Maintaining reliable transmission network 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 to provide reliable transmission service at South Morang Terminal Station (SMTS). The Gas-Insulated Switchgears (GIS) at SMTS are reaching the end of serviceable-life and is driving the timing of this investigation. 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 500 kV to lower voltages that supply Metropolitan Melbourne. AusNet Services is investigating options that could allow continued delivery of safe and reliable transmission services to users of the main transmission network.

Identified need

Some of the switchgears 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 transmission network services at SMTS and mitigate risks from asset failures.

The present value of the baseline asset failure risk costs is more than $67.52 million and the largest monetised risk is the impact on the wholesale electricity market from an asset failure.

Credible options

Three credible network options that are likely to deliver economical solutions to the identified need are considered in this RIT-T.

- Option 1 – Replace all 500 kV GIS with Air Insulated Switchgears (AIS)
- Option 2 – Staged replacement of the 500 kV GIS with AIS
- Option 3 – Replace all 500 kV GIS with modern indoor GIS

AusNet Services has not identified a credible non-network option to address the identified need. AusNet Services invites proposals from proponents of non-network solutions 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, economic benefits, and ranking of options in this RIT-T. 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 staged replacement (Option 2) 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 transmission network services at SMTS, but also mitigates safety, environmental, and emergency replacement risks from deteriorating assets.

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

Option	Central scenario	Rank
Option 1	29.0	2
Option 2	29.6	1
Option 3	-29.5	3

The optimal timing of the preferred option for most of the sensitivities studied, is 2023/24. Therefore, AusNet Services concludes that delivery of Option 2 by 2023/24 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 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 500 kV GIS 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 transmission network services at South Morang Terminal Station (SMTS). The gas-insulated switchgears (GIS) at SMTS are reaching the end of its 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 deteriorating 500 kV switchgears 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 GIS at SMTS plays 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 transformers further step the voltage down to 220 kV;
- 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 500 kV primary assets of the terminal station as the other voltages are not included in the scope of this RIT-T.

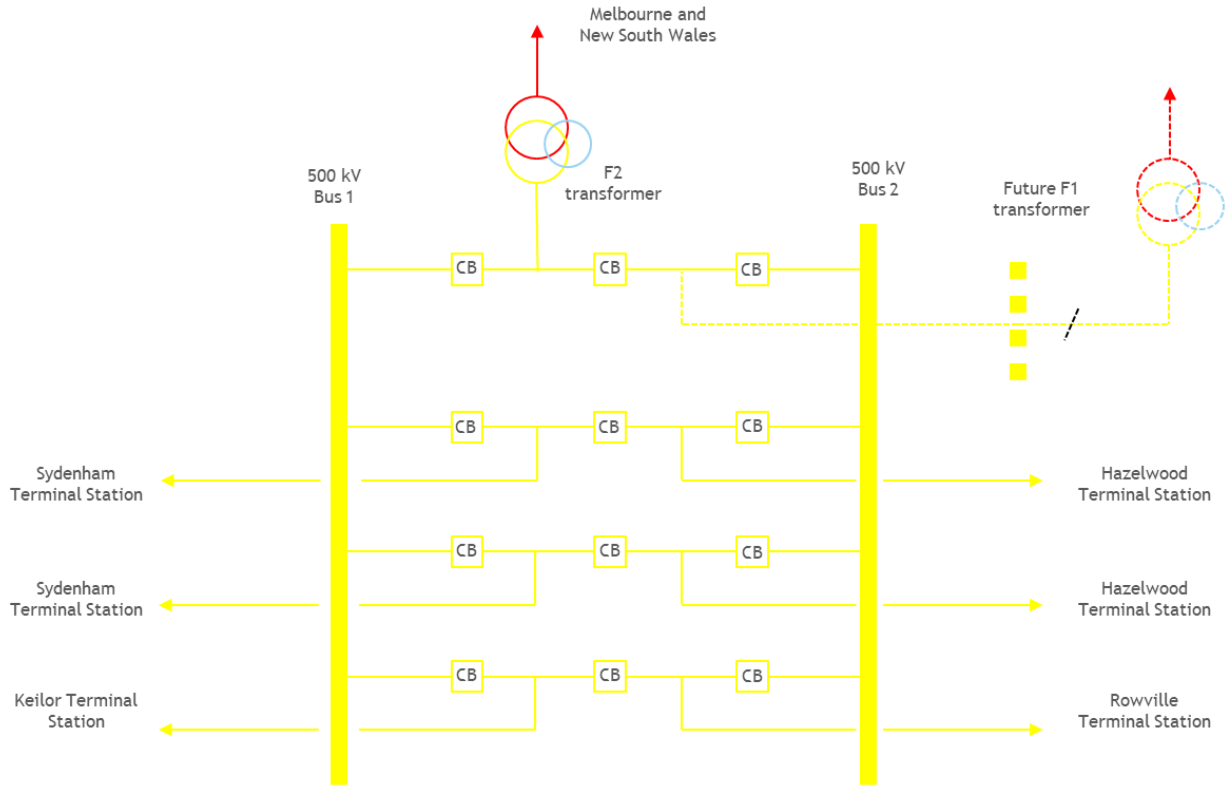

Figure 2 - SMTS 500 kV switching

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. This 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 (very poor condition) – as set out in Appendix C.

In 2019, AusNet Services conducted a condition assessment of the 500 kV GIS 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 GIS are in poor condition (C4) or very poor condition (C5). The probability of failure for these assets are high, and likely to increase further if no remedial action is taken. Table 2 below is a summary of the condition scores of the 500 kV switchgears at 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.

Table 2 - Summary of 500 kV GIS condition

Assets	Number of affected assets	Condition score
500 kV circuit breakers	11	4
	1	5
	1	3
500 kV CT switchgears	24	4
	2	5
500 kV VT switchgears	3	4

With condition scores of mostly C4 and C5, these switchgears present challenges due to duty-related deterioration. Common problems are flange corrosion, SF6 leakage and hydraulic mechanism seal deterioration. As the manufacturer no longer support this GIS, there is no access to supplier support, new spares, etc.

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

2.3. Description of the identified need

SMTS is part of the main 500 kV 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 500 kV switchgears at the terminal station has increased the likelihood of asset failure. Without remedial action, other than ongoing maintenance practice (business-as-usual), the 500 kV switchgears 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 the 500 kV switchgears.

Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at SMTS and to mitigate risks from 500 kV switchgears failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $67.52 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 reactive replacement costs and potential impact on the wholesale electricity market.

[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.

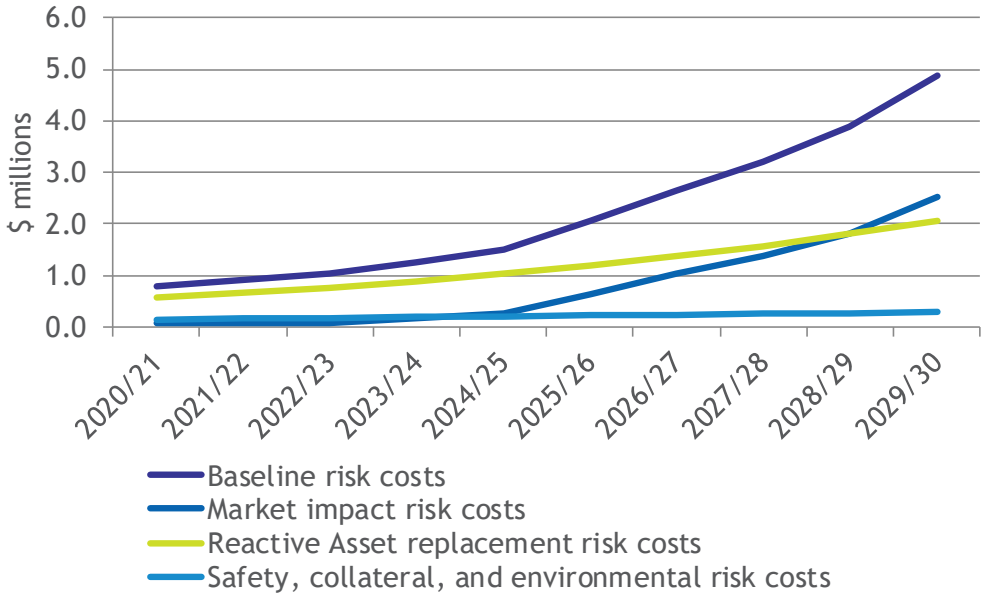

Figure 3 - Baseline risk costs

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

Failure rate and repair time

GIS is a mature technology and comparative failure rate trends of GIS over the years has been studied thoroughly and published within GIGRE. Figure 4 shows the failure rates applied in this analysis.

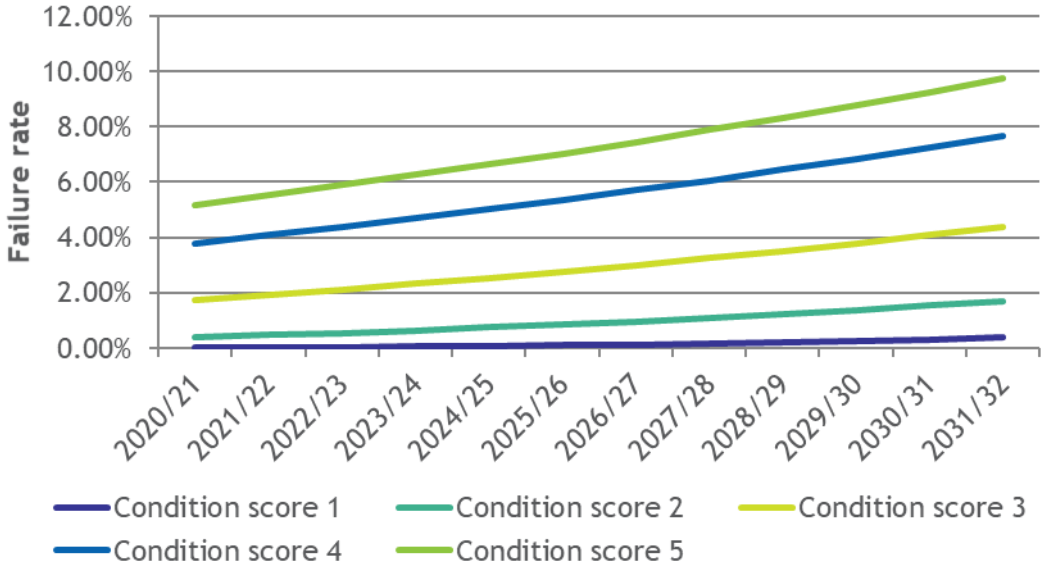

Figure 4 - Assumed failure rates for different GIS condition scores

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 risks.

By implementing this principle for assessing safety risks from explosive failure of the affected switchgears, 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 switchgears fail. An emergency asset replacement would require immediate diagnosis and emergency replacement with AIS as the 500 kV GIS is no longer supported by the supplier for major failures where no spares are available.

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

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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.

[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.

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 $100,000 per event.

3. Credible network options

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

3.1. Option 1 – Replace all 500 kV GIS with AIS

Option 1 replaces the existing 500 kV outdoor GIS with a modern outdoor AIS solution.

The estimated capital cost of this option is $69.18 million and the change in operating and maintenance cost is negligible.

3.2. Option 2 – Staged replacement of the 500 kV GIS with AIS

Option 2 is a staged replacement that consists of two independent projects to replace the outdoor 500 kV GIS with modern AIS.

The first stage involves:

- construction of one new breaker and half bay at the northern end of the existing switchyard;
- relocation of the Hazelwood Terminal Station (HWTS) to SMTS Line 1 and SMTS to Sydenham Terminal Station (SYTS) Line 1; and
- new AIS 500 kV busbars and connections between the new AIS and existing GIS busbars.

The second stage would replace all the remaining GIS with AIS five years after completion of Stage 1.

Implementing this option would improve AusNet Services ability to respond to 500 kV GIS failures as the GIS breaker and half bay that were used to connect the HWTS No.1 and SYTS No.1 lines can be used in an emergency to restore services.

The estimated capital cost of the first stage of this option is $17.82 million and the second stage is $56.49 million. The change in operating and maintenance cost is negligible.

AusNet Services' preliminary analysis shows that the optimal timing to deliver this option is 2023/24.

3.3. Option 3 – Replace all 500 kV GIS with modern indoor equivalent

This option is to replace the existing outdoor GIS with modern indoor GIS.

The estimated capital cost of this option is $146.21 million and the change in operating and maintenance cost is negligible.

3.4. Options considered but not progressed

The following options are not considered credible:

- Retirement of the switchgears would have significant network and market impact given the critical role that SMTS plays as per the following statistics observed during calendar year 2019. SMTS 500 kV enabled more than 26 TWh of electricity flow and Figure 5 shows statistics for each line and transformer connected to SMTS.

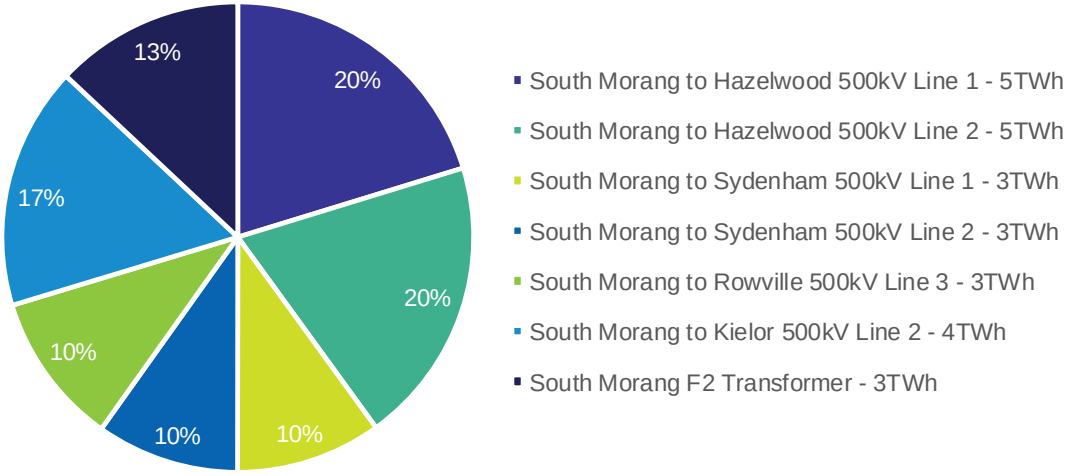

Figure 5 – Annual energy flows across the primary assets connected to SMTS, CY2019

The 2019 Victorian Annual Planning Report18 assesses the network needs for assets across the Victorian transmission system. In relation to the 500 kV GIS at SMTS, it notes that if they were to be retired, there would be reduced reliability and interconnector capabilities.

Therefore, this option is not progressed.

- Options to remediate or refurbish the GIS do not materially reduce the failure rates as technology obsolescence continues to be a limiting factor and the GIS is no longer supported by the supplier. Hence a refurbishment option is not progressed further.

3.5. Material inter-regional network impact

The proposed asset replacements at SMTSTS 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."*

[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.

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.

[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 switchgears.

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 become 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 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

[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.

investment, either generation or transmission, that will be affected by any option considered.

- 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 switchgears;
- 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, environment 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 3. The sensitivity analysis involves variations of assumptions from those used for the base case.

Table 3 - Input assumptions used for the sensitivity studies

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

Under the Central scenario, all options have positive present value of net economic benefits.

Figure 6 demonstrates that the total risk cost reduction outweighs the total capital, operating and maintenance costs for Option 1 and 2 under most sensitivities where input variables are varied one at a time. Of the options considered, Option 2 (Staged replacement) has the greatest net economic benefits.

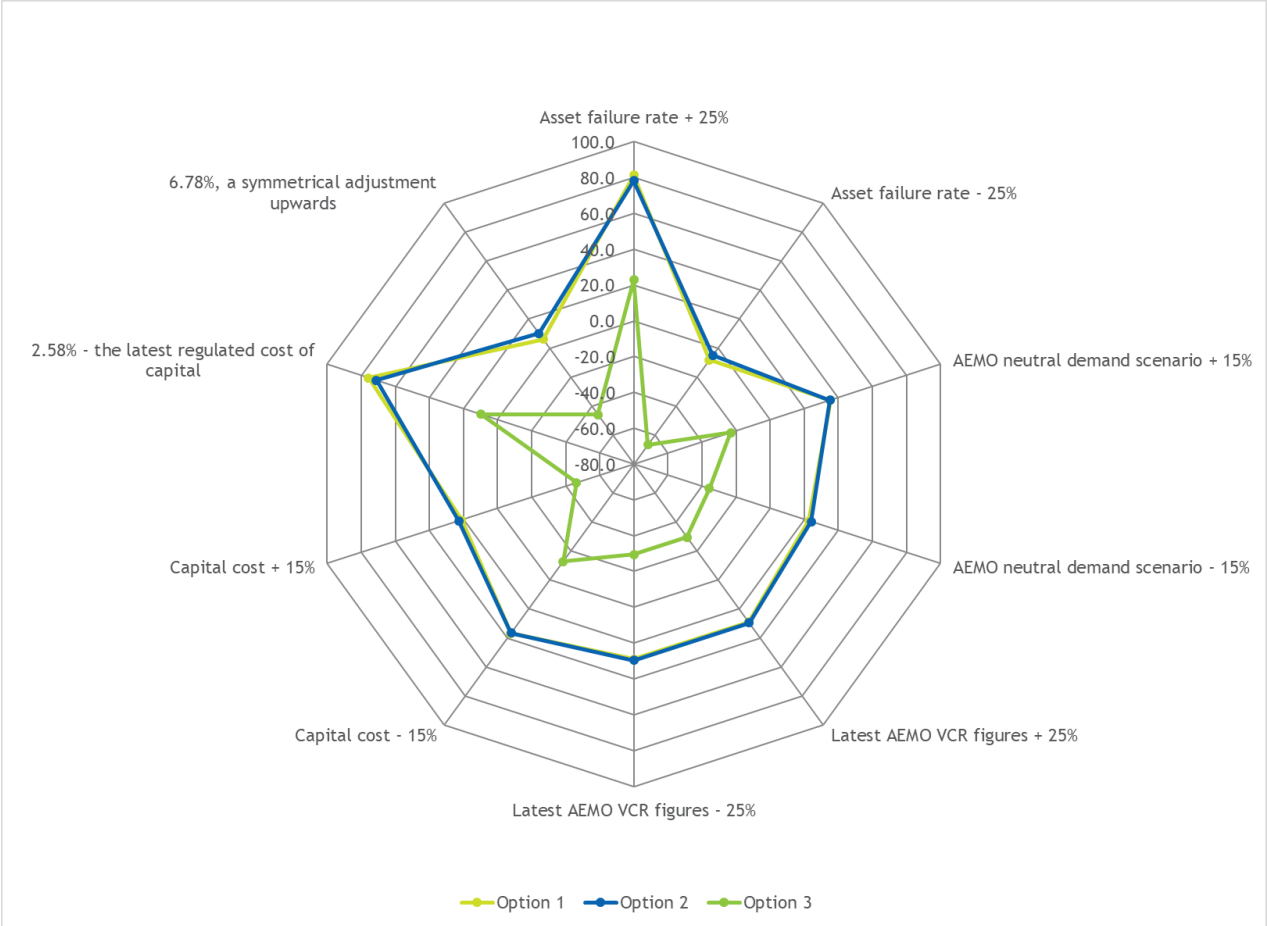

Figure 6 - Sensitivity of the net economic benefits with respect to variation of key parameters

Sensitivity of optimal timing

Figure 7 shows that the optimal timing of the preferred option is 2023/24 for most of the sensitivity studies and that the economic timing falls inside the 2022 to 2027 revenue period for all sensitivity studies.

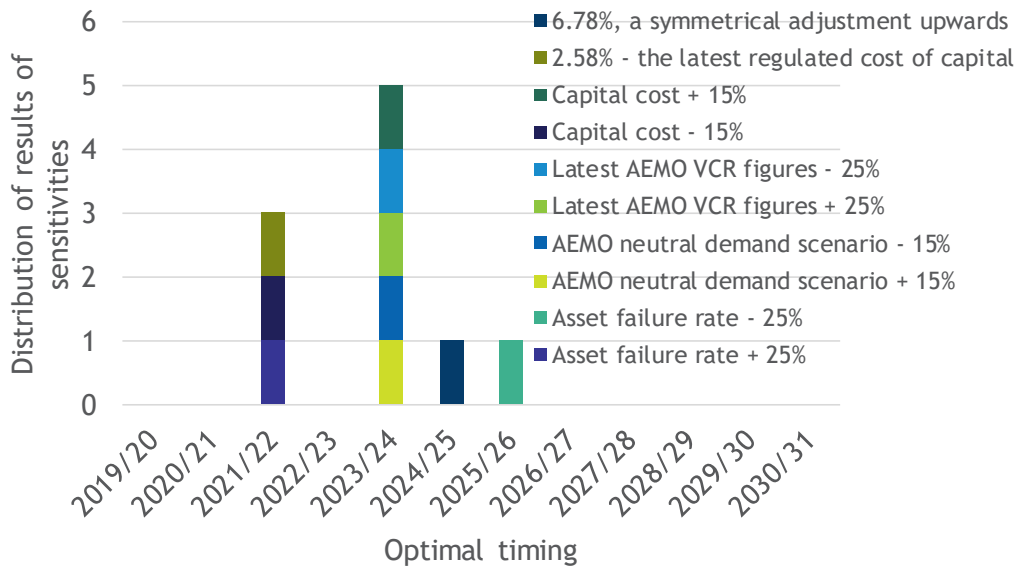

Figure 7 - Sensitivity of the optimal timing with respect to variation of key parameters

7. Draft conclusion and next steps

The staged replacement of the 500 kV GIS with AIS (Option 2) 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 the first stage of this option is $17.82 million and the second stage is $56.49 million.

Based on AusNet Services' preliminary analysis, this option is economical to proceed by 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 XX Date. In the subject field, please reference 'RIT-T PSCR South Morang Terminal Station 500 kV GIS Project.'

Appendix A - RIT-T assessment and consultation process

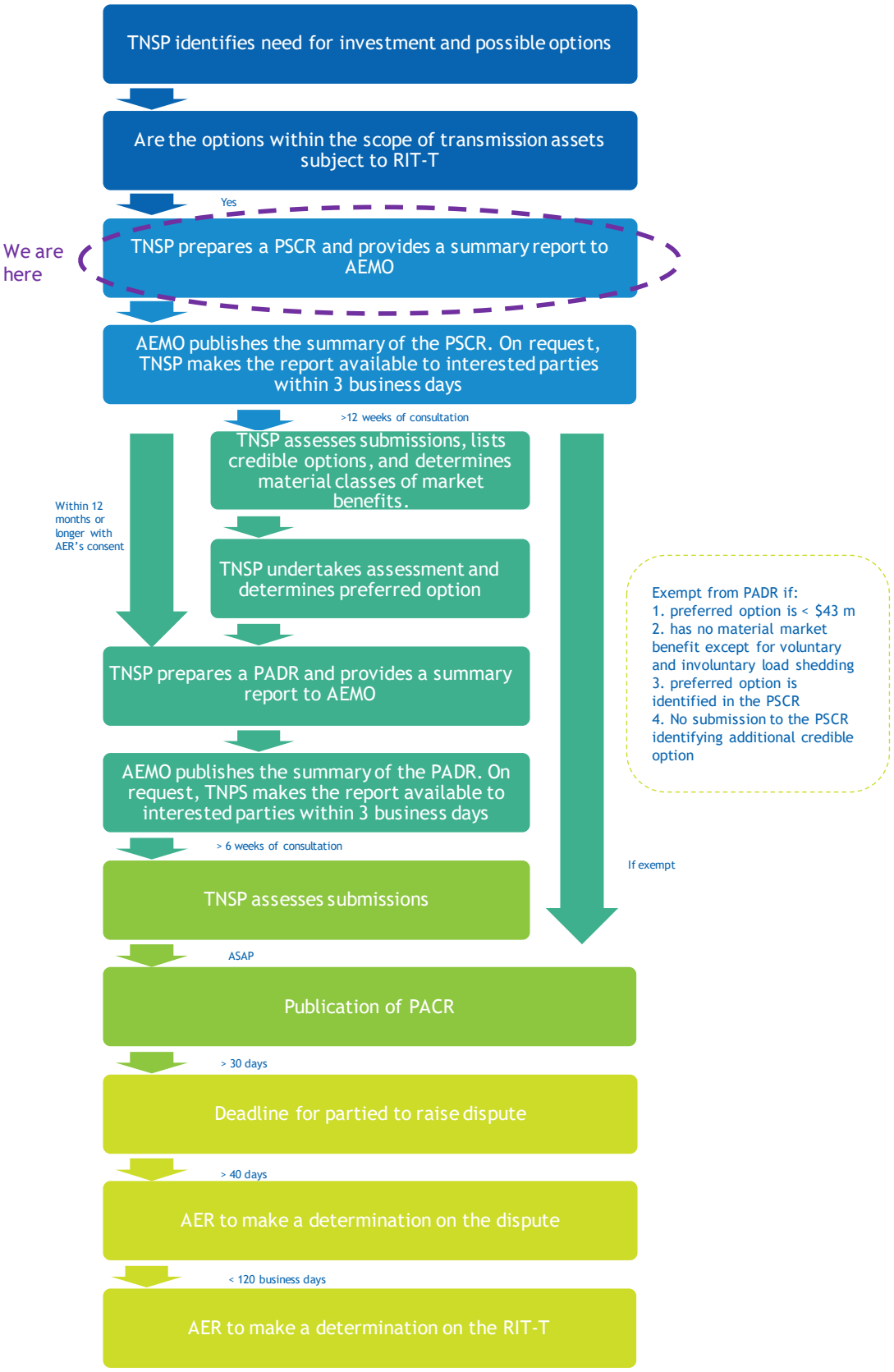

Figure 8 - RIT-T process

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 4 - 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)

ß = 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 (ß) 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).