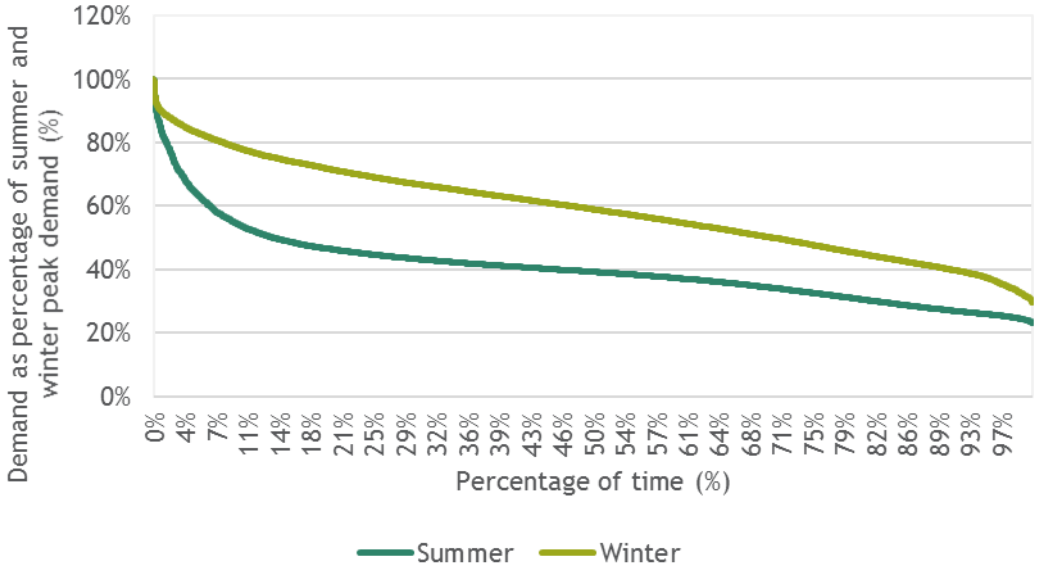

Figure 7 - East Rowville Terminal Station summer and winter demand duration curves

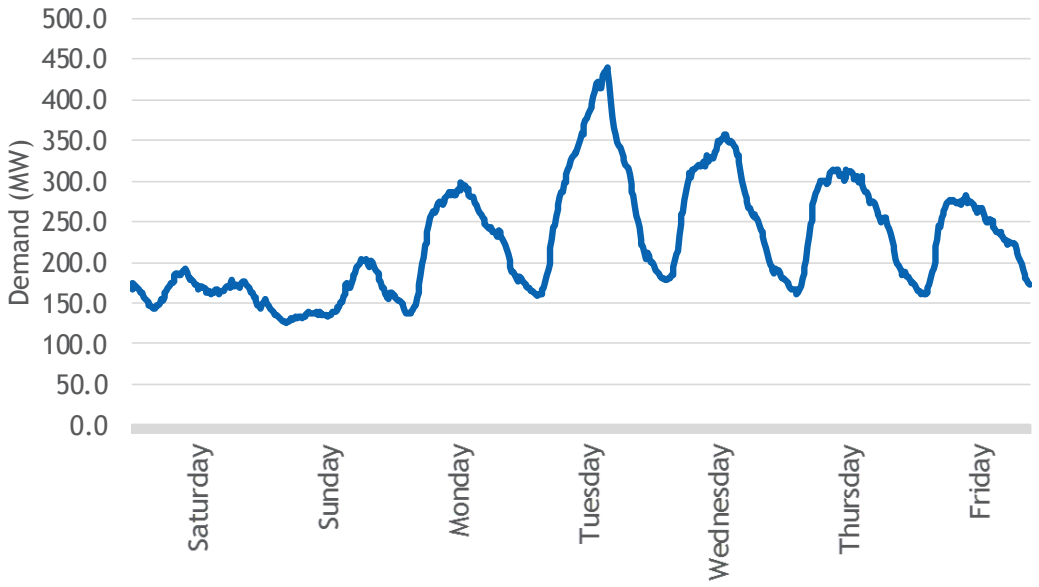

Figure 8 – East Rowville Terminal Station typical summer weekly demand profile

4.2. Location of non-network option

Non-network options connected to any of the eleven 66 kV feeders supplied from East Rowville Terminal Station could be effective in addressing the supply shortfall risk.

4.3. Information to be included in non-network solution proposals

To manage a complex portfolio of demand management of sufficient scale, proposals for non-network solutions must be at least 5 MW in size and of proven technology which may include embedded generation, energy storage (including battery system) that injects power into the grid as required, voluntary curtailment of customer demand, and permanent reduction of customer demand (including energy efficiency).

Table 5 shows the relevant parameters that must be included in any proposal for non-network solution.

Table 5 - Required information that a proponent of non-network option must submit

Parameter	Description
Block ID	Block Identifier (e.g. Block 1) of non-network solution
Block capacity	Discrete amount of the non-network option (reduced demand or additional supply) capacity in MW. Sum of block capacities must meet a minimum requirement of 5 MW. AusNet Services may choose to select a subset of blocks it determines that is most economical and reliable to dispatch.
Location	For new generation solutions, details of the proposed sites for the new generators
Availability period	Time periods the blocks are available (months/days/hours)
Call notice period	Minimum period of time before the block can be dispatched
Establishment fee	Setup payment that applies to a block

Parameter	Description
Availability fee	A fee per month for a block to be made available to be dispatched
Indicative dispatch fee	Fee for a block to be dispatched per MWh
Dispatch lead time	Time required (in hours) to activate the non-network service
Timeframe for project delivery	When the block of DR will be available for dispatch
Communications	Proposed dispatch communications protocol with AusNet Services' control room
Metering	Metering equipment installed or to be installed to measure and record the data to be verified
Any other special technical requirements	e.g. terms of commitment and length of service.

Proposals for non-network solutions should be emailed to rittconsultations@ausnetservices.com.au by 24 March 2020.

5. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology[25], AusNet Services will undertake a cost-benefit analysis to evaluate and rank the net economic benefits from various credible options.

AusNet Services proposes to undertake this assessment over a 45-year period.

All options considered will be 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 will be the year when the annual benefits from implementing the option become greater than the annualised investment costs.

5.1. Proposed scenarios and input assumptions

The robustness of the investment decision is tested using scenarios described in Table 6.

Table 6 - Summary of input assumptions for the proposed scenarios

Parameter	Low-benefit scenario	Central	High-benefit scenario
Description	explore the lower bound of potential benefits	most likely scenario	gives high estimates for the benefits
Weighting	10%	80%	10%
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 AEMO VCR figures - 25%	Latest AEMO VCR figures	Latest AEMO VCR figures + 25%
Capital cost	AusNet Services assessment + 15%	AusNet Services assessment	AusNet Services assessment – 15%
Discount rate	8.49%, a symmetrical adjustment upwards	5.9% - the latest commercial discount rate[26]	3.31% - the latest regulated cost of capital[27,28,29]

AusNet Services proposes a weighting of 80% for the Central scenario as it expects it to be most likely. For the other two scenarios, a 10% weighting will be applied for each – as the simultaneous occurrence of extreme parameters, which the scenarios represent, is less likely.

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[25] 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.

[26] Energy Networks Australia, *"RIT-T Economic Assessment Handbook,"* available at https://www.energynetworks.com.au/resources/fact-sheets/rit-t-economic-assessment-handbook/, viewed on 7 November 2019.

[27] Using the regulated nominal, pre-tax rate of return of 5.36% based on AER's final decision and the consumer price index of 1.7% as at September 2019 from the Reserve Bank of Australia.

[28] Reserve Bank of Australia, "Measures of Consumer Price Inflation," available at https://www.rba.gov.au/inflation/measures-cpi.html, viewed on 15 November 2019.

[29] Australian Energy Regulator, "AER releases final decision on rate of return for regulated energy networks," available at https://www.aer.gov.au/news-release/aer-releases-final-decision-on-rate-of-return-for-regulated-energy-networks, viewed on 7 November 2019.

5.1.1. Sensitivity analysis

The robustness of the investment decision and the optimal timing of the preferred option will be tested by a sensitivity analysis. This analysis involves variation of assumptions from those employed under the Central scenario.

5.2. 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. AusNet Services' proposed approach to calculate the benefits of reducing the risk of load shedding is set out in section 2.3.

5.3. 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, environment 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.

5.4. 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.

AusNet Services notes that non-network options of significant size and duration may impact the wholesale electricity market and the materiality of several of the classes of market benefits mentioned above. Where appropriate, AusNet Services will assess the materiality of these market benefits as part of the next step in the evaluation process.

6. Options assessment

This section details the analysis of the costs and benefits from the network options considered in this RIT-T so far. Any credible option that may arise from submissions in response to this PSCR will be assessed and presented as part of the next step of this RIT-T.

6.1. Estimated costs

Table 7 shows the present value of all costs associated with implementing the options considered.

Table 7 - Estimated PV of capital and operating costs for each option in real 2018/19 $ million

Option	Low-benefit scenario (10%)	Central (80%)	High-benefit scenario (10%)	Weighted value
Option 1	23.44	23.01	22.14	22.97
Option 2	21.57	21.89	21.92	21.86
Option 3	19.84	20.62	21.19	20.60

6.2. Estimated benefits

In all of the scenarios investigated, there is a forecast reduction in supply risks, safety risks, environment risks, and risks of replacement if the asset failed. The total risk cost reduction from the baseline risk costs is presented in Table 8.

Table 8 - Estimated PV of gross economic benefits from each option in real 2018/19 $ million

Option	Low-benefit scenario (10%)	Central (80%)	High-benefit scenario (10%)	Weighted value	Rank
Option 1	31.90	102.37	345.36	119.62	1
Option 2	31.10	101.04	341.29	118.07	2
Option 3	24.08	78.23	281.21	93.11	3

6.3. Net economic benefits

Presented in Table 9, the total risk cost reduction outweighs the total capital, operating and maintenance costs for all options under all scenarios considered. However, amongst the options considered, Option 1 has the greatest weighted net economic benefits. Note that Table 9 does not present the arithmetic subtraction of the figures in Table 7 and Table 8 as it incorporates the baseline operating and maintenance costs.

Table 9 - Estimated PV of net economic benefits from each option in real 2018/19 $ million

Option	Low-benefit scenario (10%)	Central (80%)	High-benefit scenario (10%)	Weighted value	Rank
Option 1	8.52	79.44	323.32	96.73	1
Option 2	9.59	79.22	319.46	96.28	2
Option 3	4.31	57.69	260.12	72.59	3

6.4. Sensitivity analysis

This section describes the sensitivity of the net economic benefits, ranking of options, and optimal timing of the preferred option to different assumptions on key variables.

Sensitivity of net economic benefits

Using the Central scenario as the reference, the net economic benefits from implementing an option changes with different assumptions on key variables. While it is sensitive, the net economic benefits are still positive in all sensitivities studied and the ranking of options remains similar. This confirms that the conclusions on the preferred option is robust. In most of the sensitivities tested, Option 1 is most economical amongst all the options considered, as shown in Figure 9.

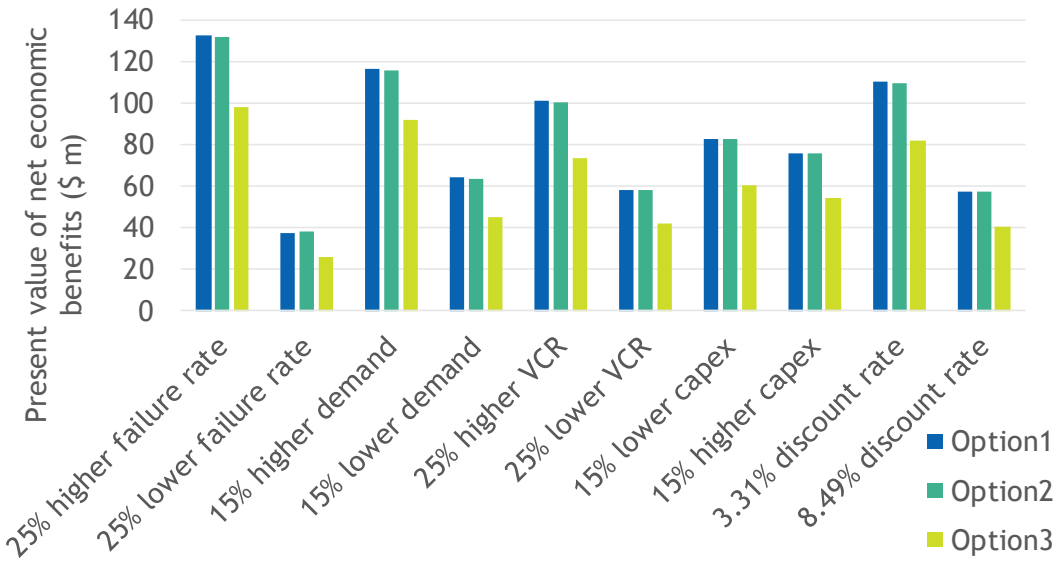

Figure 9 - Sensitivity of the net economic benefits with respect to variation of key parameters

Sensitivity of optimal timing

Figure 10 shows that under majority of all the sensitivities investigated, the optimal timing of the preferred option is as soon as possible. However, to allow for construction lead time, this option is expected to be commissioned in 2023/24.

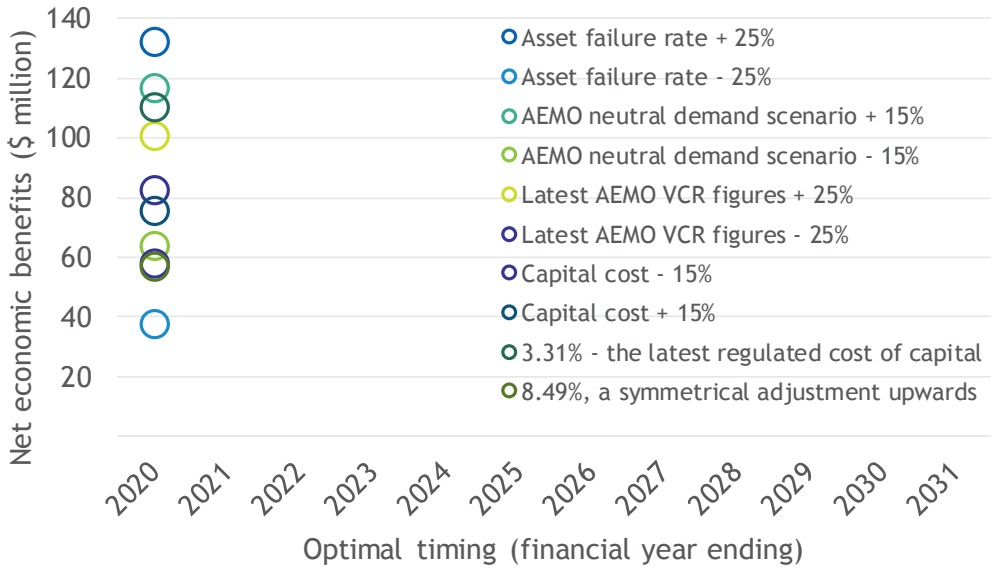

Figure 10 - Sensitivity of the optimal timing with respect to variation of key parameters

7. 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 East Rowville Terminal Station.

Whilst the present values of the net economic benefits of Option 1 (integrated project) and Option 2 (staged replacement with one transformer replacement deferred) are similar, Option 1 provides additional benefits of fully addressing the residual risks in one integrated project.

This 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 $30.6 million. The estimated operating cost is $2,000 per year.

Based on AusNet Services' preliminary analysis, this option is economical to proceed as soon as possible. However, to allow for construction lead time, this option is expected to be commissioned in 2023/24.

Submissions

AusNet Services welcomes written submissions on the topics and the credible options presented in this PSCR, and invites proposals from proponents of potential non-network options.

Submissions should be emailed to rittconsultations@ausnetservices.com.au on or before 24 March 2020. In the subject field, please reference 'RIT-T PSCR East Rowville Terminal Station.'

Exemption from preparing a PADR

Subject to receipt of technically- and economically-feasible network or non-network options, publication of a Project Assessment Draft Report (PADR) may not be required for this RIT-T as:

- the preferred option, Option 1, which has a capital cost of less than $43 million, addresses the identified need most economically;
- all credible options will not have a material class of market benefits except for those specified in NER clause 5.16.1(c)(4)(ii), and 5.16.1(c)(4)(iii); and
- this project has the benefit of NER clause 5.16.4(z1);

Should AusNet Services consider that no additional credible options were identified during the 12-week consultation period, AusNet Services intends to produce a Project Assessment Conclusions Report (PACR) before 24 May 2020.

In accordance with NER clause 5.16.4(z1)(4), the exemption from producing a PADR will no longer apply if AusNet Services considers that an additional credible option that could deliver a material market benefit is identified during the consultation period. Accordingly, AusNet Services will aim to produce a PADR which will include assessment of the net economic benefits from each additional credible option before 24 June 2020.

Appendix A - RIT-T assessment and consultation process

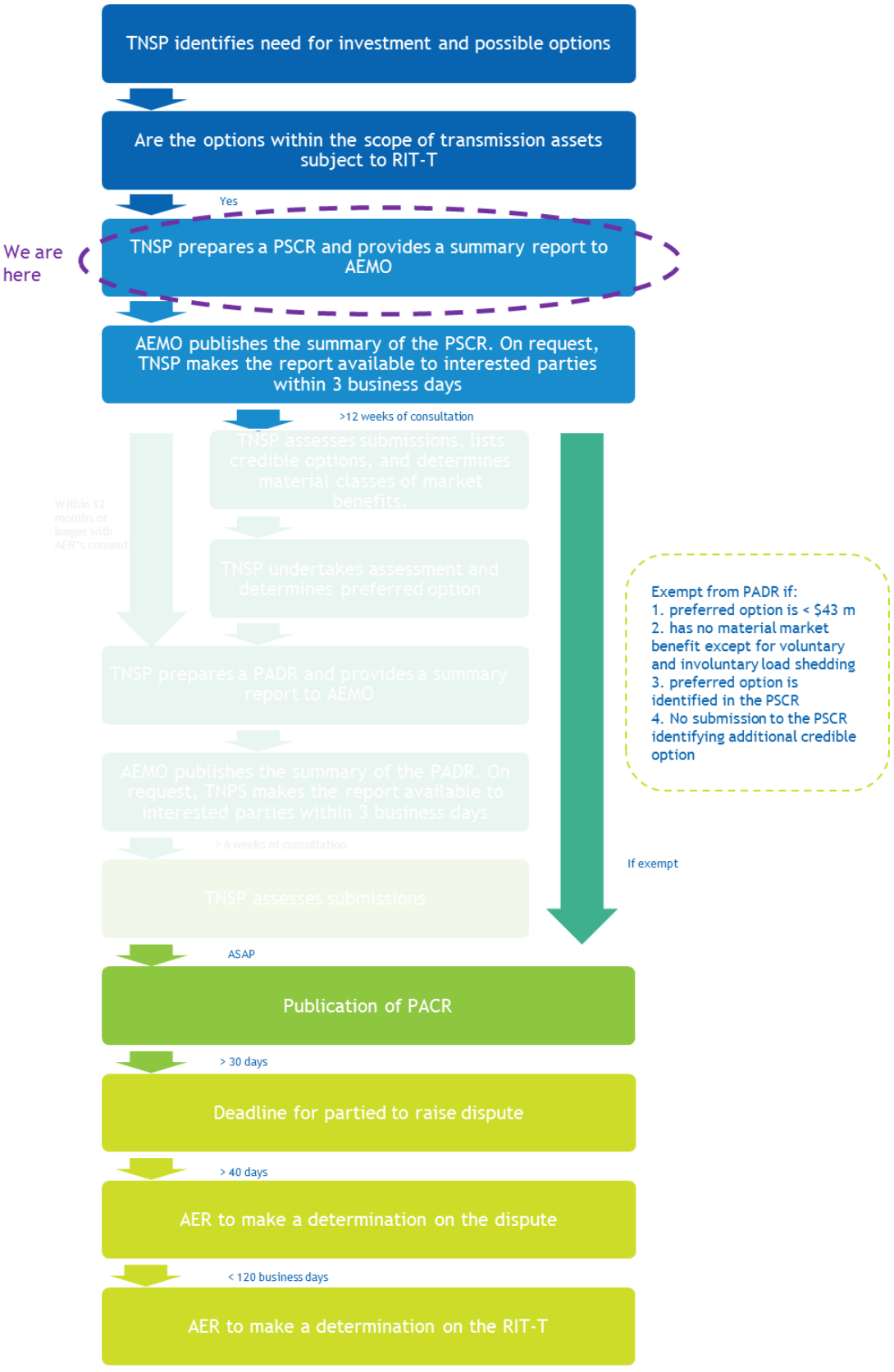

Figure 11 - RIT-T Process

Appendix B - Checklist of compliance clauses

The table below demonstrates the compliance of this PSCR with the requirements of clause 5.16.4(b) of the National Electricity Rules version 126[30], which states that a RIT-T proponent must prepare a PSCR which must include:

Table 10 - Summary of requirements

Requirement	Relevant section
(1) a description of the identified need;	2
(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-T proponent considers reliability corrective action is necessary);	2
(3) the technical characteristics of the identified need that a non-network option would be required to deliver, such as: (i) the size of load reduction of additional supply; (ii) location; and (iii) operating profile;	4
(4) if applicable, reference to any discussion on the description of the identified need or the credible options in respect of that identified need in the most recent National Transmission Network Development Plan;	Not applicable
(5) a description of all credible options of which the RIT-T proponent is aware that address the identified need, which may include, without limitation, alterative transmission options, interconnectors, generation, demand side management, market network services or other network options;	3
(6) for each credible option identified in accordance with subparagraph (5), information about: (i) the technical characteristics of the credible option; (ii) whether the credible option is reasonably likely to have a material inter-network impact; (iii) the classes of market benefits that the RIT-T proponent considers are likely not to be material in accordance with clause 5.16.1(c)(6), together with reasons of why the RIT-T proponent considers that these classes of market benefit are not likely to be material; (iv) the estimated construction timetable and commissioning date; and (v) to the extent practicable, the total indicative capital and operating and maintenance costs.	3 and 5
A RIT-T proponent is exempt from paragraphs (j) to (s) if: 1. the estimated capital cost of the proposed preferred option is less than $35 million (as varied in accordance with a cost threshold determination); 2. the relevant Network Service Provider has identified in its project specification consultation report: (i) its proposed preferred option; (ii) its reasons for the proposed preferred option; and (iii) that its RIT-T project has the benefit of this exemption;	7

30 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.

Requirement	Relevant section
3. the RIT-T proponent considers, in accordance with clause 5.16.1(c)(6), that the proposed preferred option and any other credible option in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4) except those classes specified in clauses 5.16.1(c)(4)(ii) and (iii), and has stated this in its project specification consultation report; and 4. the RIT-T proponent forms the view that no submissions were received on the project specification consultation report which identified additional credible options that could deliver a material market benefit.	

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 11 - 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).