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Managing risk on Line 16

RIT-T Project Specification Consultation Report

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Executive summary

We are applying the Regulatory Investment Test for Transmission (RIT-T) to options for mitigating safety, environmental (bushfire) and financial (high reactive maintenance) risks caused by the deteriorating condition of certain components of the 330 kV line running between the Marulan and Avon substations on the Southern NSW network ('Line 16'). Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process.

Spanning a route of 71km, Line 16 is a single-circuit 330 kV, steel tower transmission line that runs between Marulan and Avon substations. Comprised of 159 structures, the transmission line forms a key link between Snowy Hydro and the Illawarra and Sydney metropolitan areas. It also links to the network south of Marulan, connecting approximately 650MW[1]of wind generation to the region.

Condition assessment performed through our routine maintenance program between 2017 and 2021 identified several condition issues on Line 16. Laboratory testing has also identified that some insulators have reached end of serviceable life due to deteriorated insulation resistance. A significant proportion of the steel transmission structures are impacted by various levels of deterioration and corrosion. The affected components include conductor fittings, earthwire fittings and corona rings, foundations and tower steelwork, as well as components related to public safety such as climbing deterrents and signage.

Corrosion greatly increases the likelihood of structure failure, which leads to conductor drop and presents consequent safety and bushfire risk to our personnel and the public, as well as resulting in reactive maintenance costs to repair the failed elements. While this is the case for any corroded elements of the transmission network, the bushfire risks are exacerbated for Line 16 as the line traverses substantial sections of bushland and rural agricultural areas between Marulan and Avon.

As asset conditions deteriorate over time, the likelihood of failure and subsequent risks will increase should these issues not be addressed.

Identified need: managing risks on Line 16

If action is not taken, the condition of Line 16 is expected to expose us and our customers to increasing levels of risk going forward, as the likelihood of failure increases. There are significant safety and bushfire 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 safety, environmental and financial risks on Line 16.

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 condition deterioration of the affected assets due to corrosion would mean an increase in safety and bushfire risks as the likelihood of failure increases. If left untreated, corrosion of some of the vital components of the steel towers could result in incidents such as conductor drop and tower collapse. Such incidents could have serious safety consequences for nearby residents and members of the public, as well as our field crew who may be working on or near the assets. These incidents also pose significant environmental risks through potential bushfires.

[1] Summation of generation from Gullen Range Wind Farm, Crookwell 2 and Rye Park Wind Farm.

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).[2]

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.

We note that the risk cost estimating methodology adopted for this RIT-T aligns with that used in our recently submitted Revised Revenue Proposal for the 2023-28 period. It reflects feedback from the Australian Energy Regulator (AER) on the methodology initially proposed in our original revenue proposal.

Credible options considered

In this PSCR, we have considered two credible options that would meet the identified need from a technical, commercial, and project delivery perspective.[3] These are summarised in Table E-1.

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

Option	Description	Capital costs ($M +/- 25%, Real $2021-22)	Operating costs (per year), $
Option 1	Remediate identified condition issues for line components that have priority condition issues and/or have reached end of serviceable life	8.6	22,970
Option 2	Remediate all identified condition issues on the line	9.4	22,970

Neither option is expected to affect annual routine operating costs (i.e., the amounts shown above are the same as under the base case) since they do not affect the frequency of inspections. They do however affect the reactive maintenance costs relative to the base case (which are reflected in reduced 'financial risk costs').

Non-network options are not expected to be able to assist with 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 safety and environment risk posed as a result of corrosion-related asset deterioration.

The options have been assessed against three reasonable scenarios

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

Given that wholesale market benefits are not relevant for this RIT-T, the three scenarios assume the most likely scenario from the 2022 ISP (ie, the 'Step Change' scenario). The scenarios differ by the assumed level of risk costs, given that these are key parameters that may affect the ranking of the credible options.

[2] Our ENSMS follows the International Organization for Standardization's ISO31000 risk management framework which requires following a hierarchy of hazard mitigation approach.
[3] As per clause 5.15.2(a) of the NER.

Risk cost assumptions do not form part of AEMO's ISP assumptions and have been based on Transgrid's analysis.

Table E-2 Summary of scenarios

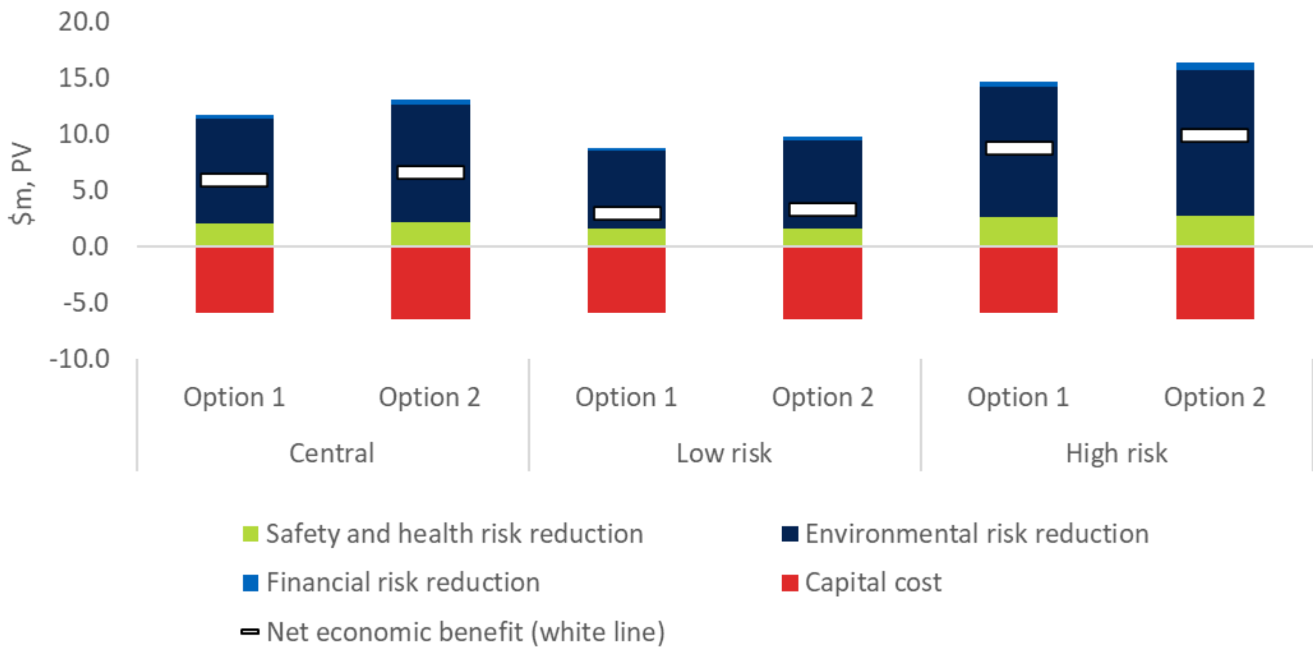
Variable / Scenario	Central	Low risk cost scenario	High risk cost scenario risk
Scenario weighting	*33%*	*33%*	*33%*
Discount rate	5.50%	5.50%	5.50%
Network capital costs	Base estimate	Base estimate	Base estimate
Operating and maintenance costs	Base estimate	Base estimate	Base estimate
Safety, environmental and financial risk benefit	Base estimate	Base estimate – 25%	Base estimate +25%

How the NPV results are affected by changes to other variables (including the discount rate and capital costs) has been investigated in sensitivity analysis.

Option 2 delivers the greatest net economic benefits

Under all scenarios, the costs of mitigating the risks under both options are found to be significantly outweighed by the expected benefit of avoiding the risks. Option 2 provides the greatest estimated net benefit of the two options considered – with net benefits that are approximately 13 per cent greater than Option 1.

Figure E-2 Net economic benefits ($m, PV)



Draft conclusion

Option 2 (remediating all identified condition issues on the line) 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 environmental risk to ALARP. Consequently, it will ensure our obligations under the *New South Wales Electricity Supply (Safety and Network Management) Regulation 2014* and our Electricity Network Safety Management System (ENSMS) are met.

The estimated capital expenditure associated with this option is $9.4 million. Routine operating and maintenance costs relating to planned checks by our field crew are approximately $22,970 per year (which is the same as under the base case and the other option considered). We calculate that the avoided risk cost by undertaking Option 2 ranges from approximately $0.8 million per year to $2.5 million per year in real terms over the assessment period.

Option 2 is found to have positive net benefits under all scenarios investigated and, on a weighted basis, will deliver $6.61 million in net economic benefits.

The works would be undertaken between 2022/23 and 2024/25. All works would be completed in accordance with the relevant standards by 2025/26 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.

Exemption from preparing a PADR

NER clause 5.16.4(z1) provides for a TNSP to be exempt from producing a Project Assessment Draft Report (PADR) for a particular RIT-T application, in the following circumstances:

- if the estimated capital cost of the preferred option is less than $46 million;
- if the TNSP identifies in its PSCR its proposed preferred option, together with its reasons for the preferred option and notes that the proposed investment has the benefit of the clause 5.16.4(z1) exemption; and
- if the TNSP considers that the proposed preferred option and any other credible options in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding.

We consider the investment in relation to Option 2 meets these criteria and therefore that we are exempt from producing a PADR under NER clause 5.16.4(z1).

In accordance with NER clause 5.16.4(z1)(4), the exemption from producing a PADR will no longer apply if we consider that an additional credible option that could deliver a material market benefit is identified during the consultation period.

Accordingly, if we consider that any additional credible options are identified, we will produce a PADR which includes an NPV assessment of the net market benefit of each additional credible option.

Should we consider that no additional credible options were identified during the consultation period, we intend to produce a PACR that addresses all submissions received, including any issues in relation to the proposed preferred option raised during the consultation period, and presents our conclusion on the preferred option for this RIT-T.

Submissions and next steps

The purpose of this PSCR is to set out the reasons we propose that action be taken, present the options that address the identified need, outline the technical characteristics that non-network options will need to provide, and allow interested parties to make submissions and provide input to the RIT-T assessment.

We welcome written submissions on materials contained in this PSCR. Submissions are due on 13 September 2023.

Submissions should be emailed to our Regulation team via regulatory.consultation@transgrid.com.au.[4] In the subject field, please reference 'Line 16 PSCR'.

At the conclusion of the consultation process, all submissions received will be published on our website. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement.

Subject to additional credible options being identified during consultation, we anticipate publication of a PACR in December 2023.

4 We are bound by the *Privacy Act 1988 (Cth)*. In making submissions in response to this consultation process, we will collect and hold your personal information such as your name, email address, employer and phone number for the purpose of receiving and following up on your submissions. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement. See Privacy Notice within the Disclaimer for more details.

Contents

1. Introduction

We are applying the Regulatory Investment Test for Transmission (RIT-T) to options for mitigating safety, environmental (bushfire) and financial (high reactive maintenance) risks caused by the deteriorating condition of certain components of the 330 kV line running between the Marulan and Avon substations on the Southern NSW network ('Line 16'). Publication of this Project Specification Consultation Report (PSCR) represents the first step in the RIT-T process.

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 PSCR[5] is to:

- set out the reasons why we propose that action be undertaken (the 'identified need');
- present the options that we currently consider address the identified need;
- outline the technical characteristics that non-network options would need to provide (although we note that non-network options are unlikely to be able to contribute to meeting the identified need for this RIT-T);
- present the economic assessment of all credible options, as well as the assumptions feeding into the analysis, and identify a preferred option at this draft stage of the RIT-T; and
- allow interested parties to make submissions and provide inputs to the RIT-T assessment.

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 PSCR, and the RIT-T more broadly, is to provide interested stakeholders the opportunity to review the analysis and assumptions, provide input to the process, and have certainty and confidence that the preferred option has been robustly identified as optimal.

1.2. Exemption from preparing a PADR

NER clause 5.16.4(z1) provides for a TNSP to be exempt from producing a Project Assessment Draft Report (PADR) for a particular RIT-T application, in the following circumstances:

- if the estimated capital cost of the preferred option is less than $46 million;
- if the TNSP identifies in its PSCR its proposed preferred option, together with its reasons for the preferred option and notes that the proposed investment has the benefit of the clause 5.16.4(z1) exemption; and

5 See Appendix A for the National Electricity Rules requirements.

- if the TNSP considers that the proposed preferred option and any other credible options in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding.

We consider the investment in relation to Option 2 meets these criteria and therefore that we are exempt from producing a PADR under NER clause 5.16.4(z1).

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Accordingly, if we consider that any additional credible options are identified, we will produce a PADR which includes an NPV assessment of the net market benefit of each additional credible option.

1.3. Submissions and next steps

We welcome written submissions on materials contained in this PSCR. Submissions are due on 13 September 2023.

Submissions should be emailed to our Regulation team via regulatory.consultation@transgrid.com.au.[6] In the subject field, please reference 'Line 16 PSCR'.

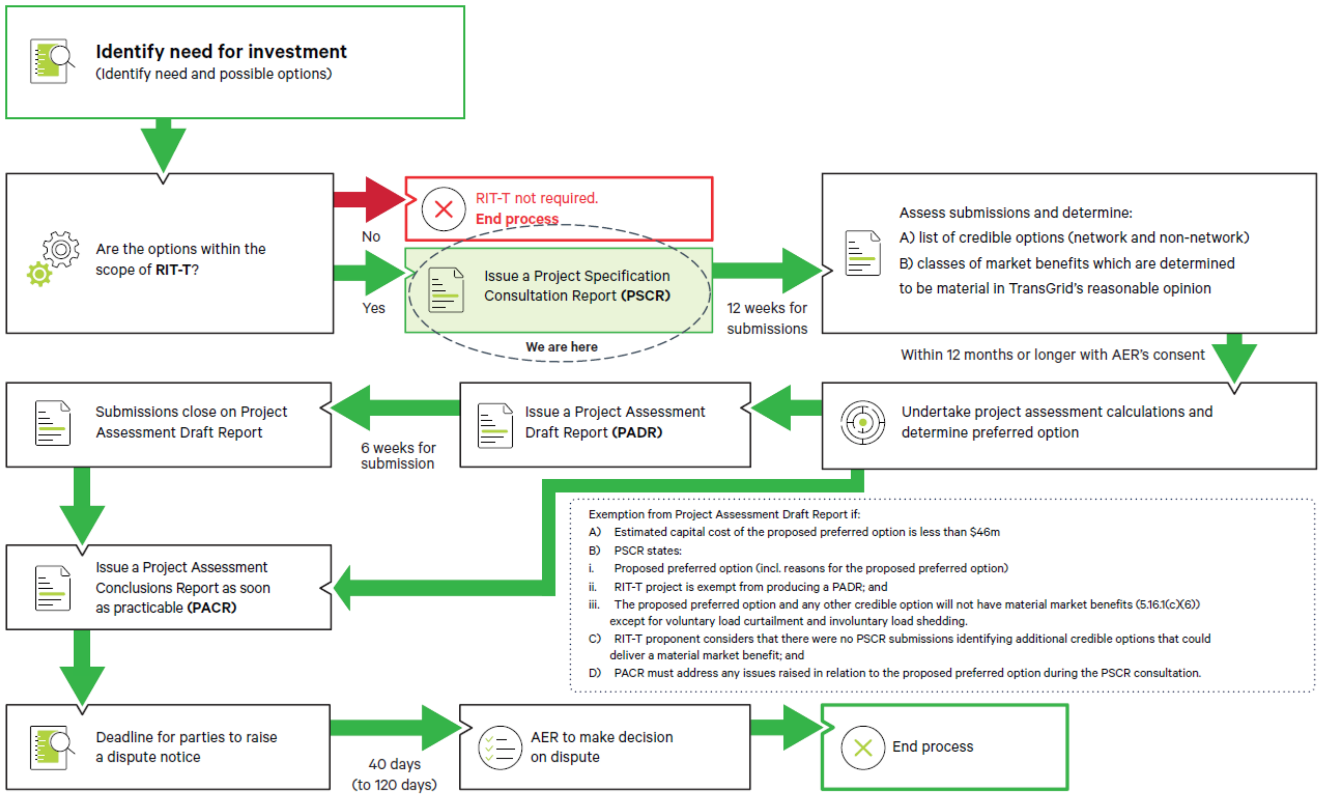
At the conclusion of the consultation process, all submissions received will be published on our website. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement.

Should we consider that no additional credible options were identified during the consultation period, we intend to produce a Project Assessment Conclusions Report (PACR) that addresses all submissions received including any issues in relation to the proposed preferred option raised during the consultation period, and presents our conclusion on the preferred option for this RIT-T.[7] Subject to additional credible options being identified, we anticipate publication of a PACR in December 2023.

[6] We are bound by the *Privacy Act 1988 (Cth)*. In making submissions in response to this consultation process, we will collect and hold your personal information such as your name, email address, employer and phone number for the purpose of receiving and following up on your submissions. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement. See Privacy Notice within the Disclaimer for more details.

[7] In accordance with NER clause 5.16.4(z2).

Figure 1-1 This PSCR is the first stage of the RIT-T process[8]



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

2. The identified need

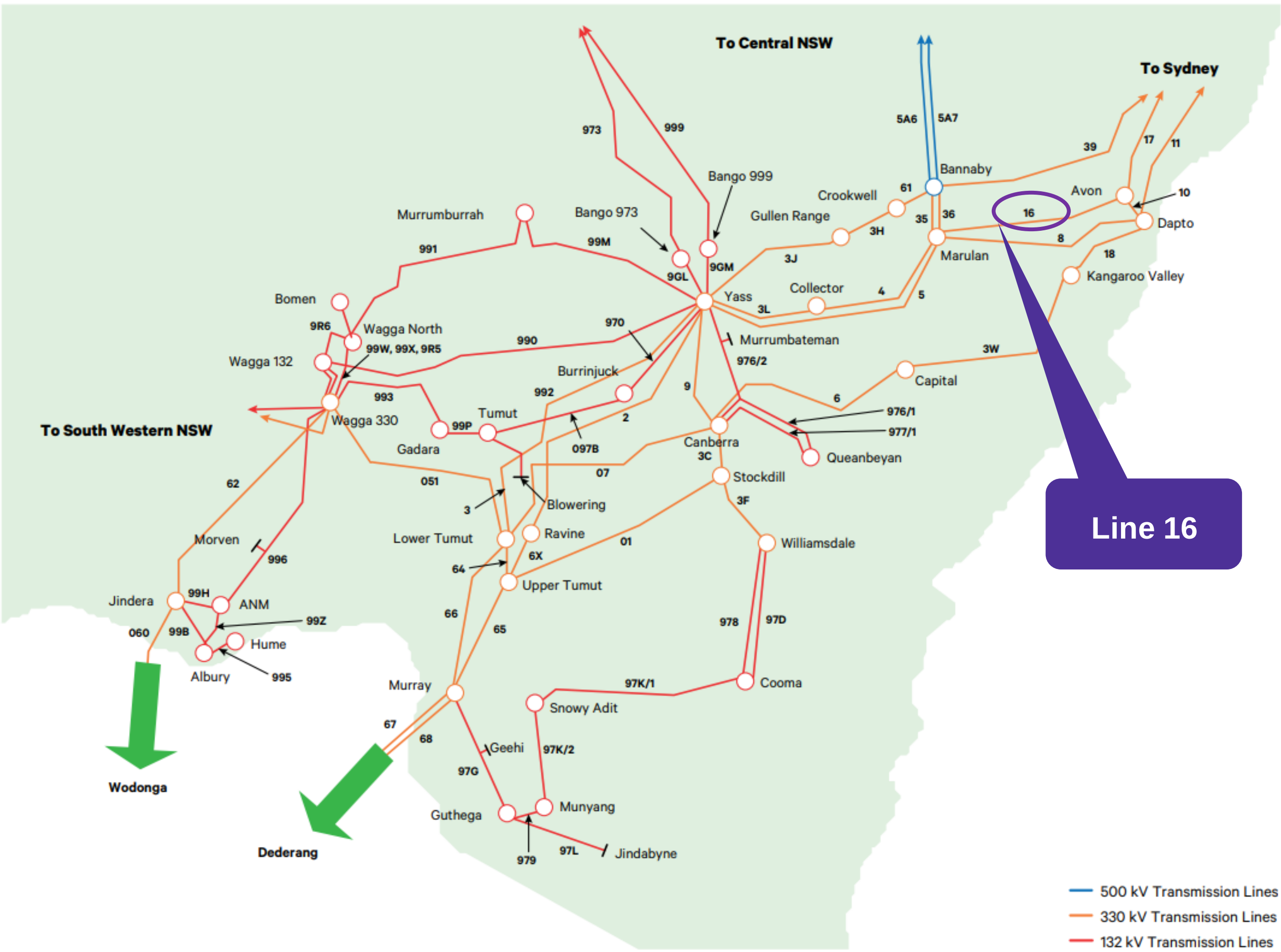
This section outlines the identified need for this RIT-T, as well as the assumptions and data underpinning it. It first sets out background information related to Line 16.

2.1. Background to the identified need

Spanning a route of 71km, Line 16 is a single-circuit 330 kV, steel tower transmission line that runs between Marulan and Avon substations. Constructed in 1962, the line is comprised of 159 structures and forms a key link between Snowy Hydro and the Illawarra and Sydney metropolitan areas. It also links to the network south of Marulan, connecting approximately 650MW[9] of wind generation to the region.

Figure depicts the location of Line 16 in our Southern NSW.

Figure 2-1 Location of Line 16



[9] Summation of generation from Gullen Range Wind Farm, Crookwell 2 and Rye Park Wind Farm.

Line 16 will continue to play a central role in supporting the flow of energy to take advantage of naturally diverse weather patterns, and in the safe and reliable operation of the power system throughout and after the transition to a low-carbon electricity future.

Figure shows typical tension and suspension structures on Line 16.

Figure 2-2 Line 16 tension tower (lefthand side) and suspension tower (righthand side)

As part of our ongoing routine asset monitoring maintenance, we have identified that many of the components of Line 16 are corroded and/or at the end of their serviceable lives, including conductor fittings, corona rings, earthwire (and its fittings), tower steel works and fasteners, and public safety equipment. Following sampling and after service testing of porcelain insulators we have been advised by the manufacturer that they have reached end of serviceable life due to deterioration of the porcelain.

The deterioration of the porcelain insulators and corrosion of fittings, fasteners and other tower elements greatly increases the likelihood of conductor drops and presents consequent safety and bushfire risk to our personnel and the public. While the issue of corrosion as the condition of asset components deteriorate can present a safety risk on any part of the transmission network, the element of bushfire risk is heightened for Line 16 due to its location. Line 16 traverses substantial sections of bushland, much of which surrounds rural and residential areas with 112 of the towers within as the highest bushfire risk consequence category and another 41 in the next highest bushfire consequence category (96% of structures are within the highest and second highest consequence categories). Line 16 also crosses the Hume and Illawarra Highways and another two main roads, and therefore has heightened safety consequences.

Of the 159 structures on Line 16, 156 have been identified as having condition issues, primarily related to insulators reaching end of serviceable life and corrosion. This greatly increases the likelihood of transmission structure failures, conductor drop, and subsequent bushfire and safety risks.

Figure , Figure and Figure below provide illustrative examples of the condition of various components.

Figure 2-3 Deterioration of insulators

Figure 2-4 Corroded earth-wire, fittings and fasteners

Figure 2-5 Corroded fasteners

Figure 2-6 below shows issues related to buried footings and resultant corrosion of ground level steel work.

Figure 2-6 Buried footings

2.2. Description of identified need

The proposed investment will enable us to manage safety and environmental risks on Line 16. 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 line will continue to deteriorate.

Further deterioration of the condition of the affected assets due to corrosion would mean an increase in bushfire and safety risks as the likelihood of failure increases. If left untreated, corrosion and deterioration of some of the vital components of the steel towers could result in incidents such as conductor drop and tower collapse. As the line traverses bushland and urban areas, the risk of bushfire and public safety incidents from conductor drop or structure failure is increased. Such incidents could have serious 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.

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).[10]

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

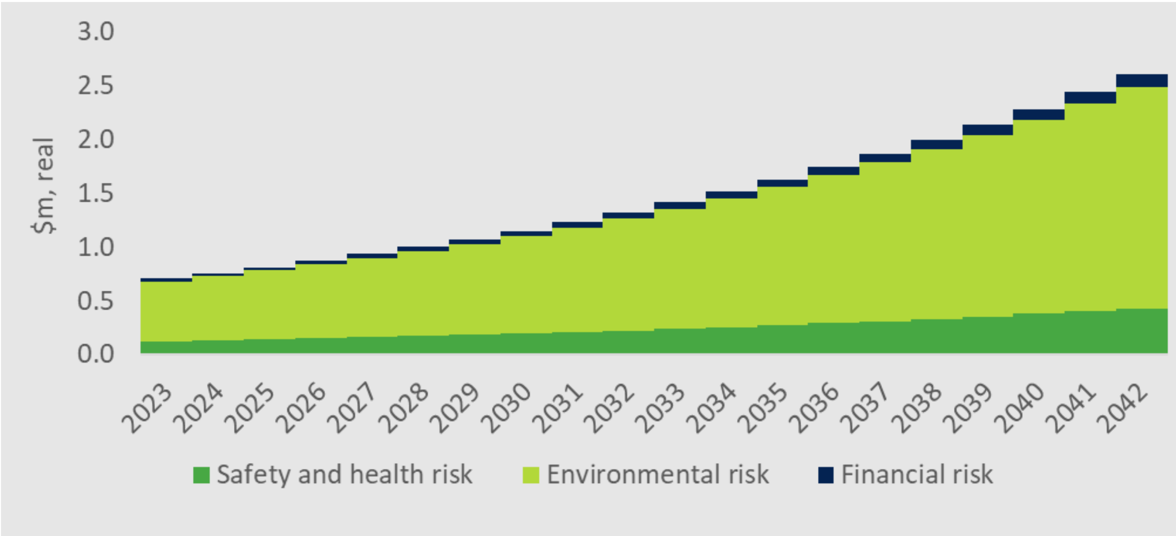
We adopt a risk cost framework to quantify and evaluate the risks and consequences of increased failure rates. Appendix B provides an overview of our Risk Assessment Methodology.

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

We note that the risk cost estimating methodology aligns with that used in our recently submitted Revised Revenue Proposal for the 2023-28 period. It reflects feedback from the Australian Energy Regulator (AER) on the methodology initially proposed in our initial Revenue Proposal.

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

Figure 2-7 Estimated risk costs



This section describes the assumptions underpinning our assessment of the risk costs, ie, the value of the risk avoided by undertaking each of the credible options. The aggregate risk cost under the base case is currently in 2023 is estimated at around $707,447/year and it is expected to increase going forward if action is not taken and the line is left to deteriorate further (reaching approximately $1.1 million/year by 2030 and $2.6 million/year 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.[11] 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.

The asset health issues identified on Line 16 is summarised in Table 2-1.

[11] 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

Table 2-1: Asset health issues along Line 16 and their consequences

<table>
<tr><th>Issue</th><th>Consequences if not remediated</th></tr>
<tr><td>Drooping of conductor dampers</td><td rowspan="10">Bushfire resulting in potential loss of property and/or life

Safety incident resulting in potential injury or death

Line outage with potential network reliability impacts</td></tr>
<tr><td>Corrosion of conductor fittings and spacers</td></tr>
<tr><td>Corrosion of corona rings</td></tr>
<tr><td>Deteriorated earthwire due to corrosion</td></tr>
<tr><td>Rust on steel at groundline</td></tr>
<tr><td>Porcelain insulators deteriorated and at end of serviceable life</td></tr>
<tr><td>Corrosion of earthwire fittings</td></tr>
<tr><td>Foundation (structure legs) covered with soil</td></tr>
<tr><td>Corrosion of tower members (base and body)</td></tr>
<tr><td>Corrosion of tower fasteners</td></tr>
<tr><td>Poor connection and bird caging of earthwire bonding</td><td>Safety incident resulting in potential injury or death</td></tr>
<tr><td>Damaged/loose earthwire dampers</td><td>Line outage with potential network reliability impacts</td></tr>
<tr><td>Faded aerial marker balls, deteriorated public safety and identification signage and deteriorated climbing deterrents</td><td>Safety incident resulting in potential injury or death

Line outage with potential network reliability impacts</td></tr>
</table>

Asset Health is used to estimate the remaining 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 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 recently undertook an assessment with the University of Melbourne[12]to improve our quantification of

[12] Refer to Network Asset Criticality Framework

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;
- 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 in to 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 bushfire risk.[13]

Bushfire risk is the largest of all risks quantified under the base case for this RIT-T, making up approximately 79 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 takes into account the cost associated with a fatality or injury including compensation, loss of productivity, litigation fees, fines and any other related costs.

Our safety model has recently been updated and developed in conjunction with asset management specialist consultancy AMCL[14]. 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.[15]

Safety risk is the second largest of all risks quantified under the base case for this RIT-T, making up 17 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.

[13] Refer to section 6.2.5 of the Network Risk Assessment Methodology
[14] Refer to Network Asset Criticality Framework
[15] Refer to section 6.2.5 of the Network Risk Assessment Methodology

Financial risk is the lowest of all risks quantified under the base case for this RIT-T, making up 4 per cent of the total estimated risk cost in present value terms.

3. 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 two 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 reasons for various reasons that are outlined in Table .

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

3.1. Base case

The costs and benefits of each option in this PSCR are compared against those of a base case. Under this base case, no proactive capital investment is made to remediate the deterioration of Line 16 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 $1.1 million per year in safety, environmental and financial risk costs by 2030, rising to $2.6 million per year by the end of the assessment period.[16] The environmental and safety risk costs are mainly due to the significant consequences of a bushfire event resulting from conductor drop or structure failure and risks associated with compromised earthing. Under the base case, all of these risks will continue to increase.

The annual transmission line routine operating expenditure under the base case is $22,970. We do not expect this to change with any of the investment options being considered, since the options will not change the frequency of planned inspections (however, the reactive maintenance costs do differ and are captured under financial risks).

3.2. Option 1 – Remediate identified condition issues for line components that have priority condition issues and/or have reached end of serviceable life

Option 1 involves:

- replacement of all suspension insulators and conductor fittings on Line 16 that have been identified as having priority condition issues (127 in total);
- remediation of all public safety related issues (signage, climbing deterant, etc.);
- remediation of all earth-wire fittings that have identified condition issues based on the latest Transmission Line Refurbishment Criteria document; and
- remediate all covered foundations and corroded groundline steel.

The works are estimated to take 30 months to complete. Project completion is assumed in 2025/26.

[16] 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.

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 $8.6 million. The estimated capital cost of this option is approximately $8.6m (June $2022) +/-25 per cent. Table shows the expected expenditure profile of this option.

Table 3-1 Option 1 Capital Cost (June $2022 million)

Item	Capital expenditure ($M +/- 25%, Real $2021-22)
FY23	0.1
FY24	0.6
FY25	7.9
Total capital cost	**8.6**

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

3.3. Option 2 – Remediate all identified condition issues on the line

Option 2 involves:

- replacement of all insulators and conductor fittings on Line 16 with condition issues (153 in total);
- remediation of all earth-wire and earth-wire fittings that have identified condition issues based;
- remediate all covered foundations and corroded groundline steel;
- remediation of all tower fasteners and steelwork with corrosion issues;
- remediation of all public safety related issues (signage, climbing deterrent, etc.); and
- remediate all covered foundations and corroded groundline steel.

The works are estimated to take 31 months to complete. Project completion is assumed in 2025/26.

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 cost of this option is approximately $9.4m (June $2022) +/-25 per cent. Table shows the expected expenditure profile of this option.

Table 3-2 Option 2 Capital Cost (June $2022 million)

Item	Capital expenditure ($M +/- 25%, Real $2021-22)
FY23	0.8
FY24	0.6

Item	Capital expenditure ($M +/- 25%, Real $2021-22)
FY25	8.0
Total capital cost	**9.4**

This option has a greater estimated risk reduction than Option 1 due to it addressing all identified components with condition issues.

3.4. Options considered but not progressed

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

Table 3-1 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 double circuit 330 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 safety and environment (bushfire) risks posed as a result of corrosion-related asset deterioration. This is outlined in section 4 below in more detail.

3.5. No material inter-network impact is expected

We have considered whether the credible options listed above is expected to have material inter-regional impact.[17] 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:[18]

- 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;

[17] As per clause 5.16.4(b)(6)(ii) of the NER.

[18] 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

- 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.

4. Non-network options

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 safety and environment risk posed as a result of corrosion-related asset deterioration.

For non-network options to assist, they would need to provide greater net economic benefits than the network options. That is, non-network options would need to reduce the safety and bushfire risk related costs (which in practice are not expected to be affected by non-network solutions).

4.1. Required technical characteristics of non-network options

The objective of this identified need is not load dependent. Line 16 forms part of the network supplying the Illawarra and Sydney metropolitan regions, which are part of the meshed 330 kV network. Unserved energy is therefore not a key driver for this RIT-T (in fact, it is expected to be immaterial under the base case and consequently has not been estimated).

Non-network options are unable to technically reduce the safety and risk related costs associated with the deteriorating asset condition, which forms the identified need for this RIT-T.

Any non-network solution is therefore only expected to only add to the costs of the options considered.

In summary, we consider that non-network options are unable to contribute to meeting the identified need for this RIT-T – this is based on:

- the fact that identified need for this investment is not driven by avoiding potential unserved energy so that no amount of demand reduction would defer or avoid the preferred network option – irrespective of the size, nature and location of the non-network option; and
- any non-network solution for this need is expected to only add to the costs of this option. That is, non-network options would not provide any net benefits.

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.[19]

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.[20]

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 minor impact on pool price);
- changes in costs for parties other than the RIT-T proponent;
- changes in ancillary services costs;
- changes in network losses;
- competition benefits; and
- Renewable Energy Target (RET) penalties.

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 .

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

Market benefits	Reason
Changes in involuntary load curtailment	Since Line 16 forms part of a meshed network (with an N-1 level of redundancy) required to supply the Sydney metropolitan area and Illawarra region, 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.

[19] 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.

[20] Australian Energy Regulator. "*Application guidelines Regulatory Investment Test for Transmission - August 2020.*" Melbourne: Australian Energy Regulator. https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf

Market benefits	Reason
Option value	We note the AER's view 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.[21] We also note the AER's 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. 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.

21 Australian Energy Regulator. "*Application guidelines Regulatory Investment Test for Transmission - August 2020.*" Melbourne: Australian Energy Regulator. https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf

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.[22]

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 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 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 5.50 per cent has been adopted as the central assumption for the NPV analysis presented in this PSCR, consistent with the assumptions adopted in AEMO's 2022 Integrated System Plan (ISP).[23] 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.[24] We have also adopted an upper bound discount rate of 7.50 per cent (ie, the upper bound proposed for the 2022 ISP).[23]

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.

22 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. Australian Energy Regulator. "Application guidelines Regulatory Investment Test for Transmission - August 2020." Melbourne: Australian Energy Regulator. https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf

23 AEMO, *2022 Integrated System Plan, June 2022*, p 91.

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

The cost estimates are developed using our 'MTWO' cost estimating system. This system utilises historical average costs, updated by the costs of the most recently implemented project with similar scope. All estimates in MTWO are developed to deliver a 'P50' portfolio value for a total program of works (i.e., there is an equal likelihood of over- or under-spending the estimate total).[25]

We estimate that actual costs will be within +/- 25 per cent of the central capital cost estimate. 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 Association for the Cost Engineering classification system.

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 PSCR assessment, which differ in terms of the key drivers of the estimated net market benefits (ie, the estimated risk costs avoided).

Given that wholesale market benefits are not relevant for this RIT-T, the three scenarios assume the most likely scenario from the 2022 ISP (ie, the 'Step Change' scenario). The scenarios differ by the assumed level of risk costs and, 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 Transgrid's 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 (ie, where wholesale market benefits are not expected to be material).[26,27]

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.
26 AER, *Application Guidelines Regulatory Investment Test for Transmission*, August 2020, pp. 40-41.
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.

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	5.50%	5.50%	5.50%
Network capital costs	Base estimate	Base estimate	Base estimate
Operating and maintenance costs	Base estimate	Base estimate	Base estimate
Safety, environmental 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 PSCR are:

- lower and higher assumed capital costs;
- lower and higher estimated safety, environmental 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.

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.

7.1. Estimated gross benefits

Table 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, ie, a reduction in safety, environmental 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	11.72	8.79	14.65	11.72
Option 2	13.09	9.82	16.36	13.09

7.2. Estimated costs

Table 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, and is the same for each option in all scenarios given nothing that affects the direct costs is varied between scenarios.

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

Option	Cost
Option 1	5.86
Option 2	6.48

7.3. Estimated net economic benefits

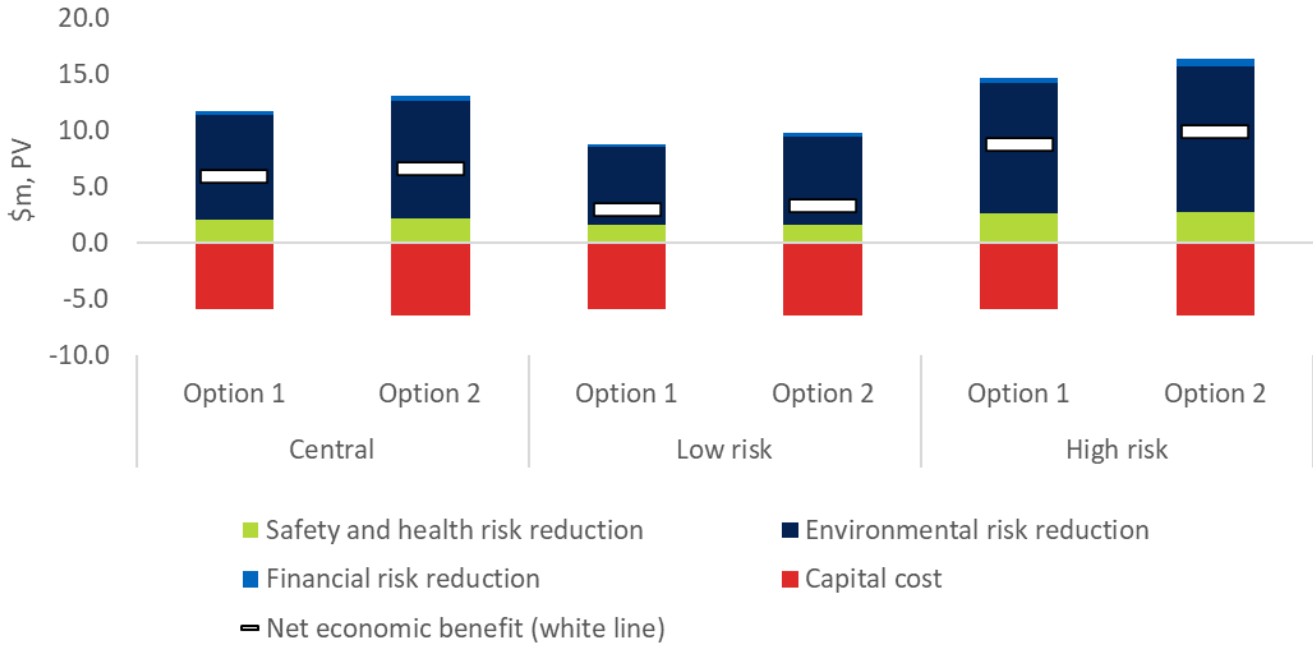
The net economic benefits are the differences between the estimated gross benefits less the estimated costs. Table below summarises the present value of the net economic benefits for each credible option across the three scenarios and the weighted net economic benefits.

Table 7-3 Net economic benefits for Option 1 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	5.86	2.93	8.79	5.86
Option 2	6.61	3.33	9.88	6.61

All options are found to have positive net benefits for all scenarios investigated. On a weighted basis, Option 2 is found to deliver the greater net economic benefits at approximately $6.61 million (11 per cent greater than Option 1).

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, if expected safety and environmental risks are not as high as expected, for example, 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 2 is found to be invariant to the assumptions of:

- a 25 per cent decrease in the assumed network capital costs;
- higher assumed safety, environmental and financial risks; and
- lower discount rate of 3.21 per cent as well as a higher rate of 7.5 per cent.

The optimal timing of Option 2 is found to be variant to the assumptions of:

- a 25 per cent increase in the assumed network capital costs; and
- lower assumed safety, environmental and financial risks.

These alternate assumptions push the optimal timing back two years and three years, respectively.

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

Figure 7-2 Optimal timing of Option 2

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 safety, environmental and financial risks; and
- lower discount rate of 3.21 per cent as well as a higher rate of 7.5 per cent.

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

Figure , Figure and Figure below illustrate the estimated net economic benefits for each option if separate key assumptions in the central scenario are varied individually. Option 2 delivers positive benefits under all scenarios.

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. 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

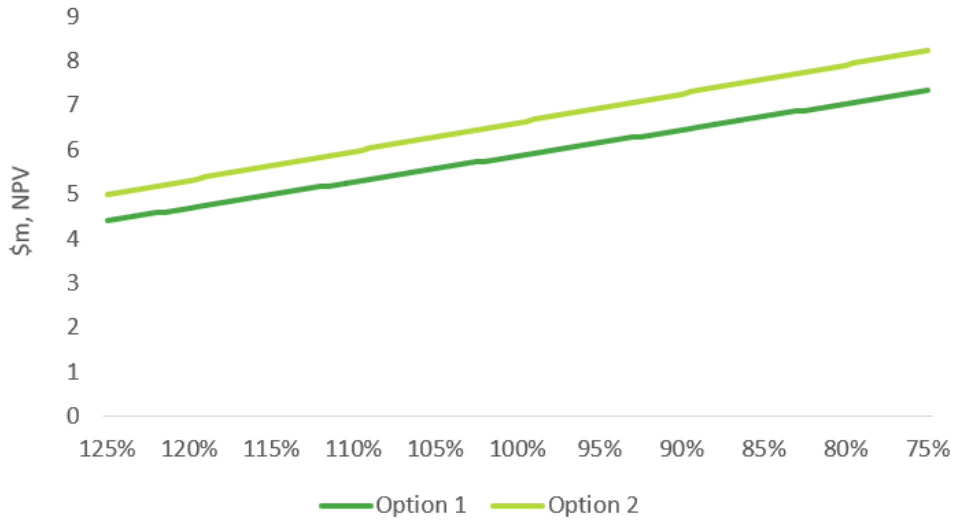


Figure 7-4 Risk costs sensitivity

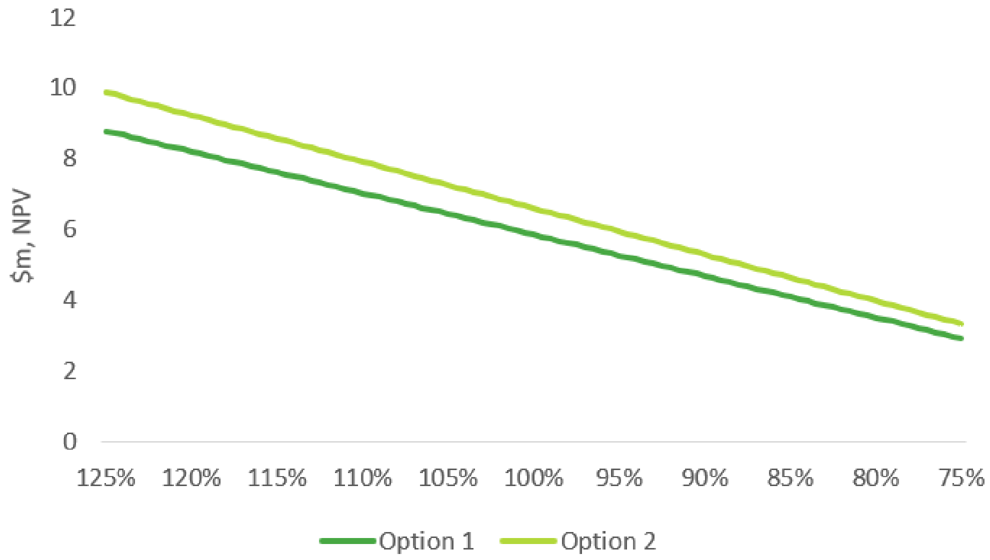
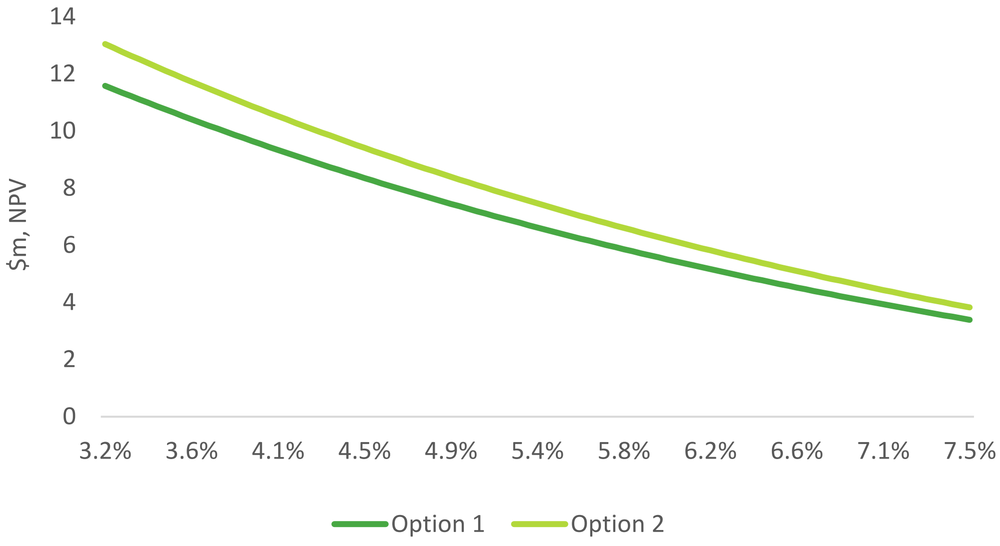


Figure 7-5 Commercial discount rate sensitivity



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

- assumed network capital costs (for all options) would need to increase by 113 per cent;
- the estimated risk costs (in aggregate) would need to fall by approximately 54 per cent; or
- the discount rate would need to be greater than 11.9 per cent.

We therefore consider the finding that Option 2 is preferred over Option 1 to be robust to the key underlying assumptions.

8. Draft conclusion and exemption from preparing a PADR

This PSCR has found that Option 2 is the preferred option at this draft stage of the RIT-T. Option 2 involves:

- replacement of all insulators and conductor fittings on Line 16 with condition issues (153 in total);
- remediation of all earth-wire and earth-wire fittings that have identified condition issues based;
- remediate all covered foundations and corroded groundline steel;
- remediation of all tower fasteners and steelwork with corrosion issues;
- remediation of all public safety related issues (signage, climbing deterrent, etc.); and
- remediate all covered foundations and corroded groundline steel.

Option 2 delivers the greatest risk reduction of the two options and, overall, the greatest estimated net market benefits. Option 2 also remains the preferred option across all sensitivities tested.

The estimated capital expenditure associated with this option is $9.4 million. Routine operating and maintenance costs are the same as the base case for this option (estimated at $22,970 per year).

The works are estimated to take 31 months to complete. Project completion is assumed in 2025/26.

NER clause 5.16.4(z1) provides for a TNSP to be exempt from producing a PADR for a particular RIT-T application, in the following circumstances:

- if the estimated capital cost of the preferred option is less than $46 million;
- if the TNSP identifies in its PSCR its proposed preferred option, together with its reasons for the preferred option and notes that the proposed investment has the benefit of the clause 5.16.4(z1) exemption; and
- if the TNSP considers that the proposed preferred option and any other credible options in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding.

We consider that the investment in relation to Option 2 meets these criteria and therefore that we are exempt from producing a PADR under NER clause 5.16.4(z1).

In accordance with NER clause 5.16.4(z1)(4), the exemption from producing a PADR will no longer apply if we consider that an additional credible option that could deliver a material market benefit is identified during the consultation period.

Accordingly, if we consider that any additional credible options are identified, we will produce a PADR which includes an NPV assessment of the net market benefit of each additional credible option.

Should we consider that no additional credible options were identified during the consultation period, we intend to produce a PACR that addresses all submissions received, including any issues in relation to the proposed preferred option raised during the consultation period, and presents our conclusion on the preferred option for this RIT-T.

Appendix A Compliance checklist

This appendix sets out a checklist which demonstrates the compliance of this PSCR with the requirements of the National Electricity Rules version 200.

Rules clause	Summary of requirements	Relevant section
5.16.4 (b)	A RIT-T proponent must prepare a report (the project specification consultation report), which must include:	–
	(1) a description of the identified need;	2
	(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-T proponent considers reliability corrective action is necessary);	2
	(3) the technical characteristics of the identified need that a non-network option would be required to deliver, such as: (i) the size of load reduction of additional supply; (ii) location; and (iii) operating profile;	4
	(4) if applicable, reference to any discussion on the description of the identified need or the credible options in respect of that identified need in the most recent National Transmission Network Development Plan;	NA
	(5) a description of all credible options of which the RIT-T proponent is aware that address the identified need, which may include, without limitation, alterative transmission options, interconnectors, generation, demand side management, market network services or other network options;	3
	(6) for each credible option identified in accordance with subparagraph (5), information about: (i) the technical characteristics of the credible option; (ii) whether the credible option is reasonably likely to have a material inter-network impact; (iii) the classes of market benefits that the RIT-T proponent considers are likely not to be material in accordance with clause 5.16.1(c)(6), together with reasons of why the RIT-T proponent considers that these classes of market benefit are not likely to be material; (iv) the estimated construction timetable and commissioning date; and (v) to the extent practicable, the total indicative capital and operating and maintenance costs.	3 & 5
5.16.4(z1)	A RIT-T proponent is exempt from [preparing a PADR] (paragraphs (j) to (s)) if: 1. the estimated capital cost of the proposed preferred option is less than $35 million[28] (as varied in accordance with a cost threshold determination); 2. the relevant Network Service Provider has identified in its project specification consultation report: (i) its proposed preferred option; (ii) its reasons for the proposed preferred option; and (iii) that its RIT-T project has the benefit of this exemption;	8

[28] Varied to $46m based on the AER Final Determination: Cost threshold review November 2021.4. Accessed 19 November 2021 https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/cost-thresholds-review-for-the-regulatory-investment-tests-2021

	3. the RIT-T proponent considers, in accordance with clause 5.16.1(c)(6), that the proposed preferred option and any other credible option in respect of the identified need will not have a material market benefit for the classes of market benefit specified in clause 5.16.1(c)(4) except those classes specified in clauses 5.16.1(c)(4)(ii) and (iii), and has stated this in its project specification consultation report; and 4. the RIT-T proponent forms the view that no submissions were received on the project specification consultation report which identified additional credible options that could deliver a material market benefit.	

Appendix B Risk Assessment Methodology

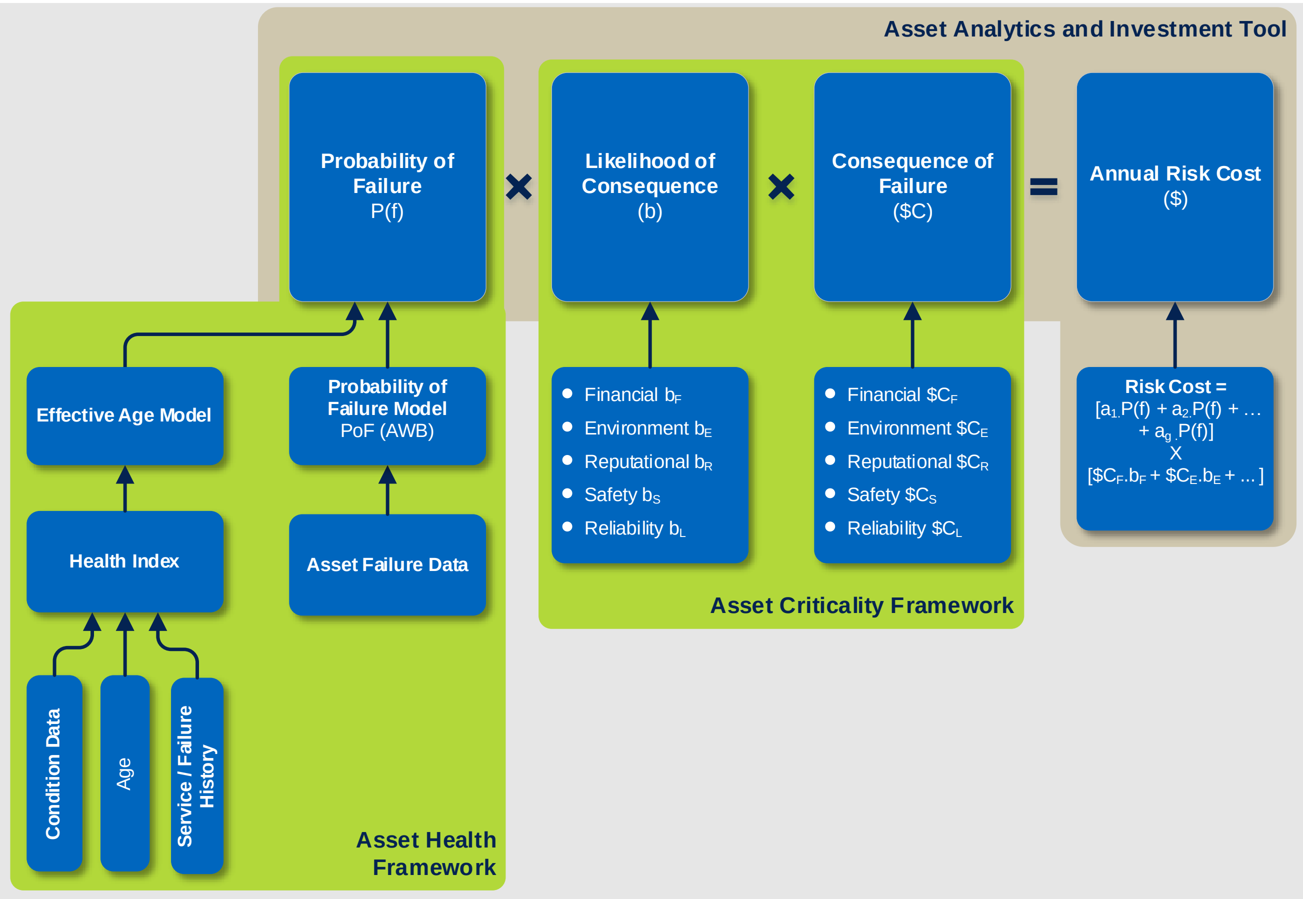
This appendix summarises our network risk assessment methodology that underpins the identified need for this RIT-T. Our risk assessment methodology is aligned with the AER's Asset Replacement Planning guideline[29] and its principles.

A fundamental part of the risk assessment methodology is calculating the annual 'risk costs' or the monetised impacts of the reliability, safety, bushfire, environmental 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- 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-8-1 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

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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,[30] 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 Table C-1 below. Further details available in our Network Asset Health Methodology.

Table C-1 Weibull parameters for asset components

Asset component	Weibull parameters	
	η	β
Structure - Towers C1	3901	1.32
Structure - Towers C2	879.4	3.1
Structure - Towers C3	270.9	2.17
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.

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