Transgrid

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Managing risk on Line 966

RIT-T Project Assessment Conclusions Report

Issue date: 1 December 2023

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Executive summary

We are applying the Regulatory Investment Test for Transmission (RIT-T) to options for mitigating environmental (bushfire), safety and financial (reactive maintenance) risks caused by the deteriorating condition of certain components of the 132 kV line running between the Armidale and Koolkhan substations in northern NSW ('Line 966'). Publication of this Project Assessment Conclusions Report (PACR) represents the final step in the RIT-T process.

Line 966 is a single-circuit 132 kV line with a route length of 176.5 km that was commissioned in 1961. Line 966 is comprised of 600 structures, 482 of which are wood pole structures.

The line is a key link in the Northern NSW transmission network and its route traverses through grazing land outside Armidale before crossing the Great Dividing Range and passing through the Nymboi-Binderay National Park and finally again through more grazing land south of Grafton. The sections on the outskirts of Armidale are in the highest bushfire consequence category.

Line 966 was impacted by both the Liberation Trail Andersons Creek Fire and the Guya Road Fire in November 2019. The fires burnt out six wood pole structures resulting in conductors on the ground and, in total, the fires impacted 190 structures on Line 966. While the worst affected structures were addressed following the fires, subsequent inspections identified an additional 23 structures as burnt to the extent that the timber is charred (which affects the pole's structural integrity). Only three of those additional 23 structures had been identified as having condition issues in inspections prior to the fires.

Outside of direct fire damage, other identified condition issues on the line impact 390 of the 600 structures across multiple line components, including conductors, porcelain insulators, conductor and earthwire dampers and fittings, and earthwire bonding and structure earthing.

In total, there are currently 94 structures that are considered to be in need of addressing (20 that were impacted by the bushfires and 74 due to general condition issues). The remaining structures identified as being damaged (either by the fires or just generally) are in a more secure state.

Asset deterioration increases the likelihood of structure failures, conductor drop, and subsequent bushfire and safety risks as well as resulting in reactive maintenance costs to repair the failed elements.

Identified need: managing risks on Line 966

If action is not taken, the condition of Line 966 will expose us and our customers to increasing levels of risk going forward, as deterioration increases the likelihood of failure. There are bushfire and safety risks under the 'do nothing' base case, as well as higher expected costs associated with reactive maintenance that may be required under emergency conditions ('financial risks').

The proposed investment will enable us to manage environmental, safety and financial risks on Line 966.

Options considered under this RIT-T have been assessed relative to a base case. Under the base case, no proactive capital investment is made and the condition of the lines will continue to deteriorate.

We manage and mitigate safety and bushfire risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with our obligations under the *New South Wales Electricity Supply (Safety and Network Management) Regulation 2014* and our Electricity Network Safety Management System (ENSMS).[1]

[1] Our ENSMS follows the International Organization for Standardization's ISO31000 risk management framework which requires following a hierarchy of hazard mitigation approach.

The proposed investment will enable us to continue to manage and operate this part of the network to a safety and risk mitigation level consistent with ALARP. Consequently, it is considered a reliability corrective action under the RIT-T. A reliability corrective action differs from a 'market benefits'-driven RIT-T in that the preferred option is permitted to have negative net economic benefits on account of it being required to meet an externally imposed obligation on the network business.

Three submissions were received in response to the PSCR

We published a Project Specification Consultation Report (PSCR) on 16 June 2023 and invited written submissions on the material presented within the document. Three submissions were received in response to the PSCR.

Submissions commented on a range of topics, including how transmission infrastructure is planned in the NEM, NSW government policy regarding renewables, landholder issues and bushfire risks. One submitter offered their strong support for Option 1 in this RIT-T.

We have responded to each submitter directly regarding their submissions as part of preparing this PACR.

No material developments since publication of the PSCR

No additional credible options were identified during the consultation period following publication of the PSCR. In addition, no material changes have occurred since the PSCR that have made an impact on the preferred option.

We note that, since the PSCR was released, there has been a law change to introduce an emissions reduction objective into the national energy objectives[2] and that the National Electricity Rules are currently being updated to add a new category of market benefit to the RIT-T reflecting changes in Australia's greenhouse gas emissions.[3] While we acknowledge this important change to the RIT-T, we note that there is not expected to be a difference in greenhouse gas emission levels between the three options assessed in this PACR since there is no change in the conductor rating included in any of the credible options considered. This new category of market benefit is therefore not expected to be material for this RIT-T and so has not been estimated.

Credible options considered

In this PACR, we have considered three credible options that meet the identified need from a technical, commercial, and project delivery perspective.[4] These are summarised in Table E-1.

2 On 12 August 2022, Energy Ministers agreed to fast track the introduction of an emissions reduction objective into the national energy objectives, consisting of the National Electricity Objective (NEO), National Gas Objective and National Energy Retail Objective. On 21 September 2023, the *Statutes Amendment (National Energy Laws) (Emissions Reductions Objectives) Act 2023* (the Act) received Royal Assent.

3 AEMC, *Harmonising the electricity network planning and investment rules and AER guidelines with the updated energy objectives (electricity)*, draft determination, 26 October 2023, p. i.

4 As per clause 5.15.2(a) of the NER.

Table E-1 Summary of credible options, $2021/22

Option	Description	Capital costs, $m	Operating costs (per year), $
Option 1	Replace only wood pole structures that are known to be degraded or bushfire impacted.	14.2	62,000
Option 2	Rebuild bushfire impacted sections of the line (with existing concrete poles to remain where practicable) and replace the existing conductor.	90.0	44,000
Option 3	Rebuild the entire line and replace the existing conductor and earthwire.	98.6	43,000

Each option has a different operating cost since each option leaves a different number of wooden poles remaining on the line that require annual maintenance.

Non-network options are not able to assist for this RIT-T

We do not consider non-network options to be commercially and technically feasible to assist with meeting the identified need for this RIT-T, as non-network options will not mitigate the environmental, safety and financial risks posed as a result of asset deterioration. In addition, we did not receive any submissions from proponents of any non-network solutions in response to the PSCR.

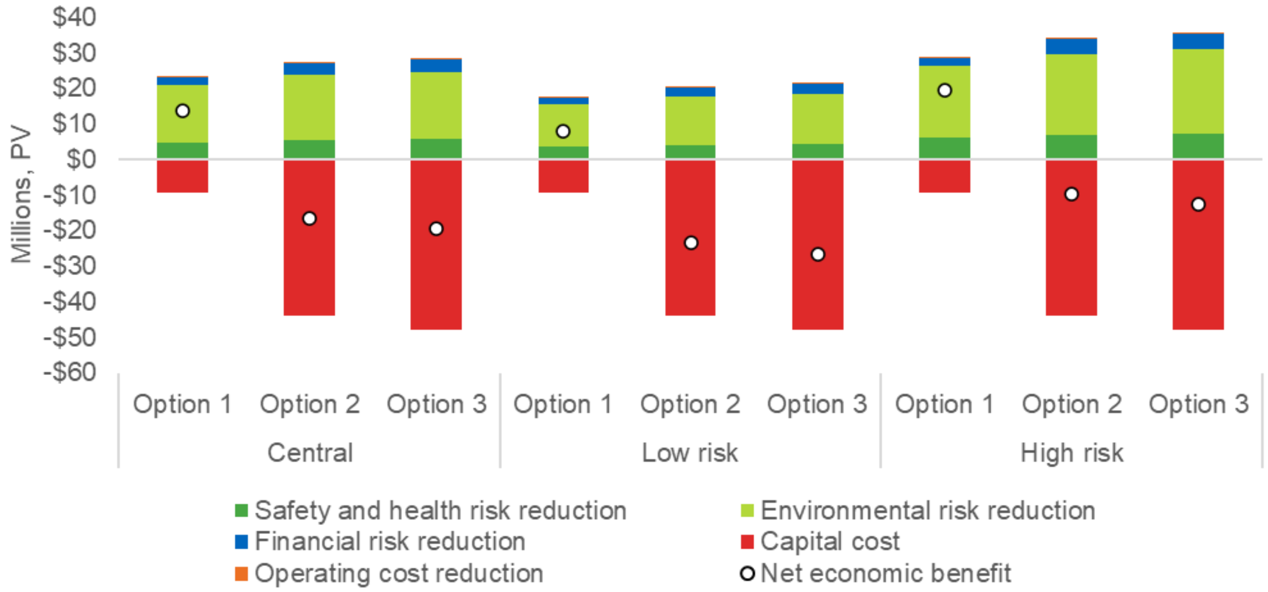
Conclusion: replacement of only wood pole structures that are known to be degraded or bushfire impacted is optimal

Option 1 is found to have positive benefits for all scenarios investigated, while Options 2 and 3 are found to have negative net benefits for all scenarios investigated. On a weighted basis, Option 1 is found to deliver the greatest net economic benefits at approximately $13.7 million.

The net benefits of all options have fallen slightly since the PSCR due to a higher commercial discount rate being applied, consistent with the latest AEMO Input Assumptions and Scenarios Report (IASR), which was published in July 2023.[5]

5 Specifically, while the PSCR applied a central discount rate of 5.50 per cent, consistent with the assumptions adopted in AEMO's 2022 Integrated System Plan, the PACR updates this to 7 per cent in-line with AEMO's latest IASR.

Figure E-1 Net economic benefits ($m, PV)



Option 1 (replacing only the wood pole structures that are known to be degraded or bushfire impacted) is the preferred option to meet the identified need at this stage of the RIT-T. Moving forward with this option is the most prudent and economically efficient solution to manage and mitigate safety and bushfire risk to ALARP. Consequently, it will ensure our obligations under the New South Wales Electricity Supply (Safety and Network Management) Regulation 2014 and our ENSMS are met.

The estimated capital expenditure associated with this option is $14.2 million (2021/22 dollars). Routine operating and maintenance costs relating to planned checks by our field crew are approximately $62,000 per year. We calculate that the avoided risk cost by undertaking Option 1 ranges from approximately $2.1 million per year to $8.8 million per year in real terms over the assessment period.

Option 1 is found to have positive net benefits under all three scenarios investigated and, on a weighted basis, will deliver $13.7 million in net economic benefits (in present value terms).

The analysis in this PACR shows that the conclusion is robust to changes in capital cost inputs, estimated risk costs and underlying discount rates. While there would need to be unrealistic changes to these key assumptions to change the ranking of the options, Transgrid will continue to monitor these assumptions and will notify the AER if such changes do occur (or appear likely), which would constitute a material change in circumstance.

The works would be undertaken between 2023/24 and 2024/25. All works would be completed in accordance with the relevant standards by 2024/25 with minimal modification to the wider transmission assets. Necessary outages of affected line(s) in service would be planned appropriately in order to complete the works with minimal impact on the network.

Next steps

This PACR represents the final step of the consultation process in relation to the application of the RIT-T process undertaken by Transgrid.

The second step of the RIT-T process, production of a Project Assessment Draft Report (PADR), was not required as the investment meets the criteria for exemption under NER clause 5.16.4(z1), ie:

- the estimated capital cost of the preferred option is less than $46 million;
- the PSCR included statements on:
  - the proposed preferred option, together with the reasons for the proposed preferred option;
  - that Transgrid expects to be exempt from producing a PADR; and
  - that the proposed preferred option and any other credible options will not have a material market benefit for the classes of market benefit specified in clause 5.15A.2(b)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding;
- no PSCR submissions identified additional credible options that could deliver a material market benefit; and
- the PACR addresses any issues raised in relation to the proposed preferred option during the PSCR consultation (noting that no issues have been raised).

Parties wishing to raise a dispute notice with the AER may do so prior to 2 January 2024 (30 days after publication of this PACR). Any dispute notices raised during this period will be addressed by the AER within 40 to 120 days, after which the formal RIT-T process will conclude.

Further details on the RIT-T can be obtained from Transgrid's Regulation team via regulatory.consultation@transgrid.com.au. In the subject field, please reference 'Line 966 PACR'.

Contents

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 options for mitigating the risks caused by the widespread condition issues on various line components of the 330 kV line running between Armidale and Koolkhan substations ('Line 966') in northern NSW.

We manage and mitigate bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with our obligations under the *New South Wales Electricity Supply (Safety and Network Management) Regulation 2014* and our Electricity Network Safety Management System (ENSMS).

This RIT-T therefore examines options for addressing the asset condition issues so that network safety continues to meet a risk mitigation level of ALARP. Consequently, it is considered a reliability corrective action under the RIT-T.

1.1. Purpose of this report

The purpose of this PACR[6] is to:

- describe the identified need;
- summarise the submissions received to the Project Specification Consultation Report (PSCR);
- describe and assess credible options to meet the identified need;
- describe the assessment approach used; and
- provide details of the proposed preferred option to meet the identified need.

Overall, this report provides transparency into the planning considerations for investment options to ensure continuing reliable supply to our customers. A key purpose of this PACR is to provide interested stakeholders the opportunity to review the analysis and assumptions and have certainty and confidence that the preferred option has been robustly identified as optimal.

1.2. Three submissions were received in response to the PSCR and there have been no material developments

We published a Project Specification Consultation Report (PSCR) on 16 June 2023 and invited written submissions on the material presented within the document. Three submissions were received in response to the PSCR.

Submissions commented on a range of topics, including how transmission infrastructure is planned in the NEM, NSW government policy regarding renewables, landholder issues and bushfire risks. One submitter offered their strong support for Option 1 in this RIT-T.

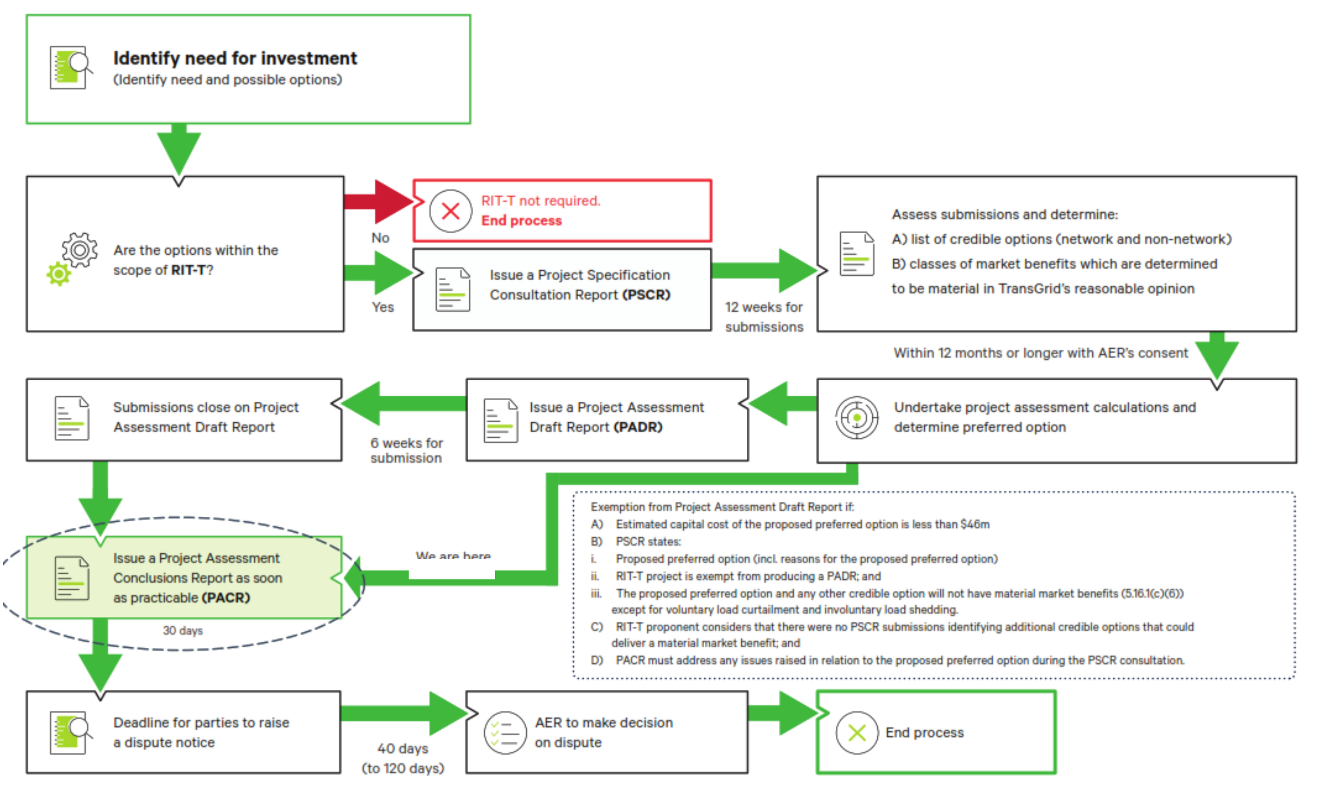
No additional credible options were identified during the consultation period following publication of the PSCR. No other material changes have occurred since the PSCR that have made an impact on the preferred option.

6 See Appendix A for the National Electricity Rules requirements.

1.3. Next steps

This PACR represents the final step of the consultation process in relation to the application of the RIT-T process undertaken by Transgrid.

Figure 1.1 This PACR is the final stage of the RIT-T process[7]



Parties wishing to raise a dispute notice with the AER may do so prior to 2 January 2024 (30 days after publication of this PACR). Any dispute notices raised during this period will be addressed by the AER within 40 to 120 days, after which the formal RIT-T process will conclude.

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[7] Australian Energy Market Commission. "*Replacement expenditure planning arrangements, Rule determination*". Sydney: AEMC, 18 July 2017.

2. The identified need

This section outlines the identified need for this RIT-T, as well as the assumptions and data underpinning it. It first sets out background information related to Line 966.

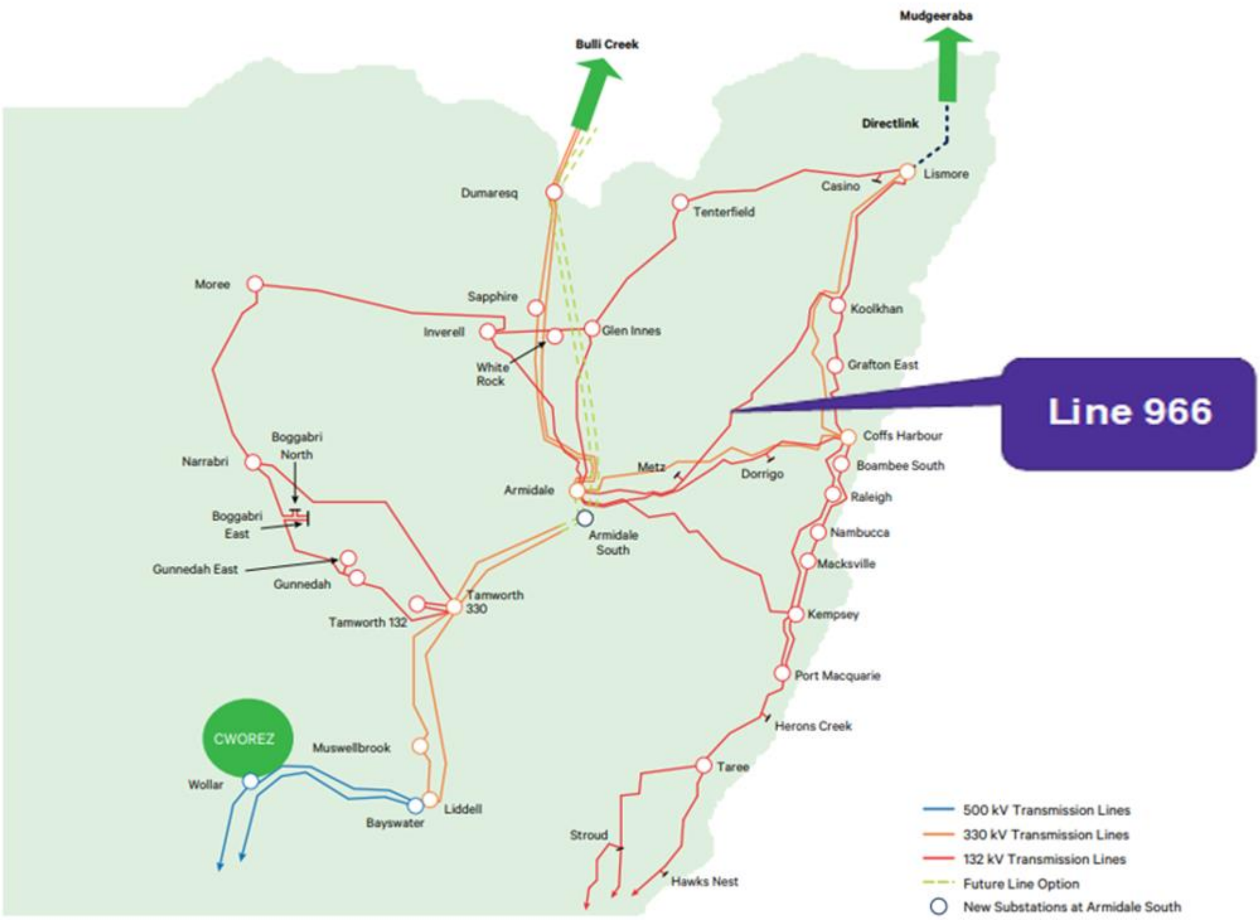
2.1. Background to the identified need

Line 966 is a single-circuit 132 kV line with a route length of 176.5 km that was commissioned in 1961. Line 966 is comprised of 600 structures, 482 of which are wood pole structures.

The line is a key link in the Northern NSW transmission network and its route traverses through grazing land outside Armidale before crossing the Great Dividing Range and passing through the Nymboi-Binderay National Park and finally again through more grazing land south of Grafton. The sections on the outskirts of Armidale are in the highest bushfire consequence category.

Figure 2-1 depicts the location of Line 966 in the Northern NSW area of our network.

Figure 2-1 Location of Line 966



Line 966 was impacted by both the Liberation Trail Andersons Creek Fire and the Guya Road Fire in November 2019. The fires fully burnt out six wood pole structures resulting in conductors on the ground and, in total, the fires impacted a total of 190 structures on Line 966.

Figure 2-2 illustrates some of the damage caused by the bushfires.

Figure 2-2 Damage caused to Line 966 in the November 2019 bushfires

While the worst affected structures were addressed following the fires, subsequent inspections identified an additional 23 structures as burnt to the extent that the timber is charred (which affects the pole's structural integrity) of which 20 were not already identified as having condition issues in recent inspections or existing asset condition records.

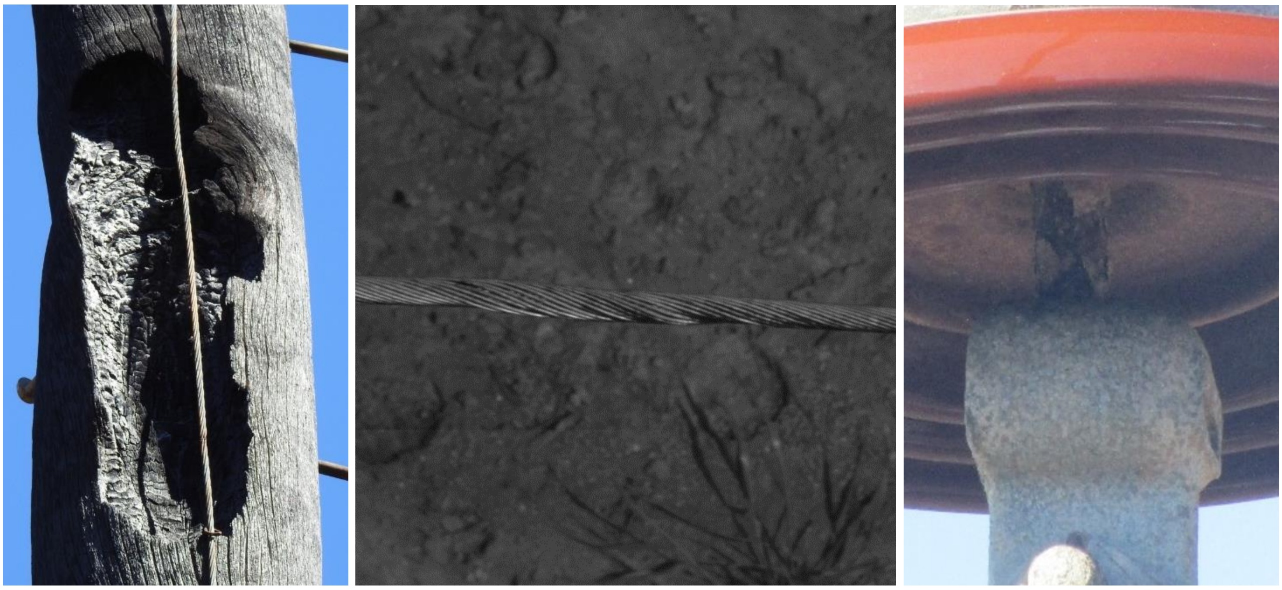
Subsequent inspections of the sections impacted by the fire identified an additional 23 structures with charred timber. The fire damage affects the outer annulus of the poles at the bottom (the bottom being the main load bearing area) with damage to these sections of the poles having potential impacts to their structural integrity.

Outside of direct fire damage, other identified condition issues on the line impact 390 of the 600 structures across multiple line components, including conductors, porcelain insulators, conductor and earthwire dampers and fittings, and earthwire bonding and structure earthing. Specifically, other condition issues on the line include, but are not limited to:

- conductor strength issues caused by significant heat stress, such as that from a bushfire event, and which may be further elevated by impact with the ground where burnt structures failed and resulted in the conductor falling;
- porcelain insulators that are deteriorated and at end of serviceable life;
- corroded conductor and earthwire dampers and fittings; and
- deteriorated earthwire bonding and structure earthing.

Figure 2-3 below provides illustrative examples of the condition of various components of Line 966. Specifically, the image on the left is a bushfire damaged pole structure, the image in the middle is a damaged conductor span and the image on the right is a corroded insulator pin structure.

Figure 2-3 Components on Line 966 in poor condition



In total, there are currently 94 structures that are considered to be in need of addressing (20 that were impacted by the bushfires and 74 due to general condition issues). The remaining structures identified as being damaged (either by the fires or just generally) are in a more secure state.

Asset deterioration greatly increases the likelihood of structure failures, conductor drop, and subsequent bushfire and safety risks. If these condition issues are not addressed through the timely implementation of the preferred technically and commercially feasible remediation option, then Line 966 will operate with increasing probability of failure as it continues to deteriorate. As this line traverses rural and residential areas that are prone to bushfire, there is a need to manage the risks associated with asset failure.

2.2. Description of the identified need

The proposed investment will enable us to manage environmental, safety and financial risks on Line 966. Options considered under this RIT-T have been assessed relative to a base case. Under the base case, no proactive capital investment is made and the condition of the lines will continue to deteriorate.

Further deterioration of the condition of Line 966 will expose us and our customers to increasing levels of risk, as deterioration increases the likelihood of failure. If left untreated, i.e., under the 'do nothing' base case, incidents such as conductor drop and tower collapse could occur. Such incidents could have safety consequences for nearby residents and members of the public, as well as field crew members who may be working on or near the assets. These incidents also have financial risks associated with reactive maintenance that may be required under emergency conditions.

We manage and mitigates bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with our obligations under the *New South Wales Electricity Supply (Safety and Network Management) Regulation 2014* and our Electricity Network Safety Management System (ENSMS).[8]

[8] Our ENSMS follows the International Organization for Standardization's ISO31000 risk management framework which requires following a hierarchy of hazard mitigation approach.

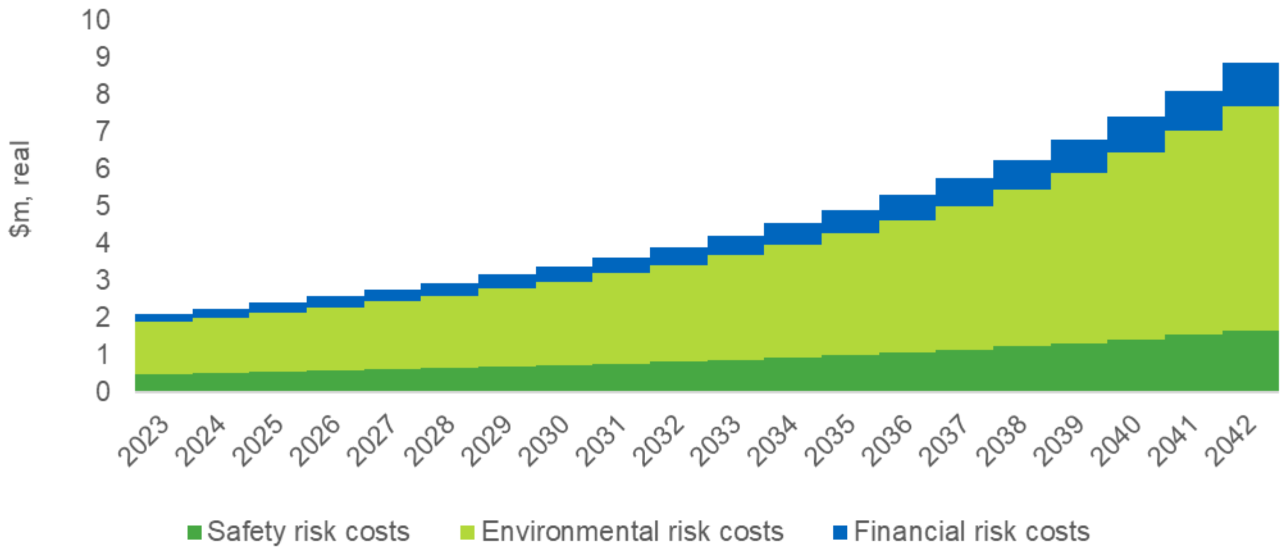
The proposed investment will enable us to continue to manage and operate this part of the network to a safety and risk mitigation level of ALARP. Consequently, it is considered a reliability corrective action under the RIT-T. A reliability corrective action differs from a 'market benefits'-driven RIT-T in that the preferred option is permitted to have negative net economic benefits on account of it being required to meet an externally imposed obligation on the network business.

2.3. Assumptions underpinning the identified need

We adopt a risk cost framework to quantify and evaluate the risks and consequences of increased failure rates. Appendix B provides an overview of our Risk Assessment methodology.

Figure 2-4 summarises the increasing risk costs over the assessment period under the base case.

Figure 2-4 Estimated risk costs



This section describes the assumptions underpinning our assessment of the risk costs, i.e., the value of the risk avoided by undertaking each of the credible options. The aggregate risk cost under the base case is currently estimated in 2021/22 dollars at around $2.1 million in 2023. This is expected to increase going forward if action is not taken and the line is left to deteriorate further, reaching approximately $3.4 million by 2030 and $8.8 million by the end of the 20-year assessment period.

2.3.1. Asset health and the probability of failure

Our asset health modelling aligns with Chapter 5.2 of the AER's asset replacement planning guideline.[9] Condition information for each asset is assessed to generate an Asset Health Index and assets in relatively poor condition, as identified through the asset health index, are candidates for a replacement or refurbishment intervention.

[9] AER, *Industry practice application note – Asset replacement planning*, January 2019 – available at https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

The asset health issues identified on Line 966 is summarised in Table 2-1.

Table 2-1: Asset health issues along Line 966 and their consequences

Issue	Consequences if not remediated
Loss of strength in conductors	Bushfire resulting in potential loss of property and/or life
Deteriorated conductor and earthwire dampers and fittings	Safety incident resulting in potential injury or death
Porcelain insulators deteriorated and at end of serviceable life	Line outage with potential network reliability impacts
Deterioration of earthwire bonding and structure earthing	Safety incident resulting in potential injury or death

Asset health is used to estimate the remaining serviceable life of an asset and forecast the associated probability of failure (PoF) of the asset now and into the future. The future health of an asset (health forecasting) is a function of its current health and any factors causing accelerated (or decelerated) degradation or 'age shifting' of one or more of its components. Such moderating factors can represent the cumulative effects arising from continual or discrete exposure to unusual events, external stresses, overloads and faults.

Asset condition information is the primary source of information on the current health of the transmission line and its components. Condition information obtained through routine inspections of the transmission line, such as condition rating of each component, and asset information, such as natural age, location and ideal life expectancy, form the basis for deriving current health.

The PoF is the likelihood that an asset will fail during a given period resulting in a particular adverse event. The probability of each failure mode is calculated using reliability engineering techniques that take into account conditional age (chronological age moderated by asset health), failure and defect history, and industry benchmarking studies. We screen out failures that are not related to end-of-life when quantifying risk for replacement projects because such risks are not addressed by these works.

2.3.2. Bushfire risk

This risk refers to the consequence to the community of an asset failure that results in a bushfire starting. We undertook detailed assessment with the University of Melbourne[10] in 2021 to improve our quantification of bushfire risks across our network, including the moderation of risk costs, using an electricity industry-developed approach.

The bushfire risk model:

- models the potential spread from a fire started at each asset in the network using recognised fire modelling software;
- calculates the consequence based on the number of houses, agricultural and forestry land use (and other infrastructure in the predicted burn area);
- moderates the consequence using a statistical distribution of fire conditions across the year to come up with a most likely consequence to be used in the investment decision;

10 Refer to Network Asset Criticality Framework

- moderates this likely consequence by the likelihood of network assets igniting a fire in the event a catastrophic asset failure occurs (i.e., not all asset failures will ignite a fire); and
- further moderates this likely consequence taking into account the expected emergency services response to a fire based on the proximity to population (i.e., locations close to population centres have the highest moderation of likely consequence as the emergency services response is expected to be relatively expeditious).

Consistent with our ALARP obligations, we apply a disproportionality factor of 'six' to the safety component of bushfire risk (i.e., loss of life).[11]

Bushfire risk makes up approximately 67 per cent of the total estimated risk cost in present value terms.

2.3.3. Safety risk

This risk refers to the safety consequence to our workforce, contractors and/or members of the public of an asset failure whose failure modes can create harm. The estimated value accounts for the cost associated with a fatality or injury including compensation, loss of productivity, litigation fees, fines and any other related costs.

Our safety model underwent a comprehensive update during 2021 and was developed in conjunction with asset management specialist consultancy AMCL.[12] The main changes to the model relate to consequence and likelihood quantifications with our safety risk now considering a range of consequences, from minor injury to fatality, and the likelihood of each based on historical events, human movement data and land use.

Consistent with our ALARP obligations, we apply a disproportionality factor of 'six' to the public safety component and 'three' to the worker safety component of safety risk.

Safety risk makes up 21 per cent of the total estimated risk cost in present value terms.

2.3.4. Financial risk

This risk refers to the direct financial consequence arising from the failure of an asset including the cost of replacement or repair of the asset (reactive maintenance), which may need to be under emergency conditions.

Financial risk makes up 12 per cent of the total estimated risk cost in present value terms.

[11] Refer to section 6.2.5 of the Network Risk Assessment Methodology
[12] Refer to Network Asset Criticality Framework

3. The PSCR received three submissions

We published a PSCR on 16 June 2023 and invited written submissions on the material presented within the document. Three submissions were received in response to the PSCR.

Submissions commented on a range of topics, including how transmission infrastructure is planned in the NEM, NSW government policy regarding renewables, landholder issues and bushfire risks. One submitter offered their strong support for Option 1 in this RIT-T.

We have responded to each submitter directly regarding their submissions as part of preparing this PACR.

4. Potential credible options

This section describes the options we have investigated to address the need, including the scope of each option and the associated costs.

We consider that there are three feasible options from a technical, commercial, and project delivery perspective that can be implemented in sufficient time to meet the identified need. Four other options were considered but not progressed for various reasons that are outlined in Table 4-4.

All costs and benefits presented in this PACR are in 2021-22 dollars, unless otherwise stated.

4.1. Base case

The costs and benefits of each option in this PACR are compared against those of a base case. Under this base case, no proactive capital investment is made to remediate the deterioration of Line 966 and the line will continue to operate and be maintained under the current regime.

While the base case is not a situation we plan to encounter, and this RIT-T has been initiated specifically to avoid it, the RIT-T assessment is required to use this base case as a common point of reference when estimating the net benefits of each credible option.

The regular maintenance regime will not be able to mitigate the risk of asset failure that will expose us and end-customers to approximately $3.4 million per year in environmental, safety and financial risk costs by 2030, rising to $8.8 million per year by the end of the assessment period.[13] The large risk costs are mainly due to the consequences of a bushfire event resulting from conductor drop or structure failure. Under the base case, all of these risks will continue to increase.

The annual transmission line routine operating expenditure under the base case is approximately $66,000. This decreases for each option that reduces the number of wooden poles on the line. This is because wooden poles require an ongoing maintenance program. Reactive maintenance costs also differ and are captured under financial risks. No capital costs are included within the base case. A breakdown of annual expenditure for the base case is presented below in Table 4-1.

Table 4-1 Breakdown of annual capital cost and operating cost for the base case (2021-22)

Years	Capital cost	Operating cost
2023	-	$66,107
2024	-	$66,107
2025	-	$66,107
2026	-	$66,107
2027	-	$66,107
2028	-	$66,107
2029	-	$66,107
2030	-	$66,107

[13] This determination of yearly risk costs is based on our network asset risk assessment methodology and incorporates variables such as likelihood of failure/exposure, various types of consequence costs and corresponding likelihood of occurrence.

2031	**-**	$66,107
2032	**-**	$66,107
2033	**-**	$66,107
2034	**-**	$66,107
2035	**-**	$66,107
2036	**-**	$66,107
2037	-	$66,107
2038	-	$66,107
2039	-	$66,107
2040	-	$66,107
2041	-	$66,107
2042	-	$66,107
Total	**-**	**$1,322,142**

4.2. Option 1 – Replace wood pole structures that are showing the greatest deterioration

Option 1 involves a targeted replacement of wood pole structures that experience the greatest deterioration with steel or concrete poles, including the bushfire impacted wood poles. The total number of structures expected to be replaced under Option 1 is 94 (20 that were impacted by the bushfires and 74 due to general condition issues). While replacing the conductor and earthwire are not included in the scope of this option, their condition and age has been reflected in the risk cost modelling for this option.

The works are estimated to take 25 months to complete. Project completion is assumed in 2024/25.

All works would be completed in accordance with the relevant standards with minimal modification to the wider transmission assets. Necessary outages of affected line(s) in service would be planned appropriately in order to complete the works with minimal impact on the network.

The estimated capital expenditure associated with this option is $14.2 million, which is comprised of:

- $3 million in labour costs;
- $2.5 million materials costs; and
- $8.7 million in expenses.

At the time of preparing this PACR, our latest asset condition information and updated design work for Option 1 suggests that the actual cost may be closer to $10 million. We have not updated the cost of Option 1 in this PACR however since this estimate is not considered sufficiently developed at this stage and is not considered material to the outcome of this RIT-T (i.e., applying a lower capital cost estimate for Option 1 will only make this option further preferred).

There are higher annual operating cost under this option compared to the other options (but lower than the base case), due to the higher number of wood poles that require an ongoing maintenance regime. Annual operating costs are estimated at $62,000/year for this option. A breakdown of annual expenditure for Option 1 is presented below in the table below.

This option has the lowest estimated risk reduction of the three options due to it being a 'minimal scope' option designed to address only the components that have experienced the greatest deterioration, to prevent failure in the short-term.

Table 4-2 Breakdown of annual capital cost and operating cost for Option 1 ($2021-22)

Years	Capital cost	Operating cost
2023	-	$66,107
2024	$283,231	$66,107
2025	$13,964,569	$66,107
2026	-	$61,548
2027	-	$61,548
2028	-	$61,548
2029	-	$61,548
2030	-	$61,548
2031	-	$61,548
2032	-	$61,548
2033	-	$61,548
2034	-	$61,548
2035	-	$61,548
2036	-	$61,548
2037	-	$61,548
2038	-	$61,548
2039	-	$61,548
2040	-	$61,548
2041	-	$61,548
2042	-	$61,548
Total	**$14,247,800**	**$1,429,283**

4.3. Option 2 – Rebuild bushfire impacted sections of the line (retaining existing concrete poles where practicable) and replace the existing conductor

Option 2 involves rebuilding the bushfire impacted sections of the line, to the nearest tension structure outside the impacted areas, replacing wood poles with concrete or steel pole structures. Existing concrete poles are to remain where practicable.

This option will address the wood pole condition issues on the bushfire impacted section of the line and other line condition issues relating to fittings, insulators and conductors. The existing Panther conductor would be replaced with Lemon ACSR/GZ including all components, hardware and fittings, and all insulators. Replacing the earthwire is not included in the scope of this option, but its condition and age has been reflected in the risk cost modelling.

The scope of work covers the replacement of 451 wood pole structures and 162.7 km of conductor.

The works are estimated to take 59 months to complete. Project completion is assumed in 2028/29.

All works would be completed in accordance with the relevant standards with minimal modification to the wider transmission assets. Necessary outages of affected line(s) in service would be planned appropriately in order to complete the works with minimal impact on the network.

The estimated capital expenditure associated with this option is $90 million, which is comprised of:

- $13.7 million in labour costs;
- $4 million materials costs; and
- $72.3 million in expenses.

'Expenses' covers any outsourced costs, such as design consultants, environmental approval consultants, construction contractors etc. Option 2 and Option 3 both involve replacing much larger portions of the line than Option 1 (which only involves replacing around 20 per cent of the line). Option 2 and Option 3 therefore involve significantly greater expenses than Option 1.

Option 2 has annual operating costs estimated at $44,000/year. This option has a lower operating cost compared to the base case and Option 1, as it has fewer wood poles that require an ongoing maintenance regime. A breakdown of annual expenditure for Option 2 is presented below in Table 4-3.

Table 4-3 Breakdown of annual capital cost and operating cost for Option 2 (2021-22)

Years	Capital cost	Operating cost
2023	$490,502	$66,107
2024	$563,829	$66,107
2025	$1,537,365	$66,107
2026	$8,525,203	$66,107
2027	$78,865,925	$66,107
2028	-	$66,107
2029	-	$44,234
2030	-	$44,234

2031	**-**	$44,234
2032	**-**	$44,234
2033	**-**	$44,234
2034	**-**	$44,234
2035	**-**	$44,234
2036	**-**	$44,234
2037	-	$44,234
2038	-	$44,234
2039	-	$44,234
2040	-	$44,234
2041	-	$44,234
2042	-	$44,234
Total	**$89,982,824**	**$1,015,913**

This option has a greater estimated risk reduction than Option 1 due to it addressing more affected wood pole structures (i.e., not just those with the greatest level of deterioration) and replacing other components (e.g., the conductor, fittings, and insulators).

4.4. Option 3 – Rebuild the entire line and replace the existing conductor and earthwire

Option 3 involves rebuilding the entire line, replacing wood poles with concrete or steel pole structures. The existing Panther conductor would be replaced with Lemon ACSR/GZ, and the earthwire replaced like-for-like. The scope of work covers replacement of 482 wood pole structures, 177 km of conductor, and 354 km of earthwire.

The works are estimated to take 60 months to complete. Project completion is assumed in 2028/29.

All works would be completed in accordance with the relevant standards with minimal modification to the wider transmission assets. Necessary outages of affected line(s) in service would be planned appropriately in order to complete the works with minimal impact on the network.

The estimated capital expenditure associated with this option is $98.6 million, which is comprised of:

- $14.9 million in labour costs;
- $4.4 million materials costs; and
- $79.3 million in expenses.

Table 4-4 shows the expected expenditure profile of this option.

Option 3 has annual operating costs estimated at $43,000/year. This option has the lowest operating cost compared to the base case and other two options, as all wood poles are replaced. A breakdown of annual expenditure for Option 3 is presented below in Table 4-4.

Table 4-4 Breakdown of annual capital cost and operating cost for Option 2 (2021-22)

Years	Capital cost	Operating cost
2023	-	$66,107
2024	$526,408	$66,107
2025	$558,872	$66,107
2026	$1,649,905	$66,107
2027	$4,674,594	$66,107
2028	$91,214,687	$66,107
2029	-	$42,876
2030	-	$42,876
2031	-	$42,876
2032	-	$42,876
2033	-	$42,876
2034	-	$42,876
2035	-	$42,876
2036	-	$42,876
2037	-	$42,876
2038	-	$42,876
2039	-	$42,876
2040	-	$42,876
2041	-	$42,876
2042	-	$42,876
Total	**$98,624,466**	**$996,901**

This option has the greatest estimated risk reduction benefit of all options given its scope includes rebuilding the entire line.

4.5. Options considered but not progressed

We considered several additional options to meet the identified need in this RIT-T. Table 4-5 summarises the reasons the following credible options were not progressed further.

Table 4-5 Options considered but not progressed

Description	Reason(s) for not progressing
Increased inspections	The condition issues have already been identified and cannot be rectified through increased inspections. This option is therefore not technically feasible.
Elimination of all associated risk	This can only be achieved through retirement and decommissioning of the associated assets. This option is therefore not technically feasible.
New transmission line	Replacement with a new 132 kV transmission line would incur significant costs, without a commensurate increase in benefits. This option is therefore not considered commercially feasible.
Non-network solutions	We do not consider non-network options to be commercially and technically feasible to assist with meeting the identified need, as non-network options will not mitigate the environmental, safety and financial risks posed as a result of asset deterioration. This is outlined in section 4 of the PSCR in more detail. Further, we have not received any proposals from non-network option proponents in response to the PSCR.

4.6. No material inter-network impact is expected

We have considered whether the credible option listed above is expected to have material inter-regional impact.[14] A 'material inter-network impact' is defined in the NER as:

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

AEMO's suggested screening test to indicate that a transmission augmentation has no material inter-network impact is that it satisfies the following:[15]

- a decrease in power transfer capability between transmission networks or in another TNSP's network of no more than the minimum of 3% of the maximum transfer capability and 50 MW;
- an increase in power transfer capability between transmission networks or in another TNSP's network of no more than the minimum of 3% of the maximum transfer capability and 50 MW;
- an increase in fault level by less than 10 MVA at any substation in another TNSP's network; and
- the investment does not involve either a series capacitor or modification in the vicinity of an existing series capacitor.

We note that each credible option satisfies these conditions as it does not modify any aspect of electrical or transmission assets. By reference to AEMO's screening criteria, there is no material inter-network impacts associated with any of the credible options considered.

14 As per clause 5.16.4(b)(6)(ii) of the NER.

15 Inter-Regional Planning Committee. *"Final Determination: Criteria for Assessing Material Inter-Network Impact of Transmission Augmentations."* Melbourne: Australian Energy Market Operator, 2004. Appendix 2 and 3. Accessed 14 May 2020. https://www.aemo.com.au/-/media/Files/PDF/170-0035-pdf

5. Materiality of market benefits

This section outlines the categories of market benefits prescribed in the National Electricity Rules (NER) and whether they are considered material for this RIT-T.[16]

We note that, since the PSCR was released, there has been a law change to introduce an emissions reduction objective into the national energy objectives[17] and that the NER are currently being updated to add a new category of market benefit to the RIT-T reflecting changes in Australia's greenhouse gas emissions.[18] While we acknowledge this important change to the RIT-T, we note that there is not expected to be a difference in greenhouse gas emission levels between the three options assessed in this PACR since there is no change in the conductor rating included in any of the credible options considered. This new category of market benefit is therefore not expected to be material for this RIT-T and so has not been estimated.

5.1. Wholesale electricity market benefits are not material

The AER has recognised that if the credible options considered will not have an impact on the wholesale electricity market, then a number of classes of market benefits will not be material in the RIT-T assessment, and so do not need to be estimated.[19]

The credible options considered in this RIT-T will not address network constraints between competing generating centres and are therefore not expected to result in any change in dispatch outcomes and wholesale market prices. We therefore consider that the following classes of market benefits are not material 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 the RIT-T proponent;
- changes in ancillary services costs;
- changes in network losses; and
- competition benefits.

5.2. No other classes of market benefits are material

In addition to the classes of market benefits listed above, NER clause 5.16.1(c)(4) requires that we consider the following classes of market benefits, listed in Table , arising from each credible option. We consider that none of the classes of market benefits listed are material for this RIT-T assessment for the reasons in Table .

[16] The NER requires that all classes of market benefits identified in relation to the RIT-T are included in the RIT-T assessment, unless the TNSP can demonstrate that a specific class (or classes) is unlikely to be material in relation to the RIT-T assessment for a specific option – NER clause 5.16.1(c)(6). See Appendix A for requirements applicable to this document.

[17] On 12 August 2022, Energy Ministers agreed to fast track the introduction of an emissions reduction objective into the national energy objectives, consisting of the National Electricity Objective (NEO), National Gas Objective and National Energy Retail Objective. On 21 September 2023, the *Statutes Amendment (National Energy Laws) (Emissions Reductions Objectives) Act 2023* (the Act) received Royal Assent.

[18] AEMC, *Harmonising the electricity network planning and investment rules and AER guidelines with the updated energy objectives (electricity)*, draft determination, 26 October 2023, p. i.

[19] AER, *Regulatory Investment Test for Transmission – Application Guidelines*, October 2023, p. 31.

Table 5-1 Reasons non-wholesale electricity market benefits are considered immaterial

Market benefits	Reason
Changes in involuntary load curtailment	Since Line 966 forms part of a meshed network (with an N-1 level of redundancy) required to supply northern NSW, a failure of one line due to condition issues results in a negligible chance of unserved energy.
Differences in the timing of expenditure	Options considered will provide an alternative to meeting reliability requirements but are unlikely to affect decisions to undertake unrelated expenditure in the network. Consequently, material market benefits will neither be gained nor lost due to changes in the timing of other network expenditure from any of the options considered.
Option value	We note the AER's view is that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available is likely to change in the future, and the credible options considered by the TNSP are sufficiently flexible to respond to that change. [20] We also note the AER's view is 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. We note that no credible option is sufficiently flexible to respond to change or uncertainty for this RIT-T. Specifically, each option is focused on proactively replacing deteriorating assets ahead of when they fail.

[20] AER, *Regulatory Investment Test for Transmission – Application Guidelines*, October 2023, p. 57.

6. Overview of the assessment approach

This section outlines the approach that we have applied in assessing the net benefits associated with each of the credible options against the base case.

6.1. Description of the base case

The costs and benefits of each option are compared against the base case. Under this base case, no proactive investment is undertaken, we incur regular and reactive maintenance costs, and the line will continue to operate with an increasing level of risk.

We note that this course of action is not expected in practice. However, this approach has been adopted since it is consistent with AER guidance on the base case for RIT-T applications.[21]

6.2. Assessment period and discount rate

A 20-year assessment period from 2022/23 to 2041/42 has been adopted for this RIT-T analysis. This period takes into account the size, complexity and expected asset life of the options.

Where the capital components of the credible options have asset lives extending beyond the end of the assessment period, the NPV modelling includes a terminal value to capture the remaining functional asset life. This ensures that the capital cost of long-lived options over the assessment period is appropriately captured, and that all options have their costs and benefits assessed over a consistent period, irrespective of option type, technology or serviceable asset life. The terminal values are calculated as the undepreciated value of capital costs at the end of the analysis period.

A real, pre-tax discount rate of 7 per cent has been adopted as the central assumption for the NPV analysis presented in this PACR, consistent with AEMO's latest Input Assumptions and Scenarios Report (IASR).[22] The RIT-T requires that sensitivity testing be conducted on the discount rate and that the regulated weighted average cost of capital (WACC) be used as the lower bound. We have therefore tested the sensitivity of the results to a lower bound discount rate of 3.21 per cent.[23] We have also adopted an upper bound discount rate of 10.5 per cent (i.e., the upper bound in the latest IASR).[22]

6.3. Approach to estimating option costs

We have estimated the capital costs of the options based on the scope of works necessary together with costing experience from previous projects of a similar nature.

In considering the option costs for this RIT-T, it has been assumed that 30% of the transmission line is located in normal soil, with 70% assumed to be in poor soil conditions. The access will be relatively straightforward as it is an existing line traversing primarily through grazing land.

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21 We note that the AER RIT-T Guidelines state that the base case is where the RIT–T proponent does not implement a credible option to meet the identified need, but rather continues its 'BAU activities'. The AER define 'BAU activities' as ongoing, economically prudent activities that occur in the absence of a credible option being implemented. See: AER, *Regulatory Investment Test for Transmission – Application Guidelines*, October 2023, p. 22.

22 AEMO, 2023 Inputs, Assumptions and Scenarios Report | Final report, July 2023, p 123.

23 This is equal to WACC (pre-tax, real) in the latest final decision for a transmission business in the NEM (Transgrid) as of the date of this analysis, see: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/transgrid-determination-2023%E2%80%9328/final-decision

All costs estimated by Transgrid's project development team use the estimating tool 'MTWO'. The MTWO cost estimating database reflects actual outturn costs built up over more than 10 years from:

- Period order agreement rates and market pricing for plant and materials.
- Labour quantities from recently completed project.
- Construction tender and contract rates from recent projects.

The MTWO estimating database is reviewed annually to reflect the latest outturn costs and confirm that estimates are within their stated accuracy range and represent the most likely expected cost of delivery (P50 costs[24]). As part of the annual review, Transgrid benchmarks the outcomes against independent estimates provided by various engineering consultancies.[25]

Transgrid does not generally apply the Association for the Advancement of Cost Engineering (AACE) international cost estimate classification system to classify cost estimates. Doing so for this RIT-T would involve significant additional costs, which would not provide a corresponding increase in benefits compared with the use of MWTO estimates and so this has not been undertaken.

We estimate that actual costs will be within +/- 25 per cent of the central capital cost estimate. While we have not explicitly applied the AACE cost estimate classification system, we note that an accuracy of +/- 25 per cent for cost estimates is consistent with industry best practice and aligns with the accuracy range of a 'Class 4' estimate, as defined in the AACE classification system.

No specific contingency allowance has been included in the cost estimates.

All cost estimates are prepared in real, 2021/22 dollars based on the information and pricing history available at the time that they were estimated. The cost estimates do not include or forecast any real cost escalation for materials.

Routine operating and maintenance costs are based on works of similar nature.

6.4. Three different scenarios have been modelled to address uncertainty

The RIT-T is focused on identifying the top ranked credible option in terms of expected net benefits. However, uncertainty exists in terms of estimating future inputs and variables (termed future 'states of the world').

To deal with this uncertainty, the NER requires that costs and market benefits for each credible option are estimated under reasonable scenarios and then weighted based on the likelihood of each scenario to determine a weighted ('expected') net benefit. It is this 'expected' net benefit that is used to rank credible options and identify the preferred option.

The credible options have been assessed under three scenarios as part of this PACR assessment, which differ in terms of the key drivers of the estimated net market benefits (i.e., the estimated risk costs avoided).

Given that wholesale market benefits are not relevant for this RIT-T, the three scenarios assume the expected most likely scenario for the 2024 ISP (i.e., the 'Step Change' scenario). The scenarios differ by

[24] I.e., there is an equal likelihood of over- or under-spending the estimate total.
[25] For further detail on our cost estimating approach refer to section 7 of our Augmentation Expenditure Overview Paper submitted with our 2023-28 Revenue Proposal.

the assumed level of risk costs, given that these are key parameters that may affect the ranking of the credible options. Risk cost assumptions do not form part of AEMO's ISP assumptions, and have been based on our analysis, as discussed in section 2.

How the NPV results are affected by changes to other variables (including the discount rate and capital costs) has been investigated in the sensitivity analysis. We consider this is consistent with the latest AER guidance for RIT-Ts of this type (i.e., where wholesale market benefits are not expected to be material).[26],[27]

Table 6-1 Summary of scenarios

Variable / Scenario	Central	Low risk cost scenario	High risk cost scenario
Scenario weighting	*1/3*	*1/3*	*1/3*
Discount rate	7.0%	7.0%	7.0%
Network capital costs	Base estimate	Base estimate	Base estimate
Operating and maintenance costs	Base estimate	Base estimate	Base estimate
Environmental, safety and financial risk benefit	Base estimate	Base estimate – 25%	Base estimate +25%

We have weighted the three scenarios equally given there is nothing to suggest an alternate weighting would be more appropriate.

6.5. Sensitivity analysis

In addition to the scenario analysis, we have also considered the robustness of the outcome of the cost benefit analysis through undertaking various sensitivity testing.

The range of factors tested as part of the sensitivity analysis in this PACR are:

- lower and higher assumed capital costs;
- lower and higher estimated environmental, safety and financial risk benefits; and
- alternate commercial discount rate assumptions.

The above list of sensitivities focuses on the key variables that could impact the identified preferred option. The results of the sensitivity tests are set out in section 7.4.

In addition, we have also sought to identify the 'boundary value' for key variables beyond which the outcome of the analysis would change, including the amount by which capital costs would need to increase for the preferred option to no longer be preferred.

[26] AER, *Regulatory Investment Test for Transmission – Application Guidelines*, October 2023, pp. 42-44.
[27] We consider the approach to scenarios and sensitivities to be consistent with the AER guidance provided in November 2022 in the context of the disputes of the North West Slopes and Bathurst, Orange and Parkes RIT-Ts. See: AER, *Decision: North West Slopes and Bathurst, Orange and Parkes Determination on dispute - Application of the regulatory investment test for transmission*, November 2022, pp. 18-20 & 31-32, as well as with the AER's RIT-T Guidelines.

7. Assessment of credible options

This section outlines the assessment we have undertaken of the credible network options. The assessment compares the costs and benefits of each credible option to the base case. The benefits of each credible option are represented by reduction in costs or risks compared to the base case.

All costs and benefits presented in this PACR are in 2021/22 dollars.

7.1. Estimated gross benefits

Table 7-1 below summarises the present value of the gross benefit estimates for each credible option relative to the base case under the three scenarios. The benefits included in this assessment consist only of avoided risk, i.e., a reduction in environmental, safety and financial risks.

Table 7-1 Estimated gross benefits from credible options relative to the base case ($m, PV)

Option/scenario	Central	Low risk cost scenario	High risk cost scenario	Weighted
Scenario weighting	*1/3*	*1/3*	*1/3*	
Option 1	22.9	17.2	28.7	22.9
Option 2	27.2	20.4	34.0	27.2
Option 3	28.3	21.2	35.3	28.3

7.2. Estimated costs

Table 7-2 below summarises the costs of the options, relative to the base case, in present value terms. The cost includes the direct capital and routine operating costs of each option, relative to the base case. The operating cost of each option is heavily influenced by the presence of wood poles, as these require an ongoing maintenance regime.

Table 7-2 Costs of credible options relative to the base case ($m, PV)

Option	Cost
Option 1	9.2
Option 2	43.8
Option 3	47.8

7.3. Estimated net economic benefits

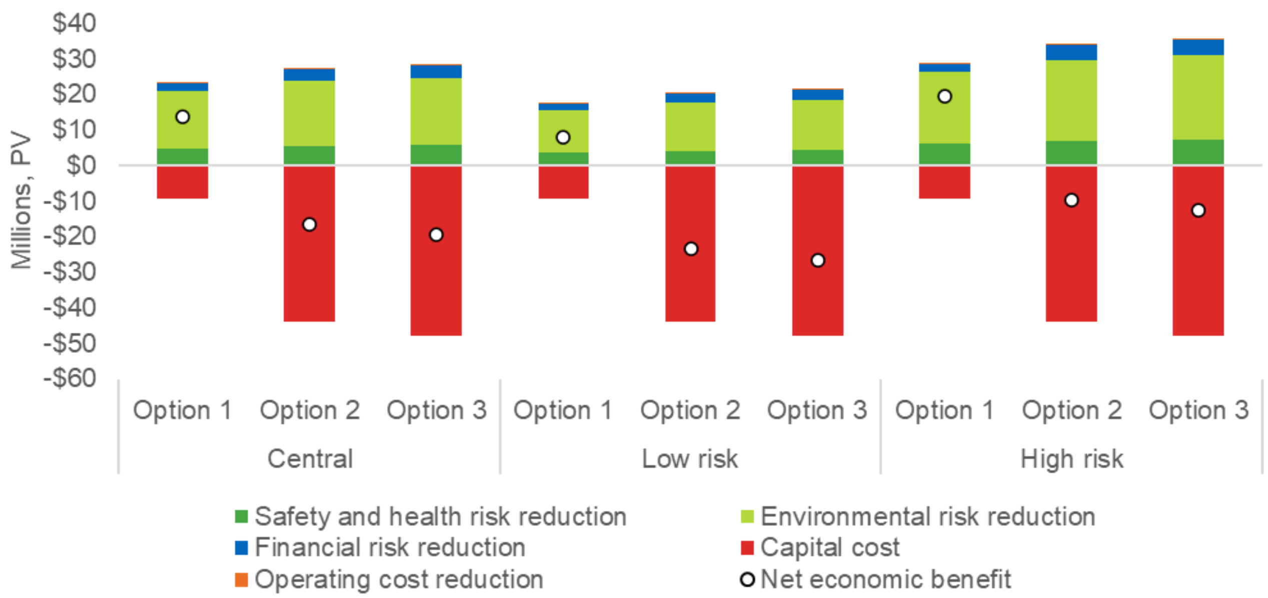
The net economic benefits are the differences between the estimated gross benefits less the estimated costs. Table below summarises the present value of the net economic benefits for each credible option across the three scenarios and the weighted net economic benefits.

Table 7-3 Net economic benefits relative to the base case ($m, PV)

Option/scenario	Central	Low risk cost scenario	High risk cost scenario	Weighted
Scenario weighting	*1/3*	*1/3*	*1/3*	
Option 1	13.7	8.0	19.5	13.7
Option 2	-16.6	-23.4	-9.8	-16.6
Option 3	-19.5	-26.6	-12.5	-19.5

Option 1 is found to have positive benefits for all scenarios investigated, while Options 2 and 3 are found to have negative net benefits for all scenarios investigated. On a weighted basis, Option 1 is found to deliver the greatest net economic benefits at approximately $13.7 million.

Figure 7-1 Net economic benefits ($m, PV)



7.4. Sensitivity testing

We have undertaken sensitivity testing to understand the robustness of the RIT-T assessment to underlying assumptions about key variables. In particular, we have undertaken two sets of sensitivity tests:

- Step 1 – testing the sensitivity of the optimal timing of the project ('trigger year') to different assumptions in relation to key variables; and
- Step 2 – once a trigger year has been determined, testing the sensitivity of the total NPV benefit associated with the investment proceeding in that year, in the event that actual circumstances turn out to be different.

Having assumed to have committed to the project by this date, we have also looked at the consequences of 'getting it wrong' under step 2 of the sensitivity testing. That is, for example, if expected safety risks are not as high as expected, the impact on the net economic benefit associated with the project continuing to go ahead on that date.

The application of the two steps to test the sensitivity of the key findings is outlined below.

7.4.1. Step 1 – Sensitivity testing of the optimal timing

This section outlines the sensitivity of the identification of the commissioning year to changes in the underlying assumptions. Each timing sensitivity has been undertaken on the central scenario.

The optimal timing of Option 1 is found to be invariant to the assumptions of:

- a 25 per cent decrease or increase in the assumed network capital costs;
- lower and higher assumed environmental, safety and financial risks; and
- lower discount rate of 3.21 per cent as well as a higher rate of 10.5 per cent.

Figure 7-2 below outlines the impact on the optimal commissioning year, under a range of alternative assumptions. It illustrates that for Option 1, the optimal commissioning date is found to be in 2025/26 for all of the sensitivities investigated.

Figure 7-2 Optimal timing of Option 1

7.4.2. Step 2 – Sensitivity of the overall net benefit

We have conducted sensitivity analysis on the present value of the net economic benefit, based on undertaking the project by 2025/26. Specifically, we have investigated the same sensitivities under this step as in the first step:

- a 25 per cent increase/decrease in the assumed network capital costs;
- lower (or higher) assumed environmental, safety and financial risks; and
- lower discount rate of 3.21 per cent as well as a higher rate of 10.5 per cent.

All these sensitivities investigate the consequences of 'getting it wrong' having committed to a certain investment decision.

Figure 7-3, Figure 7-4 and Figure 7-5 below illustrate the estimated net economic benefits for each option if separate key assumptions in the central scenario are varied individually.

Option 1 delivers positive benefits under all scenarios, while Option 2 and Option 3 only deliver positive net benefits under extreme sensitivities (and are never ranked above Option 1).

The sensitivity testing focuses on the central scenario given the ranking of the options is found to be the same across all three scenarios investigated and there are significant expected net market benefits under each scenario for Option 1. That is, we do not expect the key findings to change for this RIT-T if the sensitivity testing was expanded to cover the low risk and high-risk scenarios.

Figure 7-3 Capital cost sensitivity

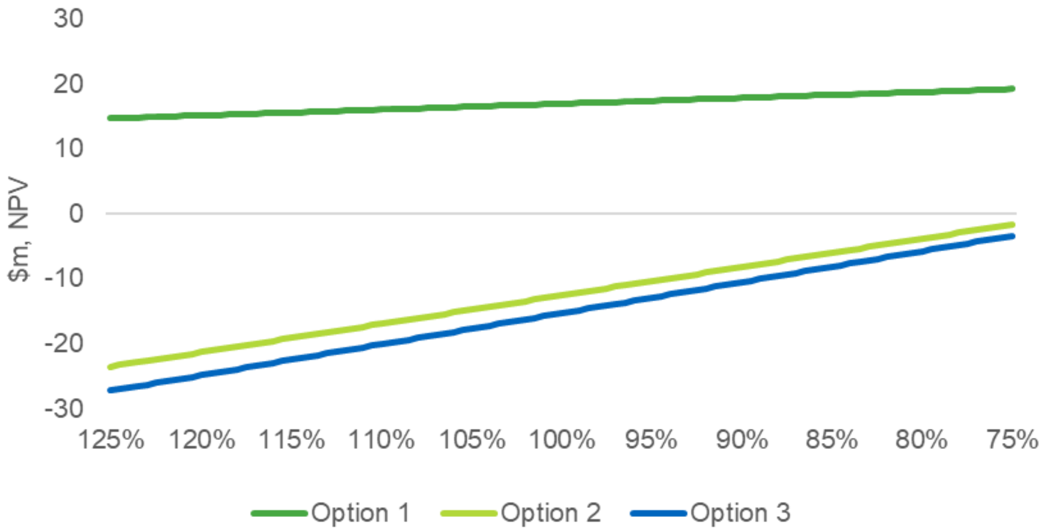


Figure 7-4 Risk costs sensitivity

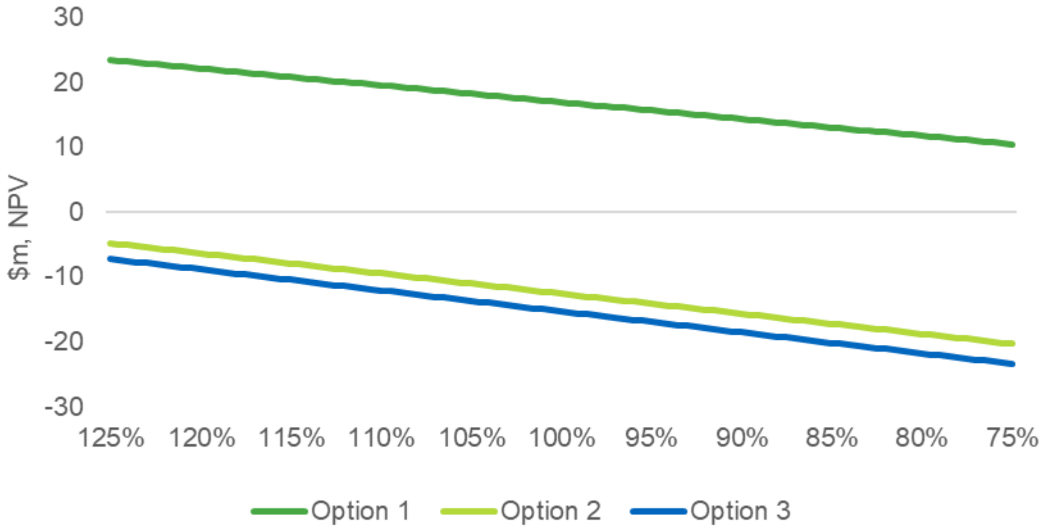
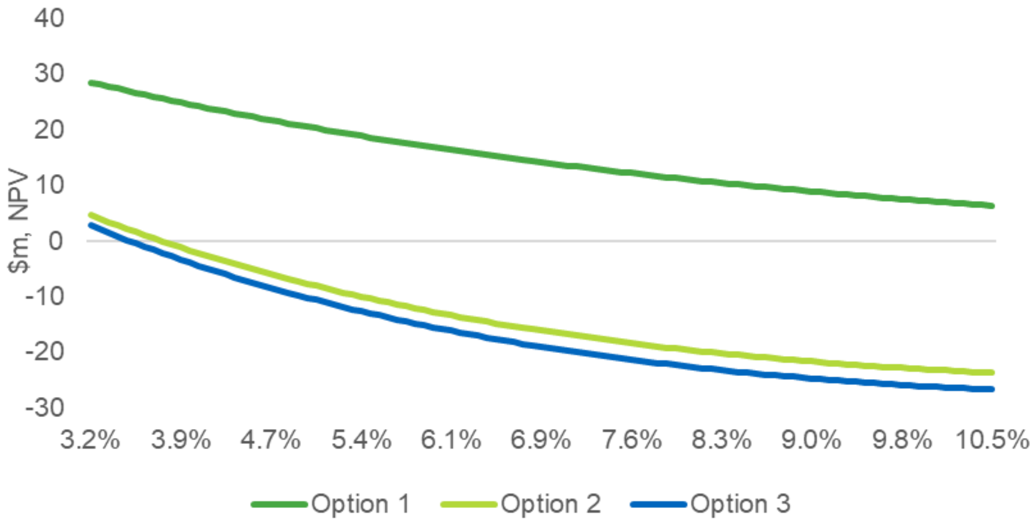


Figure 7-5 Commercial discount rate sensitivity



In terms of boundary testing, we find that the following would need to occur for the second ranked option, Option 2, to have net market benefits equal to that of Option 1:

- assumed network capital costs (for all options) would need to reduce by 87 per cent;
- the estimated risk costs (in aggregate) would need to increase 812 per cent; and
- a negative discount rate of 0.59 per cent.

These boundaries where Option 1 would no longer top ranked are extreme and are unlikely to eventuate. We therefore consider the finding that Option 1 is preferred over Options 2 and 3 to be robust to the key underlying assumptions.

8. Final conclusion on the preferred option

This PACR has found that Option 1 is the preferred option for this RIT-T. Option 1 involves a targeted replacement of wood pole structures that experience the greatest deterioration with steel or concrete poles including the bushfire impacted wood poles. The total number of structures expected to be replaced is 94 (20 that were impacted by the bushfires and 74 due to general condition issues).

Option 1 does not deliver the greatest risk reduction of the options assessed. However, it has a much lower cost and delivers the greatest estimated net market benefits. Option 1 remains the preferred option across all sensitivities tested.

The estimated capital expenditure associated with Option 1 is $14.2 million (in 2021/22 dollars). Routine operating and maintenance costs are estimated at approximately $62,000 per year and are less than the base case.

The works are estimated to take 25 months to complete. Project completion is assumed in 2024/25.

Option 1 is the preferred option in accordance with NER clause 5.15A.2(b)(12) 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. The analysis undertaken and the identification of Option 1 as the preferred option satisfies the RIT-T.

Transgrid considers this conclusion to be robust to changes in capital cost inputs, estimated risk costs and underlying discount rates, noting that there would need to be unrealistic changes to these key assumptions to change the ranking of the options (as shown via the boundary testing at the end of section 7). Transgrid will however continue to monitor these key assumptions and will notify the AER if such changes do occur (or appear likely), which would constitute a material change in circumstance.

Appendix A Compliance checklist

This appendix sets out a checklist which demonstrates the compliance of this PACR with the requirements of the National Electricity Rules version 203.

Rules clause	Summary of requirements	Relevant section(s) in the 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;	4
	(2) a summary of, and commentary on, the submissions to the project specification consultation report;	3
	(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 & 6
	(4) a detailed description of the methodologies used in quantifying each class of material market benefit and cost;	4 & 5
	(5) reasons why the RIT-T proponent has determined that a class or classes of market benefit are not material;	5
	(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;	7
	(8) the identification of the proposed preferred option;	7
	(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 & 8

Appendix B Risk Assessment Methodology

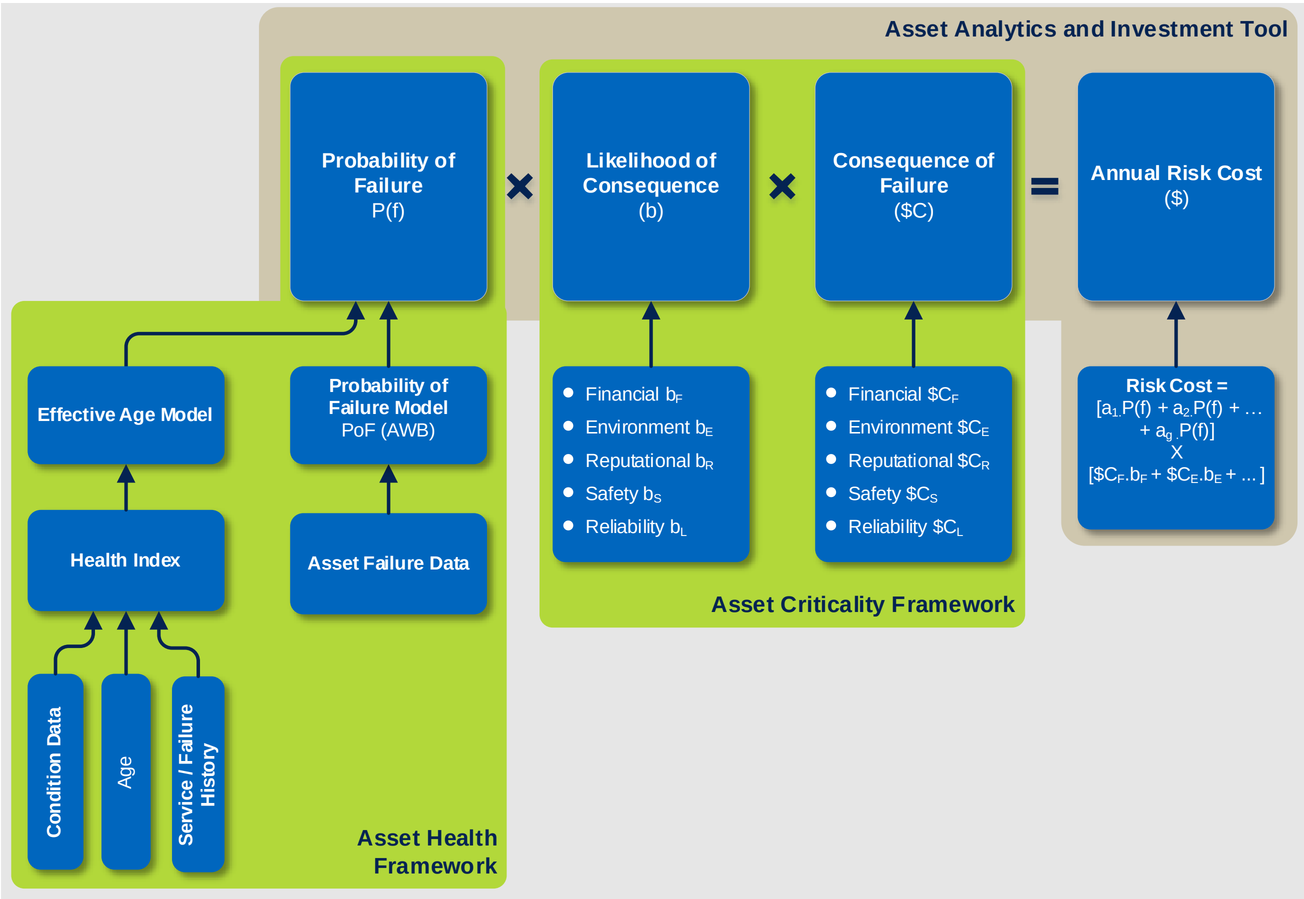
This appendix summarises our network risk assessment methodology that underpins the identified need for this RIT-T. Our risk assessment methodology is aligned with the AER's Asset Replacement Planning guideline[28] and its principles.

A fundamental part of the risk assessment methodology is calculating the annual 'risk costs' or the monetised impacts of the environmental, safety and financial risks.

The monetary value of risk (per year) for an individual asset failure resulting in an undesired outcome, is the likelihood (probability) of failure (in that year with respect to its age), as determined through modelling the failure behaviour of an asset (Asset Health), multiplied by the consequence (cost of the impact) of the undesired outcome occurring, as determined through the consequence analysis (Asset Criticality).

Figure B-1 below summarises the framework for calculating the 'risk costs', which has been applied on our asset portfolio considered to need replacement or refurbishment.

Figure B-1 Risk cost calculation



Economic justification of repex to address an identified need is supported by risk monetised benefit streams, to allow the costs of the project or program to be assessed against the value of the avoided risks

[28] Industry practice application note - Asset replacement planning, AER January 2019

and costs. The major quantified risks we apply for repex justifications include asset failures that materialise as:

- bushfire risk;
- safety risk;
- environmental risk;
- reliability risk; and
- financial risk.

The risk categories relevant to this RIT-T are explained in Section 2.3.

Further details are available in our Network Asset Risk Assessment Methodology.

Appendix C Asset Health and Probability of Failure

The first step in calculating the PoF of an asset is determining the asset health and associated effective age,[29] which considers that:

- an asset consists of different components, each with a particular function, criticality, underlying reliability, life expectancy and remaining life - the overall health of an asset is a compound function of all of these attributes;
- key asset condition measures and failure data provides vital information on the current health of an asset, where the 'current effective age' is derived from asset information and condition data;
- the future health of an asset (health forecasting) is a function of its current health and any factors causing accelerated (or decelerated) degradation or 'age shifting' of one or more of its components – such moderating factors can represent the cumulative effects arising from continual or discrete exposure to unusual internal, external stresses, overloads and faults; and
- 'future effective age' is derived by moderating 'current effective age' based on factors such as, external environment/influence, expected stress events and operating/loading condition.

The PoF is the likelihood that an asset will fail during a given period resulting in a particular adverse event, e.g., equipment failure, pole failure, broken overhead conductor.

The outputs of the PoF calculation are one or more probability of failure time series which provide a mapping between the effective age, discussed above, and the yearly probability of failure value for a given asset class. This analysis is performed by generating statistical failure curves, normally using Weibull analysis, to determine a PoF time series set for each asset that gives a probability of failure for each further year of asset life. This establishes how likely it is that the asset will fail over time.

The Weibull parameters which represent the probability of failure curve for key transmission line components are summarised in

[29] Apparent age of an asset based on its condition.

Table C-1 Weibull parameters for asset components below.

Further details are available in our [Network Asset Health Methodology.]

Table C-1 Weibull parameters for asset components

Asset component	Weibull parameters	
	η	β
Structure - Wood Pole NR	89	12
Insulators - Non Ceramic Insulators	26.55	3.232
Insulators - Porcelain Disc - Low corrosion	261.7	4.581
Insulators - Porcelain Disc - High corrosion	173.7	4.763
Conductor Fittings - C1/C2	127.4	4.376
Conductor Fittings - C3/C4	64.24	10.13
Earthwire Fittings - C1/C2	116.5	5.198
Earthwire Fittings - C3/C4	66.61	10.98

Note: C1 (Very Low), C2 (Low), C3 (Medium) and C4 (High) relate to atmospheric corrosion zones based on Australian Standard AS 4312-2008.