Maintain reliable transmission network services at Sydneham Terminal Station

Project Specification Consultation Report

Regulatory Investment Test - Transmission

October 2020

missionzero

AusNet services

Important notice

Purpose

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

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Executive summary

AusNet Services is initiating this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain reliable transmission network services at Sydenham Terminal Station (SYTS). 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].

SYTS is owned and operated by AusNet Services and is located in Sydenham north west of the Melbourne's CBD. It was commissioned in the early 1980s and forms part of the main Victorian 500 kV transmission system.

Identified need

As expected of assets that have been in service for a long time, the condition of the 500 kV gas insulated switchgear (GIS) 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, environment, collateral damage and potential costs of emergency replacements. Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at SYTS and mitigate risks from asset failures.

The present value of the baseline risk costs to maintain the existing assets in service is more than $168 million and the biggest component of the baseline risk is the impact on the market (generation and electricity consumers) of an asset failure at SYTS. AusNet Services is therefore investigating options that could allow continued delivery of safe and reliable transmission network services to users of the main transmission network.

Credible options

AusNet Services estimates that network or non-network investments are likely to deliver more economical and reliable solutions compared with keeping the existing assets in service and identified the following credible network solutions that could meet the identified need:

- Option 1 – Replace the GIS with air insulated switchgear (AIS)
- Option 2 – Replace the GIS with indoor GIS

AusNet Services 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 allow for the retirement or deferral of switchgear replacements at SYTS by providing local supply or demand curtailment of sufficient scale.

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 consistent with the Australian Energy Market Operator's (AEMO) *2020 Integrated System Plan (ISP)*: Slow Change, Central Scenario, and Fast Change

[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.

scenarios; and

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

Options assessment and draft conclusion

AusNet Services' cost-benefit assessment confirms that Option 1 is the most economic option as it provides the highest present value of net economic benefits. This option will not only maintain supply reliability, but also mitigates safety, environmental, and emergency replacement risk costs from deteriorating GIS.

The optimal timing of the preferred option 2024/25.

The robustness of this RIT-T has been tested by a sensitivity analysis, which concluded that the preferred option has the highest net present benefit of all options for all sensitivities studied. Therefore, AusNet Services concludes that delivery of Option 1 by 2024/25 is the most economical and thus the preferred option to address the identified need at SYTS.

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 XXX Date. In the subject field, please reference 'RIT-T PSCR SYTS.'

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 XXX Date.

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Tables

1. Introduction

AusNet Services is initiating this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain reliable transmission network services at Sydenham Terminal Station (SYTS) in response to the deterioration of assets at SYTS.

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 presented in AusNet Services Asset Renewal Plan that is published as part of AEMO's 2019 Victorian Transmission Annual Planning Report (VAPR)[6].

1.1. Making submissions

AusNet Services welcomes written submissions on 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 XXX Date. In the subject field, please reference 'RIT-T PSCR Sydenham 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 version150"*
[5] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission"*
[6] Australian Energy Market Operator, *"Victorian Annual Planning Report"*

2. Identified need

The role of SYTS in providing electricity network 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. Transmission network services at SYTS

SYTS is owned and operated by AusNet Services and is located north west of Melbourne's CBD. It is part of the main 500 kV transmission network, which provides major transmission network services in Victoria. The 500 kV transmission backbone runs from east to west across the state and connects generation in the Latrobe Valley and western parts of Victoria with the major load center in Melbourne. It also forms an interconnector with South Australia at Heywood Terminal Station (HYTS) as shown blow.

Figure 1 – 500 kV Transmission Backbone

SYTS serves as a 500 kV switching station located inside the Melbourne metropolitan area as shown in Figure 2.

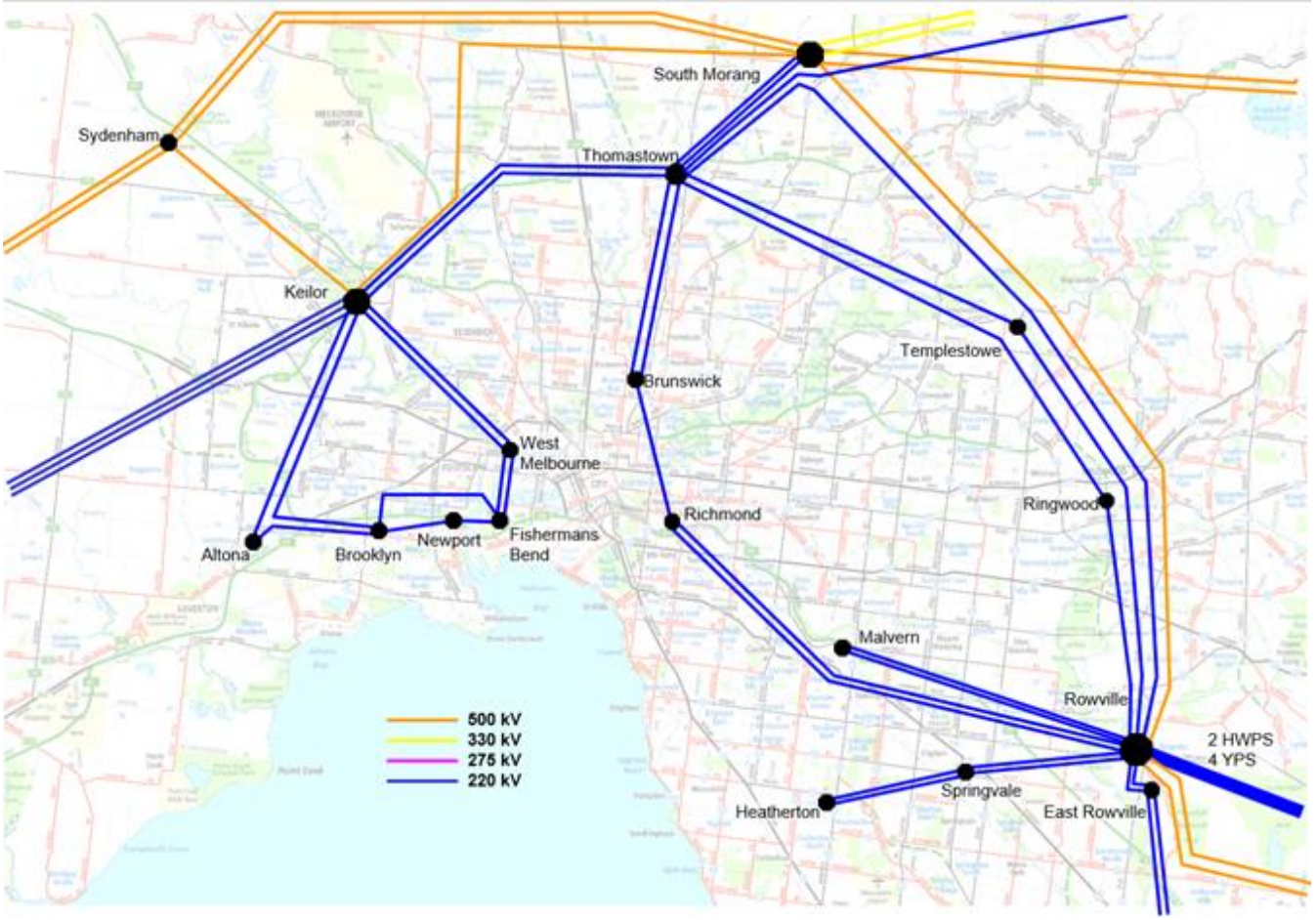

Figure 2 - Transmission network connected at SYTS

2.2. Asset condition

The condition of most of the GIS is in a poor condition despite a major refurbishment of the GIS that has been undertaken around five years ago. The GIS is no longer supported by the original equipment manufacturer (OEM) and AusNet Services has only a limited number of spares to repair asset failures. The mean time to restore supply following an asset failure is expected to be very long, especially when faced with multiple failures.

AusNet Services classifies asset condition using scores that range from C1 (initial service condition) to C5 (very poor) – as set out in Appendix C. The probability of GIS failure is high and is likely to increase further if no remedial action is taken. Table 1 provides a summary of the condition of the GIS.

Asset class	Condition scores				
	C1	C2	C3	C4	C5
500 kV GIS	O	0	1	4	1

Table 1 - Summary of major equipment condition scores

2.3. Description of the identified need

SYTS is part of the main Victorian 500 kV transmission network, which provides major transmission network services in Victoria. AusNet Services expects that the services that the terminal station provides will continue to be required given the transmission network developments that are

foreshadowed in AEMO's Integrated System Plan[7], which also includes connecting two more 500 kV lines from North Ballarat Terminal Station at SYTS by September 2024.

Without remedial action, other than ongoing maintenance practice (business-as-usual), the GIS is expected to deteriorate further and more rapidly. This will increase the probability of asset failure, resulting in a higher likelihood of an impact on users of the transmission network, heightened safety risks due to potential explosive failure of the assets, environmental risks, collateral damage risks, 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 reliable transmission network services at SYTS and to mitigate risks from asset failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $168 million over the forty-five year period from 2020/2021. The key elements of these risk costs are shown in Figure 4. The largest component of the baseline risk costs is the monetized market impact from the potential failure of assets.

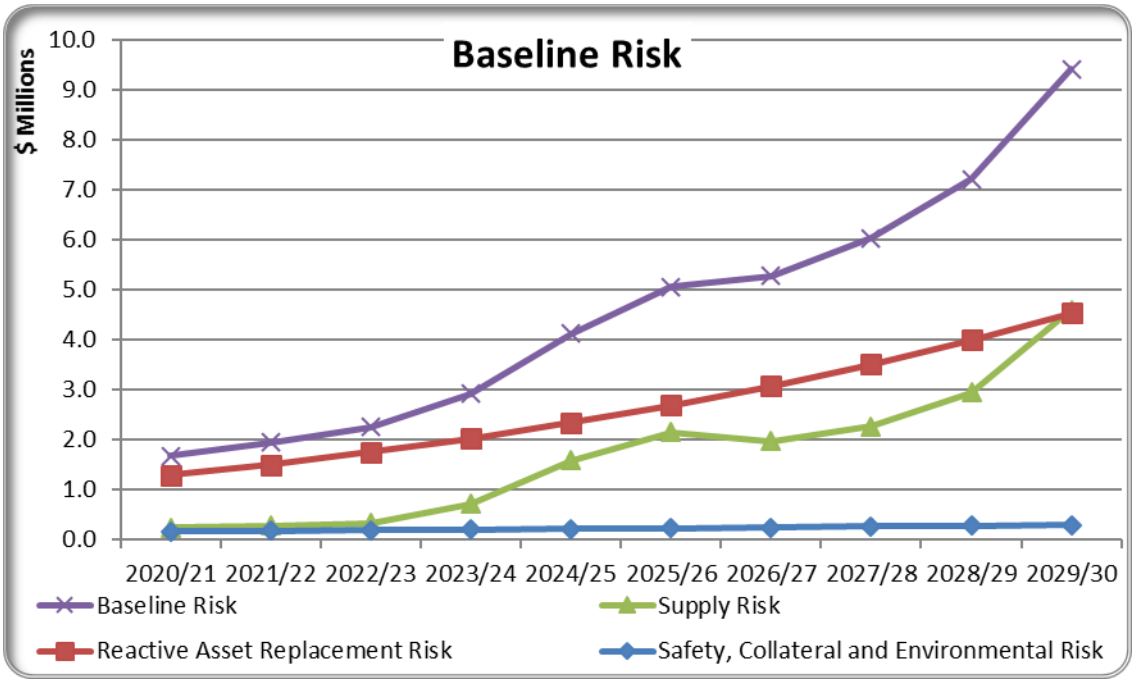

Figure 3 - Baseline risk costs

By delivering the options identified in this RIT-T, AusNet Services will be able to maintain reliable transmission network services at SYTS and mitigate safety and environmental risks, as required by the NER and Electricity Safety Act 1998[8].

2.3.1. Assumptions

Aside from the failure rates (determined by the condition of the assets), AusNet Services also adopted the following assumptions to quantify the risks associated with asset failure.

Market impact costs

AusNet Services calculated the market impact cost, which consist of increased generation cost and expected unserved energy of an asset failure at SYTS based on the latest Value of Customer Reliability (VCR).

[7] AEMO, Integrated System Plan for the National Electricity Market

[8] 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.

Safety risk costs

The Electricity Safety Act 1998[9] 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[10] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[11]; and
- a disproportionality factor[12].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the practice notes[13] provided by the AER.

Financial risk costs

As there is a lasting need for the services that SYTS provides, the failure rate weighted cost of replacing failed assets (or undertaking reactive maintenance) is included in the assessment.[14]

Environmental risk costs

Environmental risks from plant that contains large volumes of oil or SF6, which may be released in an event of asset failure, is valued at $100,000 per event.

[9] 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

[10] 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

[11] 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

[12] 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.

[13] 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

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

3.1. Option 1 – Replace the GIS with AIS

Option 1 involves replacement of the 500 kV GIS with AIS just to the north of the existing GIS. The estimated capital cost of this option is $66 million with no material change in operating and maintenance cost.

3.2. Option 2 – Replace the GIS with indoor GIS

Option 2 replaces the outdoor GIS with indoor GIS at an estimated cost of $132 million and no material change in operating and maintenance cost.

3.3. Material inter-regional network impact

The proposed asset replacement at SYTS 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."*

No material inter-regional network impact associated with any option considered in this RIT-T has been identified when applying AEMO's suggested screening test, which requires the investment to be tested against the following criteria:[15]

- a decrease 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 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.

[15] Inter-Regional Planning Committee, *"Final Determination: Criteria for Assessing Material Inter-Network Impact of Transmission Augmentations"*

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, but considers that it is unlikely that non-network solutions will be technically feasible solutions given that SYTS is part of the main transmission extra high voltage backbone.

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

5. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology[16], 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. Input assumptions and sensitivity studies

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 base case.

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 latest regulated cost of capital	4.68% - the latest commercial discount rate	6.78% - a symmetrical adjustment upwards

Table 2 - Input assumptions used for the sensitivity studies

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 classes of market benefits that are likely to be material include changes in involuntary load shedding, and changes in fuel cost arising through different patterns of generation dispatch. AusNet Services' proposed approach to assess these classes of market benefits 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

[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

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 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.
- 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 the investment options are driven by asset deterioration, there is no need to incorporate flexibility in response to uncertainty around any other factor.

6. Options assessment

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 considered in this RIT-T will deliver a reduction in supply risk, safety risk, environmental risk, collateral risk and risk cost of emergency replacement if the asset failed.

6.1. 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 of key variables.

Sensitivity of net economic benefits

Using the base case as the reference, the net economic benefits from implementing an option changes for different assumptions of key variables. The net economic benefits are positive for all sensitivities studied for Option 1 (Replace with AIS) and Option 1 has the highest net benefits for all sensitivities tested, as shown in Figure 4. Option 1 is thus the most economical investment option.

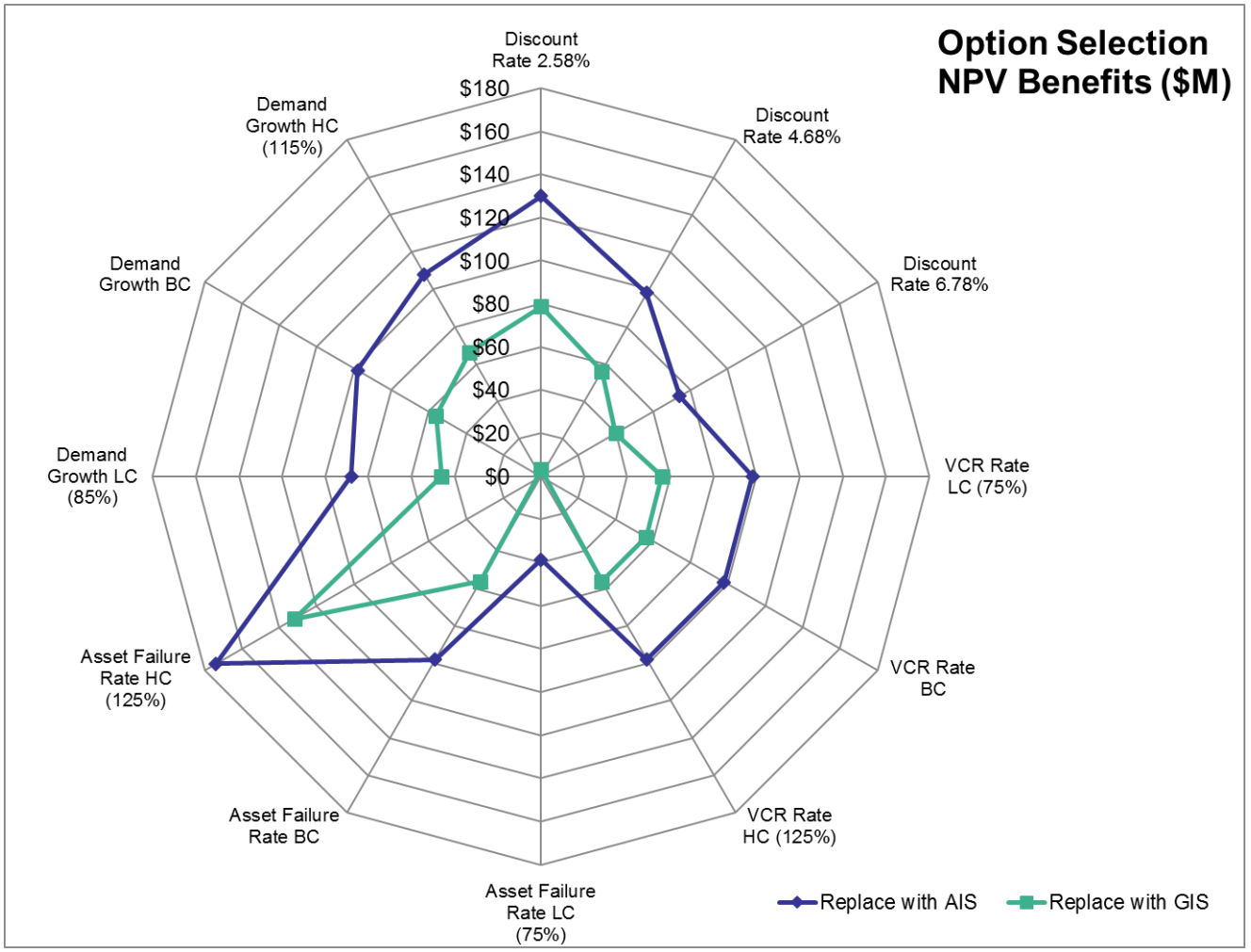

Figure 4 - Sensitivity of net economic benefits with respect to variation of key parameters

Sensitivity of optimal timing

Figure 5 shows that the optimal timing of the preferred option is 20204/25 and that the investment is needed within the 2022 to 2027 regulatory control period.

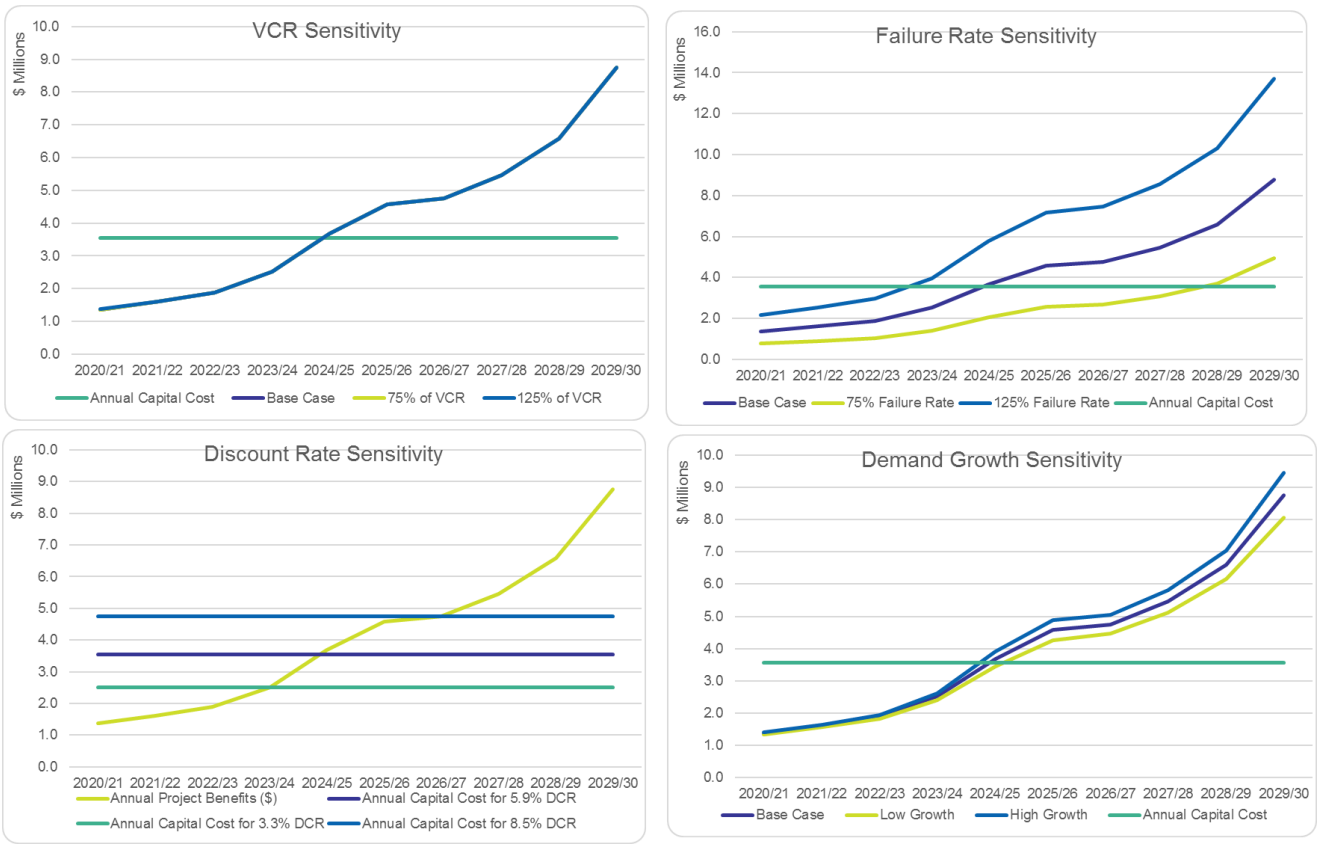

Figure 5 - Sensitivity of the optimal timing with respect to variation of key parameters

7. Draft conclusion and next steps

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain reliable transmission services at SYTS and manage safety, environmental and emergency replacement risks. This preferred option involves the following scope of work in a single integrated project:

- Construction of a new 500 kV switchyard using conventional air insulated switchgear.
- Transferring the 500 kV lines from the GIS to the AIS

The estimated capital cost of this option is $66 million with no material change in operating cost. The project is economic by 2024/25.

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 X Date. In the subject field, please reference 'RIT-T PSCR Sydenham Terminal Station.'

Appendix A - RIT-T assessment and consultation process

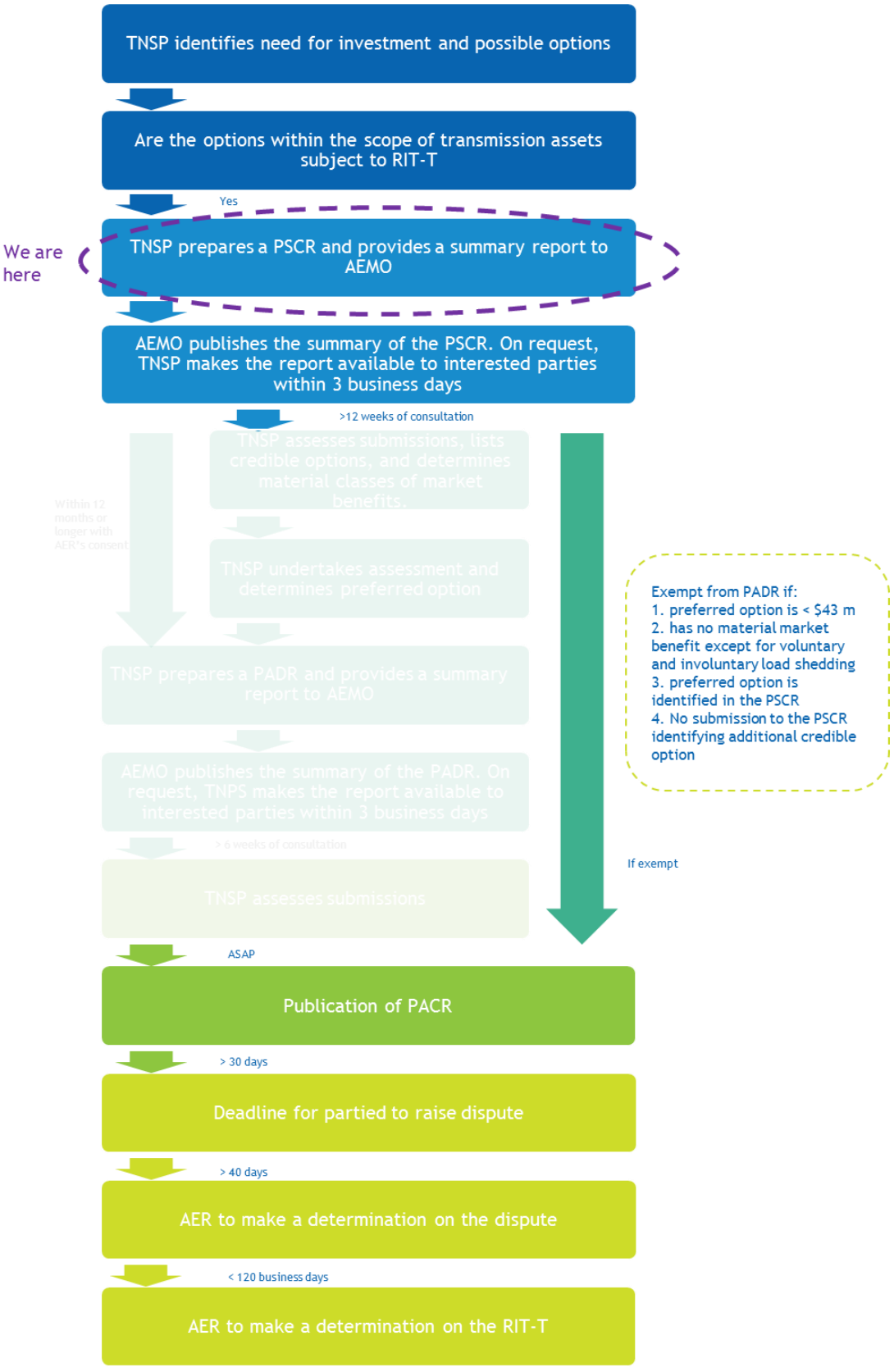

Figure 6 - RIT-T Process

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).