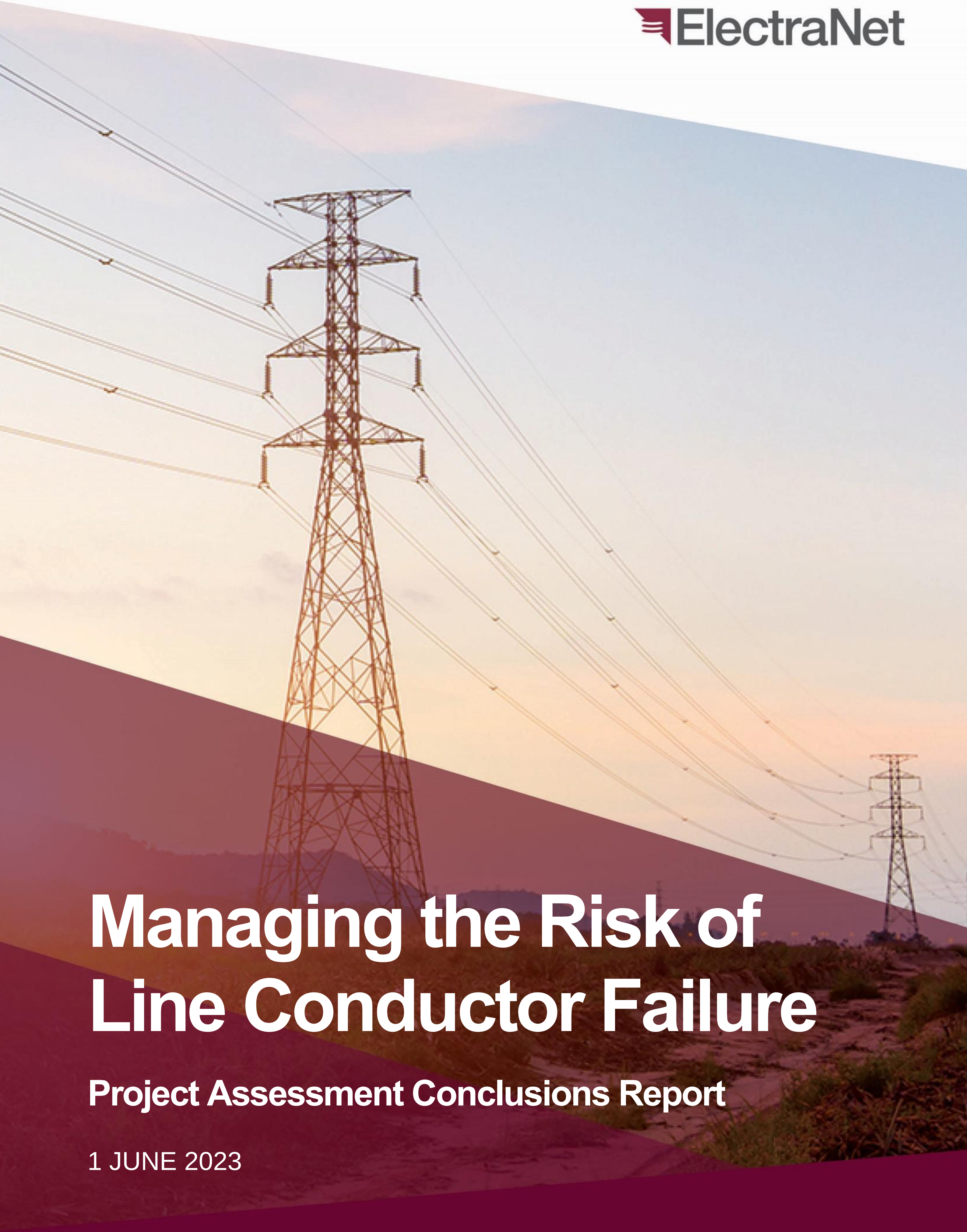


Managing the Risk of Line Conductor Failure

Project Assessment Conclusions Report

1 JUNE 2023

EXECUTIVE SUMMARY

This Project Assessment Conclusions Report is the final stage of an investigation into the most economic option to address the risk of the line conductors failing on seven 132 kV transmission lines on South Australia's transmission network in the Mid North and Riverland regions to maintain safe and efficient supply to customers.

Line conductors are essential to the task of transmitting electricity. Without them, no power can be transmitted between generators and customers. The line conductors in question are in poor condition and pose a risk to public safety and continuity of customer supply.

The initial report was released in November 2022 identifying a proposed solution

The Project Specification Consultation Report (PSCR) for this project was published on 1 November 2022. It outlined that there is only one technically and economically feasible option, which is to replace the line conductors on seven 132 kV transmission lines that are in poor condition and have reached the end of their useful lives, at a capital cost of approximately $25.6 million. This option also allows us to continue to meet the reliability standards of the Electricity Transmission Code at the relevant connection points on the network.

Other options considered include the full replacement of the seven transmission lines at a capital cost of $57.7 million, which is significantly more costly than the proposed solution without providing any additional benefits and is therefore economically infeasible. Another conceivable option was to abandon the transmission line and use generation support, which is a non-network option. Local generation support would be required at each of the four SA Water pump stations to enable the retirement of the transmission lines in question. While this may provide the electricity supply for the individual pump stations it would be substantially more expensive than replacing the conductors on the lines in question.

The PSCR assessed different timings of the line conductor replacement option and found the estimated net market benefits to be robust and that the preferred option should be undertaken as soon as possible.

The PSCR also explained why network support solutions cannot credibly meet the identified need for this RIT-T, which is to manage the risk of failure of line conductors on seven transmission lines efficiently.

No submissions were received on the PSCR.

This PACR maintains the initial conclusion that replacing the identified line conductor on the seven 132 kV transmission lines within the 2024-2028 regulatory period is the preferred option[1].

The preferred option that has been identified is Option 1, which is to replace the line conductors on the seven 132 kV transmission lines between 2023 and 2026. The estimated capital cost of this replacement is $25.6m.

We have undertaken a thorough sensitivity testing exercise to investigate the robustness of the RIT-T assessment to underlying assumptions about each of the key variables. For all sensitivity tests undertaken, the preferred option remains replacing the line conductors by the end of 2026.

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

Next steps

ElectraNet intends to commence work on replacing the line conductors in 2023 and to have all conductors replaced by the end of 2026.

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

Contents

ElectraNet
electranet.com.au

Tables

Figures

Appendices

Glossary

AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CBL	Conductor Breaking Load
ESCOSA	Essential Services Commission of South Australia
ETC	Electricity Transmission Code
NPV	Net Present Value
NEM	National Electricity Market
NER, Rules	National Electricity Rules
PACR	Project Assessment Conclusions Report
PADR	Project Assessment Draft Report
PSCR	Project Specification Consultation Report
PV	Present Value
RET	Renewable Energy Target
RIT-T	Regulatory Investment Test for Transmission
TNSP	Transmission Network Service Provider
USE	Unserved Energy
VCR	Value of Customer Reliability

1. Introduction

This Project Assessment Conclusions Report (PACR) represents the final step in the application of the Regulatory Investment Test for Transmission (RIT-T) to address the risk of line conductor failure on seven 132 kV transmission lines located in the Mid North and Riverland regions of the South Australian transmission network.

A Project Specification Consultation Report (PSCR) was released on 1 November 2022 that described the identified need we are seeking to address, set out the technical characteristics that a network support option would be required to deliver and outlined the credible option we consider addresses the identified need.

The PSCR also set out an economic assessment, along with a draft conclusion on the preferred option, as well as how ElectraNet was intending to apply the NER exemption from preparing a Project Assessment Draft Report (PADR) for this RIT-T.

No submissions were received on the PSCR.

Appendix A defines the terms used in the economic assessment and Appendix B provides the process that we followed.

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 the cost of at least one credible option exceeds $7 million.[2]

Accordingly, we have applied the RIT-T to the proposed replacement of transmission line conductors.

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.

1.2. Next steps

ElectraNet intends to commence work on replacing the line conductors on the seven 132 kV transmission lines in 2023 and to have all conductors replaced by the end of 2026.

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

[2] NER clause 5.15A.1(c) states that the purpose of the RIT–T is to: identify the credible option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity in the market (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 or the provision of system strength services required under clause 5.20C.3.

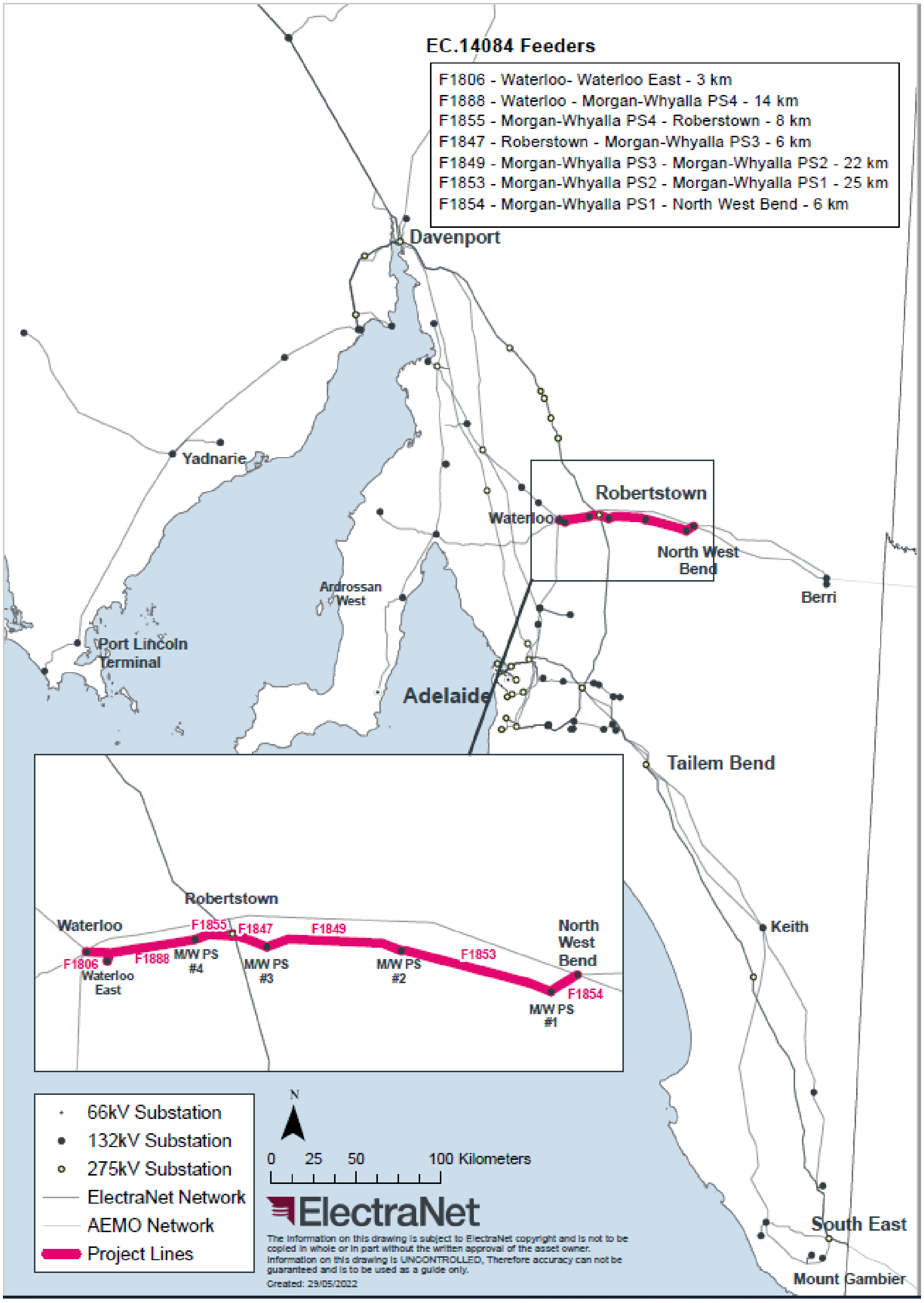
2. The identified need for this RIT-T is to ensure reliable and safe supply of electricity to South Australia

This section outlines the identified need for the RIT-T as well as the assumptions underpinning it. It first provides some background on the identified transmission lines and their role in the wider transmission of electricity in South Australia.

2.1. Background to the identified need

The seven 132 kV transmission lines identified as requiring conductor replacement are located in the Mid North and Riverland regions of South Australia (refer Figure 1).

Figure 1 - Location of the line conductors identified for replacement



The primary role of the line conductors on these transmission lines is to provide electricity to power four SA Water Morgan - Whyalla pump stations that supply water to the local communities and to the cities of Port Pirie, Port Augusta, and Whyalla, located in the upper Mid North and Eyre regions in South Australia. Their secondary role is to provide N-1 line capacity to the North West Bend substation[3] that is a Category 4 connection point under the Electricity Transmission Code (ETC).

The seven transmission lines and line conductor lengths are:

- F1806: Waterloo - Waterloo East - 3 km[4]
- F1888: Waterloo East - Morgan Whyalla PS4 - 14 km
- F1855: Morgan Whyalla PS4 - Robertstown - 8 km
- F1847: Robertstown - Morgan Whyalla PS3 - 6 km
- F1849: Morgan Whyalla PS3 - Morgan Whyalla PS2 - 22 km
- F1853: Morgan Whyalla PS2 - Morgan Whyalla PS1 - 25 km
- F1854: Morgan Whyalla PS1 - North West Bend - 6 km

Detailed condition assessments completed on the above transmission lines indicate that their line conductors have severe fretting and an excessive number of broken strands (refer Figure 2). This indicates that these conductors are at end of life and are at increasing risk of failure.

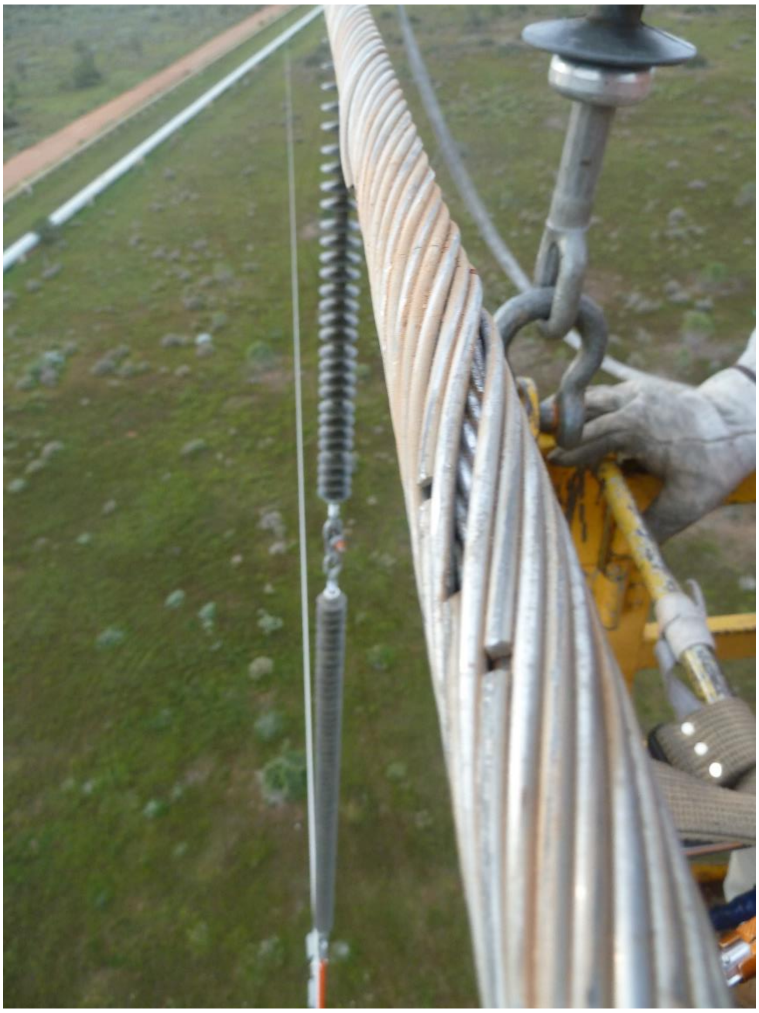
It is good industry practice to replace the conductor when the remaining tension capacity is less than 80% of its designed capacity (known as Conductor Breaking Load or CBL). All test samples from the above line conductors show remaining tensile strength in a range of 66% to 77% of its CBL.

---

3 ESCOSA ETC TC/09.4 24 June 2021, section 2.4 assigns North West Bend Substation as a Category 4 Exit Point, (section 2.8) requiring ElectraNet to provide “N-1” equivalent line capacity for at least 100 percent of the agreed maximum demand.

4 Excludes built section 1252 on transmission lines F1806 and F1888 as this built section is classified as a negotiated asset

Figure 2 - Transmission Line Conductor showing damaged strands



The line conductors identified for replacement were all commissioned in 1968 with a design life[5] of 50 years.

If the line conductors in question are not replaced, it is increasingly likely that several will fail with the following three possible consequences:

- loss of supply to one or more of the four SA Water Morgan - Whyalla pump stations, potentially affecting SA Water's ability to supply water to the upper Mid North and Eyre Peninsula regions of South Australia.
- incurring the higher cost of repairing the transmission line on failure in a reactive fashion
- risk of fire starts from dropped line conductors, with consequent impact on public safety.

[5] The AER considers that repex involves replacing an asset or asset component with its modern equivalent where the asset has reached the end of its *economic life*. This considers the age, condition, technology and operating environment of an existing asset. We present here the technical/ design lives of transmission conductors for context. We note that the assessment of replacing the identified assets, both in the Revenue Proposal and this RIT-T, is consistent with the concept of economic life, i.e., the expenditure decision is primarily based on the existing asset's inability to efficiently maintain its service performance requirement.

2.2. Description of the identified need for this RIT-T

As set out in the PSCR, the identified need for this project is to manage the risk of failure of line conductors on seven transmission lines efficiently.

We have assessed the condition and required timing for the replacement of line conductors as part of our ongoing asset management processes. There is an increasing likelihood that several of these line conductors will fail in coming years given their current condition. Failure could result in unplanned customer outages and the risk of fire start.

We have classified this RIT-T as a 'market benefits' driven RIT-T as the economic assessment is not being progressed specifically to meet a mandatory reliability standard, but rather to deliver net benefits to customers.

Nevertheless, 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."[6]

Further, the Regulations specify, "a system of maintenance must be instituted for aerial lines, their structures, and their components, including…managed replacement programs for components approaching the end of their serviceable life. Maintenance programs must be carried out in accordance with the listed standards."[7]

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

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

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

3. Potential credible options to address the identified need

There is only one economically feasible option, which is to replace the identified sections of line conductor.

We have however investigated different timings for this work to determine the optimal timing. This assessment is presented in section 4.5.

The option is technically and economically feasible and able to be implemented in sufficient time to meet the identified need.

Option 1 – Planned replacement of transmission line conductors by 2028 – involves replacing the line conductors and associated hardware on the seven transmission lines identified in section 2.1.

Replacing these line conductors and associated hardware is planned to occur between 2023 and 2026. Significant landholder engagement will be required to manage easement access and avoid periods of cropping and other seasonal agricultural activities.

The estimated capital cost of this option is approximately $25.6 million.

There is no change in routine maintenance when the assets are replaced under Option 1 compared to the base case.

The estimated construction time is approximately three years. We estimate that all line conductors could be replaced and commissioned by the end of 2026 under this option.

3.1. Options considered but not progressed

We have also considered other credible options that could meet the identified need.

Total line replacement

One conceivable option would be to replace the entire transmission lines, as opposed to just the line conductor. However, the capital cost of this is expected to be in the order of $57.7m and would require an expansion of the existing easements to enable the new lines to be constructed before the old lines are decommissioned. This would be significantly more costly than the option outlined above with no additional benefits.

In addition, the condition of other transmission line components is such that they do not require replacing based on their asset condition. Replacing the line conductors is expected to extend the overall life of the transmission lines by 35 years, increasing the utilisation of the other components of the lines in question.

For these two reasons replacing the lines in question entirely is not economically feasible.

Abandon transmission line and use generation support

Another conceivable option, which is a non-network option, would be to consider local generation support at each of the four SA Water pump stations and retire the transmission lines in question.

While this may provide the electricity supply for the individual pump stations it would be substantially more expensive than replacing the conductors on the lines in question. The non-network solution at North West Bend would need to cater for the full range of the demand including maximum positive and maximum negative demand (from onsite solar PV output).

4. Assessment of the credible options

This section outlines the assessment we have undertaken of the credible network option. The assessment compares the option against a base case 'do nothing' option.

For completeness, this section repeats the underlying assessment in the PSCR. There have been no changes made since the publication of the PSCR that would affect the finding that Option 1 is preferred.

Appendix C, Appendix D and Appendix E provide details about the assumptions underpinning the identified need, the materiality of market benefits and the modelling methodologies used for the assessment of the options in this RIT-T. This information was included in the PSCR and there have been no changes made since its publication.

4.1. 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.

In a market benefit driven RIT-T such as this, the choice of reasonable scenarios must reflect any variables or parameters that are likely to affect the ranking of the credible options, or whether the net economic benefit of any of the credible options is positive or negative.[8]

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 – 25% - low benefits scenario, 50% - central benefits scenario, and 25% - high benefits scenario.[9]

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
Commercial discount rate[10]	7.5%	5.5%	2.0%
Risk cost of unplanned conductor outage	70 per cent of base case estimates	Base case estimates	130 per cent of base case estimates
Risk cost of conductor drop	70 per cent of base case estimates	Base case estimates	130 per cent of base case estimates

8 AER, *Regulatory Investment Test for Transmission*, August 2020, version 1, paragraph 16, p. 7.

9 In accordance with paragraph 4(a) of the RIT-T.

10 Expressed on a real, pre-tax basis

4.2. Gross benefits for each credible option

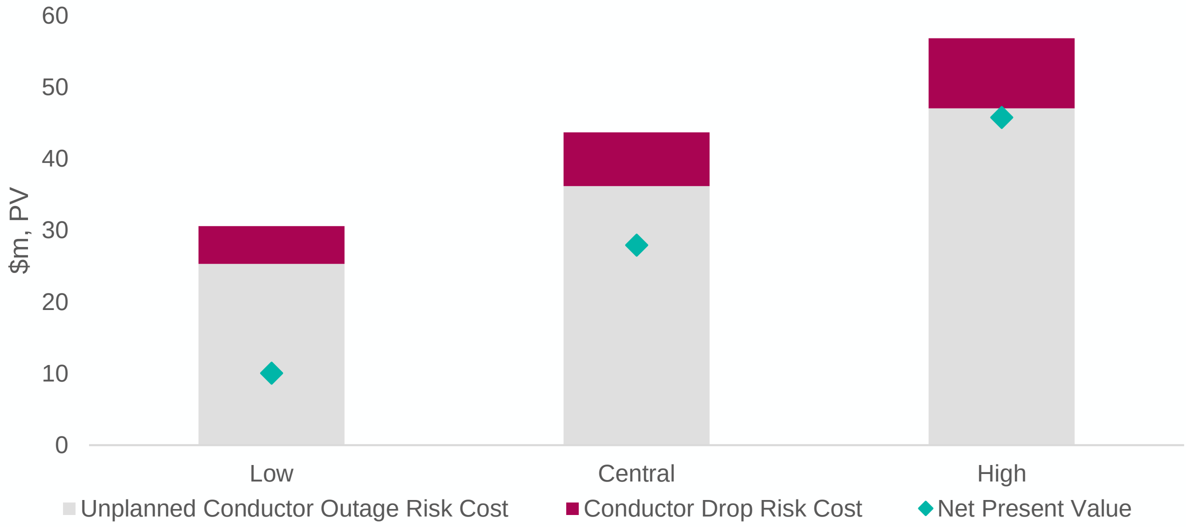
Table 2 summarises the gross benefit estimated for the preferred option (Option 1) relative to the 'do nothing' base case in present value terms. The gross market benefit has been calculated for each of the three scenarios outlined in Table 2.

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

Option	Low benefits scenario	Central scenario	High benefits scenario
Option 1 – Planned replacement of line conductors by 2028	30.6	43.7	56.8

Figure 3 below provides a breakdown of benefits. It shows that the benefits are derived from the avoided risk of line conductor failure and the reduced time taken to resolve such failures.

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



4.3. Estimated costs for each credible option

Table 3 summarises the capital costs of the preferred option, relative to the base case, 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 1 – Planned replacement of line conductors by 2028	-20.6	-15.8	-11.1

4.4. Net present value assessment outcomes

Table 4 summarises the net market benefit for Option 1 across the three scenarios, as well as on a weighted basis. The net market benefit is the gross benefit (as set out in section 4.2) minus the cost (as outlined in section 4.3), all expressed in present value terms.

The table demonstrates that Option 1 provides a strong expected net economic benefit on a probability-weighted basis in all scenarios.

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

Option	Low benefits scenario	Central scenario	High benefits scenario	Weighted
Option 1 – Planned replacement of line conductors by 2028	10.0	27.9	45.8	23.4

4.5. 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 tested the optimal timing of the project, and the sensitivity of this timing to key variables. 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 (all sensitivities tested are presented in Figure 4).

4.5.1. Sensitivity testing of the optimal timing for the credible option

We have estimated the optimal timing for Option 1 based on when the expected NPV is maximised. This process was undertaken for both the central set of assumptions and a range of alternative assumptions for key variables.

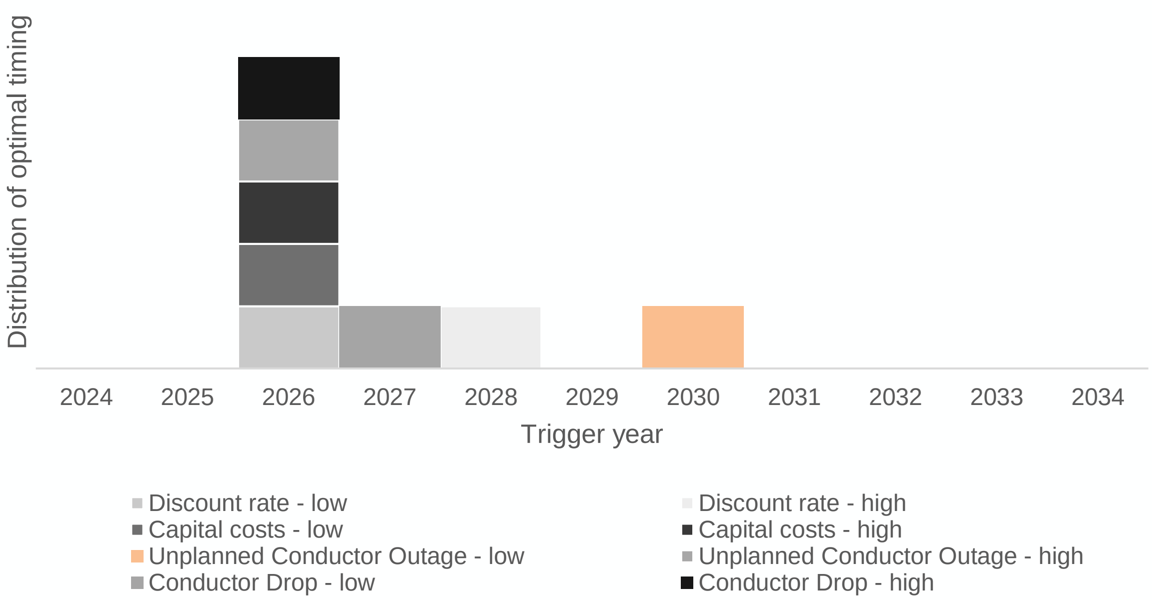
Figure 4 shows the impact on the optimal year to complete the program, under a range of alternative assumptions.

Specifically, it shows, for each sensitivity, the year that results in the highest expected net market benefits. For each sensitivity all other inputs are the same as in the central case.

The optimal completion date is found to be in the year 2026, within the 2024-2028 regulatory period. This indicates that benefits are maximised for a significant majority of the sensitivities investigated if the project is delivered within this time. The exception to this is for the 'Unplanned line conductor outage – low' sensitivity (shown in Figure 4 by the non-grey bars):

This sensitivity delays the optimal timing of the investment as it reduces the benefits that are accrued relatively early in the modelling period. However, as the large majority of sensitivities indicate that the optimal timing is to commence within the 2024-2028 regulatory period, we consider that the investment should proceed to be completed within the 2024-2028 regulatory period.

Figure 4 – Optimal timing of project under a range of different sensitivities



4.5.2. 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 four figures in Figure 5 below illustrate the estimated net market benefits for each option if the six separate key assumptions in the central scenario are varied individually. Importantly, for all sensitivity tests shown below, the estimated net market benefit of Option 1 is found to be strongly positive.

Table 5 demonstrates the 'threshold' values for each of the key assumptions, i.e., how much would each key assumption need to be changed by for Option 1 to no longer have positive net market benefits.

Figure 5 - Sensitivity testing of the NPV of net market benefits

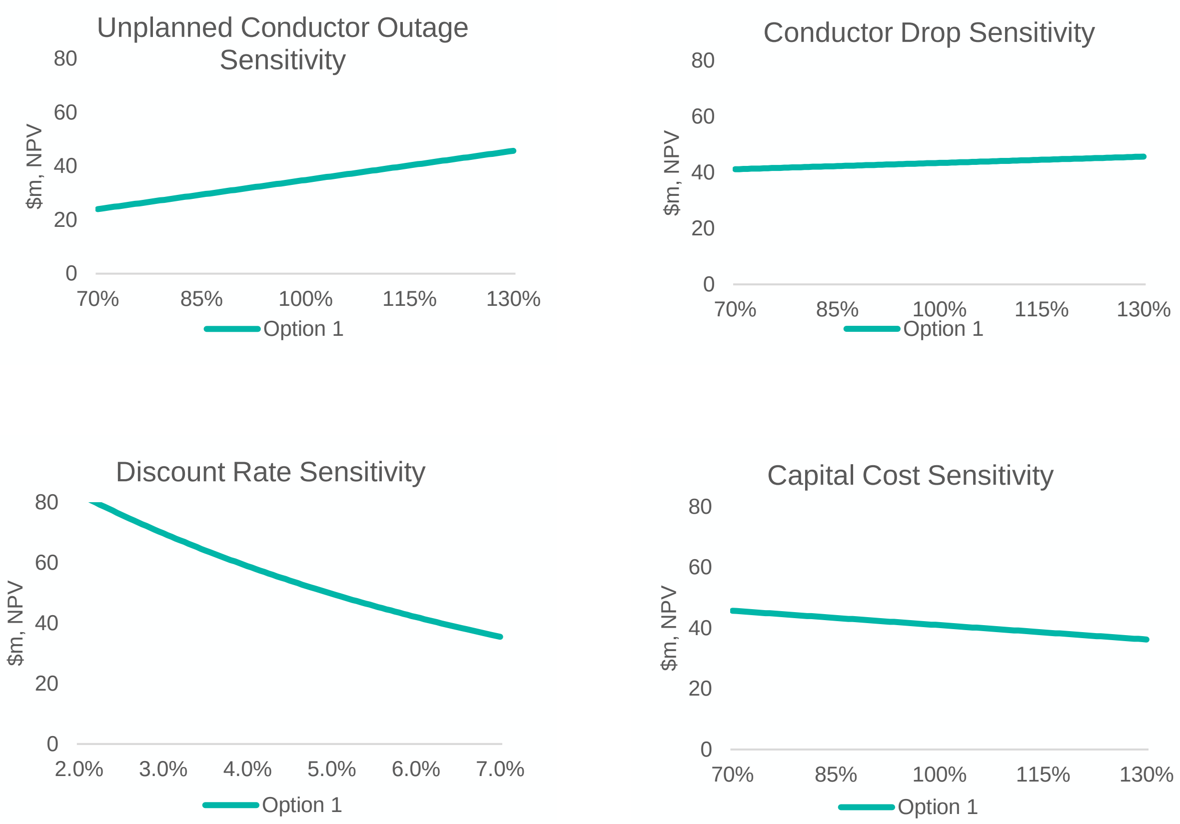


Table 5 - Threshold values for preferred option to no longer have positive net market benefits

Key variable/parameter	Threshold value
Capital cost	414% of central estimate
Discount rate	29% of rate assumed in central scenario
Unplanned Conductor Outage	-97% of central estimate
Conductor Drop	-469% of central estimate

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

While the results are most sensitive to the underlying capital costs, we consider that the amount by which costs would need to increase for there to be negative expected benefits is highly unlikely since these costs have recently been reviewed and are estimated to a higher level of accuracy than +/- 30 per cent.

5. Conclusion on the preferred option

The preferred option that has been identified in this assessment for addressing the identified need is Option 1, i.e., replacing line conductors by 2028. This option is described in section 3 and is estimated to have a capital cost of $25.6 million.

Option 1 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 1 ensures ongoing compliance with a range of obligations under the NER.

We consider that the analysis undertaken and the identification of Option 1 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 identified line conductors on the seven 132 kV transmission lines in 2023 and to have all assets replaced by the end of 2026.

City West Substation

Appendices

Appendix A Definitions

All laws, regulations, orders, licences, codes, determinations and other regulatory instruments (other than the NER) which apply to Registered Participants from time to time, including those applicable in each participating jurisdiction as listed below, to the extent that they regulate or contain terms and conditions relating to access to a network, connection to a network, the provision of network services, network service price or augmentation of a network.

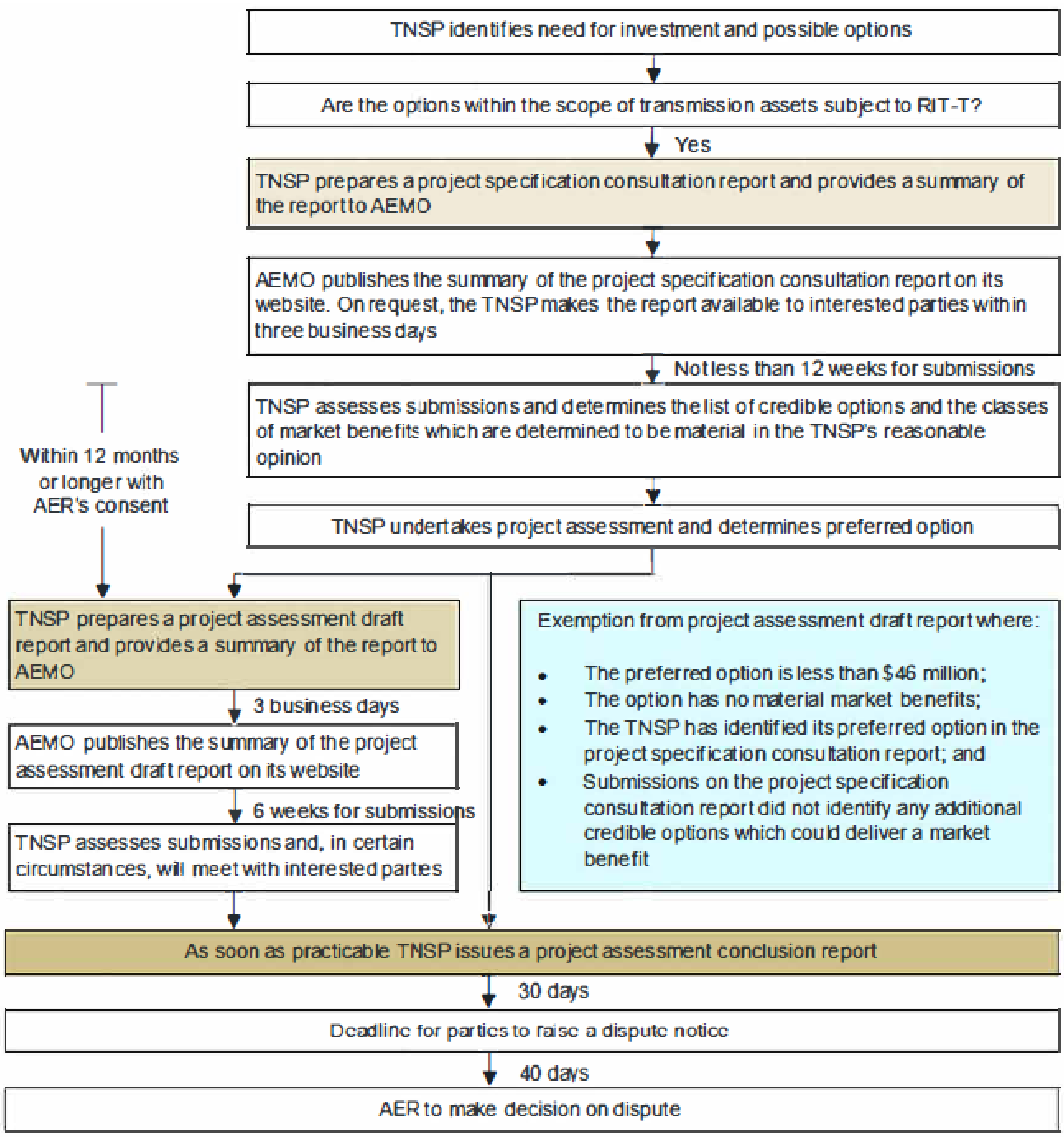
Definitions	
AEMO	Australian Energy Market Operator
Base case	A situation in which no option is implemented by, or on behalf of the transmission network service provider.
Commercially feasible	An option is commercially feasible if a reasonable and objective operator, acting rationally in accordance with 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: address the identified need; is (or are) commercially and technically feasible; and 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: the present value of the benefits of a credible option calculated by: comparing, for each relevant reasonable scenario: the state of the world with the credible option in place to the state of the world in the base case, And weighting the benefits derived in sub-paragraph (i) by the probability of each relevant reasonable scenario occurring. 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 6 - The RIT-T assessment and consultation process



electranet.com.au

Appendix C Assumptions underpinning the identified need

This appendix summarises the key assumptions from the risk cost modelling and other 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 risk cost model focuses on two modes of failure, being:

- Unplanned line conductor outage – where a high priority line conductor defect triggers an urgent unplanned response, impacting on supply, and
- Line conductor drop – where the line conductor fails and falls to the ground.

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

C.1. The probability of failure

Operation of a transmission line with a reduced cross-sectional area caused by broken strands leads to overheating. This leads to aluminium and steel strands annealing, reducing the tensile strength of the conductor until it fails.

The analysis presented here is based on asset condition assessment of the identified lines.

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, and thus an unplanned outage, and 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.[11] 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 curves, which are the same for each of the identified lines, are shown below as Figure 7, relating to unplanned outages and Figure 8, relating to conductor drops.

[11] https://www.electranet.com.au/what-we-do/network/regulatory-investment-test/

Figure 7 - Probability of Failure for an Unplanned Outage

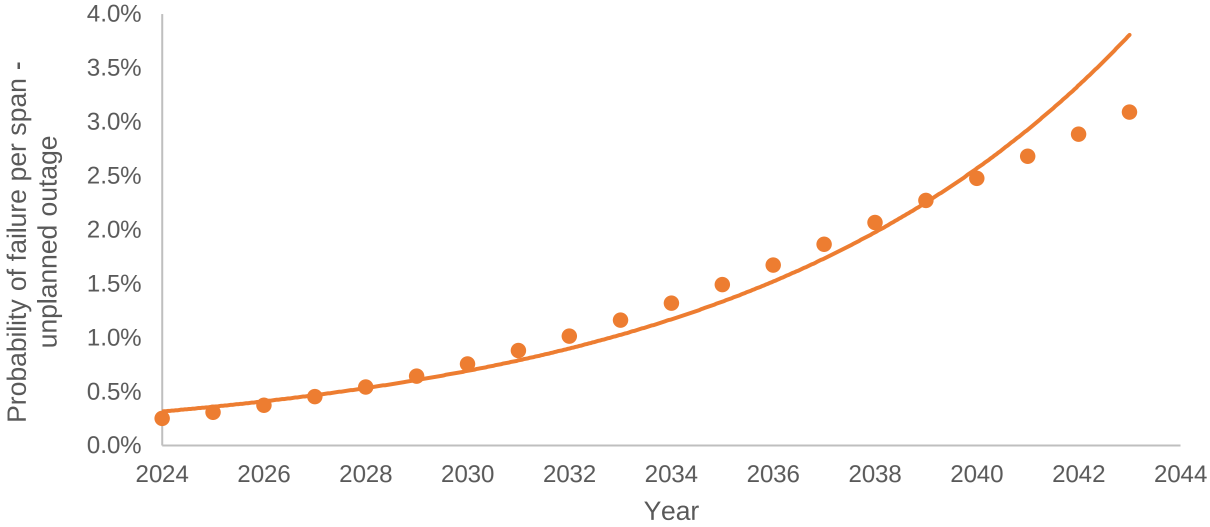
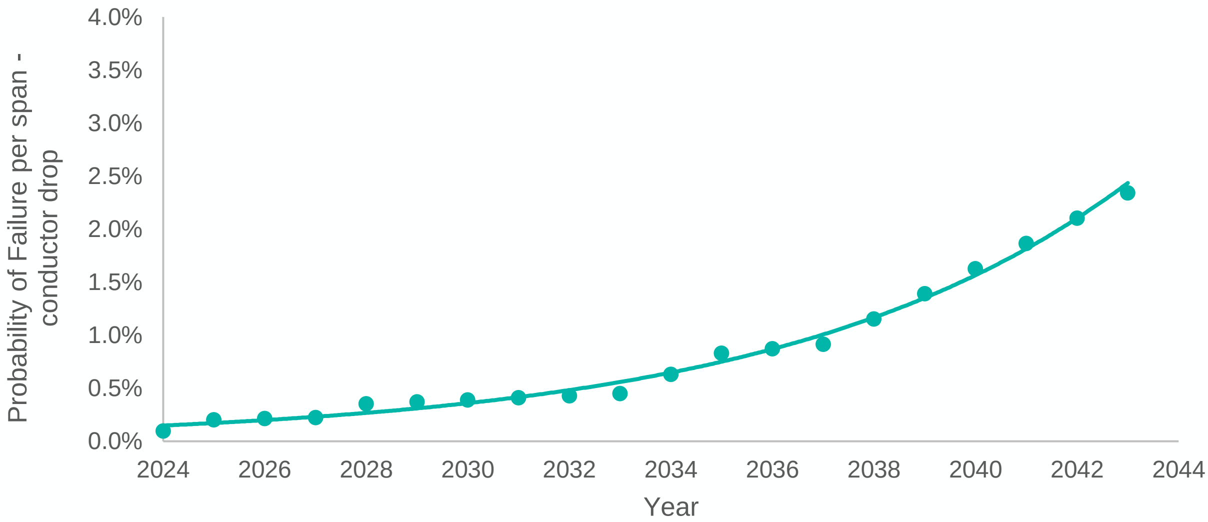


Figure 8 - Probability of failure for Conductor Drop



C.2. The adverse effects of line conductor failure

The potential consequences relating to the conductors on the seven transmission lines in question are listed in section 2.1 above. Broadly, they include:

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

ElectraNet
electranet.com.au

C.3. The likelihood and cost of line conductor failure

Our risk cost model analyses the consequences listed in Appendix C.2. It estimates the ‘likelihood of consequence’ (LoC) and ‘cost of consequence’ (CoC) of line conductor failures.

Outage duration is based on the typical time to repair a line conductor following a failure.

Outage cost is based on the Australian Energy Regulator’s (AER) estimated Value of Customer Reliability (VCR) of a mixed load for South Australia when the connection point is not directly connected to a customer. When the connection point is directly connected to a customer the VCR of a direct connect load has been applied. All loads are based on the average load from 2019-20 which is representative of current loads.

Several additional adverse effects have not been captured in our risk cost modelling but are expected to further increase the net market benefits associated with Option 1. These include:

- Loss of supply of water to customers
- Loss of generation from solar generation at SA Water sites
- A simultaneous failure of line protection when a live line conductor falls to the ground causing a fire start

Section 4 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.[12]

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 are described in section 2.

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

We consider that 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.

The benefit associated with the reduction in unserved energy is valued using VCR, expressed in $/MWh. The VCR is the AER's estimate of the value customers place on having reliable electricity supplies. The risk cost modelling has applied VCR values sourced from the AER's 2021 Value of Customer Reliability Annual Adjustment,[13] of $31,440/MWh for residential loads for South Australia, and a VCR of $10,930/MWh for SA Water pumping stations.

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.[14]

Option 1 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);
- 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.

---

[12] The NER requires that all categories of market benefit identified in relation to the RIT-T are included in the RIT-T assessment, unless the TNSP can demonstrate that a specific category (or categories) is unlikely to be material in relation to the RIT-T assessment for a specific option – NER clause 5.16.2(c)(6). Under NER clause 5.16.4(b)(6)(iii), the PSCR should set out the classes of market benefit that the RIT-T proponent considers are not likely to be material for a particular RIT-T assessment.

[13] AER, *2021 VCR Annual Adjustment*, December 2021, p. 2.

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

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 6

Table 6 - Reasons why 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.
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.[15] 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.

[15] 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 framework

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

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, the AER found it to be consistent with good industry practice and to reflect reasonable inputs and assumptions.[16]

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.

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.

We have adopted a real, pre-tax discount rate of 5.5 percent as the central assumption for the analysis presented in this report, consistent with AEMO's Inputs, Assumptions and Scenarios Report – July 2021.[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]

We have therefore tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 2.0 percent, and an upper bound discount rate of 7.5 percent.[19]

---

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

17 AER, *Regulatory Investment Test for Transmission*, August 2020 p. 6 and AEMO*, Inputs, Assumptions and Scenarios Report*, July 2021, p. 104.

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

19 AEMO*, Inputs, Assumptions and Scenarios Report*, July 2021, p. 104.

ElectraNet
electranet.com.au

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 199.

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)	NA
5.16.4(k)	The project assessment draft report must include:	-
	(1) a description of each credible option assessed;	3
	(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;	3, 4, 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;	4
	(8) the identification of the proposed preferred option;	5
	(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*.	3 & 5

ElectraNet
electranet.com.au

ElectraNet