Maintaining reliable power transformation services at South Morang Terminal Station

Project Specification Consultation Report

Regulatory Investment Test - Transmission

XX Date

Important notice

Purpose

AusNet Services has prepared this document to provide information about potential limitations in Victorian 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 reliable power transformation services at South Morang Terminal Station (SMTS). Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process[1] in accordance with clause 5.16 of the National Electricity Rules (NER)[2] and section 4.2 of the RIT-T Application Guidelines.[3]

SMTS is owned and operated by AusNet Services and is located 23 km north of Melbourne. SMTS is part of the main 500 kV transmission network with ties to Tasmania and major generation in the Latrobe Valley, the Victoria-South Australia interconnector in the west and the interconnector between Victoria and New South Wales. The terminal station also provides transformation capacity from 500kV to lower voltages that supply the Metropolitan Melbourne. AusNet Services is therefore investigating options that could allow continued delivery of safe and reliable power transformation services to users of the main transmission network.

Identified need

The 330/220 kV H1 transformer and the 330 kV circuit breaker associated with the 500/330 kV F2 transformer at SMTS have been in service for an extended period of time. The condition of the assets has deteriorated to a level where there is a material risk of asset failure, which could have an impact on electricity supply reliability, generation cost, safety, and potential costs of emergency replacements. The 'identified need' this RIT-T intends to address is to maintain reliable power transformation services at SMTS and mitigate risks from asset failures.

The present value of the baseline risk costs associated with maintaining the existing transformer in service is more than $109.17 million – the largest component of which comes from the impact on the wholesale electricity market.

Credible options

One credible network option that is likely to deliver an economical solution to the identified need is considered in this RIT-T, but variation of timing is investigated. The resulting options are:

- Option 1 – Integrated replacement of the H1 transformer and 330kV circuit breaker
- Option 2 - Integrated replacement of the H1 transformer and 330kV circuit breaker but delayed by four years

AusNet Services has not identified credible non-network option that may assist in addressing the identified need and invites 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.

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 sensitivity analysis which involves variation of assumptions around the values used for the Central scenario.

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

[2] Australian Energy Market Commission, *"National Electricity Rule version 140,"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 28 May 2020.

[3] 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 28 May 2020.

This draft conclusion section is included in the Draft PSCR for the purposes of supporting AusNet Services Transmission Revenue Reset submission. The draft conclusion indicates the most economic option of the credible options identified. When the timing is right for this RIT-T to proceed, this section will be removed, and AusNet Services will seek input from the market regarding other options and will evaluate all credible options in accordance with the RIT-T process.

Options assessment and draft conclusion

AusNet Services' cost-benefit assessment concludes that integrated replacement (Option 1) is the most economic option as it provides the highest present value of net economic benefits under the Central scenario as shown in the table below.

This option will not only maintain reliable power transformation services at SMTS, but also mitigates safety, environmental, and emergency replacement risks from deteriorating assets.

Table 1 - Estimated PV of net economic benefits from each option in real 2019/20 $ million

Option	Central scenario	Rank
Option 1	61.2	1
Option 2	56.3	2

The optimal timing of delivery of the preferred option, for most of the sensitivities studied, is 2025/26.

Therefore, AusNet Services concludes that delivery of Option 1 by 2025/26 is the most economical and preferred option to address the identified need.

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 XX Date. In the subject field, please reference 'RIT-T PSCR South Morang Terminal Station H Transformer Project.'

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.

Next steps

Assessments of the options and responses to this PSCR will be presented in the Project Assessment Draft Report (PADR) that is intended to be published before XX Date.

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Tables

1. Introduction

AusNet Services is initiating this Regulatory Investment Test for Transmission (RIT-T) to evaluate options for maintaining reliable power transformation services at South Morang Terminal Station (SMTS). The 330/220 kV H1 transformer and associated switchgear at SMTS are reaching the end of serviceable life which is driving the need for this investment.

Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process[4] in accordance with clause 5.16 of the National Electricity Rules (NER)[5] and section 4.2 of the RIT-T Application Guidelines[6].

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 materiality of each class of market benefit considered in this RIT-T.

The need for investment to address asset failure risks from the deteriorating 330/220 kV H1 transformer and associated switchgear at SMTS is included in AusNet Services' revenue proposal for the 2022 to 2027 regulatory control period. This specific investment need is also identified in AusNet Services Asset Renewal Plan, published as part of AEMO's 2019 Victorian Transmission Annual Planning Report (VAPR)[7].

[4] A RIT-T process will assess the economic efficiency and technical feasibility of proposed network and non-network options.
[5] Australian Energy Market Commission, *"National Electricity Rule version 140,"* available at https://www.aemc.gov.au/regulation/energy-rules/national-electricity-rules/current, viewed on 28 May 2020.
[6] 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 28 May 2020.
[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 28 May 2020.

2. Identified need

The 330/220 kV H1 transformer and associated switchgear at SMTS play an important role in the safe and reliable operation of the terminal station. The condition of these key assets and the quantification of the asset failure risk costs are discussed in this section.

2.1. Victorian transmission network

SMTS is owned and operated by AusNet Services and is located 21 km north of Melbourne. It is part of the main 500 kV transmission network with ties to Tasmania and major generation in the Latrobe Valley, the Victoria-South Australia interconnector in the west and the interconnector between Victoria and New South Wales.

Figure 1 – SMTS and the Victorian transmission network

South Morang Terminal Station

SMTS has four voltage levels and connects six other terminal stations.

- The 500 kV side connects three 500 kV lines from Hazelwood and Rowville terminal stations in the east and three 500 kV lines to Sydenham and Keilor terminal stations in the west. A 1,000 MVA transformer steps the voltage down from 500 kV to 330 kV;
- There are two 1,100 MVA lines that connect the 330 kV side of SMTS to Dederang Terminal Station (DDTS). From this voltage level, two 700 MVA transformers further step the voltage down to 220 kV - these two H transformers are vital to the operation of the 220 kV metropolitan transmission network;
- Two 220 kV lines connect SMTS to Thomastown Terminal Station (TTS); and
- There are two 220/66 kV transformers.

A new 500/330 kV transformer will be built at SMTS as part of the Victorian New South Wales interconnector upgrade to increase the inter-regional transmission capacity by 170 MW during peak demand conditions.[8] It is scheduled to be commissioned by 2022/23.

Figure 2 shows the 330 kV primary assets of the terminal station as the other voltages are not included in the scope of this RIT-T.

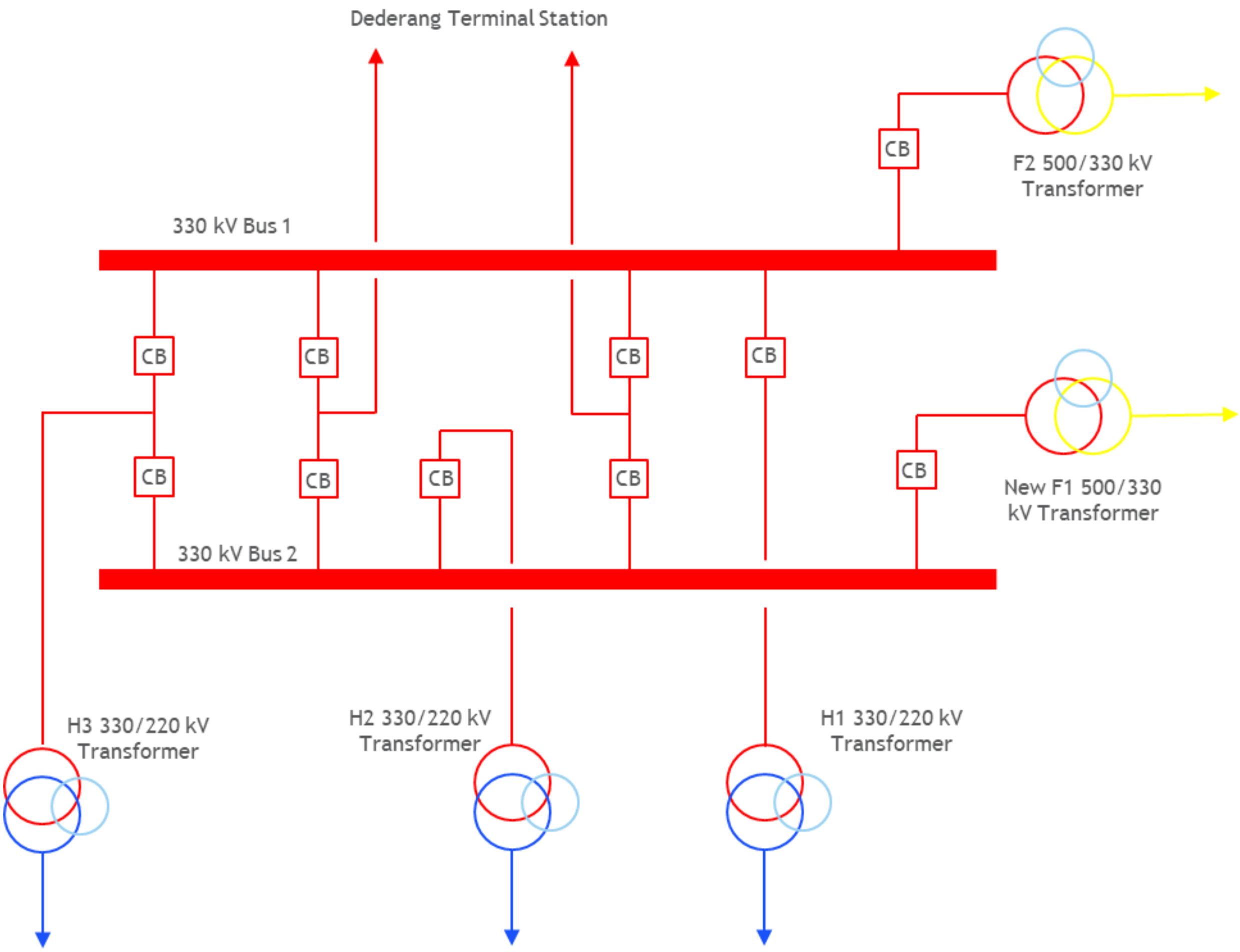

Figure 2 - SMTS 330 kV switching

Apart from the primary assets illustrated above, there is auxiliary plant (not included in Figure 2) within SMTS that is essential for reliable and safe operation of the terminal station. The auxiliary plant includes instrument transformers, isolators, control systems, protection systems, etc.

2.2. Asset condition

AusNet Services classifies asset conditions using scores that range from C1 (initial service condition) to C5 (extreme deterioration) – as set out in Appendix C.

In 2019, AusNet Services conducted a condition assessment of the H Transformers at SMTS where the components were evaluated across a range of criteria including: physical condition; spares availability; estimated rate of deterioration; and manufacturer support. The assessment revealed that the existing H1 and H2 transformers are in poor condition (C4) or very poor condition (C5) as expected of an asset that have been in service for the past 50 years. To address risk imposed by the H1 and H2 condition, an H3 transformer was installed in 2018 to replace the H2 transformer. This replacement in 2018 of the H2 transformer was the first stage of a staged replacement of the 330/22 kV transformer at SMTS. The H2 transformer is being kept at SMTS until the second stage (this project) of the SMTS

[8] Australian Energy Market Operator, *"Victoria to New South Wales interconnector upgrade regulatory investment test for transmission,"* Available at https://aemo.com.au/en/initiatives/major-programs/victoria-to-new-south-wales-interconnector-upgrade-regulatory-investment-test-for-transmission, viewed on 28 May 2020.

330/22 kV transformer replacement has been completed.

While H1 is not yet replaced, the probability of failure for these assets is high, and likely to increase further if no remedial action is taken. The H1 transformer has a condition score of 4 while the circuit breaker connecting the F2 transformer at SMTS has a condition score of 5.

No alternative maintenance strategies have been identified that would materially reduce the failure rates or address the lack of manufacturer support.

2.3. Description of the identified need

SMTS is part of the main transmission network which provides major transmission network services in Victoria and is part of AEMO's Integrated System Plan[9].

The poor condition of the H1 330/220 kV transformer and the circuit breaker that connects the 500/330 kV F2 transformer has increased the likelihood of asset failure. Without remedial action, other than ongoing maintenance practice (business-as-usual), the assets are expected to deteriorate further and more rapidly. This will increase the market impact risk due to prolonged outages of the connected transmission lines and transformers. In addition, there is also increased safety, environmental, collateral damage and emergency replacement risks due to the poor condition of these assets.

Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable power transformation services at SMTS and to mitigate risks from asset failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $109 million over 45 years from 2020/2021. The key elements of these risk costs are shown in Figure 3. The largest component of the baseline risk costs comes from the potential impact on the wholesale electricity market.

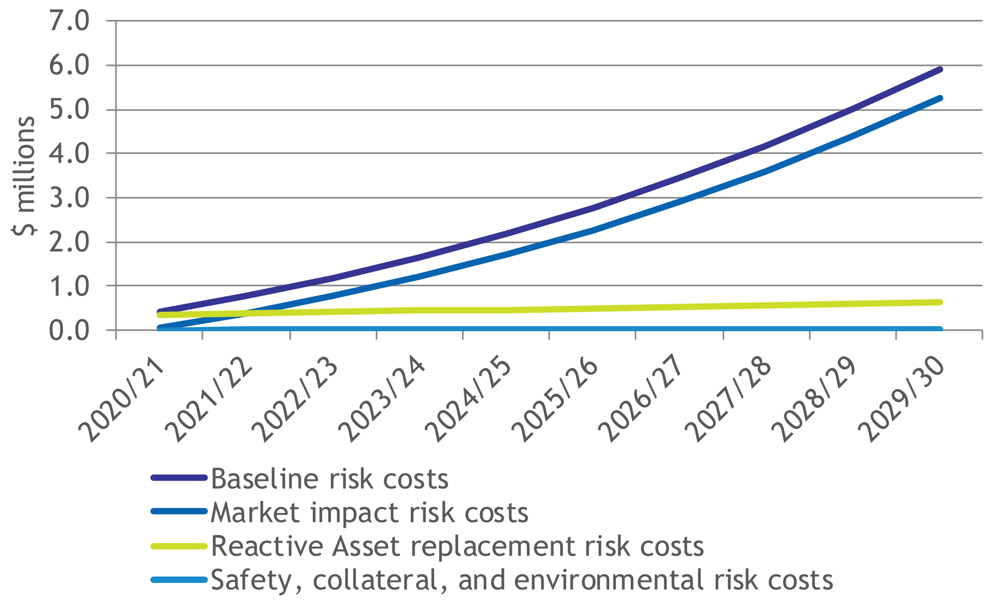

Figure 3 - Baseline risk costs

[9] Australian Energy Market Operator, *"2020 Integrated System Plan (ISP),"* available at https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp, viewed on 28 May 2020.

2.3.1. Assumptions

In addition to the failure rates, which are determined by the condition of the assets, and the likelihood of relevant consequences, further assumptions to quantify the risks associated with asset failure are used. These assumptions are detailed in the following subsections.

Failure rate and repair time

Transformer failure rates are well-established as the technology has been in service across the network for a long time. Figure 4 shows the failure rates applied in this analysis.

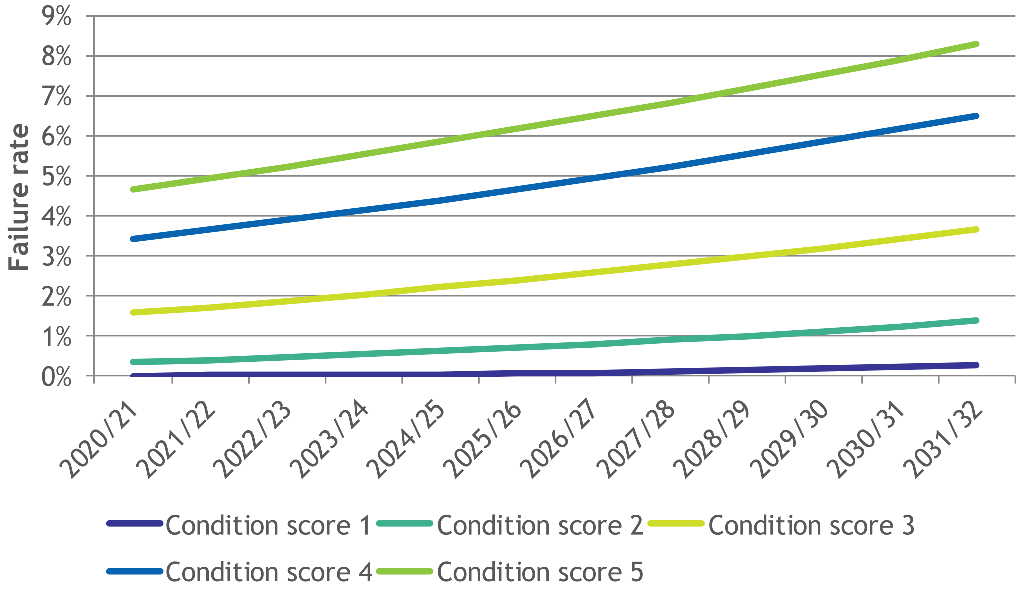

Figure 4 - Forecast transformer failure rates

Market impact costs

A comprehensive market modelling study is used to assess the market impact of a failure of the different assets at SMTS. The study uses the general market modelling assumptions used for the Central scenario of the 2020 ISP[10] which includes NEM operational demand forecasts, generation costs forecasts, generation retirement schedule, and forecast transmission developments.

The calculated involuntary load shedding is valued at the latest Value of Customer Reliability (VCR)[11].

Safety risk costs

The Electricity Safety Act 1998[12] requires AusNet Services to design, construct, operate, maintain, and decommission the 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

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[10] Australian Energy Market Operator, *"2020 Integrated System Plan (ISP),"* available at https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp, viewed on 28 May 2020.

[11] 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 28 May 2020.

[12] 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 28 May 2020.

risks.

By implementing this principle for assessing safety risks from explosive failure of the affected transformer, AusNet Services uses:

- a value of statistical life[13] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[14]; and
- a disproportionality factor[15].

AusNet Services notes that this approach, including the use of a disproportionality factor, is consistent with the RIT-T Industry Practice Notes[16] provided by the AER.

Financial risk costs

There is an ongoing need for the services provided by SMTS and an emergency asset replacement would be required to continue the service should the transformer fail. An emergency asset replacement would require immediate diagnosis and emergency replacement.

The failure rate weighted emergency asset replacement cost (or cost to undertake reactive maintenance) is included in the assessment.[17]

Environmental risk costs

Environmental risks from plant that contains large volumes of oil, which may be released in the event of an asset failure, is valued at $100,000 per event.

[13] 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 28 May 2020.

[14] 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 28 May 2020.

[15] 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.

[16] 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 28 May 2020.

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

3. Credible network options

The only network options that AusNet Services has identified are presented below. A variant of the option, delayed by four years, is also considered.

3.1. Option 1 – Integrated replacement

Option 1 replaces selected assets in an integrated project and includes replacement of the H1 transformer with a new 330/220/22 transformer adjacent to the H3 transformer, and replacement of associated secondary equipment. The H1 and H2 transformers will be retired as part of the project.

A spare transformer phase is also included in this option.

The 330 kV circuit breaker associated with the F2 transformer will also be replaced.

The estimated capital cost of this option is $43.55 million and the change in operating and maintenance cost is negligible.

AusNet Services' preliminary analysis shows that the optimal timing to deliver this option is 2025/26.

3.1. Option 2 – Integrated but delayed replacement

Option 2 constitutes the same replacement activities as Option 1 except that it is delayed by four years.

The estimated capital cost of this option is $43.55 million and the change in operating and maintenance cost is negligible.

3.2. Options considered but not progressed

The following options are not considered credible:

- Retirement of a 330/220 kV transformers would have significant network and market impact given the critical role that the transformers play as per the following statistics observed during the period between May 2019 to April 2020. The 330/220 kV H transformers at SMTS has allowed over 2,365 GWh of electricity flow. Figure 5 shows these statistics for each H transformer at SMTS.

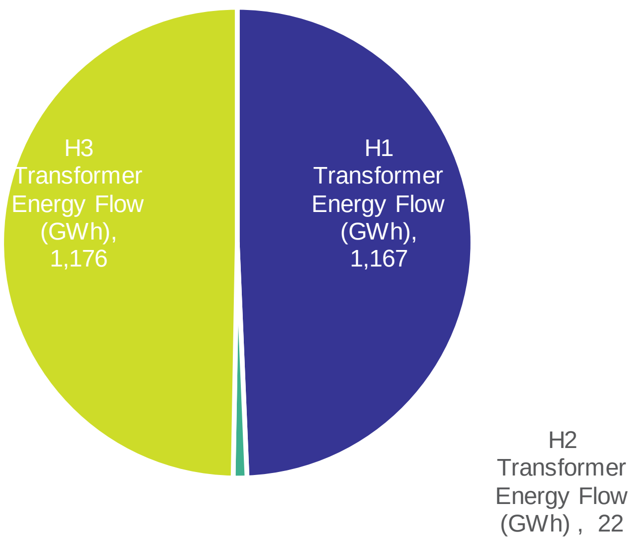

Figure 5 – Annual energy flows across the H transformers at SMTS

The 2019 Victorian Annual Planning Report[18] assesses the network needs for assets across the Victorian transmission system. In relation to the 330/220 kV transformers at SMTS, it notes that if they were to be retired, there would be reduced reliability and capability to meet peak demand.

Therefore, this option is not progressed.

- Options to remediate or refurbish the transformer does not materially reduce the failure rate, hence refurbishment is not progressed further.

3.3. Material inter-regional network impact

The proposed asset replacements at SMTS will not change the transmission network configuration and none of the network options 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 screening test for material inter-network impact[19] of a transmission investment is described as follows:

- a decrease in power transfer capability between transmission networks or in another TNSP's network of 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 more than the minimum of 3% of the maximum transfer capability and 50 MW
- an increase in fault level by more than 10 MVA at any substation in another TNSP's network
- the investment involves either a series capacitor or modification in the vicinity of an existing series capacitor.

AusNet Services assessment of these criteria is that there is no material inter-regional network impact associated with any options considered.

[18] 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 28 May 2020.

[19] 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 28 May 2020.

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. AusNet Services has not identified any technically-feasible non-network solution that would meet the identified need.

Proposals for non-network solutions should be emailed to rittconsultations@ausnetservices.com.au by XX Date.

5. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology [20], AusNet Services will undertake a cost-benefit analysis to evaluate and rank the net economic benefits of various credible options.

AusNet Services proposes to undertake this assessment over the 45-year life of the proposed assets.

All options considered will be assessed against a business-as-usual case where no proactive capital investment is made.

Optimal timing of an investment will be the year when the annual benefits from implementing the option becomes greater than the annualised investment costs.

Estimating wholesale electricity market impacts

The classes of market benefits that have impacts on the wholesale electricity market will be estimated using a standard market modelling approach based on long-run marginal cost bidding model. This approach is similar to that implemented for the ISP[21] and other RIT-Ts.

5.1. Proposed analysis and input assumptions

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.

The Central scenario uses AusNet Services assessment of failure rates, AEMO's 2019 Transmission Connection Point Forecasts for the Neutral Scenario, Latest AER VCR figures, and 4.68% - the latest commercial discount rate.

5.2. Materiality of classes of market benefits

The options identified in this RIT-T are expected to have a material impact on the wholesale electricity market. Therefore, several classes of market benefits[22] set out in NER clause 5.16.1(c)(4) will be estimated in this analysis: changes in involuntary load shedding, changes in voluntary load curtailment, and changes in fuel consumption arising through different patterns of generation dispatch.

However, for the reasons stated below, the following classes of market benefits are considered immaterial.

- Differences in the timing of the expenditure – there is no other investment impacted by any of the credible options considered in this RIT-T.
- Changes in ancillary services costs - the options are not expected to impact on the demand for and supply of ancillary services.
- 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.

[20] 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 28 May 2020.

[21] Australian Energy Market Operator, *"Scenarios, inputs, assumptions, methodologies and guidelines,"* available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/scenarios-inputs-assumptions-methodologies-and-guidelines, viewed on 28 May 2020.

[22] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission,"* p32, available at https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf, viewed on 28 May 2020.

- Change in network losses – this class is estimated to be small and unlikely to be a material class of market benefit for any of the credible options.
- Competition benefit – the benefit is disproportional to the amount of work involve in estimating this class of market benefit.
- Option value – as any of the options considered does not avoid risk of stranded assets nor provide any flexibility on further investments, this class is considered immaterial.

5.3. Other classes of benefits

AusNet Services expects that implementing any of the credible options identified in this RIT-T will result in material reduction in the following:

- safety risks from potential explosive failure of deteriorated transformer;
- collateral damage risks to adjacent plant; and
- risk of emergency asset replacements and repairs.

The treatment of these risk cost savings in the RIT-T analysis is aligned with the RIT-T Industry Practice Notes[23] published by the Australian Energy Regulator (AER).

[23] 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 28 May 2020.

6. Options assessment and sensitivity analysis

This section details the analysis of the costs and benefits from the network options considered in this RIT-T. 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.

All the options assessed will deliver a forecast reduction in market impact cost, safety risks, environmental risks, collateral risk and risks of replacement if the asset failed.

The robustness of the investment decision is tested using a range of input assumptions as described in Table 2. The sensitivity analysis involves variations of assumptions from those used for the base case.

Table 2 - 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

Under the Central scenario, Option 1 has an estimated present value of net economic benefits of $61.2 million (real 2019/20 $).

Figure 6 demonstrates that the total risk cost reduction outweighs the total capital, operating and maintenance costs for Option 1 under all sensitivities where input variables are varied one at a time.

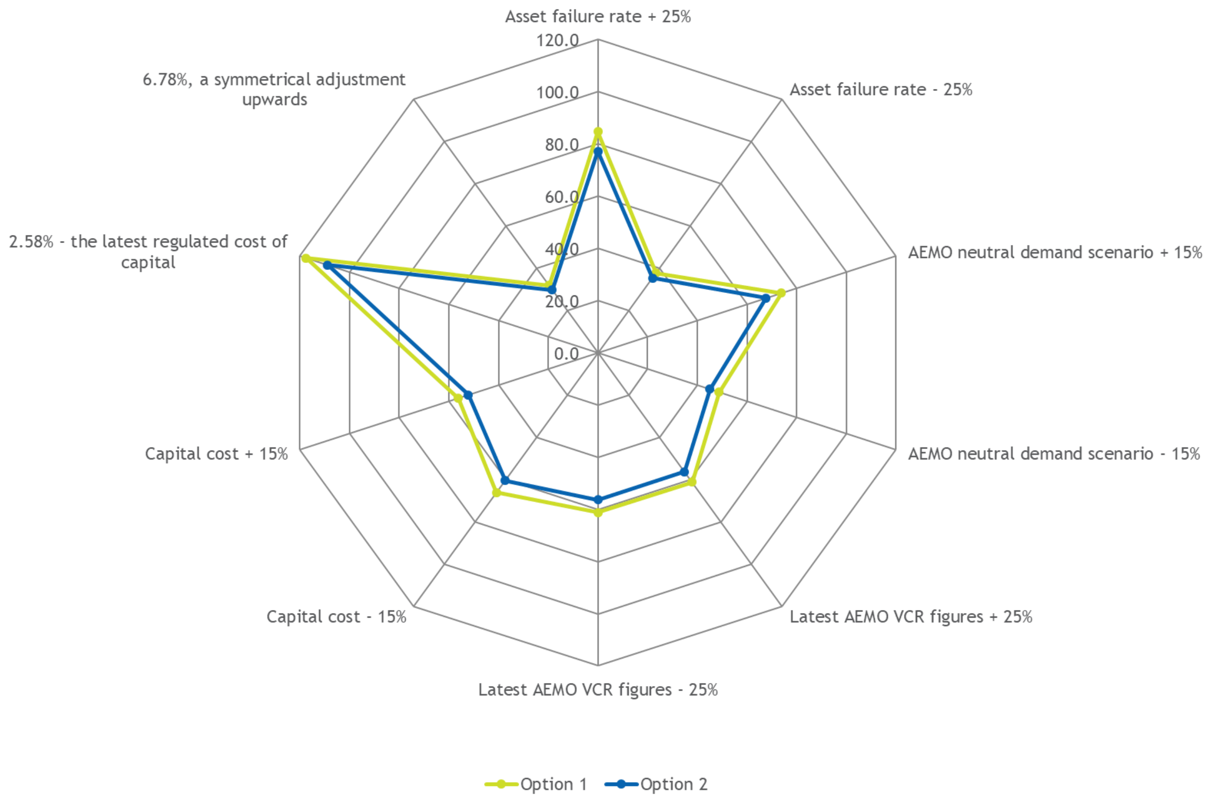

Figure 6 - Sensitivity of the net economic benefits with respect to variation of key parameters

Sensitivity of optimal timing

Figure 7 shows that the optimal timing of the preferred option is 2025/26 for most of the sensitivity studies and that the economic timing falls inside the 2022 to 2027 revenue period for all sensitivity studies.

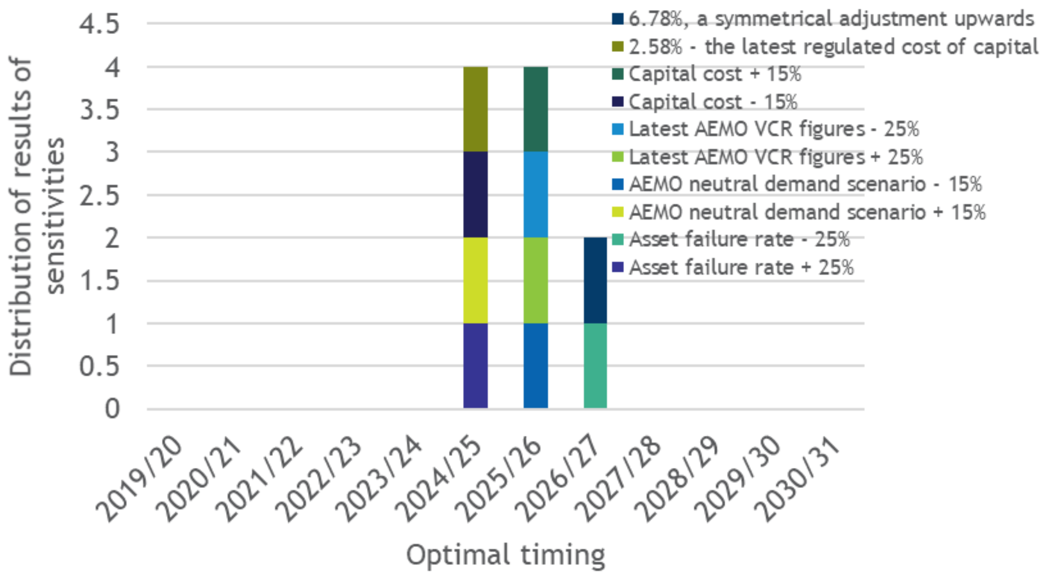

Figure 7 - Sensitivity of the optimal timing with respect to variation of key parameters

7. Draft conclusion and next steps

The replacement of the H1 330/220 kV transformer, the 330 kV circuit breaker associated with the 500/330 kV F2 transformer, and secondary assets is the most economical option to address the identified need and manage safety, environmental and emergency replacement risks at SMTS.

The estimated capital cost of this option is $43.55 million.

Based on AusNet Services' preliminary analysis, this option is economical to proceed by 2025/26.

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 XX Date. In the subject field, please reference 'RIT-T PSCR South Morang Terminal Station H Transformer Project.'

Appendix A - RIT-T assessment and consultation process

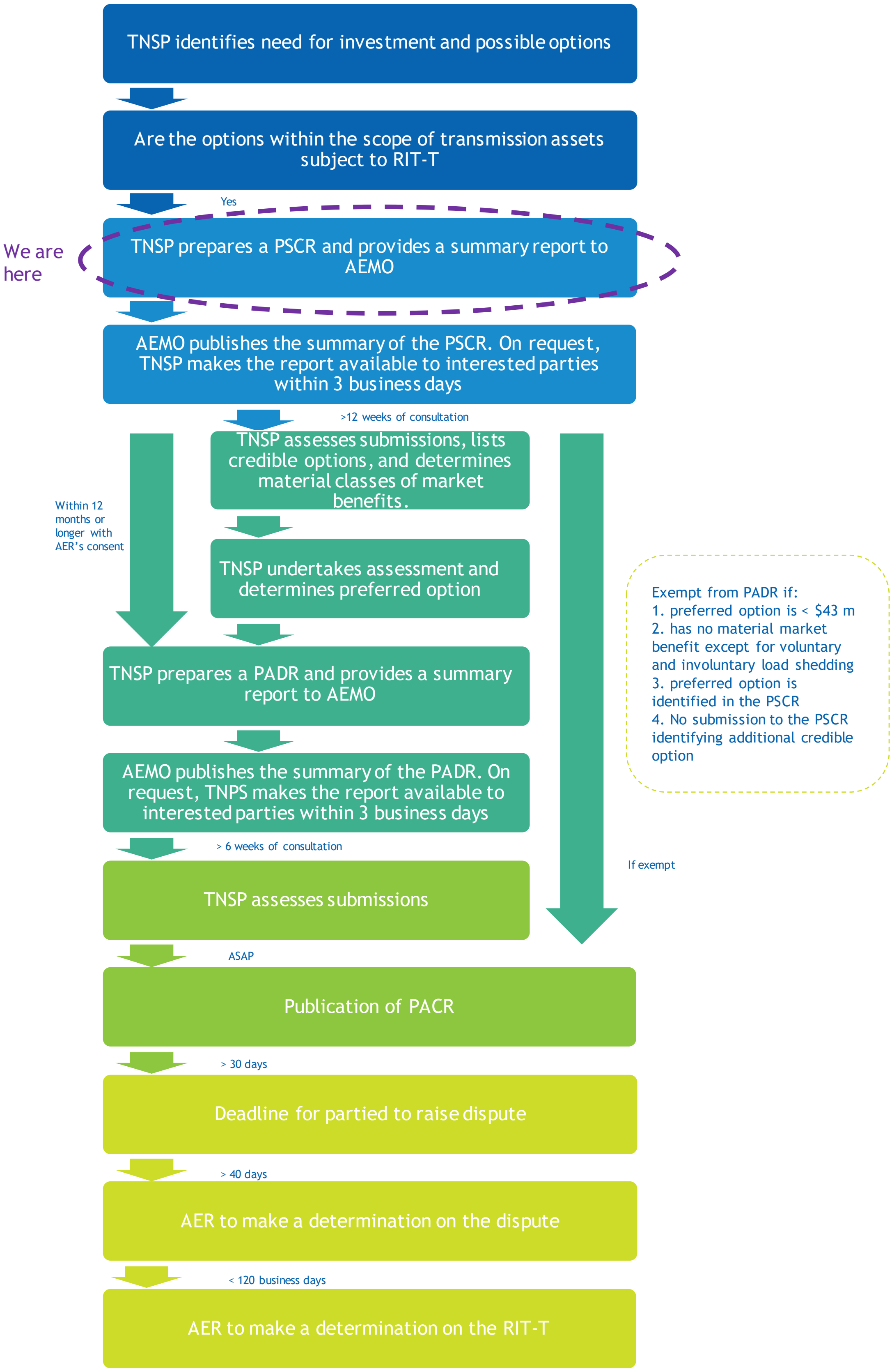

Figure 8 - RIT-T process

Appendix B - 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 3 - 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).