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Managing the Risk of Hummock to Ardrossan West 132 kV Line Failure

Project Assessment Conclusions Report

5 December 2024

Executive Summary

This Project Assessment Conclusions Report is the final stage of identifying the preferred option to address an identified need relating to the replacement of the Hummocks to Ardrossan West 132 kV transmission line located in Yorke Peninsula region in South Australia to maintain safe and reliable electricity supply to customers.

The identified need for this project is to continue to provide safe and reliable electricity transmission services in South Australia at a prudent and efficient cost.

Specifically, the identified need for this Regulatory Investment Test for Transmission (RIT-T) is to efficiently manage the risk of failure of conductor and conductor hardware on the Hummocks to Ardrossan West 132 kV transmission line that are in poor condition and have reached the end of their technical lives.

The Hummocks to Ardrossan West 132 kV transmission line is a radial transmission line that connects the Lower Yorke Peninsula region to the South Australian transmission network and the National Electricity Market. Condition assessment undertaken on this transmission line has identified that the conductor and conductor hardware are in poor condition and have reached the end of their technical and economic lives and require replacement by 2028 period to manage the increased risk of unsafe operation and involuntary load shedding.

The Project Specification Consultation Report was released in June 2024 identifying a proposed solution.

The Project Specification Consultation Report (PSCR) for this project was published on 19 June 2024. It described the identified need and suggested that there is only one technically and economically feasible option to meet that need, which is to replace the Hummocks to Ardrossan West 132 kV transmission line in its entirely and to decommission the existing line with an estimated capital cost of approximately $34.6 million.

The PSCR assessed the options of replacing the full transmission line in its entirety, to the option of refurbishing the transmission line, including replacing the conductor and conductor hardware, as well as the option to defer both options by 5 years. The PSCR concluded that replacing the Hummocks to Ardrossan West 132 kV transmission line in its entirely between 2025 and 2028 is the preferred.

The PSCR also explained why non-network options are expected to have a feasible role. This is due to the unique and specific role that the line insulation systems play in transmitting electricity.

Submission to the Project Specification Consultation Report.

We received one submission to the Project Specification Consultation Report. This submission was from Xatech International Ptd Ltd, and this is available for review on ElectraNet website.

This submission did not identify any additional credible options that deliver a material market benefit and the exemption from producing a Project Assessment Draft Report still applies.

This PACR maintains the initial conclusion that replacing the Hummocks to Ardrossan West 132 kV transmission line in its entirely within the 2024-2028 regulatory period is the preferred option[1].

The preferred option that has been identified in this assessment for addressing the identified need is Option 1, which is to replace the Hummocks to Ardrossan West 132 kV transmission line in its entirely by 2028.

Most of the expected benefits are derived from the avoided risk of line conductor and earthwire drop and the resulting in safety, bushfires, and continuation of supply risk, and the time and cost taken to resolve such failures. Other significant benefits are from avoiding increasing additional maintenance costs that are likely to be incurred if the conductor and conductor hardware are not replaced.

On a weighted basis (i.e., weighted across the three scenarios investigated), the preferred option is expected to deliver approximately $80.8 million in net market benefits.

Next steps

ElectraNet intends to commence work on replacing the Hummocks to Ardrossan West 132 kV transmission line in 2025.

Further details in relation to this project can be obtained from consultation@electranet.com.au.

[1] The preferred option is defined as the option that maximises net benefits under the RIT-T framework.

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Glossary

AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BESS	Battery Energy Storage System
ETC	Electricity Transmission Code
NPV	Net Present Value
NEM	National Electricity Market
NER	National Electricity Rules
PACR	Project Assessment Conclusions Report
PADR	Project Assessment Draft Report
PSCR	Project Specification Consultation Report
RET	Renewable Energy Target
RIT-T	Regulatory Investment Test for Transmission
TNSP	Transmission Network Service Provider
VCR	Value of Customer Reliability

1 Introduction

This Project Assessment Conclusions Report (PACR) is the final step in the application of the Regulatory Investment Test for Transmission (RIT-T) to address the risk of failure of the risk of failure of conductor and conductor hardware on the Hummocks to Ardrossan West 132 kV transmission line located in Yorke Peninsula region in South Australia.

The Project Specification Consultation Report (PSCR) was released on 19 June 2024. It

- described the identified need that we are seeking to address, together with the assumptions used in identifying this need;
- set out the technical characteristics that a non-network option would be required to deliver to address this identified need;
- outlined the only credible option that we consider addresses the identified need;
- discussed specific categories of market benefit that, in the case of this RIT-T assessment, are unlikely to be material;
- presented the results of our economic assessment of the credible option and identifies the preferred option and the reasons for the preferred option; and
- set out our basis for exemption from a Project Assessment Draft Report (PADR).

We received one submission to the PSCR. This submission did not identify any additional credible options that could deliver a material market benefit, as such the exemption from the PADR still applies.

1.1 Why we consider this RIT-T is necessary

The National Electricity Rules (NER) require the application of the RIT-T to replacement capital expenditure where there is at least one credible option costing more than $7 million.[2]

Accordingly, we have initiated this RIT-T to consult on proposed expenditure related to replacing the Hummocks to Ardrossan West 132 kV transmission line, noting that none of the exemptions listed in NER clause 5.16.3(a) apply.

The credible option discussed in this PACR has not been foreshadowed in AEMO's Integrated System Plan (ISP) as the works involved do not impact on the main transmission flow paths between the NEM regions.

[2] NER clause 5.15A.1(c) states that the purpose of the regulatory investment test for transmission in respect of its application to both types of projects is to identify the credible option that maximises the present value of net economic benefit (the preferred option). For the avoidance of doubt, a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is, a net economic cost) to the extent the identified need is for reliability corrective action or the provision of inertia network services required under clause 5.20B.4..

1.2 Next steps

ElectraNet intends to commence work on replacing the Hummocks to Ardrossan West 132 kV transmission line in its entirely and to decommission the existing line in 2025. Further details in relation to this project can be obtained from consultation@electranet.com.au

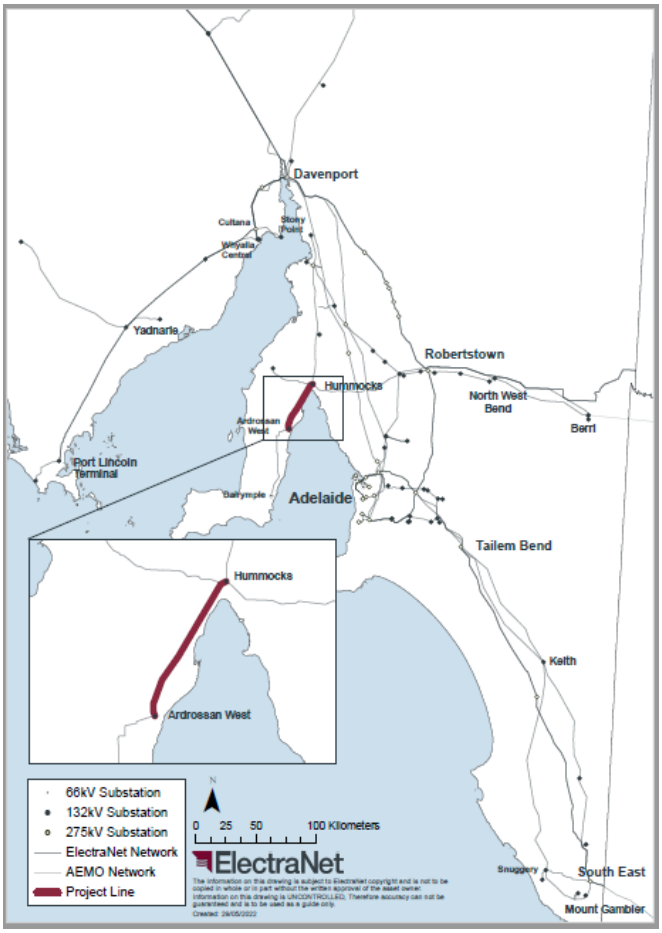
2 The identified need for this RIT-T is to ensure safe and reliable supply of electricity in South Australia

This section outlines the identified need and the assumptions underpinning it. It first provides some background on F1803 Hummocks - Ardrossan West 132 kV transmission line and its role in the transmission of electricity in South Australia.

2.1 Background to the identified need

The Hummocks - Ardrossan West 132 kV transmission line identified as replacement is located adjacent to the St Vincent Gulf coastline in the Yorke Peninsula region in South Australia (refer Figure 1).

Figure 1 - Location of the Hummocks - Ardrossan West 132 kV transmission line for replacement



The primary role of the Hummocks - Ardrossan West 132 kV transmission line is to provide power to customers in the lower Yorke Peninsula region of South Australia.

Additionally, it:

- enables the Dalrymple BESS to participate in the NEM and to provide network support when required, and

- enables the Wattle Point windfarm to participate in and provide renewable energy to the NEM.

It has been identified that a substantial proportion of the conductor and conductor hardware are in poor condition and pose a risk to public safety and continuity of customer supply.

Figure 2 – Example of typical corrosion on the conductor and conductor hardware on F1803 Hummocks – Ardrossan West 132 kV transmission line identified for replacement.

The Hummocks - Ardrossan West 132kV line is approximately 44km in length, was commissioned in 1973 and is predominantly located in C4 corrosion zone. The conductor is Wolf 30/7/0.102 ACSR/GZ type and has a nominal life of 35 years.

The main End-of-Life driver for the conductor and conductor hardware including the overhead earthwire are caused by corrosion and is heavily influenced by the atmospheric corrosion zone of the coastline that the asset is exposed to.

Corrosion escalates the likelihood of conductor drops and exponentially presents consequent safety and bushfire risks to our personnel and the community, resulting in reactive maintenance costs to repair the failed elements. While this is the case for any corroded transmission network elements, the bushfire risks are exacerbated for the lines under analysis as they cross substantial sections of bushland, part of which surrounds residential areas.

The line has a significant number of issues, these are:

- the conductor and overhead earthwire has numerous defects including significant corrosion at the insulator attachment points and in the mid-span – This failure mode can result in dropping of a conductor and/or earthwire.
- original installed conductor dampers damaged the conductor at the damper attachment point. Temporary repairs (armour rods/helical repairs) were installed. This damage is a potential accelerator for further conductor corrosion and strand breakage.
- other conductor hardware is at End-of-Design life (insulators, dampers, armour rods/helical repairs, bolted connections at tension structures)

The level of defects on this line indicates that the overall conductor and conductor hardware components are approaching end-of-life.

If the Hummocks - Ardrossan West 132 kV conductor and conductor hardware in question are not replaced, it is increasingly likely that they will fail with the following three possible consequences:

- unplanned outages that may result in loss of customer supply to the lower Yorke Peninsula region.
- incurring the higher cost of repairing the transmission line on failure in a reactive fashion.
- risk of fire start from dropped line conductors, with consequent impact on public safety.

2.2 Description of the identified need for this RIT-T

As set out in the PSCR, the identified need is to efficiently manage the risk of failure conductor and conductor hardware on the Hummocks to Ardrossan West 132 kV transmission line that is in poor condition and have reached the end of their technical lives.

We have assessed the condition of all our transmission lines as part of our ongoing asset management processes. We have identified that there is increased likelihood that the conductor and conductor hardware on the Hummocks to

Ardrossan West 132 kV transmission line will fail in coming years given their current condition.

If action is not taken, further deterioration conditions of the assets in question would escalate the safety and bushfire risk as the likelihood of failure increases rapidly due to the assets operating near coastal areas with moderate atmospheric salinity (high corrosion zone). This might result in incidents such as conductor drop, which would pose considerable safety risks for the general public and bushfire risk and supply interruption to the lower Yorke Peninsula region, triggering reactive maintenance that might be required to repair the line under emergency conditions.

In its Industry Practice Note for asset replacement planning, the Australian Energy Regulator says that Network Service Providers should apply the As Low as Reasonably Practicable (ALARP) approach to safety matters.[3] This is consistent with South Australia's Workplace Health and Safety Act, which requires us to ensure, so far as is reasonably practicable, the health and safety of workers at our various sites and of the public generally. It is also consistent with our Safety, Reliability and Maintenance Technical Management Plan and with the obligation in our transmission licence to ensure that we operate the network in a manner consistent with good electricity industry practice.

Further, the Electricity (General) Regulations (the Regulations) 2012 require that aerial lines (including service lines) must be "operated and maintained to be safe for the electrical service conditions and the physical environment in which they operate."[4]

The Regulations specify:

> *(12) (1) Aerial lines, their structures and components must be maintained to be in a safe operating condition*
>
> *(2) a system of maintenance must be instituted for aerial lines, their structures and their components, including -*
>
> > *(a) predetermined processes to confirm the safe state of components;*
> >
> > *(b) managed replacement programs for components approaching the end of their serviceable life.*

[3] Australian Energy Regulator, "Industry practice application note Asset replacement planning", p.51, available from www.aer.gov.au, retrieved 2 April 2024.

[4] Electricity (General) Regulations 2012 (SA) s 48

(3) Maintenance programs must be carried out in accordance with the listed standards."[5]

These obligations have been taken in to account in quantifying the benefits of this project which is classified as a 'market benefits' RIT-T. It is being progressed to deliver positive net benefits to customers by managing the risk of asset failure.

A full cost benefit assessment has been undertaken, comparing the risk cost reduction benefits of asset replacement options with the cost of those options.

[5] Electricity (General) Regulations 2012 (SA) Schedule 1.

3 Submission to the Project Specification Consultation Report

We received one submission to the PSCR, this is available for review on the ElectraNet website[6].

This submission was provided by Xatech International Ptd Ltd for consideration of the Epsilon Cable HVCRC High Voltage Conductor as a replacement conductor on the Hummocks to Ardrossan West 132 kV transmission line.

The assessment of the submission did not identify any additional credible options that would deliver a material market benefit and as per NER clause 5.16.4(z1)(4) the exemption from producing a Project Assessment Draft Report still applies[7].

This submission to consider Epsilon Cable HVCRC High Voltage Conductor as a replacement conductor on the Hummocks to Ardrossan West 132 kV transmission line will be assessed as part of our delivery process.

[6] Link to Xatech International Ptd Ltd submission

[7] Reference AEMC, National Electricity Rules, version 217 clause 5.16.4.(z1)(4)

4 Credible options to address the identified need

In the PSCR we identified two credible options; Option 1, refurbishment of the existing line, replacing the line conductor and conductor hardware and Option 2, replacement of the F1803 Hummocks – Ardrossan West 132 kV transmission line in its entirety and to decommission the existing line.

We investigated both network options and their timings in order to determine the preferred option and optimal timing. We determined that preferred option and optimal timing was Option 2a, replacing the F1803 Hummocks – Ardrossan West 132 kV transmission line in its entirety and to decommission the existing line by 2028. This assessment is presented in section 5.5.

Option 2a is technically and economically feasible and able to be implemented in sufficient time to meet the identified need.[8]

We have not identified any other credible options that would meet the identified need. This decision has not changed since issuing the PSCR.

4.1 Option 2a – Planned replacement of Hummocks - Ardrossan West Transmission Line by 2028

Option 2a involves replacing F1803 Hummocks – Ardrossan West 132 kV transmission line in its entirety and to decommission the existing line identified in section 2.1 by 2028.

To facilitate this, the existing easements along the existing line will need to be expanded along the route to enable construction of the new line whilst the existing line remains in service. This will involve significant stakeholder engagement to acquire the easements and manage access during construction.

ElectraNet has prepared an estimate of the cost of implementing this option which is $34.6 million. This is a Class 4 estimate prepared in accordance with the Australian Association of Cost Engineer's 'class 4' estimate categorisation. As such it was produced through a desktop review based on a scope prepared by ElectraNet's asset engineering team. It has an estimating range of -30% to +50%.

There is no change in routine maintenance when the assets are replaced under the preferred option compared to the base case.

The estimated easement acquisition and construction time is approximately 4 years. We estimate that new line could be constructed and commissioned by 2028

[8] In accordance with those identified in section **Error! Reference source not found.**.

under this option. The existing line would be decommissioned and removed by 2028.

4.2 Option 1 – Refurbishment the existing line

Option 1 refurbishment the existing line, replacing the line conductor and conductor hardware.

Whilst this option is technically feasible, the construction challenges associated with executing this option are substantial due to the duration of the construction outage and the required generation support to the lower Yorke Peninsula region during the construction outage period. The cost associated with the generation support results in a significantly higher delivery cost compared to the preferred option. For this reason, this option was not being progressed.

The results of our analysis for this option are included in section 5.

4.3 There is not expected to be a material inter-network impact

We have considered whether the credible option will have a material inter-regional impact[9].

By reference to AEMO's screening test for an inter-network impact[10], a material inter-regional impact arises if the option:

- involves a series capacitor or modification near an existing series capacitor;
- is expected to result in a change in power transfer capability between South Australia and neighbouring transmission networks; or
- is expected to increase fault levels at any substation in another TNSP's network.

None of these criteria are satisfied for the project discussed here. Therefore, ElectraNet does not consider there are any associated material inter-network impacts.

[9] In accordance with NER clause 5.16.4(b)(6)(ii).

[10] AEMO's suggested screening test for a material inter-network impact is set out in Appendix 3 of the Inter-Regional Planning Committee's Final Determination: Criteria for Assessing Material Inter-Network Impact of Transmission Augmentations, Version 1.3, October 2004.

5 Assessment of credible options

This section outlines the assessment we have undertaken of the two credible network options to either Option 1a, refurbish the Hummocks to Ardrossan West 132 kV line by 2028 or Option 2a, replace the Hummocks to Ardrossan West 132 kV line by 2028, as well as the options 1b and 2b, to defer both options by 5 years. The assessment compares these four options against a base case 'do nothing' option.

For clarity, this section re-presents the underlying assessment in the PSCR. There were no material changes since the PSCR that would affect the finding that Option 2a is preferred.

5.1 Description of reasonable scenarios

A RIT-T analysis is required to incorporate several different reasonable scenarios, which are used to estimate expected net market benefits. The number and choice of reasonable scenarios must be appropriate to the credible options under consideration.

We have developed three scenarios for this RIT-T assessment:

- a 'central' scenario reflecting our base set of key assumptions;
- a 'low benefits' scenario – reflecting a more extreme pessimistic set of assumptions, which represents a lower bound on potential market benefits that could be realised; and
- a 'high benefits' scenario – reflecting a more extreme optimistic set of assumptions, which represents an upper bound on potential market benefits that could be realised.

Table 1 summarises the key assumptions making up each scenario.

Given that the low and high benefits scenarios are more unlikely to occur the scenarios have been weighted accordingly; 33% - low benefits scenario, 33% - central benefits scenario, and 33% - high benefits scenario.[11]

Table 1 - Summary of the three scenarios

Key variable/parameter	Low benefits scenario	Central scenario	High benefits scenario
Capital costs	130 per cent of base case estimate	Base case estimate	70 per cent of base case estimate

[11] In accordance with paragraph 4(a) of the RIT-T.

Commercial discount rate[12]	3.0%	7.0%	10.5%
Unplanned conductor outage	70 per cent of base case estimates	Base case estimates	130 per cent of base case estimates
Unplanned earthwire outage	70 per cent of base case estimates	Base case estimates	130 per cent of base case estimates
Conductor drop	70 per cent of base case estimates	Base case estimates	130 per cent of base case estimates
Earthwire drop	70 per cent of base case estimates	Base case estimates	130 per cent of base case estimates

5.2 Gross benefits for each credible option

The table below summarises the gross benefit estimated for all options, relative to the 'do nothing' base case in present value terms. The gross market benefit has been calculated for each of the three scenarios outlined in Table 1.

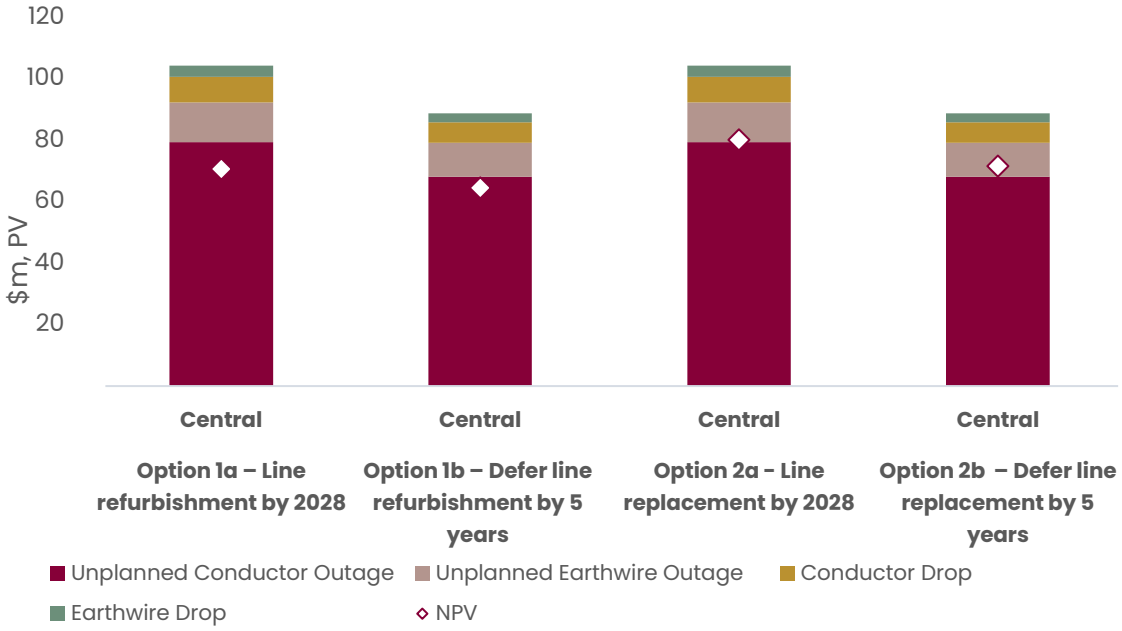
Table 2 - Estimated gross market benefit for each option, PV $m

Option	Low benefits scenario	Central scenario	High benefits scenario
Option 1a – Line refurbishment by 2028	78.5	104.2	126.5
Option 1b – Defer line refurbishment by 5 years	69.7	88.7	103.2
Option 2a – Line replacement by 2028	78.5	104.2	126.5
Option 2b – Defer line replacement by 5 years	69.7	88.7	103.2

Figure 3 below provides a breakdown of benefits on central scenario for all options against the base. It shows that the benefits are derived from the avoided risk of transmission line failure and the reduced time taken to resolve such failures.

[12] Expressed on a real, pre-tax basis

Figure 3 - Breakdown of present value gross economic benefits of the preferred option



5.3 Estimated costs for each credible option

Table 3 summarises the capital costs of all options in present value terms for the different scenarios as described in Table 1.

Table 3 - Estimated capital cost for each option, PV $m

Option	Low benefits scenario	Central scenario	High benefits scenario
Option 1a – Line refurbishment by 2028	-40.8	-33.7	-23.7
Option 1b – Defer line refurbishment by 5 years	-31.9	-24.3	-15.7
Option 2a – Line replacement by 2028	-24.8	-24.1	-18.0
Option 2b – Defer line replacement by 5 years	-19.2	-17.1	-11.8

5.4 Net present value assessment outcomes

Table 4 summarises the net market benefit of all options across the three scenarios, as well as on a weighted basis. The net market benefit is the gross benefit and are all expressed in present value terms.

The table demonstrates that Option 2a replacing the Hummocks to Ardrossan West 132 kV transmission line has the strongest expected net economic benefit on

a probability-weighted basis in all scenarios as compared to the base case of 'do nothing' option and the other options considered.

Table 4 - Estimated net market benefit for each option, NPV $m

Option	Low benefits scenario	Central scenario	High benefits scenario	Weighted
Option 1a – Line refurbishment by 2028	37.7	70.5	102.9	70.4
Option 1b – Defer line refurbishment by 5 years	37.8	64.4	87.5	63.2
Option 2a – Line replacement by 2028	53.7	80.1	108.6	80.8
Option 2b – Defer line replacement by 5 years	50.5	71.6	91.5	71.2

We have been conservative in our approach by not including the additional benefits of this option discussed in section 4.3.

5.5 Sensitivity testing

We have undertaken a thorough sensitivity testing exercise to understand the robustness of the RIT-T assessment to underlying assumptions about key variables.

In particular, we have then tested the sensitivity of the total net market benefit to variations in the key factors underlying the assessment, such as for example the sensitivity of the project to increases in capital costs and optimal timing.

Our assessment demonstrates that undertaking Option 2a, replacement of the Hummocks – Ardrossan West 132 kV transmission line by 2028 has a higher NPV benefit compared to Option 1a, refurbishment of the same line by 2028 and compared either option to delay the project by 5 years.

The timing of Option 2a enables us to manage the risk of Hummocks to Ardrossan West 132 kV transmission line failure.

5.5.1 Sensitivity of the overall net market benefit

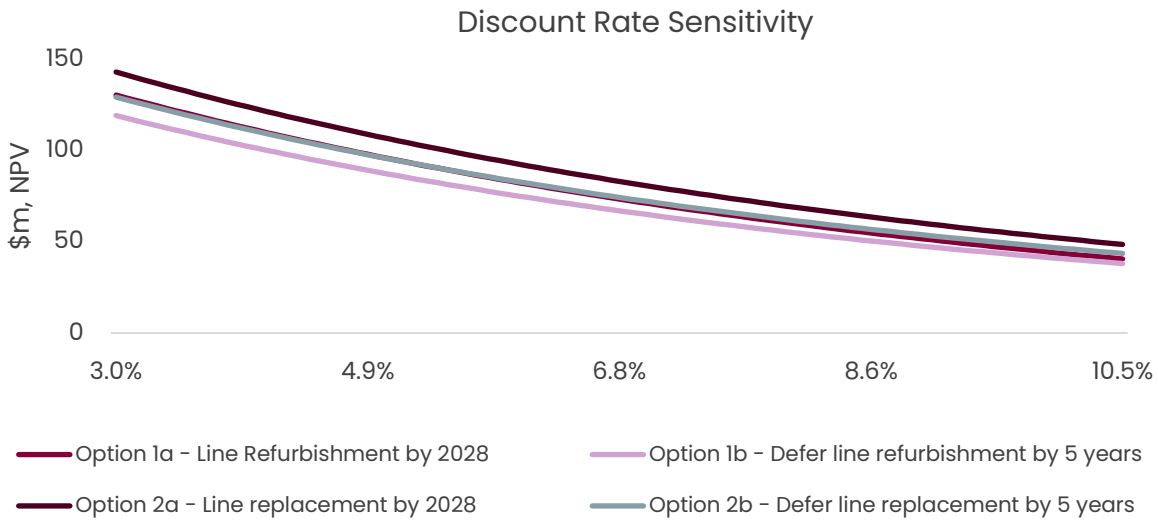
We have also reviewed the consequences for the preferred option of 'getting it wrong' if the key underlying input assumptions are not accurate.

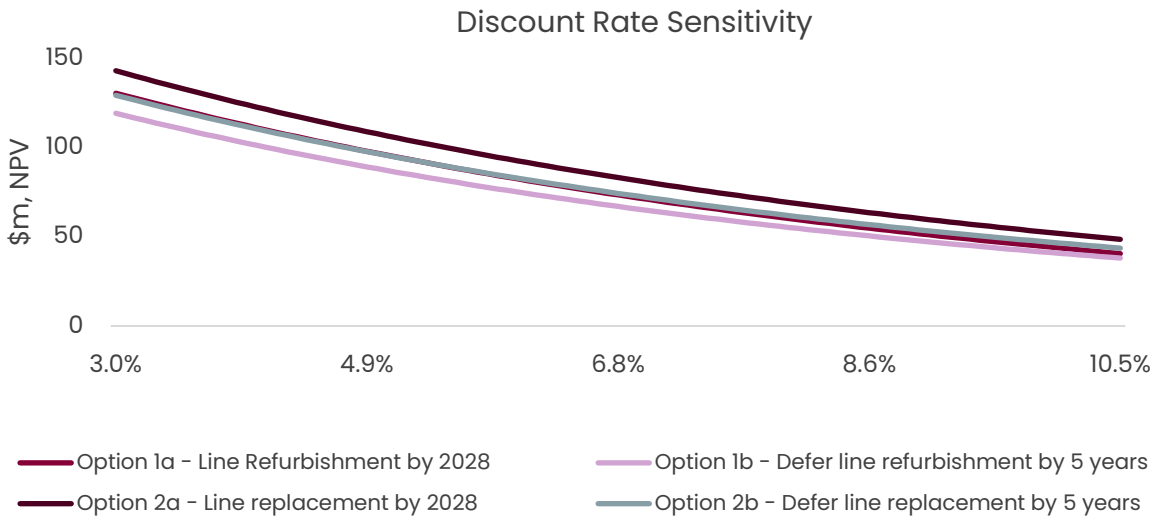
The charts in Figure 4 below illustrate the estimated net market benefits for each option if the four separate key assumptions in the central scenario are varied individually. Importantly, for all sensitivity tests shown below, the estimated net

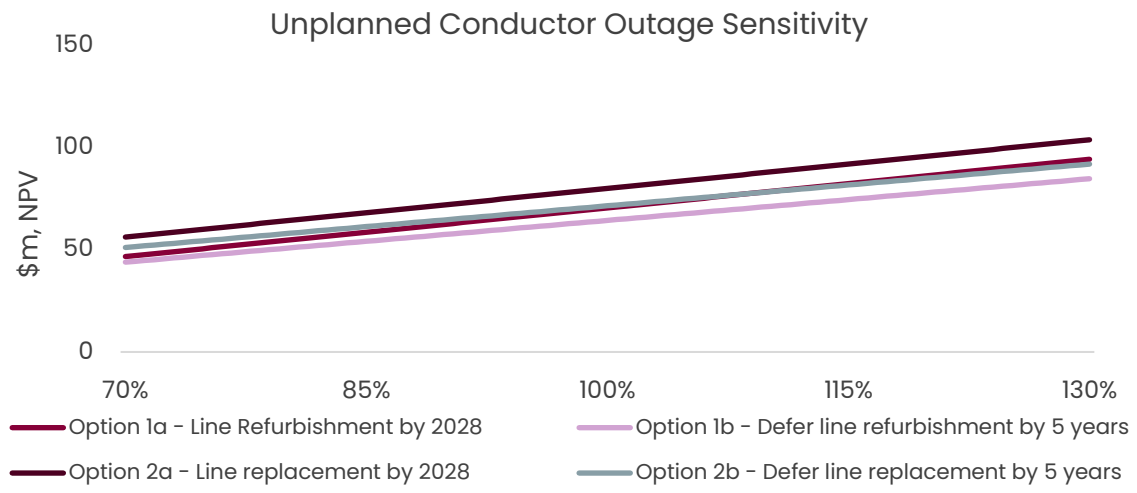
market benefit of line replacement option is found to be strongly positive and significantly higher than the conductor replacement option or the delay options.

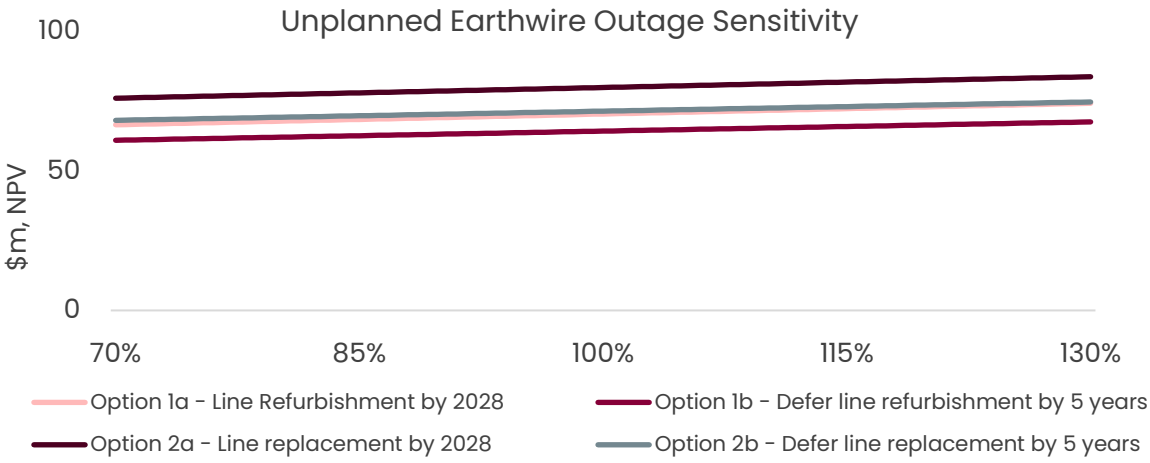
We do not consider that any of these threshold values can be reasonably expected and, thus, considers that the expected net market benefits have been demonstrated to be robust to a range of alternate input assumptions.

Figure 4 - Sensitivity testing of the NPV of net market benefits









For details about the economic modelling and process we followed, please refer to the following appendices:

- Appendix A defines the terms used in the economic assessment,
- **Error! Reference source not found.** provides the process that we followed,
- Appendix C the assumptions underpinning the identified need,
- Appendix D the materiality of market benefits, and
- Appendix E the modelling methodologies used for the assessment of the options.

This information was included in the PSCR.

6 Conclusion on the preferred option

The preferred option that has been identified in this assessment for addressing the identified need is Option 2a, i.e. replacing the Hummocks to Ardrossan West 132 kV transmission line by 2028. This option is described in section 4 and is estimated to have a capital cost of $34.6 million.

Option 2a is the preferred option in accordance with NER clause 5.16.1(b) because it is the credible option that maximises the net present value of the net economic benefit to all those who produce, consume and transport electricity in the market. In addition, Option 2a ensures ongoing compliance with a range of obligations under the NER.

We consider that the analysis undertaken and the identification of Option 2a as the preferred option satisfies the RIT-T.

The Compliance Checklist in Appendix F demonstrates that the PACR complies with section 5.16.4(v) of the NER.

We intend to commence work on replacing the Hummocks to Ardrossan West 132 kV transmission line by 2025 and to have the line replaced by 2028.

Appendix A Definitions

This appendix defines the terms used in the economic assessment.

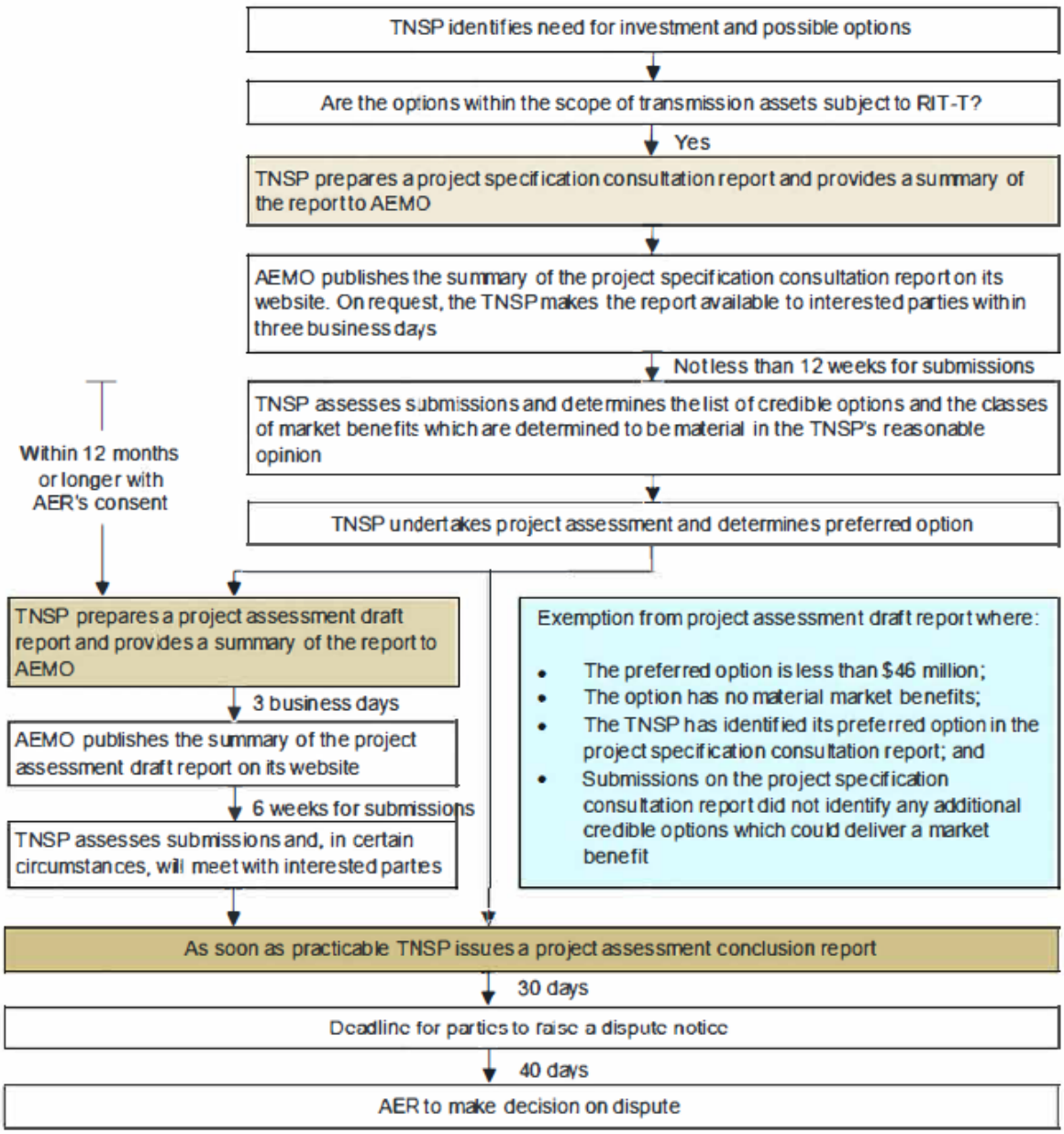
Definitions	
AEMO	Australian Energy Market Operator
Base case	A situation in which no option is implemented by, or on behalf of the transmission network service provider.
Commercially feasible	An option is commercially feasible if a reasonable and objective operator, acting rationally in accordance with the requirements of the RIT-T, would be prepared to develop or provide the option in isolation of any substitute options. This is taken to be synonymous with 'economically feasible'.
Costs	Costs are the present value of the direct costs of a credible option.
Credible option	A credible option is an option (or group of options) that: a) address the identified need; b) is (or are) commercially and technically feasible; and c) can be implemented in sufficient time to meet the identified need.
Economically feasible	An option is likely to be economically feasible where its estimated costs are comparable to other credible options which address the identified need. One important exception to this Rules guidance applies where it is expected that a credible option or options are likely to deliver materially higher market benefits. In these circumstances the option may be "economically feasible" despite the higher expected cost. This is taken to be synonymous with 'commercially feasible'.
Identified need	The reason why the Transmission Network Service Provider proposes that a particular investment be undertaken in respect of its transmission network.

Definitions	
Market benefit	Market benefit must be: a) the present value of the benefits of a credible option calculated by: i) comparing, for each relevant reasonable scenario: a) the state of the world with the credible option in place to b) the state of the world in the base case, And ii) weighting the benefits derived in sub-paragraph (i) by the probability of each relevant reasonable scenario occurring. b) a benefit to those who consume, produce and transport electricity in the market, that is, the change in producer plus consumer surplus.
Net market benefit	Net market benefit equals the market benefit less costs.
Preferred option	The preferred option is the credible option that maximises the net economic benefit to all those who produce, consume and transport electricity in the market compared to all other credible options. Where the identified need is for reliability corrective action, a preferred option may have a negative net economic benefit (that is, a net economic cost).
Reasonable Scenario	Reasonable scenario means a set of variables or parameters that are not expected to change across each of the credible options or the base case.
Technically feasible	An option is technically feasible if there is a high likelihood that it will, if developed, provide the services that the RIT-T proponent has claimed it could provide for the purposes of the RIT-T assessment.

Appendix B Process for implementing the RIT-T

For the purposes of applying the RIT-T, the NER establishes a typically three stage process, i.e.: (1) the PSCR; (2) the PADR; and (3) the PACR. This process is summarised in the figure below (in gold), as well as the criteria for PADR exemption that this RIT-T is seeking to apply (in blue).

Figure 5 - The RIT-T assessment and consultation process



Appendix C Assumptions underpinning the identified need

This appendix summarises the key assumptions that underpin the identified need for this RIT-T. Appendix E provides further details on the general modelling approaches applied, including the risk cost modelling framework.

For the purposes of this assessment, the impact of the failures considered in the cost risk model for the conductor and conductor hardware failures focuses on four failure modes, being:

- asset failure - Cost of repair for an unplanned failure triggering an emergency response;
- service interruption – Impact of loss of supply to customers in event of a conductor or conductor hardware failure that causes a line outage;
- public Injury – Risk of injury to the public in the event conductor and earthwire drop; and
- bushfire/ environmental – risk of bushfire(s) and potential environmental and capital damage.

Each failure mode has different characteristics and consequential likelihoods of occurring, as detailed in the sections below.

C.1 The probability of failure

This project is driven by risks and probability of failure is associated with two major asset classes; conductor asset class and insulator asset class.

Conductor Asset Class

The operation of a transmission line with a conductor with a reduced cross-sectional area caused by corrosion and broken strands leads to overheating. This overheating anneals and reduces the tensile strength of the aluminium and steel strands of the conductor until it fails.

The analysis presented here is based on asset condition assessment of the conductor on the Hummock to Ardrossan West 132 kV transmission line.

The modelled benefit of the project is that it will prevent future failures that would otherwise occur. The rate at which these failures are expected to occur in the base case is estimated based on the rate at which minor defects deteriorate to become more serious defects and the probability that, when this happens, the conductor will require urgent repair, resulting in an unplanned outages and potential conductor drop.

The rate at which this deterioration is projected to occur was modelled in the same way as in the previous Eyre Peninsula RIT-T. This was applied to the number of

defects that had been identified when the project was first analysed to produce a conservative estimate of the expected number of failures in the base case.

The probability of failure curve, is shown below as Figure 4, relating to unplanned outages and Figure 5, relating to conductor drops.

Figure 6 - Probability of Failure for an Unplanned Outage

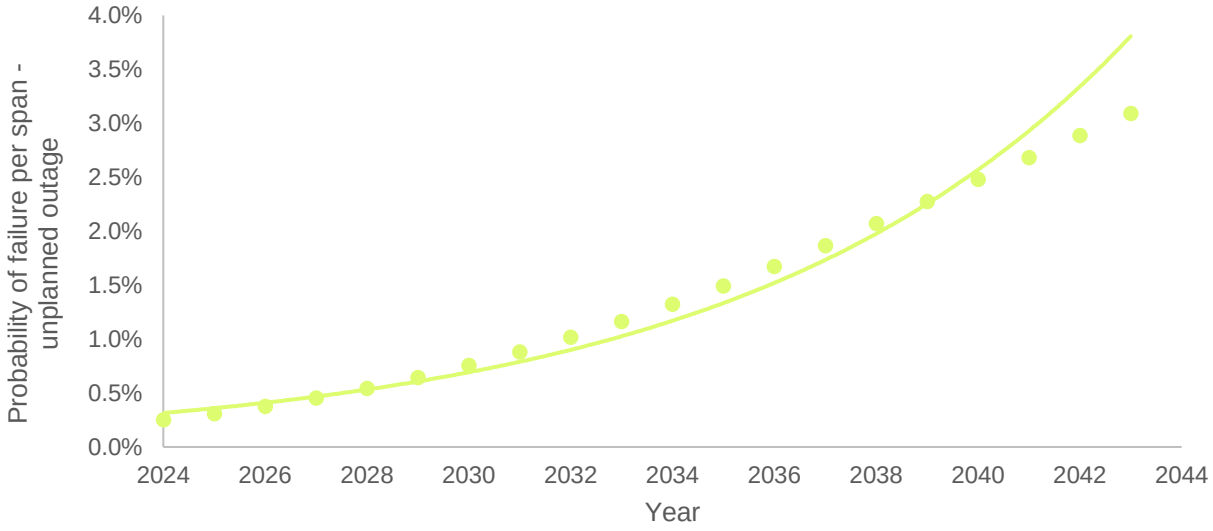
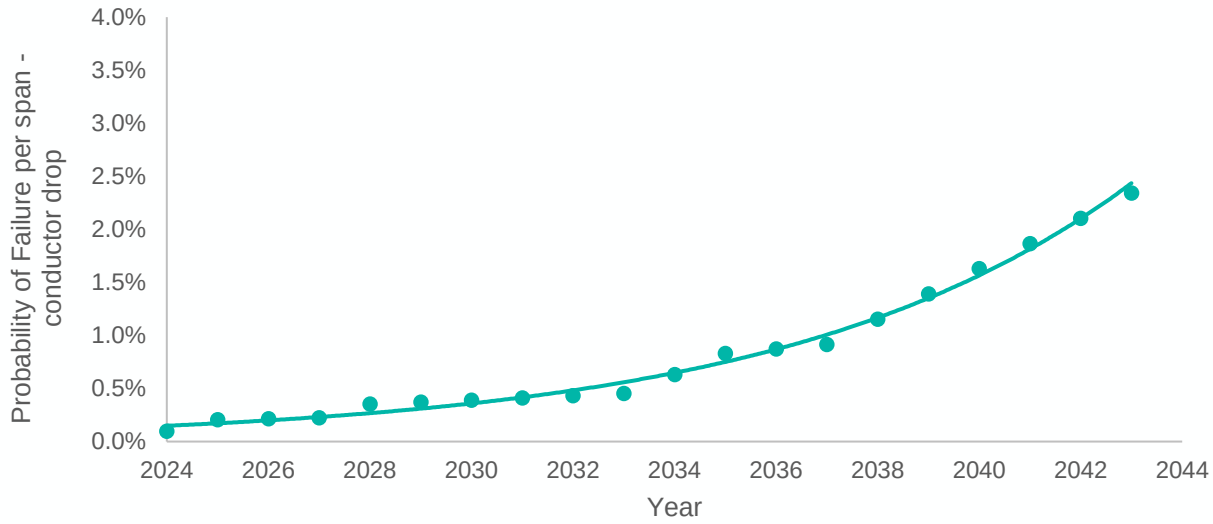


Figure 7 - Probability of failure for Conductor Drop



Insulator Asset Class

Insulators are a major component of the conductor hardware support systems. The insulators on this transmission line have internal failure modes of porcelain cap-and-pin discs that cannot be visually identified. Only live-line non-destructive testing of individual discs can verify the internal electrical integrity

(failure mode) that can result in separation of the insulator cap from the pin, a catastrophic failure.

We have conducted a porcelain disc voltage-drop testing program on the insulators across the network that has determined a statistically valid failure rate, via sample-based testing, and has identified an unacceptable risk of failure profile for dropping conductor to ground and potential fire-start event at strain and vertical flying angle locations on this transmission line. A full cyclic testing and corrective replacement program is cost prohibitive and does not materially reduce the risk of failure.

Due to the unpredictable P-F interval and the scale of the asset base, the line insulation systems which are at end of life are to be replaced by toughened glass cap and pin disc insulators that do not have the same failure mode or risk of dropping the conductor. Reliability centre maintenance analysis on disc insulators (porcelain) has confirmed the failure mode risk can only be successfully managed by redesign (replacement with an insulator that does not pose the same failure mode, i.e., glass disc insulation).

C.2 The consequences of failure

The consequences of F1803 Hummocks – Ardrossan West 132 kV transmission line conductor and conductor hardware failure are:

- unserved energy to electricity customers while a failed line conductor and hardware is repaired or replaced;
- higher corrective maintenance costs associated with having to repair transmission line conductor and conductor hardware in an unplanned fashion; and
- potential fire start and risk to public safety.

C.3 The likelihood and cost of line insulation system failure

Our risk cost model analyses the consequences of failure identified above. It estimates the 'likelihood of consequence' (LoC) and 'cost of consequence' (CoC) of line conductor and conductor hardware failures.

Outage duration is based on the typical time to repair the conductor and its hardware following a failure.

Outage cost is based on the Australian Energy Regulator's (AER) estimated Value of Customer Reliability (VCR) which is expressed in dollars per kilowatt-hour (kWh) and reflect the value different customer types place on reliable electricity supply. All loads are based on a representative load trace taken from 2019-20 escalated to 2023 dollars based on the Consumer Price Index for that year.

The following adverse effects have not been captured in our risk cost modelling but are expected to further increase the net market benefits associated with Option 2a.

These include:

- loss of network support from BESS at Dalrymple; and
- loss of embedded renewable generation from Wattle Point Windfarm.

Section 5 demonstrates these additional benefits would not change the preferred option and so they are not considered material in the context of this RIT-T.

Appendix D Materiality of market benefits for this RIT-T assessment

This appendix outlines the categories of market benefits prescribed in the NER and whether they are considered material for this RIT-T.

The bulk of the benefits associated with the preferred option are captured in the expected costs avoided by the option (i.e., the avoided expected costs compared to the base case). These include avoided risk costs as described above.

Of these avoided costs only unserved energy due to involuntary load shedding is considered a market benefit category under the NER.

D.1 Avoided involuntary load shedding is the only relevant market benefit

The only relevant market benefit for this RIT-T relates to changes in involuntary load shedding. The expected unserved energy under the base case, which is avoided under the preferred option, has been estimated as part of our risk cost modelling.

D.2 Market benefits relating to the wholesale market are not material

The AER has recognised that a number of classes of market benefits will not be material in a RIT-T assessment if the credible options considered will not have an impact on the wholesale market. In this case the impacts do not need to be estimated.[13]

The preferred option would not affect network constraints between competing generating centres so it would not change dispatch outcomes or wholesale market prices.

Therefore, we consider the following classes of market benefits to be immaterial for this RIT-T assessment:

- changes in fuel consumption arising through different patterns of generation dispatch;
- changes in voluntary load curtailment (since there is no impact on pool price);

[13] AER, *Regulatory Investment Test for Transmission Application Guidelines*, August 2020, p. 29.

- changes in costs for parties, other than for ElectraNet (since there will be no deferral of generation investment);
- changes in ancillary services costs;
- competition benefits; and
- Renewable Energy Target (RET) penalties.

D.3 Other classes of market benefits are not expected to be material

In addition to the classes of market benefits listed above, NER clause 5.16.1(c)(4) requires us to consider the following classes of market benefits in relation to each credible option:

- differences in the timing of transmission investment;
- option value; and
- changes in network losses.

We consider that none of these are material for this RIT-T assessment for the reasons set out in Table 5.

Table 5 - Reasons why non-wholesale market benefit categories are considered immaterial.

Market benefit category	Reason(s) why it is considered immaterial
Differences in the timing of transmission investment	The preferred option does not affect the timing of other unrelated transmission investments (i.e., transmission investments based on a need that falls outside the scope of that described in section 2). Consequently, the market benefits associated with differences in the timing of unrelated transmission investment are not material to the RIT-T assessment.

Market benefit category	Reason(s) why it is considered immaterial
Option value	The AER has stated that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change and the credible options considered by the TNSP are sufficiently flexible to respond to that change.[14] None of these conditions apply to the present assessment. The AER has also stated the view that appropriate identification of credible options and reasonable scenarios captures any option value, thereby meeting the NER requirement to consider option value as a class of market benefit under the RIT-T. Changes in future demand levels are not relevant for this RIT-T since the need for and timing of the required investment is being driven by asset condition rather than future demand growth. As a result, it is not relevant to consider different future demand scenarios in undertaking the RIT-T analysis.
Changes in network losses	Given the preferred option maintains the current network capacity at the same location, there are not expected to be any differences in network losses.

[14] AER, *Regulatory Investment Test for Transmission Application Guidelines*, August 2020, p. 52.

Appendix E Description of the modelling methodologies applied

This appendix outlines the methodologies and assumptions we have applied to undertake this RIT-T assessment.

E.1 Overview of the risk cost modelling analysis

We have applied an asset 'risk cost' evaluation framework to quantify the risk cost reduction associated with replacing the identified line insulation systems.

The 'risk cost reduction' has been calculated as the product of:

- Probability of Failure, which is the probability of a failure occurring based on asset failure history information and industry data;
- Likelihood of Consequence, which is the likelihood of an adverse consequence of the failure event based on historical information and statistical factors; and
- Cost of Consequence, which is the estimated cost of the adverse consequence.

These three variables allow the expected risk cost reduction benefit to be quantified and an assessment against the cost of the project to be undertaken. The risk cost reduction benefit is the difference between risk costs incurred under the base case and the preferred option.

The approach we apply to quantifying risk was presented as part of our Revenue Proposal for the 2024-2028 regulatory control period. In its Draft Decision on that proposal, the AER found it to be consistent with good industry practice and to generally reflect reasonable inputs and assumptions.[15]

More detail on the key inputs and assumptions made for individual asset risk cost evaluations can be found in ElectraNet's asset risk cost modelling guideline.[16]

E.2 The discount rate and assessment period

The RIT-T analysis has been undertaken over a 20-year period from 2024 to 2043. This considers the size, complexity and expected life of each option to provide a reasonable indication of its cost.

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[15] AER, *ElectraNet transmission determination 2023 to 2028*, Draft Decision, Attachment 5 – Capital expenditure, September 2022

[16] Available at https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/electranet-determination-2018-23/proposal#step-50979.

The asset life of a line insulation system is more than 20 years. We have taken a terminal value approach to incorporating capital costs in the assessment, which ensures that the capital cost of each option is appropriately captured in the 20-year assessment period.

We have adopted a real, pre-tax discount rate of 7.0 percent as the central assumption for the analysis presented in this report, consistent with AEMO's most recent Inputs, Assumptions and Scenarios Report.[17] We consider that this is a reasonable contemporary approximation of a 'commercial' discount rate (a different concept to a regulatory WACC), consistent with the RIT-T.

The RIT-T requires that sensitivity testing be conducted on the discount rate and that the discount rate scenarios from AEMO's ISP Inputs Assumptions and Scenarios Report should be applied.[18]

[17] AEMO, Inputs, Assumptions and Scenarios Report, July 2023, p. 123.

[18] AER, *Regulatory Investment Test for Transmission*, August 2020 p. 6.

Appendix F Compliance Checklist

This appendix sets out a compliance checklist which demonstrates the compliance of this PACR with the requirements of clause 5.16.4(v) of the NER version 217.

Rules clause	Summary of requirements	Relevant section(s) in PACR
5.16.4(v)	The project assessment conclusions report must set out:	-
	(1) the matters detailed in the project assessment draft report as required under paragraph (k): and	See below
	(2) a summary of, and the RIT-T proponent's response to, submissions received, if any, from interested parties sought under paragraph (q)	3
5.16.4(k)	The project assessment draft report must include:	-
	(1) a description of each credible option assessed;	4
	(2) a summary of, and commentary on, the submissions to the project specification consultation report;	NA
	(3) a quantification of the costs, including a breakdown of operating and capital expenditure, and classes of material market benefit for each credible option;	4,5, Appendix D & Appendix E
	(4) a detailed description of the methodologies used in quantifying each class of material market benefit and cost;	Appendix D
	(5) reasons why the RIT-T proponent has determined that a class or classes of market benefit are not material;	Appendix D
	(6) the identification of any class of market benefit estimated to arise outside the region of the Transmission Network Service Provider affected by the RIT-T project, and quantification of the value of such market benefits (in aggregate across all regions);	NA
	(7) the results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results;	5
	(8) the identification of the proposed preferred option;	6

Rules clause	Summary of requirements	Relevant section(s) in PACR
	(9) for the proposed preferred option identified under subparagraph (8), the RIT-T proponent must provide: (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date; (iii) if the proposed preferred option is likely to have a *material inter-network impact* and if the *Transmission Network Service Provider* affected by the RIT-T project has received an *augmentation technical report*, that report; and (iv) a statement and the accompanying detailed analysis that the preferred option satisfies the *regulatory investment test for transmission*.	4 & 5
	(10) if each of the following apply to the RIT-T project: (i) the estimated capital cost of the proposed preferred option is greater than $100 million (as varied in accordance with a cost threshold determination); and (ii) AEMO is not the sole RIT-T proponent, the RIT reopening triggers applying to the RIT-T project.	N/A

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