Maintain reliable transmission network services at Moorabool Terminal Station

Project Specification Consultation Report

Regulatory Investment Test - Transmission

March 2022

mission zero

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 Moorabool Terminal Station (MLTS). 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].

MLTS is owned and operated by AusNet Services and is located north of Geelong in Victoria. It was commissioned in the early 1980s and forms part of the main Victorian 500 kV transmission system with transformation from 500 kV to 220 kV.

Identified need

The condition of some of the 500 kV and 220 kV circuit breakers and instrument transformers at MLTS has deteriorated over time 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 emergency replacement cost. Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at MLTS and mitigate risks from asset failures.

AusNet Services estimates that the present value of the baseline risk costs associated with maintaining the existing assets in service is more than $74 million – the biggest component of which comes from the impact on the market (generation and electricity consumers) of an asset failure at MLTS. 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 determined that network or non-network investments are likely to deliver more economical and reliable solutions compared than keeping the existing assets in service. The following credible network solutions could meet the identified need:

- Option 1 – Integrated Replacement that replaces selected 500 kV and 220 kV switchgear in an integrated project; or
- Option 2 – Staged replacement with 220 kV switchgear deferred; or
- Option 3 – Staged replacement with 500 kV switchgear deferred.

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 rather than replacement or deferral of switchgear replacements at MLTS.

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.

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

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 23 June 2022. In the subject field, please reference 'RIT-T PSCR Moorabool 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 23 July 2022.

Table of Contents

1. Introduction 3
1.1. Making submissions 3
2. Identified need 4
2.1. Transmission services at Moorabool 4
2.2. Asset condition 5
2.3. Description of the identified need 6
2.3.1. Assumptions 7
3. Credible network options 9
3.1. Option 1 –Integrated Replacement 9
3.2. Option 2 – Staged replacement with 220 kV switchgear deferred 9
3.3. Option 3 – Staged replacement with 500 kV switchgear deferred 9
3.4. Material inter-regional network impact 9
4. Non-network options 10
5. Assessment approach 11
5.1. Proposed scenarios and input assumptions 11
5.2. Material classes of market benefits 11
5.3. Other classes of benefits 11
5.4. Classes of market benefits that are not material 12
Appendix A - RIT-T assessment and consultation process 13
Appendix B - Asset condition framework 14

Figures

Figure 1 – 500 kV Transmission Network Backbone 4
Figure 2 – Transmission network connected at MLTS 5
Figure 3 - Baseline risk costs 7
Figure 4 - RIT-T Process 13

Tables

Table 1 - Summary of major equipment condition scores 5
Table 2 - Summary of input assumptions for the proposed scenarios 11
Table 3 - Condition scores framework 14

1. Introduction

AusNet Services is initiating this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain reliable transmission network services at Moorabool Terminal Station (MLTS) to mitigate the risk of assets failure at MLTS.

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 2021 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 23 June 2022. In the subject field, please reference 'RIT-T PSCR Moorabool 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] The RIT-T process assesses the economic efficiency and technical feasibility of proposed network and non-network options

[4] Australian Energy Market Commission, *"National Electricity Rules"*

[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 MLTS 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 services at Moorabool

MLTS is owned and operated by AusNet Services and is located near Geelong. 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 centre in Melbourne. It also forms an interconnector with South Australia at Heywood Terminal Station (HYTS) as shown below.

Figure 1 – 500 kV Transmission Network Backbone

MLTS serves as a 500 kV switching station with 500/220 kV transformation that ties the 500 kV transmission network backbone with the 220 kV transmission network near Geelong as shown in Figure 2. MLTS has two 1000 MVA 500/220 kV transformers. The ongoing need for MLTS is both demonstrated in AEMO’s Integrated System Plan (ISP) and Victorian Annual Planning Report (VAPR).

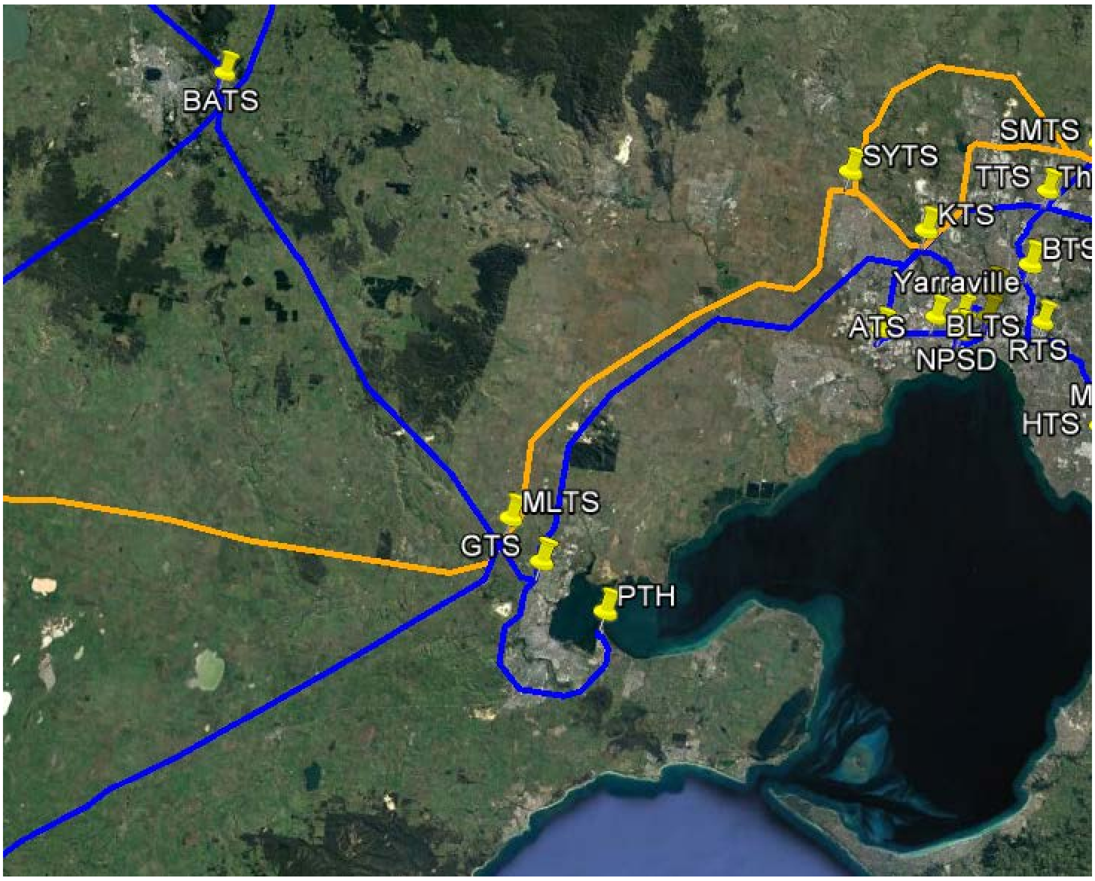

Figure 2 - Transmission network connected at MLTS

2.2. Asset condition

Several primary (circuit breakers and instrument transformers) and secondary (protection and control) assets at MLTS are in poor condition as expected of assets that have been in service for a long period of time.

AusNet Services classifies asset condition using scores that range from C1 (initial service condition) to C5 (very poor) as set out in Appendix B. The latest asset condition assessment for MLTS reveals some assets at the terminal station are in poor condition (C4) or very poor condition (C5). For the affected assets the probability of failure is high, and is likely to increase further if no remedial action is taken. Table 1 provides a summary of the condition of relevant major equipment.

Asset class	Condition scores				
	C1	C2	C3	C4	C5
500 kV circuit breakers	1	0	0	0	8
220 kV circuit breakers	3	2	1	3	7
500 kV and 220 kV Current transformers	3	31	12	24	5
500 kV and 220 kV Voltage transformers	7	0	1	13	14

Table 1 - Summary of major equipment condition scores

500 kV circuit breakers

Eight of the nine 500 kV circuit breakers are in very poor condition and are approaching their end of serviceable life. This is expected of assets that have been in service for a long period of time.

With a condition score of C5, these circuit breakers present challenges due to duty-related deterioration. Common problems are flange corrosion, SF6 leakage and hydraulic mechanism seal deterioration. Spares are limited and large component parts are not replaceable. Manufacturer support for these assets is also limited and refurbishment is thus not a viable economic option.

220 kV circuit breakers

Ten of the sixteen 220 kV circuit breakers are in poor condition and are approaching their end of serviceable life. This is expected of assets that have been in service for a long period of time.

With condition scores of C4 and C5, these circuit breakers present challenges due to duty-related deterioration. Spares are limited and large component parts are not replaceable. Manufacturer support for these assets is limited and refurbishment is thus not a viable economic option.

500 kV and 220 kV instrument transformers

Several instrument transformers at MLTS are in poor condition and in an advanced deterioration stage (C4 and C5). Management of safety risks from potential explosive failures of instrument transformers is costly due to the need for regular oil sampling and partial discharge condition monitoring. Refurbishment is not a viable economic option for these assets.

2.3. Description of the identified need

Moorabool Terminal Station is part of the main 500 kV transmission network, which provides major transmission 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].

The poor condition of some of the components at the terminal station has increased the likelihood of asset failures. Such failures would result in prolonged outages.

Without remedial action, other than ongoing maintenance practice (business-as-usual), affected assets are expected to deteriorate further and more rapidly. Further increase in the probability of asset failure will result in a higher likelihood of an impact on transmission network users, heightened safety risks due to potential explosive failure, environmental risks, collateral damage risks, and the risk of increased costs resulting from emergency asset replacements and reactive repairs. Therefore, the 'identified need' this RIT-T intends to address is to maintain reliable transmission network services at MLTS and to mitigate risks from asset failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $74 million over the forty-five year period from 2022/2023. The key risks are shown in Figure 3 with the largest component of the baseline risk costs being the market impact from an asset failure, which will impact customers through higher electricity cost as generators will have to be operated out of merit and involutory load shedding may be required due to network constraints.

[7] AEMO, Draft 2022 Integrated System Plan for the National Electricity Market

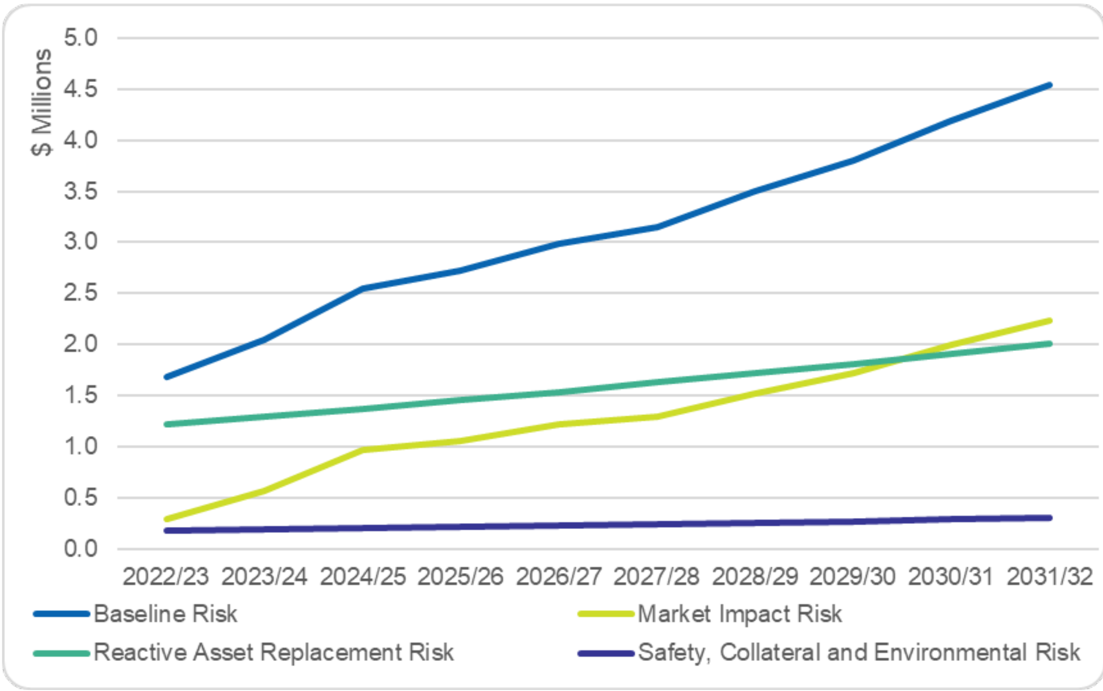

Figure 3 - Baseline risk costs

By undertaking the options identified in this RIT-T, AusNet Services will be able to maintain reliable transmission network services at MLTS 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) and the likelihood of relevant consequences, AusNet Services adopted further assumptions to quantify the risks associated with asset failure. These assumptions are detailed in the following subsections.

Market impact and supply risk costs

AusNet Services calculated the market impact cost, which consist of increased generation cost and expected unserved energy resulting from an asset failure at MLTS based on the Victoria state wide Value of Customer Reliability (VCR)[9] of $42.59/kWh.

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;

[8] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Energy Safe Act 1998"*
[9] 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).
[10] Victorian State Government, Victorian Legislation and Parliamentary Documents, *"Energy Safe Act 1998"*
[11] Department of the Prime Minister and Cabinet, Australian Government, *"Best Practice Regulation Guidance Note: Value of statistical life"*

- 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 MLTS 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 could impact the environment when it fails and where cleanup cost could be in the order of $30,000 per event.

[12] Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13"

[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"*

[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. The technical requirements that a non-network option would have to provide are detailed in the next section.

3.1. Option 1 –Integrated Replacement

Option 1 involves replacement of all poor and very poor condition 500 kV and 220 kV assets in a single integrated project. It includes:

- Replacement of eight 500 kV circuit breakers and associated primary and secondary equipment; and
- Replacement of ten 220 kV circuit breakers and associated primary and secondary equipment.

The estimated capital cost of this option is $28.4 million and the change in operating and maintenance cost is negligible.

3.2. Option 2 – Staged replacement with 220 kV switchgear deferred

Option 2 is a staged replacement option to assess whether it would be more economic to stage the asset replacement investment over two stages that are about five years apart.

The first stage replaces all 500 kV assets that are in poor and very poor condition and all 220 kV assets that are targeted for replacement are deferred about seven years after completion of the first stage.

The estimated capital cost of the first and second stage of this option is $21.5 million and $8.4 million respectively. The change in operating and maintenance cost is negligible.

3.3. Option 3 – Staged replacement with 500 kV switchgear deferred

Option 3 is another staged replacement option to assess whether it would be more economic to stage the asset replacement investment over two stages that are about five years apart.

The first stage replaces all 220 kV assets that are in poor and very poor condition and all 500 kV assets that are targeted for replacement are deferred about seven years after completion of the first stage.

The estimated capital cost of the first and second stage of this option is $8.4 million and $21.5 million respectively. The change in operating and maintenance cost is negligible.

3.4. Material inter-regional network impact

The proposed asset replacements at MLTS 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.

It is considered unlikely that non-network solutions will provide technically feasible alternatives given that MLTS is part of the extra high voltage main transmission network backbone with 500 kV and 220 kV transmission lines being switched at MLTS.

A non-network option will have to provide transmission network services that facilitate least cost dispatch of NEM generation and avoid network constraints impacting efficient generation dispatch or the reliability of the transmission network service to end consumers.

Proposals for non-network solutions should be emailed to rittconsultations@ausnetservices.com.au by 23 June 2022.

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 become greater than the annualised investment costs.

5.1. Proposed scenarios and input assumptions

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

Parameter	Lower Bound	Base Case	Upper Bound
Market Scenario	Slow Change Scenario	Step Change Scenario	Hydrogen Superpower Scenario
Asset failure rate	AusNet Services assessment – 15%	AusNet Services assessment	AusNet Services assessment + 15%
Project Capital Cost	Base Case - 15%	Base Case Estimate	Base Case + 15%
Discount rate[17]	2.0% - the WACC rate of a network business	5.5% - the latest commercial discount rate	7.5% - Upper Bound

Table 2 - Summary of input assumptions for the proposed scenarios

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.

5.2. 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 consumption arising through different patterns of generation dispatch.

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 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.

[16] Australian Energy Regulator, *"Industry practice application note for asset replacement planning"*

[17] Discount rates as recommended in the AEMO Inputs Assumptions and Scenarios Report (IASR) 2021

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

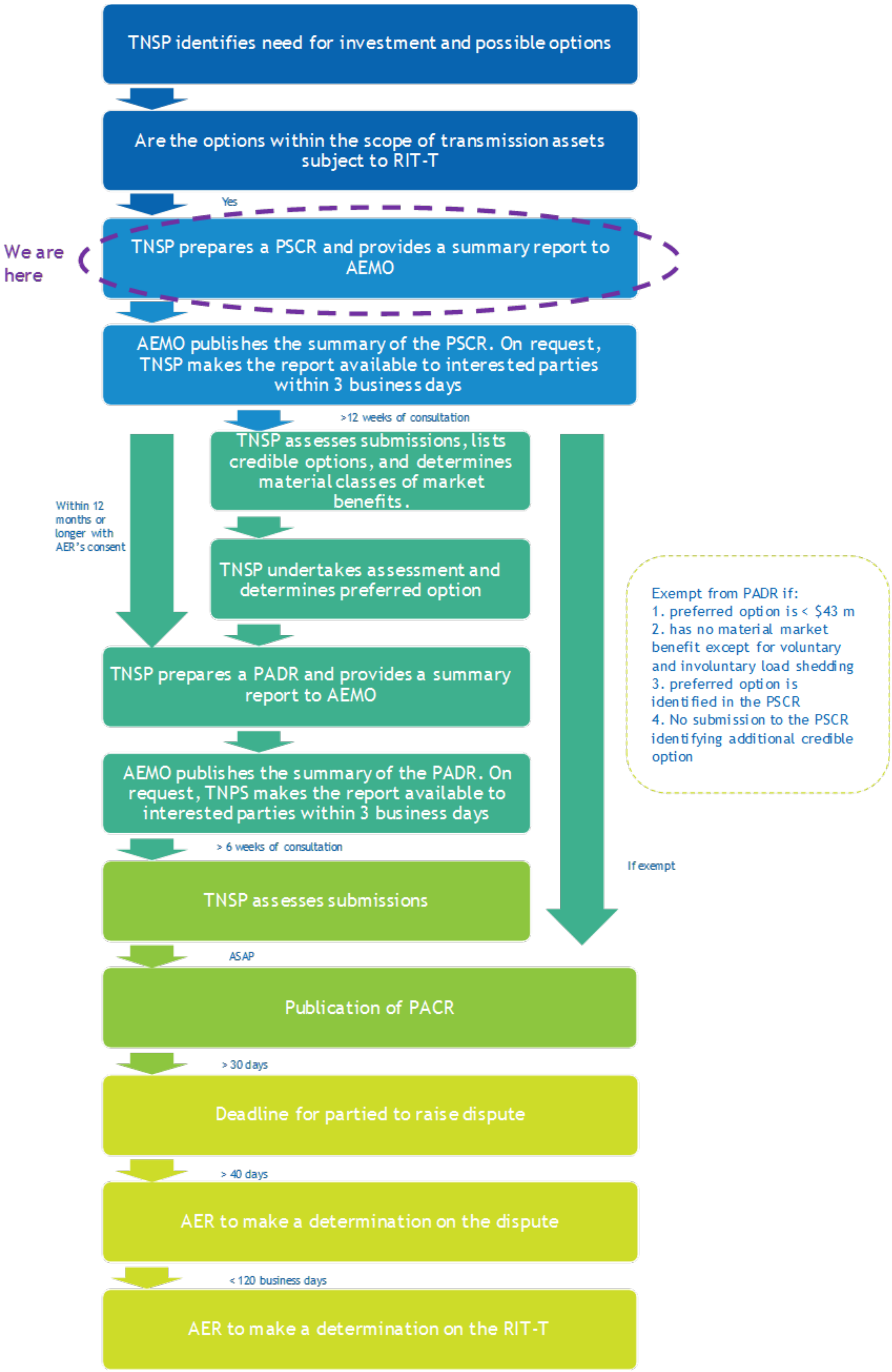

Figure 4 - RIT-T Process

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).