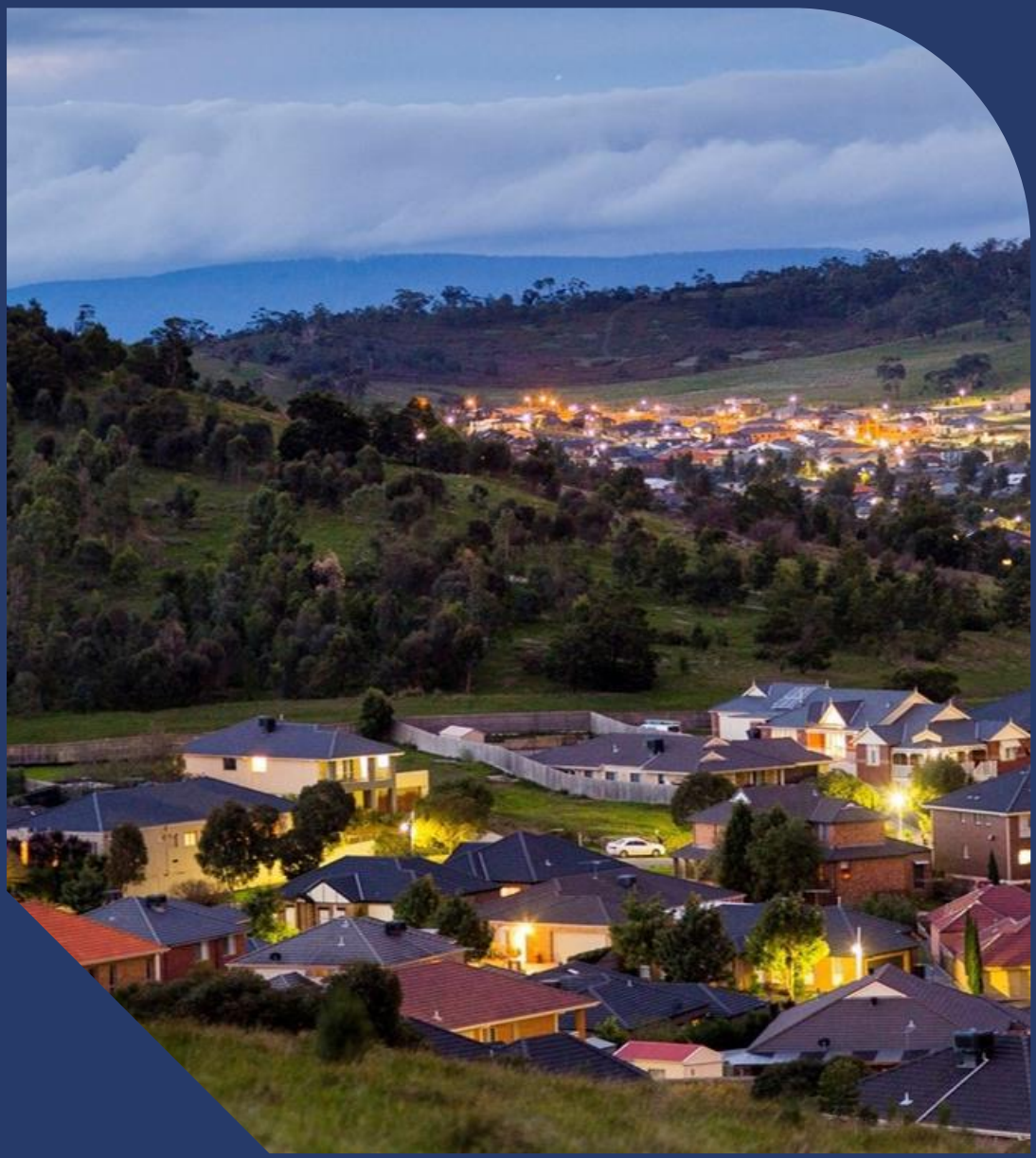
AusNet

Maintaining reliable 330/220 kV transformation network services at South Morang Terminal Station

Regulatory Investment Test for Transmission (RIT-T)

Project Assessment Conclusion Report

April 2025



1. Executive summary

South Morang Terminal Station (SMTS) is owned and operated by AusNet and is in South Morang north of Melbourne's CBD. It forms part of the main Victorian 500 kV, 330 kV and 220 kV transmission network with ties to Tasmania and major generation in the Latrobe Valley, the Victoria-South Australia interconnector, the interconnector between Victoria and New South Wales and the Melbourne metropolitan 220 kV network.

AusNet Services undertook this Regulatory Investment Test for Transmission (RIT-T) to evaluate options to maintain reliable 330/220 kV transformation network services at South Morang Terminal Station (SMTS).

The Project Specification Consultation Report (PSCR), which represents the first step in the RIT-T process was published in August 2024 and the succeeding Project Assessment Draft Report (PADR) was published in February 2025. Publication of this Project Assessment Conclusions Report (PACR) represents the third and final step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER) and section 4.2 of the RIT-T Application Guidelines.

The RIT-T analysis shows that it is no longer economical to continue to provide transmission network services with the existing assets at SMTS as the asset failure risk has increased to a level where investment to replace the selected assets presents a more economical option.

No non-network or other network proposals were received during the RIT-T consultation.

Identified need

The H1 and H2 330/220 kV transformers at SMTS are in poor to very poor condition, increasing the risk of failure. Without intervention, these assets will deteriorate faster, leading to prolonged outages and higher market impact risks. Additionally, there are increased safety, environmental, and emergency replacement risks. The RIT-T aims to ensure reliable 330/220 kV transformation services are maintained at SMTS. AusNet Services calculated the baseline risk costs at over $150 million over 45 years, mainly due to supply interruption risks affecting electricity consumers.

Credible options

Three credible network options to replace the H1 and H2 330/220 kV transformers that are likely to deliver an economical solution to the identified need has been considered in this RIT-T.

- Option 1 – Replace the H1 and H2 transformers with an in-service and a hot spare transformer
- Option 2 – Replace the H1 and H2 transformers with an in-service and a cold spare single-phase transformer
- Option 3 – Deferred replacement with a new transformer and a single-phase spare transformer

Assessment approach

AusNet Services followed the Australian Energy Regulator (AER)'s Industry practice application note for asset replacement planning to analyse and rank the economic cost and benefits of the investment options considered in this RIT-T. The assessment approach includes consideration of the costs and economic benefits for each option, and testing the robustness of the investment decision through:

- the use of scenarios that are consistent with the Australian Energy Market Operator's (AEMO) latest Inputs, Assumptions and Scenarios Report (IASR); and
- sensitivity analysis that involves variation of assumptions around the values used for the central scenario.

RIT-T Conclusion

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain reliable 330/220 kV transformation network services at SMTS and manage safety, environmental, collateral and emergency replacement risks. The preferred option involves selective replacement of assets that are in poor condition, including two 330/220 kV transformers with one of the new transformers to be used as a hot spare, as well as protection relays and secondary assets that are in poor or very poor condition.

The estimated capital cost of this option is $155.6 million with no material change in operating and maintenance cost. The project is economic by 2028/2029 based on a total investment cost of $155.6 million and AusNet Services is targeting a commissioning date of end 2028.

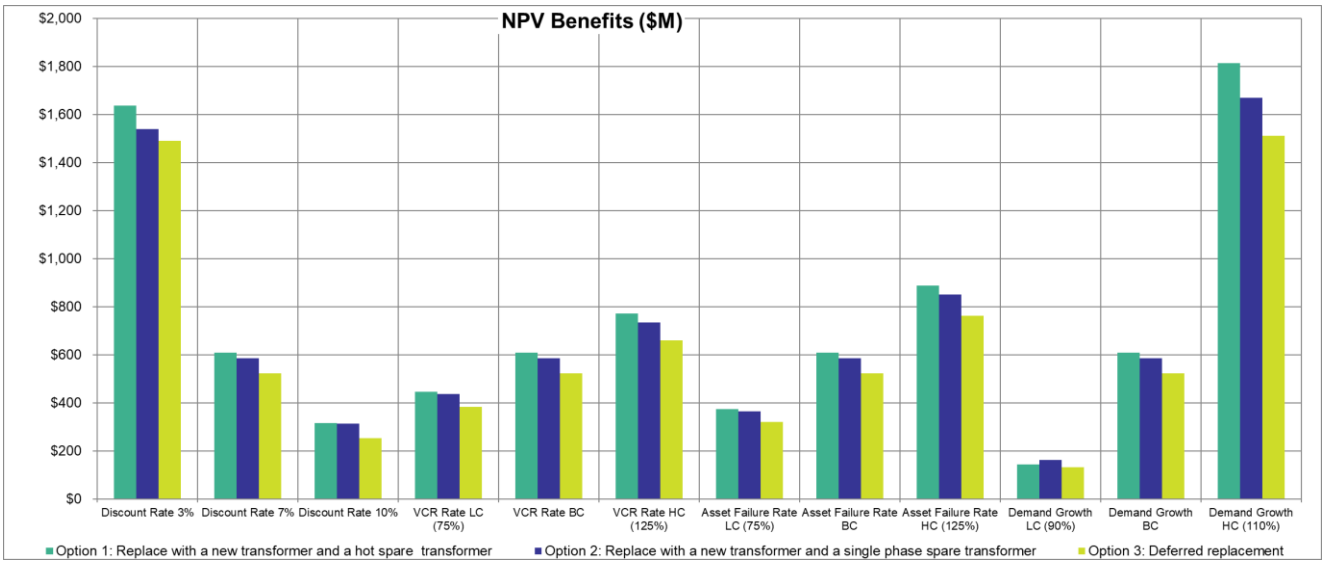


Figure 1 - Preferred option (scenarios and sensitivity analysis)

Next steps

In accordance with clause 5.16B of the NER, within 30 days of the date of publication of this PACR, any party disputing the conclusion made in this PACR should give notice of the dispute in writing setting out the grounds for the dispute (the dispute notice) to the AER. If there are no dispute notices within 30 days of the date of publication of this PACR, AusNet Services expects to implement the preferred option.

AusNet

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2. Introduction

AusNet Services initiated this RIT-T to evaluate options to maintain reliable 330/220 kV transformation network services at SMTS and to mitigate the risk of assets failures.

The PSCR, which represents the first step in the RIT-T process was published in August 2024 and the succeeding PADR was published in February 2025. Publication of this PACR represents the third and final step in the RIT-T process in accordance with clause 5.16 of the National Electricity Rules (NER) and section 4.2 of the RIT-T Application Guidelines.

This document describes:

- the identified need that AusNet Services is seeking to address;
- credible network options that may address the identified need;
- a summary of, and the RIT-T proponent's response to, the submissions received to the PADR, if any;
- the assessment approach and assumptions that AusNet Services employed for this RIT-T assessment as well as the specific categories of market benefits that are unlikely to be material;
- the option evaluation; and
- the identification of the preferred option.

The need for investment to address risks from the deteriorating assets at SMTS has been included in AusNet Services' revenue proposal for the 2022 to 2027 regulatory control period.[1] This investment need is also presented in AusNet Services Asset Renewal Plan that is published as part of AEMO's 2024 Victorian Transmission Annual Planning Report (VAPR)[2]

1 Australian Energy Regulator, "*AusNet Services - Determination 2017–2022*"
2 Australian Energy Market Operator, "*Victorian Annual Planning Report*"

3. Identified need

This section of the PACR describes the condition of key assets at SMTS, quantify the risk costs of an asset failure and establish the need for investment.

3.1 Transmission network services at South Morang

SMTS is owned and operated by AusNet and is north of greater Melbourne. SMTS is one of the major terminal stations in Victoria which connects six other terminal stations and has four voltage levels – 500 kV, 330 kV, 220 kV and 66 kV. 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. Two 1,000 MVA transformers steps the voltage down from 500 kV to 330 kV. There are three 700 MVA transformers (H1, H2 and H3) that steps the voltage down from 330 kV to 220 kV and two transformers that step the voltage down from 220 kV to 66 kV.

The H3 transformer was installed in 2018 to address the risk of a transformer failure given that AusNet did not have a suitable spare transformer at the time, and it was the first stage of a staged replacement of the 330/220 kV transformers.

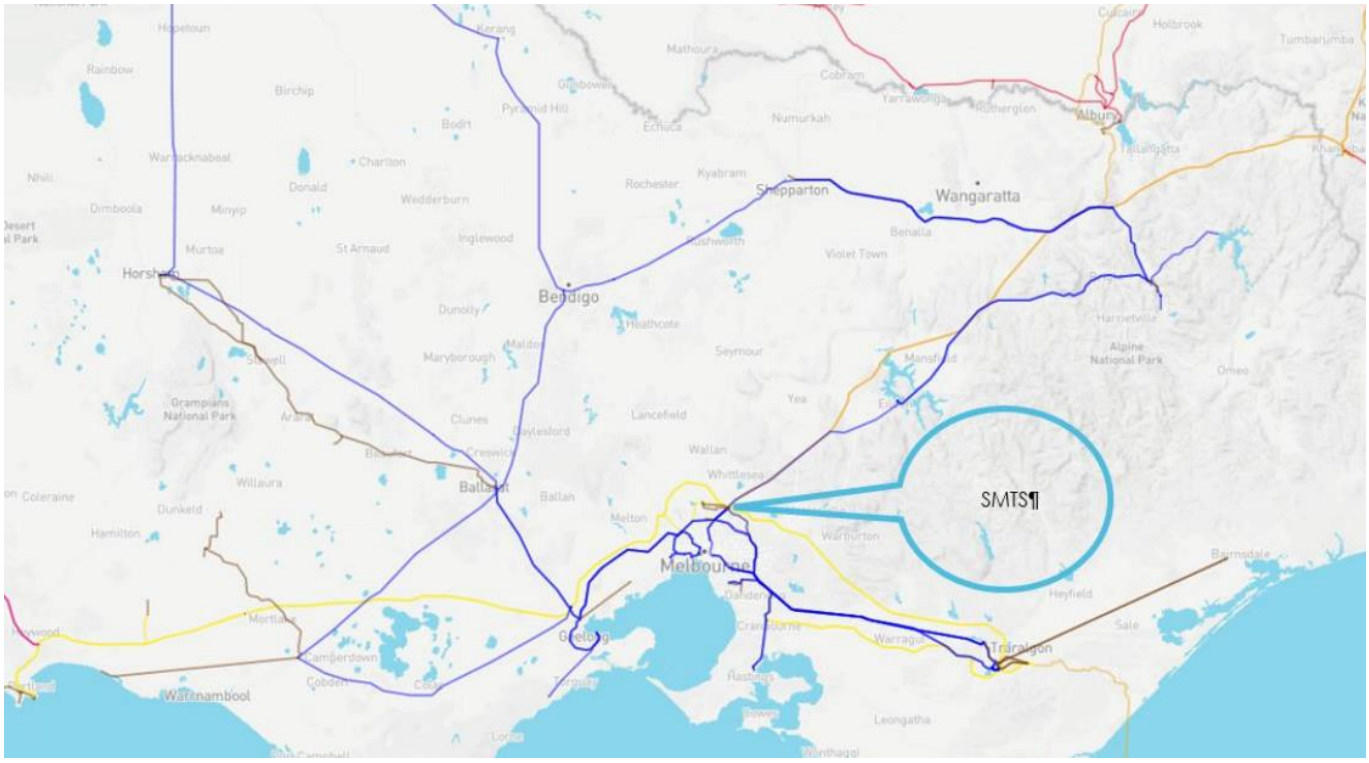

Figure 2 – SMTS and the Victorian transmission network

The ongoing need for SMTS is demonstrated in AEMO's Integrated System Plan (ISP) and Victorian Annual Planning Report (VAPR).

3.2 Asset condition

AusNet conducted a condition assessment of the H1 and H2 Transformers 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 H1 and H2 transformers are in very poor condition as expected of assets that have been in service since 1967 and 1968.

No alternative maintenance strategies have been identified that would materially reduce the failure rate or address the lack of manufacturer support for these two transformers.

3.3 Description of the identified need

SMTS is part of the main 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 and VAPR.

The poor condition of the H1 and H2 330/220 kV transformers 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 impact on transmission network users, heightened safety risks, 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 330/220 kV transformation network services at SMTS and to mitigate risks from asset failures.

AusNet Services calculated the present value of the baseline risk costs to be more than $150 million over the forty-five-year period from 2025. The key risks are shown in Figure 3 with the largest component of the baseline risk costs being the supply interruption risk, which is borne by electricity consumers.

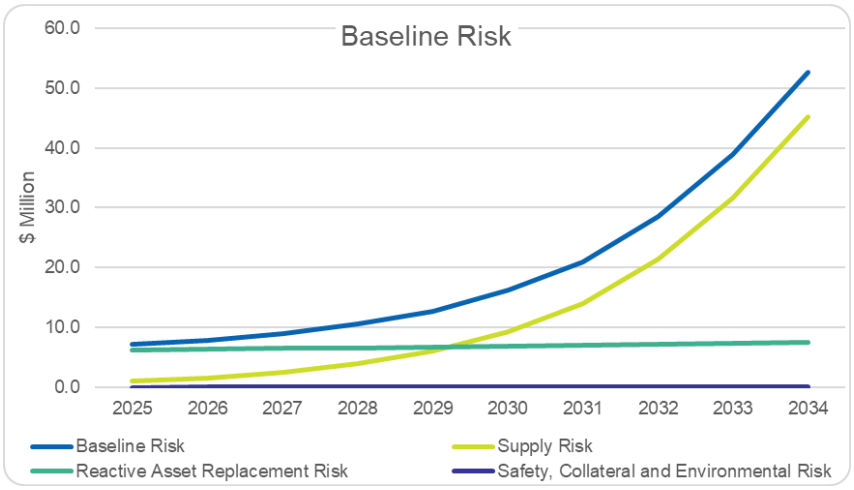

Figure 3 - Baseline risk costs

By undertaking the options identified in this RIT-T, AusNet Services will be able to maintain reliable 330/220 kV transformation network services at SMTS and mitigate safety and environmental risks as required by the NER and Electricity Safety Act 1998[3].

3.4 Assumptions

The identified need is underpinned by several assumptions, including the risk of asset failure (determined by the condition of the assets), the likelihood of the relevant consequences, and several assumptions adopted from the latest Inputs Assumptions and Scenarios Report (IASR). These assumptions are outlined below.

Failure rate and repair time

Both quantitative and qualitative analysis is used to assess the condition of the asset so that an estimate of how long an asset can remain in service can be made. Table 1 shows the failure rates applied in this analysis.

Transformer Failure Rates	2025	2026	2027	2028	2029	2030	2031	2032
H1 (Hot Spare Transformer)	0.088	0.090	0.092	0.094	0.095	0.097	0.099	0.101
H2	0.078	0.080	0.082	0.083	0.085	0.087	0.089	0.091
H3	0.009	0.010	0.010	0.011	0.012	0.012	0.013	0.013

Table 1 – 330/220 kV Transformer failure rates

The mean time to replace a transformer following a major failure has been assumed to be 24 months when no spare is available.

Market impact and supply risk costs

Market modelling and network studies are used to assess the market impact of transformer failures at SMTS. These studies use the latest assumptions from AEMO's Inputs Assumptions and Scenarios Report (IASR) which includes demand forecasts, generation cost forecasts, generation retirement schedules, and forecast transmission developments.

3 Victorian State Government, Victorian Legislation and Parliamentary Documents, "Electricity Safe Act 1998"

Involuntary load shedding is valued at the latest Value of Customer Reliability (VCR)[4].

Safety risk costs

The Electricity Safety Act 1998[5] 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[6] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[7]; and
- a disproportionality factor[8].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the AER's Industry practice application note[9].

Financial risk costs

There is an ongoing need for the services provided at SMTS and emergency asset replacement or repairs would be required to continue the service should a transformer fail. The failure rate weighted emergency asset replacement cost (or undertaking reactive maintenance) is included in the assessment[11].

Environmental risk costs

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

Approach to estimating option costs

The costs for each option have been calculated by AusNet's cost estimation team based on recent similar project costs and scope. Costs are expected to be within +/-25 per cent of the actual cost.

The costs presented in this PSCR are comprehensive including escalations, overheads and financing charges. All cost estimates are escalated to real 2025 dollars based on the information available at the time of preparing this report.

No contingency allowance has been included in the cost estimates.

We note that social license costs have not been included as they are not expected to be material for this RIT-T.

Operating and maintenance costs are negligible as far as this RT-T is concerned.

Where capital components have asset lives greater than ten years, we have adopted a residual value approach to incorporating capital costs in the assessment, which ensures that the capital costs of long-lived options are appropriately captured in the assessment period.

4 In dollar terms, the Value of Customer Reliability (VCR) represents a customer's willingness to pay for the reliable supply of electricity
5 Victorian State Government, Victorian Legislation and Parliamentary Documents, "Electricity Safe Act 1998"
6 Department of the Prime Minister and Cabinet, Australian Government, "Best Practice Regulation Guidance Note: Value of statistical life"
7 Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13"
8 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.
9 Australian Energy Regulator, "Industry practice application note – Asset replacement planning, July 2024"

4. Credible network options

This section describes the credible options that have been considered to address the identified need, including:

- the technical characteristics of each option;
- the estimated construction time and commissioning date; and
- the total indicative capital and operating and maintenance costs.

The purpose of the RIT-T is to identify the credible option that maximises the net market benefit for most scenarios. An important aspect of this task is to consider non-network and network options on an equal footing, to ensure an efficient outcome for all network users. None of the options considered are expected to have an inter-regional impact.

4.1 Option 1: Replace with a new transformer and a hot spare transformer

Option 1 replaces the H1 and H2 transformers with two new 330/220 kV transformers; utilising one as an in-service unit and the other as a hot spare. The project also replaces associated secondary equipment. The old H1 and H2 transformers will be retired as part of the project. The estimated capital cost of this option is $155.6 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 4 years.

4.2 Option 2: Replace with a new transformer and a single-phase spare transformer

Option 2 replaces the H1 and H2 transformers with one new 330/220 kV transformers and a cold spare single-phase transformer. The project also replaces associated secondary equipment. The old H1 and H2 transformers will be retired as part of the project. The estimated capital cost of this option is $113 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 4 years.

4.3 Option 3: Deferred replacement with a new transformer and a single-phase spare transformer

Option 3 is similar to Option 2 except it defers the investment with 5 years. This option replaces the H1 and H2 transformers with one new 330/220 kV transformers and a cold spare single-phase transformer. The project also replaces associated secondary equipment. The old H1 and H2 transformers will be retired as part of the project. The estimated capital cost of this option is $113 million and the change in operating and maintenance cost is negligible. The estimated project delivery time is 4 years.

4.4 Material inter-regional network impact

The proposed asset replacements at SMTS will not change the transmission network configuration and none of the network options considered are likely to have a material inter-regional network impact. A 'material inter- regional network impact' is defined in the NER as:

"A material impact on another Transmission Network Service Provider's network, which may include (without limitation): (a) the imposition of power transfer constraints within another Transmission Network Service Provider's network; or (b) an adverse impact on the quality of supply in another Transmission Network Service Provider's network."

5. Assessment approach

Consistent with the RIT-T requirements and Industry practice application note, AusNet Services undertook a cost-benefit analysis to evaluate and rank the net economic benefits of the credible options over a 45-year period.

All options considered have been 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 is the year when the annual benefits from implementing the option become greater than the annualised investment cost.

5.1 Sensitivity analysis and input assumptions

The robustness of the investment decision and the optimal timing of the preferred option have been tested by a sensitivity analysis. This analysis involves variation of assumptions from those employed for the central (most likely) scenario.

Parameter	Lower Bound	Most likely (central) assumption or scenario	Upper Bound
VCR	75% of central assumption	Latest AER published VCR	125% of central assumption
Asset failure rate	75% of central assumption	Assessed failure rate	125% of central assumption
Demand Growth	90% of central assumption	AEMO Connection Point Forecast	110% of central assumption
Discount rate[10]	WACC rate of network business (3.0%)	Latest commercial discount rate from IASR (7%)	Upper Bound (10%)
Project Capital Cost	75% of estimated cost	Estimated cost	125% of estimated cost

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 only class of market benefits that is likely to be material is the change in involuntary load shedding. AusNet Services' approach to calculate the benefits of reducing the risk of involuntary load shedding is set out in section 3.4.

5.3 Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects 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.

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.

10 Discount rates as recommended in the AEMO Inputs, Assumptions and Scenarios Report (IASR)

- 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.
- Change in network losses –while changes in network losses are considered in the assessment, they are estimated to be small and unlikely to be a material class of market benefits for any of the credible options.

6. Options assessment

This section presents the results of the economic cost benefit analysis and the economic timing of the preferred option.

All the options considered in this RIT-T will deliver a reduction in market impact risk, safety risk, environmental risk, collateral risk and risk cost of emergency replacement in the event of asset failure.

Presented in Figure 4, the total risk cost reduction outweighs the investment cost for all options for all sensitivities where input variables are varied one at a time.

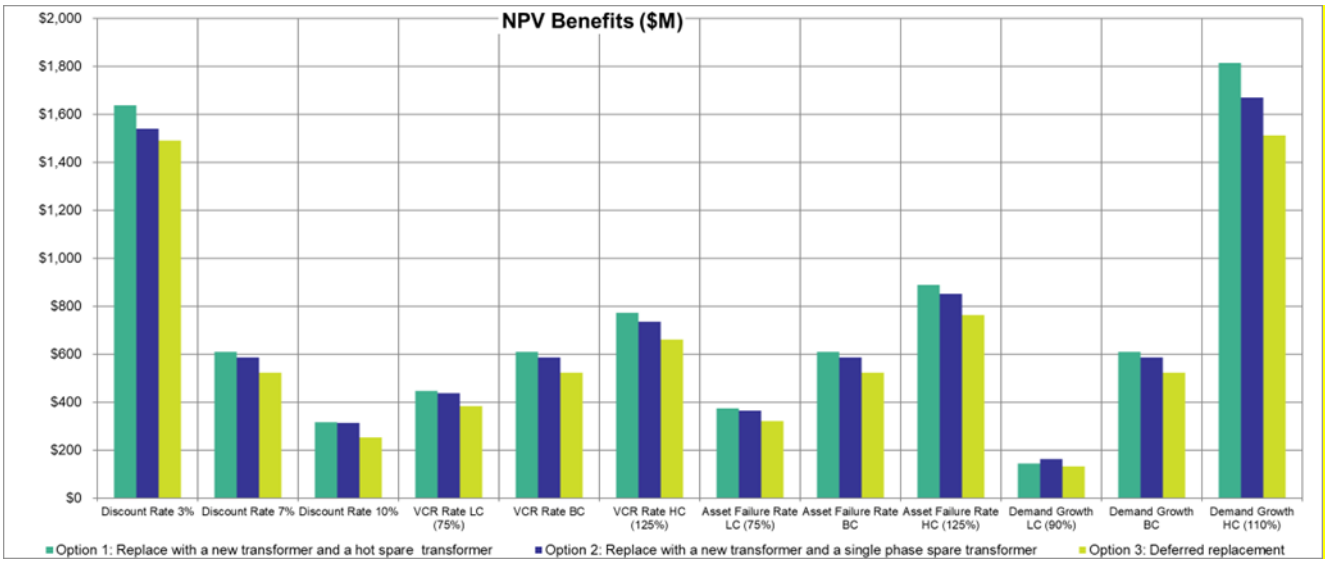

Figure 4 – Option Selection, scenario and sensitivity study

6.1 Preferred Option

Option 1 has the highest net economic benefit for all the scenarios and sensitivities considered except the low demand growth scenario and is therefore the preferred option. Scenario weighting will not make a difference to the preferred option as Option 1 has the highest net benefits for all but one of the scenarios / sensitivity studies.

6.2 Optimal timing of the preferred option

This section describes the optimal investment timing of the preferred option for different assumptions of key variables. Figure 5 shows that the optimal timing of the preferred option (Option 1) is before 2028/29 and that the investment is needed within the 2027 to 2032 regulatory control period.

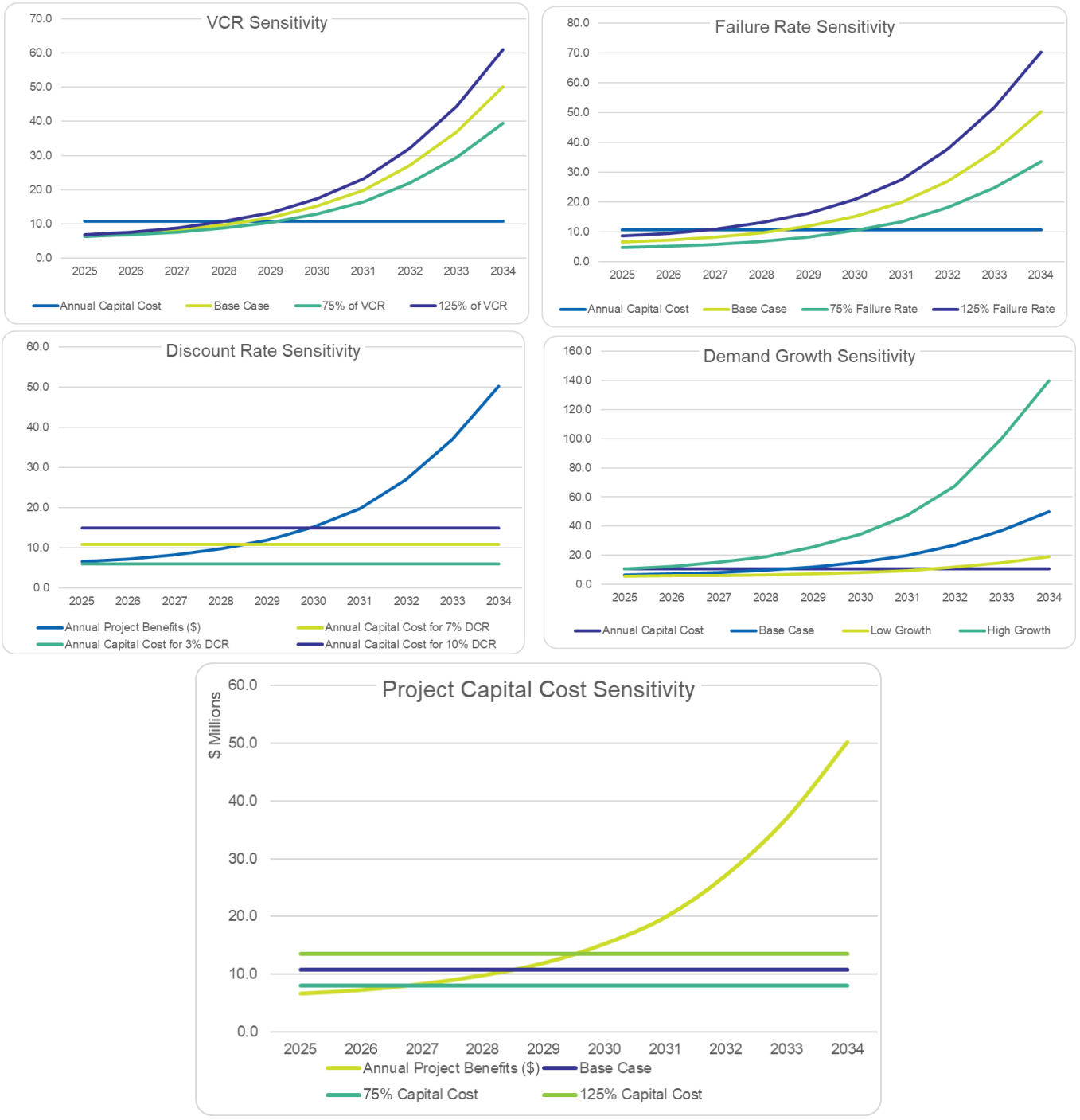

Figure 5 - Optimal investment timing

6.3 Capital and operating cost of the preferred option

The direct capital expenditure of the preferred option (Option 1) is $146.6 M and the main elements are as follows:

- Design and studies $2.6 M
- Internal labour $7.3 M
- Materials $71.0 M
- Plant and equipment $0.1 M
- Contracts $51.6 M
- Other including overheads and finance charges $13.9 M

6.4 Proposed re-opening triggers

Under the updated Rules relating to a Material Change in Circumstance (MCC), AusNet is required to set out re-opening triggers for this RIT-T. Consistent with these new requirements and drawing on the results of the sensitivity assessments outlined, AusNet considered the impact of changes in key underlying assumptions to identify reopening triggers. The only assumption that will result in a change in the preferred options is when a low demand growth scenario eventuates. The low demand scenario used in the sensitivity study is based on demand being 10% lower than the AEMO 2024 Connection point demand forecast for each one and all the years in the ten-year forecast period for the supply area downstream from SMTS 220 kV. The re-opening triggers for this RIT-T are proposed to be:

- AusNet will use the 2025 AEMO and 2025 Distribution Business (DB) demand forecasts once published in 2025 to assess whether both the AEMO and DB forecasts are materially lower (more than 10%) than the AEMO 2024 Connection Point Forecast for each year over the ten-year forecast period.

Should these occur, AusNet would prepare a letter to the AER advising of actions proposed to take in response and timeframes to take such actions. Consideration will also be given to any committed and sunk costs should the updated forecasts not be available before the project starts and costs are committed and whether new step loads such as data centres are probable but not included as committed projects in the official demand forecasts. This project plans to execute contracts for two replacement transformers by September 2025 (after the RIT-T process is expected to be finalised) by which time a change in the preferred option can no longer be made without incurring sunk costs.

7. Conclusion

Amongst the options considered in this RIT-T, Option 1 is the most economical option to maintain reliable 330/220 kV transformation network services at SMTS and manage safety, environmental, collateral and emergency replacement risks. The preferred option involves selective replacement of assets that are in poor condition, including two 330/220 kV transformers with one of the new transformers to be used as a hot spare, as well as protection relays and secondary assets that are in poor or very poor condition.

The estimated capital cost of this option is $155.6 million with no material change in operating and maintenance cost. The project is economical by 2028/2029 based on a total investment cost of $155.6 million and AusNet Services is targeting a commissioning date of end 2028.

7.1 Next steps

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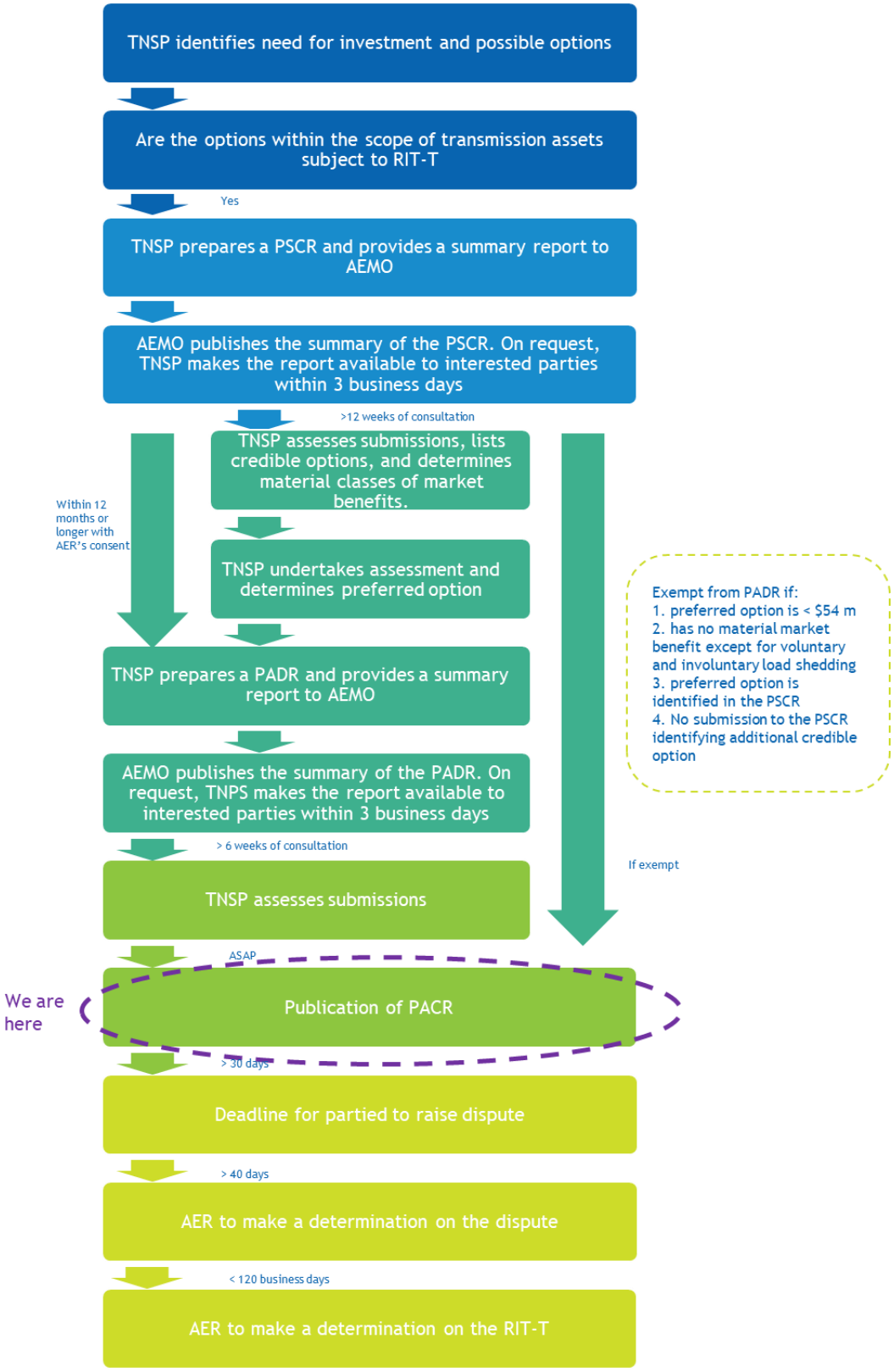
Appendix A – RIT-T assessment and consultation process



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