Maintain reliable transmission network services at Sydenham Terminal Station

Project Specification Consultation Report

Regulatory Investment Test - Transmission

December 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.

Disclaimer

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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 $187 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

Network or non-network investments are likely to deliver more economical and reliable solutions compared with keeping the existing assets in service. The following credible network solutions that could meet the identified need has been identified:

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

[1] Australian Energy Market Commission, *"National Electricity Rule version 155"*
[2] Australian Energy Regulator, *"Application guidelines Regulatory investment test for transmission,"*

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 15 March 2021. 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.

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 15 June 2021.

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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 2020 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 15 March 2021. 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 version 155"*
[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.

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.

AEMO initiated an augmentation named the Western Victorian project that will connect two more 500 kV lines at SYTS, which will enhance the importance of SYTS as a 500 kV switching station[7].

[7] AEMO, Western Victorian Regulatory Investment Test for Transmission

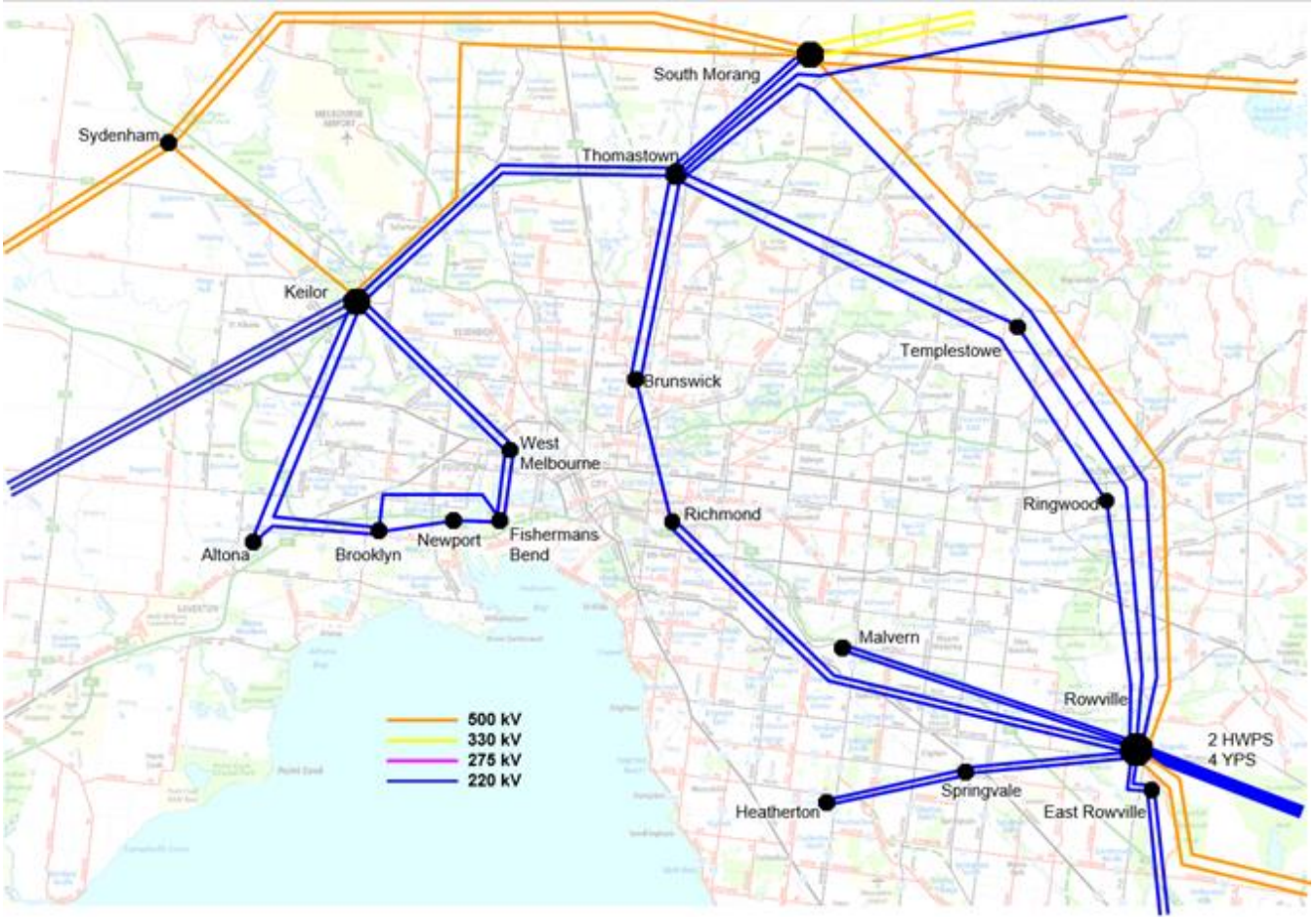

Figure 2 – Transmission network connected at SYTS

2.2. Asset condition

The condition 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 and respond to 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[8], 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 asset failures, 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 $187 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.

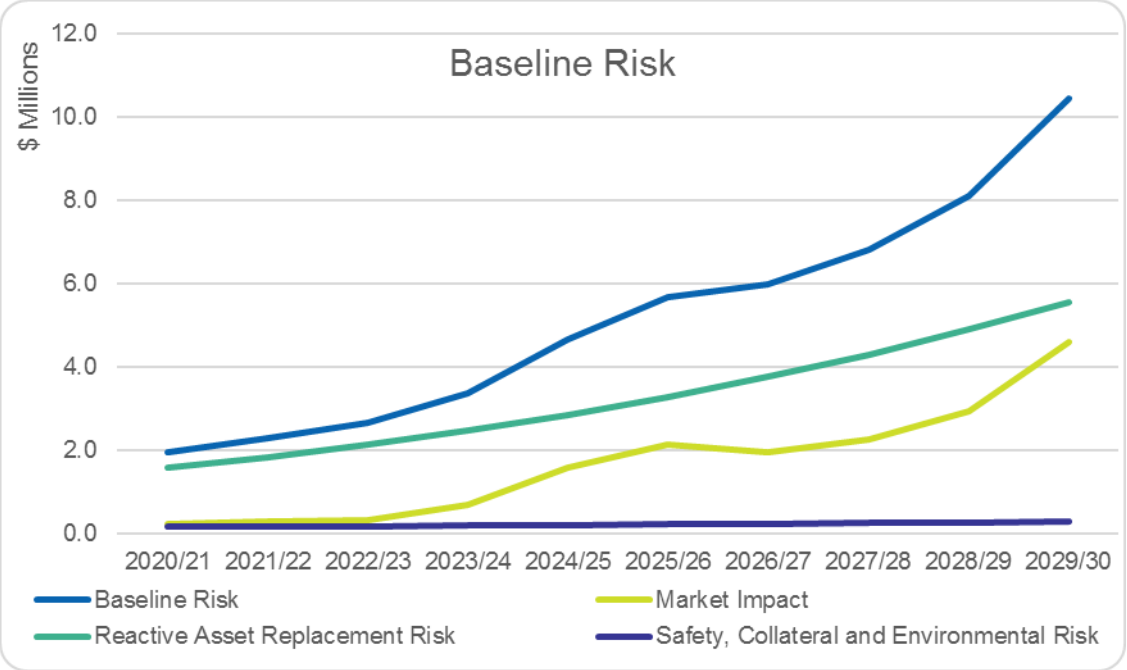

Figure 3 - Baseline risk costs

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[9].

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).

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

[9] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Electricity Safety 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[10] 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[11] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[12]; and
- a disproportionality factor[13].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the practice notes[14] 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.[15]

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.

[10] 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

[11] 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

[12] 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

[13] 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.

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

[15] 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 that 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 $81 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."*

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 and for the following reason. A non-network solution will have to substitute the service and function provided by one or all five 500 kV lines that are connected at SYTS to be considered a feasible alternative to the network options proposed to address the identified need.

Proposals for non-network solutions should be emailed to rittconsultations@ausnetservices.com.au by 15 March 2021.

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. The optimal timing of an investment option will be the year when the annual benefits from implementing the option exceeds the annualised investment costs.

5.1. Proposed scenarios and input assumptions

The robustness of the investment decision is tested using scenarios described in Table 2.

Parameter	Slow Change Scenario	Central Scenario	Fast Change Scenario
Description	Slow-down of the energy transition, characterised by slower changes in technology costs, and low political, commercial, and consumer motivation	The pace of transition is determined by market forces under current federal and state government policies	More rapid technology-led transition, its costs reduced by advancements in grid-scale technology and targeted policy support
Network capital cost	AusNet Services assessment - 15%	AusNet Services assessment	AusNet Services assessment + 15%
Discount rate	2.58% - the latest regulated cost of capital	4.68% - latest commercial discount rate	6.78% - a symmetrical adjustment upwards
Market modelling input assumptions[17]	AEMO's 2020 Planning and forecasting inputs and assumptions for the Slow Change scenario	AEMO's 2020 Planning and forecasting inputs and assumptions for the Central scenario	AEMO's 2020 Planning and forecasting inputs and assumptions for the Fast Change scenario
Victorian connection point demand forecast	AEMO's 2019 Transmission Connection Point Forecast adjusted to AEMO's 2020 Planning and forecasting inputs and assumptions for the Slow Change Scenario	AEMO 2019 Transmission Connection Point Forecast	AEMO's 2019 Transmission Connection Point Forecast adjusted to AEMO's 2020 Planning and forecasting inputs and assumptions for the Fast Change Scenario
Value of customer reliability[18]	Latest AER VCR figures – 30%	Latest AER VCR figures	Latest AER VCR figures + 30%
Weighting	25%	50%	25%

Table 2 - Summary of input assumptions for the proposed scenarios

[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.

[17] Australian Energy Market Operator, "2020 ISP scenarios, inputs, assumptions and methodologies," available at https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp/2020-isp-inputs-and-assumptions

[18] : Australian Energy Regulator, "Values of customer reliability," available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/values-of-customer-reliability

AusNet Services proposes a weighting of 50% for the Central scenario as it expects it to be the most likely scenario and a 25% weighting for each one of the other two scenarios.

5.1.1. Sensitivity analysis

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

5.2. Material classes of market benefits

NER clause 5.16.1(c)(4) formally sets out the classes of market benefits that must be considered in a RIT-T. AusNet Services estimates that the classes of market benefits that are likely to be material include changes in voluntary and involuntary load shedding, and changes in fuel cost arising through different patterns of generation dispatch. AusNet Services' will use a standard market modelling approach to assess these classes of market benefits.

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, environmental risks from possible SF6 release to the atmosphere, oil spillage, collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs by implementing any of the options considered in this RIT-T.

5.4. Classes of market benefits that are not material

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

- Changes in 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.

Appendix A - RIT-T assessment and consultation process

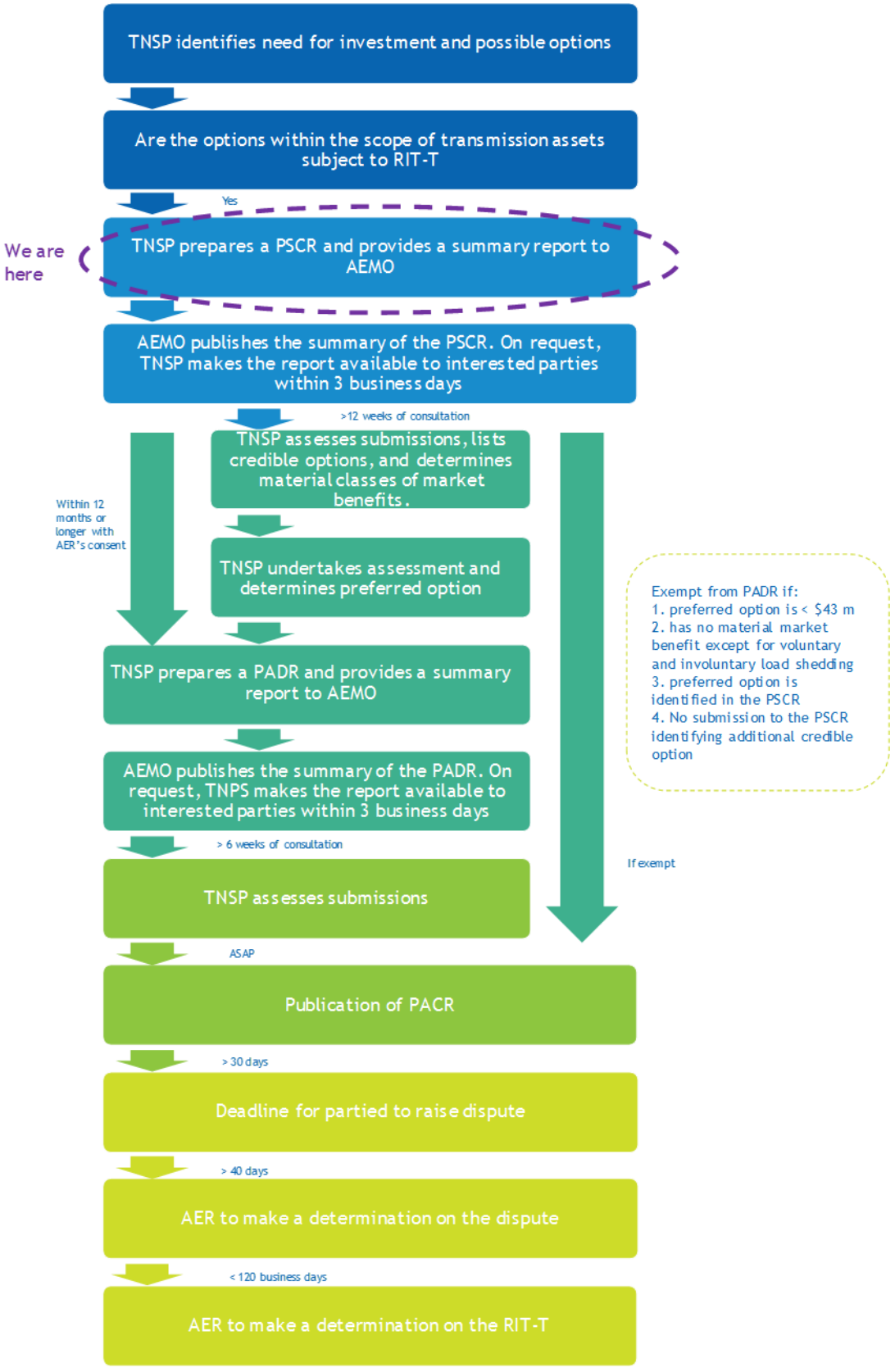

Figure 4 - RIT-T Process

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.

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

Table 3 - Condition scores framework

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).