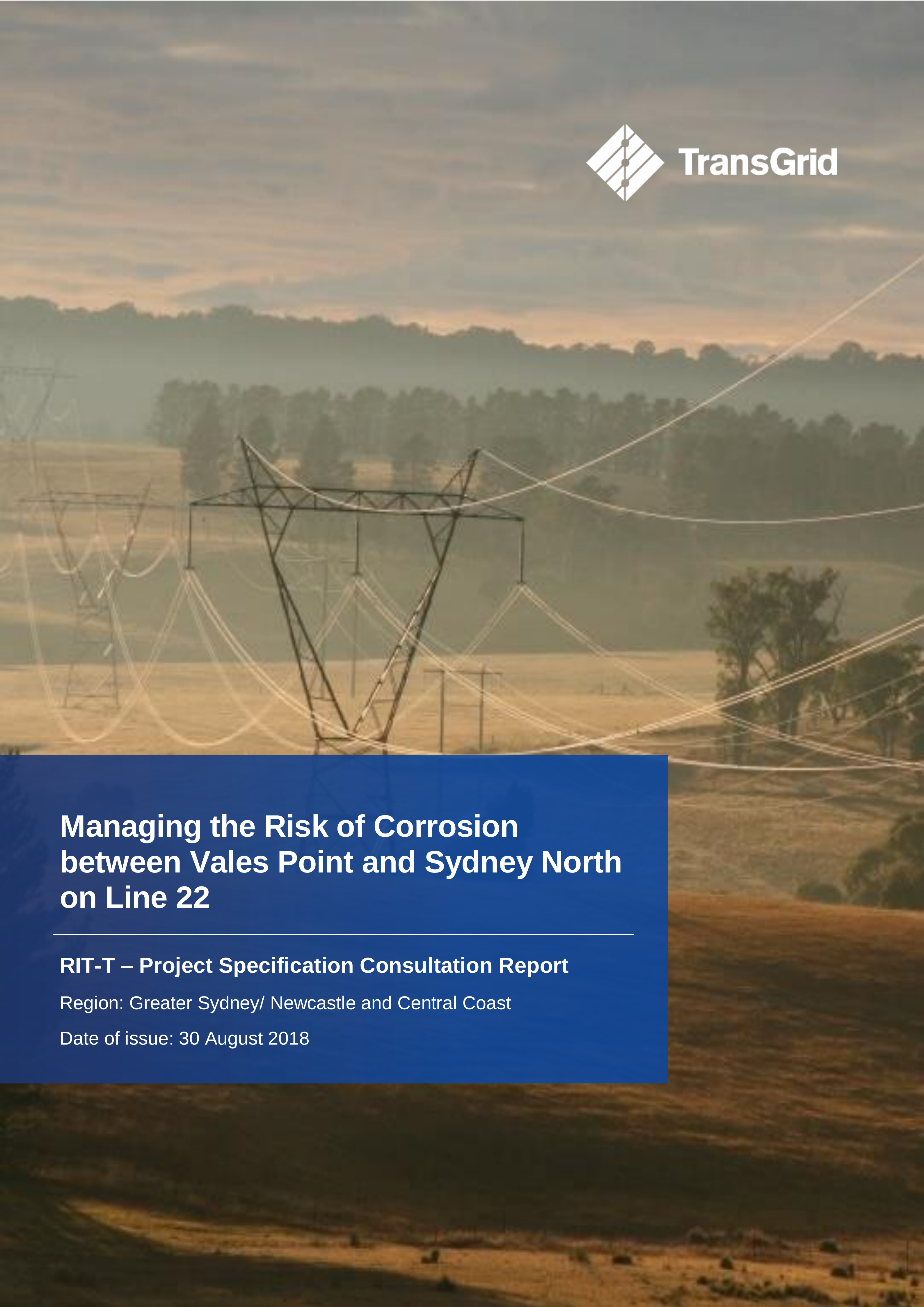

Managing the Risk of Corrosion between Vales Point and Sydney North on Line 22

RIT-T – Project Specification Consultation Report

Region: Greater Sydney/ Newcastle and Central Coast

Date of issue: 30 August 2018

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Executive summary

This RIT-T has been initiated to address corrosion issues on a key transmission line from the Central Coast to Sydney

This report represents the first step in the application of the Regulatory Investment Test for Transmission (RIT-T) to options for mitigating the risk TransGrid, and its ultimate downstream consumers, face in terms of corroding components of one of the key 330 kV transmission lines from the Central Coast to Sydney.

In particular, constructed in 1962, Line 22 is a single circuit steel tower 330 kV transmission line connecting Vales Point and Sydney North 330 kV substations. The transmission line is 86km long and predominately traverses small rural holdings, heavily timbered ridgetops and National Parks. It crosses the M1 Motorway, Pacific Highway and Main Northern Railway line as well as numerous local roads.

The transmission line is part of the meshed network supplying Sydney, which meets the reliability standard of N-1 and N-2 redundancies. It is therefore part of the network that connects existing generators north of Sydney (including the Central Coast, Upper Hunter and northern NSW) and the major load centre of Sydney East, Sydney North and Tuggerah.

As part of TransGrid's ongoing routine asset monitoring maintenance, it has been revealed that many of the 190 transmission structures of Line 22 are corroded, including steel towers, insulators, conductor fittings and conductor/earth wire. These steel components were coated at manufacture with a sacrificial galvanising layer to protect the steel from corrosion. Over time this galvanising layer has been consumed and now the steel itself is being consumed, accelerating the process of corrosion.

Corrosion greatly increases the likelihood of conductor drops and presents consequent bushfire risks and safety risks. While this is the case for any corroded elements of the transmission network, the bushfire risks are exacerbated for Line 22 as the line traverses substantial sections of bushland, much of which surrounds residential and urban areas.

Asset health assessments since 2016 have identified the corrosion related issues on Line 22 and the plan to refurbish the line by replacing the identified corroding components has been in-place since. An allowance has been made for this work in TransGrid's 2018-23 Revenue Proposal to the Australian Energy Regulator.

Rule changes to the National Electricity Rules (NER) in July 2017 extended the application of regulatory investment tests to replacement capital expenditure from 18 September 2017. The application of the RIT-T to replacement expenditure commenced on 18 September 2017, however, all replacement expenditure projects that were 'committed' by 30 January 2018 are exempt.

While the planning process for replacing the identified components of Line 22 are now well-advanced, the project is not yet 'committed'. Accordingly, TransGrid has initiated this RIT-T to consult on its proposed expenditure related to replacing these assets.

The 'identified need' for this RIT-T focuses on mitigating bushfire risk

TransGrid manages and mitigates bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with TransGrid's obligations under the *New South Wales Electricity Supply (Safety and Network Management) Regulation 2014* and TransGrid's Electricity Network Safety Management System. In particular, risks are mitigated unless the cost involved in further reducing the risk would be grossly disproportionate to the benefit gained.

TransGrid considers this a ‘reliability corrective action’ under the RIT-T as the proposed investment is for the purpose of meeting service standards linked to applicable regulatory instruments. Overall, TransGrid considers that the option proposed in this Project Specification Consultation Report (PSCR) will enable TransGrid to appropriately manage the bushfire and safety risks associated with Line 22 going forward.

TransGrid considers that refurbishing Line 22 is the only credible network option

TransGrid considers that there is only one feasible option from a technological and project delivery perspective, ie, replacing or refurbishing the identified corroded components in one-go.

This involves remediation of Line 22, including the treatment of corrosion of tower steelwork and replacement of components which have reached end of life due to corrosion. The estimated capital cost of this option is approximately $9.08 million and, by undertaking the remediation works, the life of the asset will be extended by approximately 20 years.

We have also investigated a range of other potential network options, including, staging the delivery of the remediation work over multiple years, replacing Line 22 and decommissioning the line. However, each of these potential options are considered strongly inferior to the refurbishment option, primarily due to significantly higher costs, and so have not been progressed.

In addition, while the remediation work is considered the only feasible option from a technological and project delivery perspective, we have investigated alternate timings for delivery. This assessment has confirmed that the optimal commissioning is as soon as possible, ie, 2021/22.

TransGrid does not consider network support solutions can address the bushfire and safety risks

TransGrid does not consider that non-network solutions can assist with meeting the identified need for this RIT-T. This is driven by the fact that the network refurbishment proposed is targeted at reducing the risk of bushfires occurring from physical failure of elements of Line 22 (as opposed to reducing expected unserved energy), as well as the relatively low overall cost of refurbishing the line (ie, $9.08 million in capital cost to replace or refurbish all identified components).

Notwithstanding, this report sets out the required technical characteristics for a non-network option, consistent with the requirements of the RIT-T.

Net benefits have been estimated across three different ‘scenarios’

TransGrid has constructed three alternative scenarios for this PSCR assessment – namely:

> a ‘low benefit’ scenario, involving a number of assumptions that give rise to a lower bound Net Present Value (NPV) estimate for the refurbishment option, in order to represent a conservative future state of the world with respect to potential benefits that could be realised;

> a ‘central’ scenario, which consists of assumptions that reflect TransGrid’s central set of variable estimates which, in TransGrid’s opinion, provides the most likely scenario; and

> a ‘high benefit’ scenario – this scenario reflects an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected net benefits.

A summary of the key variables in each scenario is provided in the table below.

E.Table 1 Summary of the three scenarios investigated

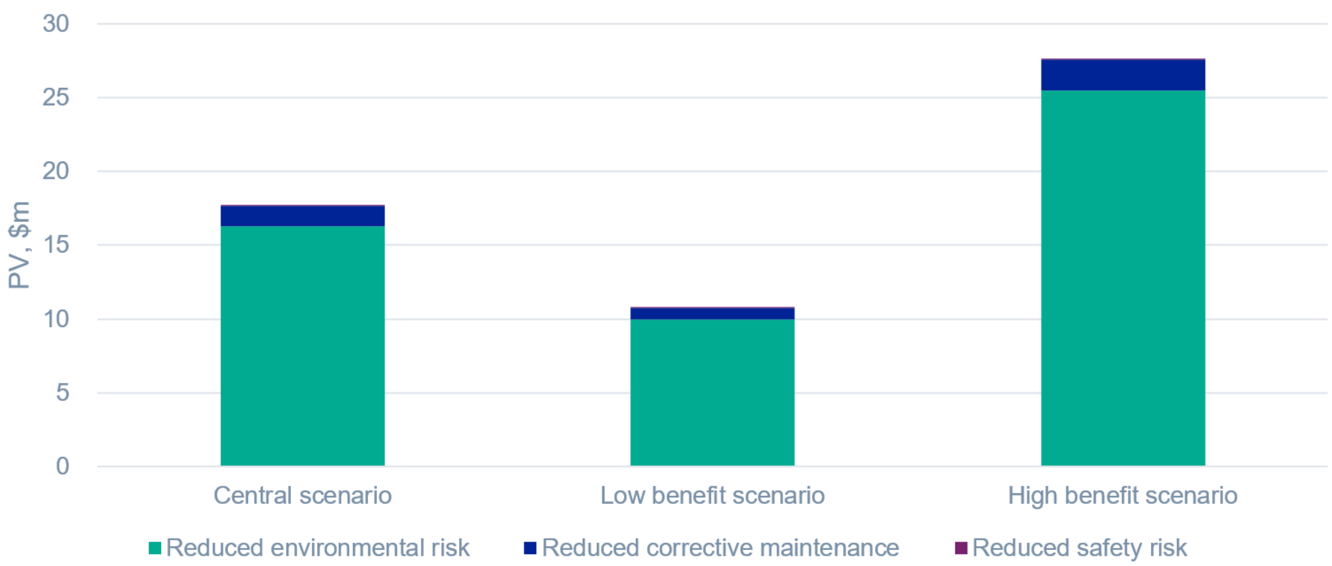
Variable / Scenario	Central	Low benefits	High benefits
Network capital costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Avoided bushfire risk	Base estimate	Base estimate - 25%	Base estimate + 25%
Avoided corrective maintenance	Base estimate	Base estimate - 25%	Base estimate + 25%
Discount rate	7.04 per cent	9.48 per cent	4.60 per cent

The three scenarios do not involve different assumptions about load forecasts (or the VCR) for this RIT-T as avoided unserved energy is expected to be immaterial and the wider identified need is not affected by demand (or the value consumers place on it).

The refurbishment works are found to deliver strongly positive net benefits

The figure below provides a breakdown of benefits estimated for the refurbishing option, showing almost all of the benefits for each option are derived from avoided risk of bushfires (ie, 'environmental risk'), while other avoided costs contribute relatively small amounts to overall gross benefits.

E.Figure 1 Breakdown of gross economic benefits relative to the base case, PV $m



The table below summarises the net market benefit in NPV terms across the three scenarios, as well as on a weighted basis. The table shows that refurbishing Line 22 is found to have positive net market benefits for all scenarios investigated. On a weighted basis, refurbishing the line is expected to deliver approximately $11 million in net market benefits.

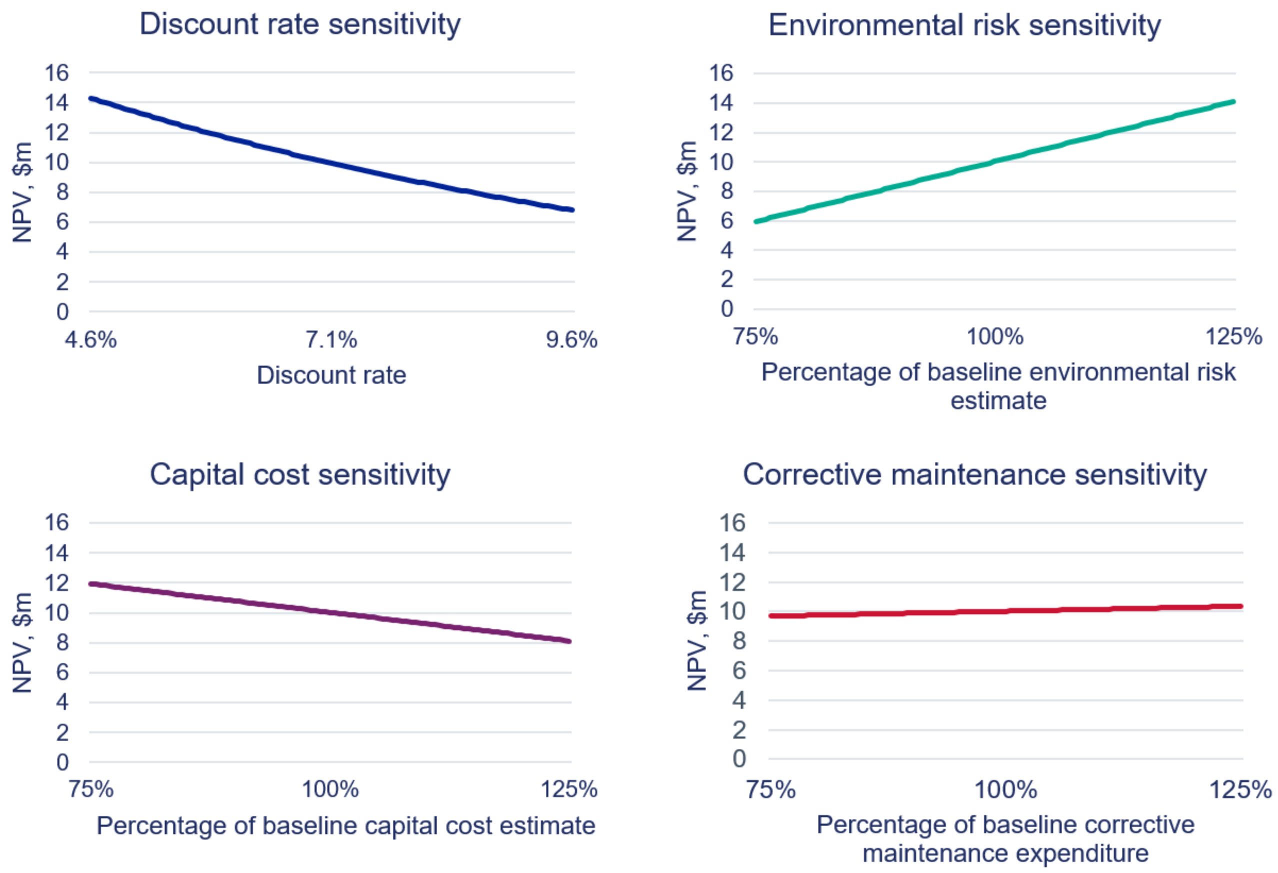
E.Table 2 Present value of net market benefits relative to the base case, PV $m 2017/18

Option/Scenario	Central	Low benefit	High benefit	Weighted
Refurbish Line 22	10.03	1.49	21.74	10.82

TransGrid has also conducted sensitivity analysis on the overall NPV of the net market benefit to investigate the consequences of ‘getting it wrong’ having committed to a certain investment decision.

The four figures below illustrate the estimated net market benefits for each option if we vary four separate key assumptions in the central scenario individually. Importantly, for all sensitivity tests shown below, the estimated net market benefit of refurbishing Line 22 is found to be positive.

E.Figure 2 Sensitivity testing



The results are found to be most sensitive to the assumed bushfire risk avoided. We have extended this sensitivity exercise and found that there would need to be a greater than 60 per cent reduction in the avoided environmental risk estimate to result in no net market benefits (ie, a NPV of zero), holding all else constant. TransGrid considers it extremely unlikely that the central estimate of bushfire risk would fall outside the extended sensitivity.

Draft conclusion and exemption from preparing a Project Assessment Draft Report (PADR)

Refurbishing the existing line is the preferred option at this draft stage and involves replacing the identified corroded components in one-go. In particular, this option involves the remediation of Line 22, including the treatment of corrosion of tower steelwork and replacement of components which have reached end of life due to corrosion. By undertaking the remediation works, the life of the Line 22 is expected to be extended by approximately 20 years.

It is expected that the remediation works will be undertaken in various stages between 2018/19 and 2020/21. The two broad stages to replacing all corroded elements are:

> Stage 1 (2018/19 and 2019/20) – Planning and procurement (including completion of the RIT-T); and

> Stage 2 (2020/21) – Project delivery and construction.

While physical delivery and replacement of the identified assets is planned to occur over 2020/21, it will be delivered in a staged fashion over the course of the year with replacement targeted on asset condition.[1] All work is expected to be completed by 2021/22.

The estimated capital cost of this option is approximately $9.08 million. Routine operating and maintenance cost are approximately $30,000/annum in 2018/19 (around 0.3 per cent of the capital expenditure), which is the same as the base case as these costs relate to planned routine checks of the line by TransGrid field staff.

The preferred option to refurbish the line reduces the bushfire risk to acceptable levels and this risk reduction outweighs the capital expenditure.

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 $41 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.

TransGrid considers that its investment in relation to Option 1 is 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 TransGrid considers that an additional credible option that could deliver a material market benefit is identified during the consultation period.

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

Should TransGrid consider that no additional credible options were identified during the consultation period, TransGrid intends to produce a PACR that addresses all submissions received including any issues in relation to the proposed preferred option raised during the consultation period.[2]

1 Appendix C provides a breakdown of the specific remediation measures included in this option, by issue.

2 In accordance with NER clause 5.16.4(z2).

Submissions and next steps

TransGrid welcomes written submissions on material contained in this PSCR. Submissions are due on or before 29 November 2018.

Submissions should be emailed to TransGrid's Prescribed Revenue & Pricing team via RIT-TConsultations@transgrid.com.au. In the subject field, please reference "PSCR Line 22 project".

Submissions will be published on the TransGrid website. If you do not want your submission to be made publicly available, please clearly specify this at the time of lodging your submission.

Subject to submissions received on this PSCR, a Project Assessment Conclusions Report (PACR), including full option analysis, is expected to be published by February 2019.

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1. Introduction

This Project Specification Consultation Report (PSCR) represents the first step in the application of the Regulatory Investment Test for Transmission (RIT-T) to options for mitigating the risk TransGrid, and its ultimate downstream consumers, face in terms of corroding components of one of the key 330 kV transmission lines from the Central Coast to Sydney (Line 22).

In particular, Line 22 was constructed in 1962 and many of the 190 transmission structures are now corroded, including steel towers, insulators, conductor fittings and conductor/earth wire. The line itself it traverses small rural holdings, heavily timbered ridgetops and National Parks and the failure of the corroding transmission structures and/or physical conductor drops presents bushfire risks and safety risks. While these risks have an inherently low probability, the consequences can be catastrophic.

TransGrid routinely assesses the condition of, and timing of ultimate replacement for, its assets as part of its ongoing asset management processes. Asset health assessments since 2016 have identified a number of corrosion related issues on Line 22 and the plan to refurbish the line by replacing the identified corroding components has been in-place since 2016. An allowance has been made for this work in TransGrid's 2018-23 Revenue Proposal to the Australian Energy Regulator.

Rule changes to the National Electricity Rules (NER) in July 2017 extended the application of regulatory investment tests to replacement capital expenditure from 18 September 2017. The application of the RIT-T to replacement expenditure commenced on 18 September 2017, however, all replacement expenditure projects that were 'committed' by 30 January 2018 are exempt.[3]

While the planning process for replacing the identified components of Line 22 are now well-advanced, the project is not yet 'committed'. Accordingly, TransGrid has initiated this RIT-T to consult on its proposed expenditure related to replacing these assets.

1.1 Purpose of this report

The purpose of this PSCR is to:

- Set out the reasons why TransGrid proposes that action be undertaken (that is, the 'identified need')
- Present the option that TransGrid currently considers addresses the identified need
- Outline the technical characteristics that non-network solutions would need to provide, whilst outlining how these solutions are unlikely to be able to contribute to meeting the identified need for this RIT-T
- Allow interested parties to make submissions and provide input to the RIT-T assessment.

The entire RIT-T process is detailed in Appendix B. The next steps for this particular RIT T assessment are discussed further below.

[3] See paragraph 18 of the AER's RIT-T for the definition of a 'committed project'.

1.2 How to make a submission and next steps

TransGrid welcomes written submissions on material contained in this PSCR. Submissions are due on or before 29 November 2018.

Submissions should be emailed to TransGrid's Prescribed Revenue & Pricing team via RIT-TConsultations@transgrid.com.au. In the subject field, please reference "PSCR Line 22 project".

Submissions will be published on the TransGrid website. If you do not want your submission to be made publicly available, please clearly specify this at the time of lodging your submission.

Subject to submissions received on this PSCR, a Project Assessment Conclusions Report (PACR), including full option analysis, is expected to be published by February 2019.

TransGrid is bound by the *Privacy Act 1988 (Cth)*. In making a submission in response to our consultation process in relation to the Line 22 RIT-T submission, TransGrid will collect and hold your personal information (that is, information about you such as your name, email address, employer and phone number). TransGrid will collect this information for the purpose of receiving your submission and may use your contact details to follow up on your submission. Under the National Electricity Law there are circumstances where TransGrid may be compelled to provide information to the AER. We will advise you should this occur. At the conclusion of the submissions process, all submissions received will be published on the TransGrid website. If you do not wish for your submission to be made publicly available, then please clearly specify this at the time of lodging your submission. Our Privacy Policy sets out our approach to managing your personal information. In particular, it explains how you may seek to access and/or correct the personal information that we hold about you, as well as how to make a complaint about a breach of our obligations under the Privacy Act, and how we will deal with complaints. You can access our Privacy Policy here (https://www.transgrid.com.au/Pages/Privacy.aspx).

2. The identified need for this RIT-T

This section outlines the identified need for this RIT-T, as well as the assumptions and data underpinning it. It first sets out useful background on Line 22 and the assets affected by corrosion.

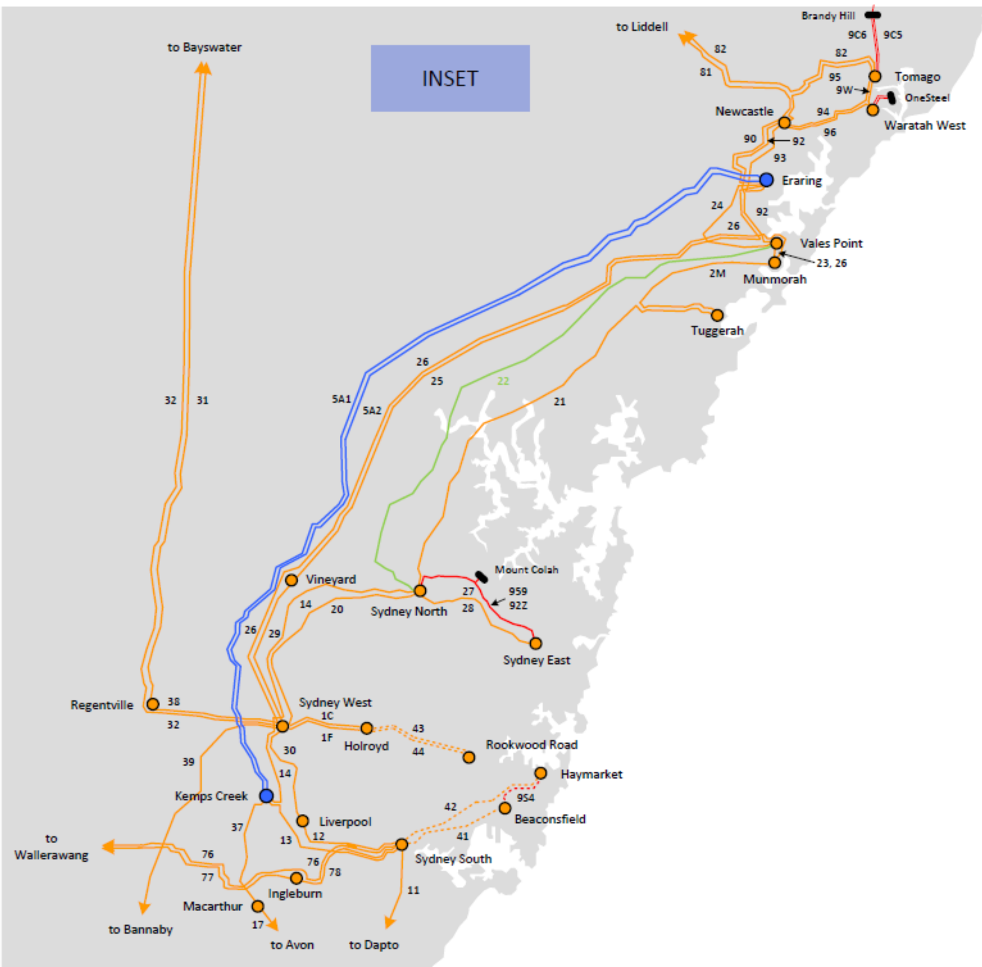
2.1 Background to the identified need

Constructed in 1962, Line 22 is a single circuit steel tower 330 kV transmission line connecting Vales Point and Sydney North 330 kV substations. The transmission line is 86km long and predominately traverses small rural holdings, heavily timbered ridgetops and National Parks. It crosses the M1 Motorway, Pacific Highway and Main Northern Railway line as well as numerous local roads.

The transmission line is part of the meshed network supplying Sydney, which meets the reliability standard of N-1 and N-2 redundancies. It is therefore part of the network that connects existing generators north of Sydney (including the Central Coast, Upper Hunter and northern NSW) and the major load centre of Sydney East, Sydney North and Tuggerah.

The figure below provides an overview of the greater Sydney, Newcastle and Central Coast network, with Line 22 highlighted green.

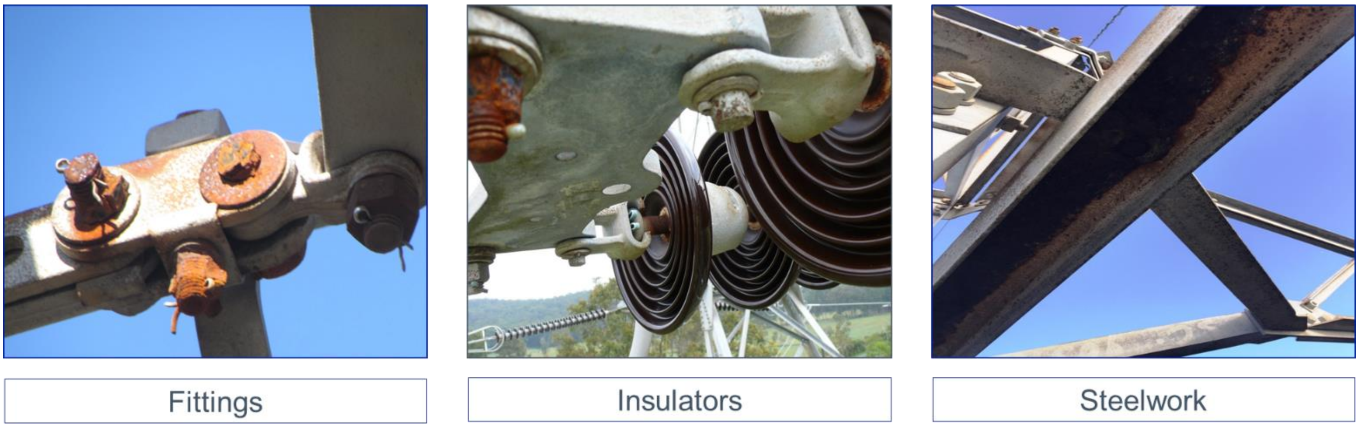
Figure 1 Greater Sydney, Newcastle and Central Coast network



As part of TransGrid's ongoing routine asset monitoring maintenance, it has been revealed that many of the 190 transmission structures of Line 22 are corroded, including steel towers, insulators, conductor fittings and conductor/earth wire. These steel components were coated at manufacture with a sacrificial galvanising layer to protect the steel from corrosion. Over time this galvanising layer has been consumed and now the steel itself is being consumed, accelerating the process of corrosion.

The figure below provides two photos of corroded elements of Line 22 taken by TransGrid field staff.

Figure 2 Examples of corroded elements of Line 22



Corrosion greatly increases the likelihood of conductor drops and presents consequent bushfire risks and safety risks. While this is the case for any corroded elements of the transmission network, the bushfire risks are exacerbated for Line 22 as the line traverses substantial sections of bushland, much of which surrounds residential and urban areas.

The most significant element of concern is ground line corrosion of steel transmission tower legs at the footings. As these are the critical load bearing members of the tower, they cannot be easily remediated if the condition passes a stage where rectification work is not possible. Parts of Line 22 pass also through some low lying and coastal areas which promote buried steel corrosion. Erosion of soil has also led to issues with earth strap corrosion, which further raises the public safety risks.

2.2 Description of the identified need

TransGrid manages and mitigates bushfire and safety risks to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with TransGrid's obligations under the New South Wales *Electricity Supply (Safety and Network Management) Regulation 2014* and TransGrid's Electricity Network Safety Management System (ENSMS).[4] In particular, risks are mitigated unless it is possible to demonstrate that the cost involved in further reducing the risk would be grossly disproportionate to the benefit gained.

TransGrid therefore considers this a 'reliability corrective action' under the RIT-T as the proposed investment is for the purpose of meeting service standards linked to applicable regulatory instruments. A reliability corrective action differs from a 'market benefit' driven RIT-T in that the preferred option is permitted to have negative net market benefits (on account of it being required to meet an externally imposed obligation on the network business).

That said, TransGrid considers that the preferred option for this RIT-T demonstrates strongly positive net market benefits. The approach to determining this, and the assessment itself, is presented in this PSCR.

Overall, TransGrid considers that the option proposed in this PSCR will enable TransGrid to appropriately manage the bushfire and safety risks associated with Line 22 going forward.

2.3 Assumptions underpinning the identified need

Failure of the transmission structures due to corrosion may result in bushfire and safety risks and forced outages of the line. Routine inspections of these assets cannot completely address the deteriorating condition of these assets and, importantly, introduces TransGrid field crews to unnecessarily unsafe situations.

The need to undertake investment is predicated on the deteriorating condition of the identified assets affected by corrosion and the characteristics of any resultant physical asset failures.

As part of preparing its Revenue Proposal for the current regulatory control period, TransGrid developed a Network Asset Risk Assessment Methodology to quantify risk for replacement and refurbishment projects. In particular, the risk assessment methodology:

> Uses externally verifiable parameters to calculate asset health and failure consequences
> Assesses and analyses asset condition to determine remaining life and probability of failure
> Applies a worst case asset failure consequence and significantly moderates this down to reflect the likely consequence in the particular circumstances
> Identifies safety and compliance obligations with a linkage to key enterprise risks

This section summarises the key assumptions and data from the risk assessment methodology modelling that underpin the identified need for this RIT-T and the assessment undertaken in the preparing the Revenue Proposal. [5] Section 6 provides further detail on the general modelling approaches applied, including the commercial discounts rate used.

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4 TransGrid ENSMS follows the ISO31000 risk management framework which requires following hierarchy of hazard mitigation approach.

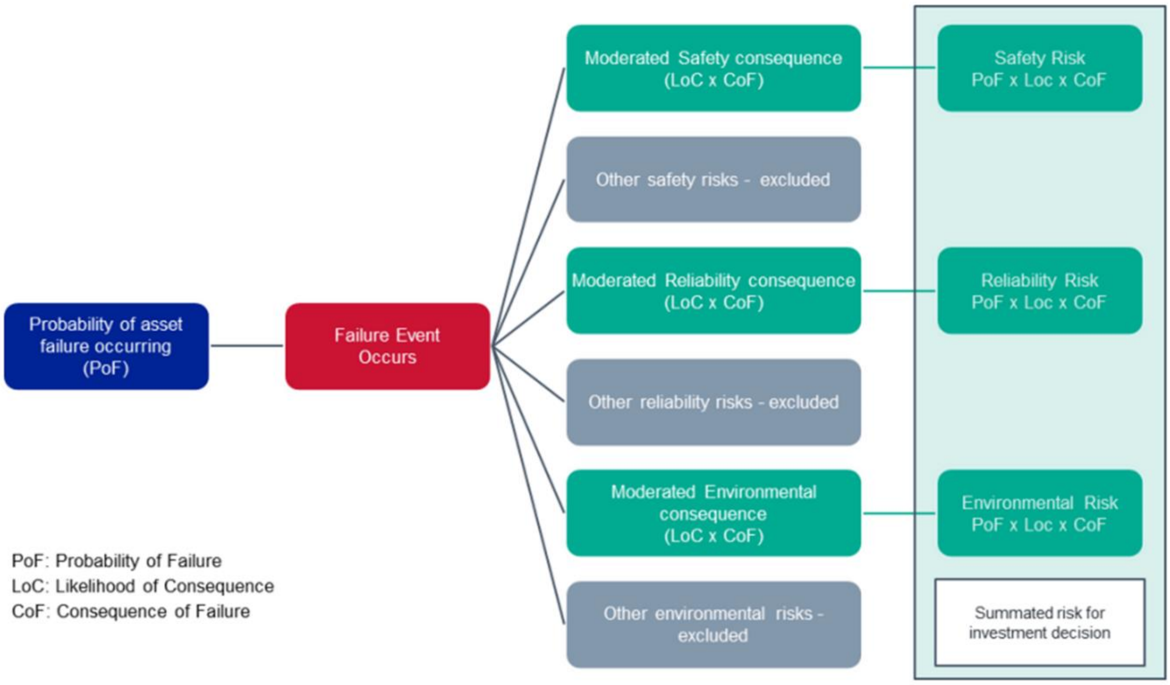
5 For additional information on the risk assessment methodology, please refer to pages 63-69 of our Revised Regulatory Proposal for the period 2018-23, available at: https://www.aer.gov.au/system/files/TransGrid%20-%20Revised%20Revenue%20Proposal%20-%201%20December%202017.pdf

2.3.1 Overview of how the risks have been assessed

A fundamental part of the risk assessment methodology is calculating the 'risk costs', ie, the monetised impacts of the reliability, safety, environmental and other risks.

The figure below summarises the framework for calculating the 'risk cost', which has been applied across TransGrid's portfolio of assets considered to need replacing and/or refurbishing.

Figure 3 Overview of TransGrid's 'risk cost' framework



The ultimate 'risk costs' for a project are calculated based on the Probability of a Failure (PoF), the Consequence of Failure (CoF) and the corresponding Likelihood of Consequence (LoC) in the particular situation.

In calculating the PoF, each failure mode that could result in a consequential impact is considered. For replacement planning, only 'life ending' failures are ultimately used to calculate the risk cost. PoF is calculated for each failure mode considering 'conditional age' (chronological age adjusted by asset health), failure and defect history and benchmarking studies. For 'wear out' failures a Weibull curve may be fitted and for random failures a static failure rate may be used.

In calculating the CoF and LoC, TransGrid uses a moderated 'worst case' consequence to value risk. This is an accepted approach in risk management with the benefit of ensuring that low probability but high consequence events are not dismissed or overlooked. It also excludes the risk costs of lower consequence but potentially more likely events (the resultant calculated risk is lower than it would be if these were included).

Recognising that this assessment approach has inherent uncertainty built into it, this RIT-T investigates a number of different scenarios and sensitivities that have been designed to see whether assuming alternate assumptions regarding risks and consequences (as well as other variables, such as the discount rate assumed) have an impact on the identification of the preferred option. These are outlined in more detail in sections 6.3 and 7.4 below and the results, in terms of the effects on net benefits are presented in section 7.

2.3.2 Line 22 condition issues and their consequences

TransGrid's asset health assessments since 2016 have identified a number of corrosion related issues on Line 22. The specific issues identified, their cause and their potential consequences are outlined in the table below.[6]

Table 1 Line 22's identified asset issues and their potential consequences

Issue	Cause	Extent (% line)	Quantity	Impact
Corroded earthwire	Zinc galvanising end of life	40%	70km (35 km route length)	
Corroded suspension insulators	Corrosion of steel caps and pins. Zinc sleeve protection end of life	30%	117 insulator strings	
Corroded conductor attachment fittings	Zinc galvanising end of life	20%	163 fittings	Conductor drop
Corrosion of earthwire attachment fittings	Zinc galvanising end of life	15%	76 fittings	
Corroded tension insulators	Corrosion of steel caps and pins. Zinc sleeve protection end of life	11%	42 insulator strings	
Ground line corrosion of steel at footing	Buried steelwork at footing	35%	67 towers	
Corrosion of tower steel members	Zinc galvanising end of life	35%	66 towers	Structural failure of tower
Corroded fasteners	Zinc galvanising at end of life	1%	86 towers	
Earthwire dampers	Damaged/weathered	20%	151 dampers	Accelerated asset fatigue due to vibration
Conductor dampers	Damaged/weathered	10%	454 dampers	
Buried concrete foundations	Erosion of soil building up around footings	45%	86 towers	Accelerated corrosion of critical member
Earth strap	Corrosion as buried at footing	5%	10 towers	Earthing safety hazard

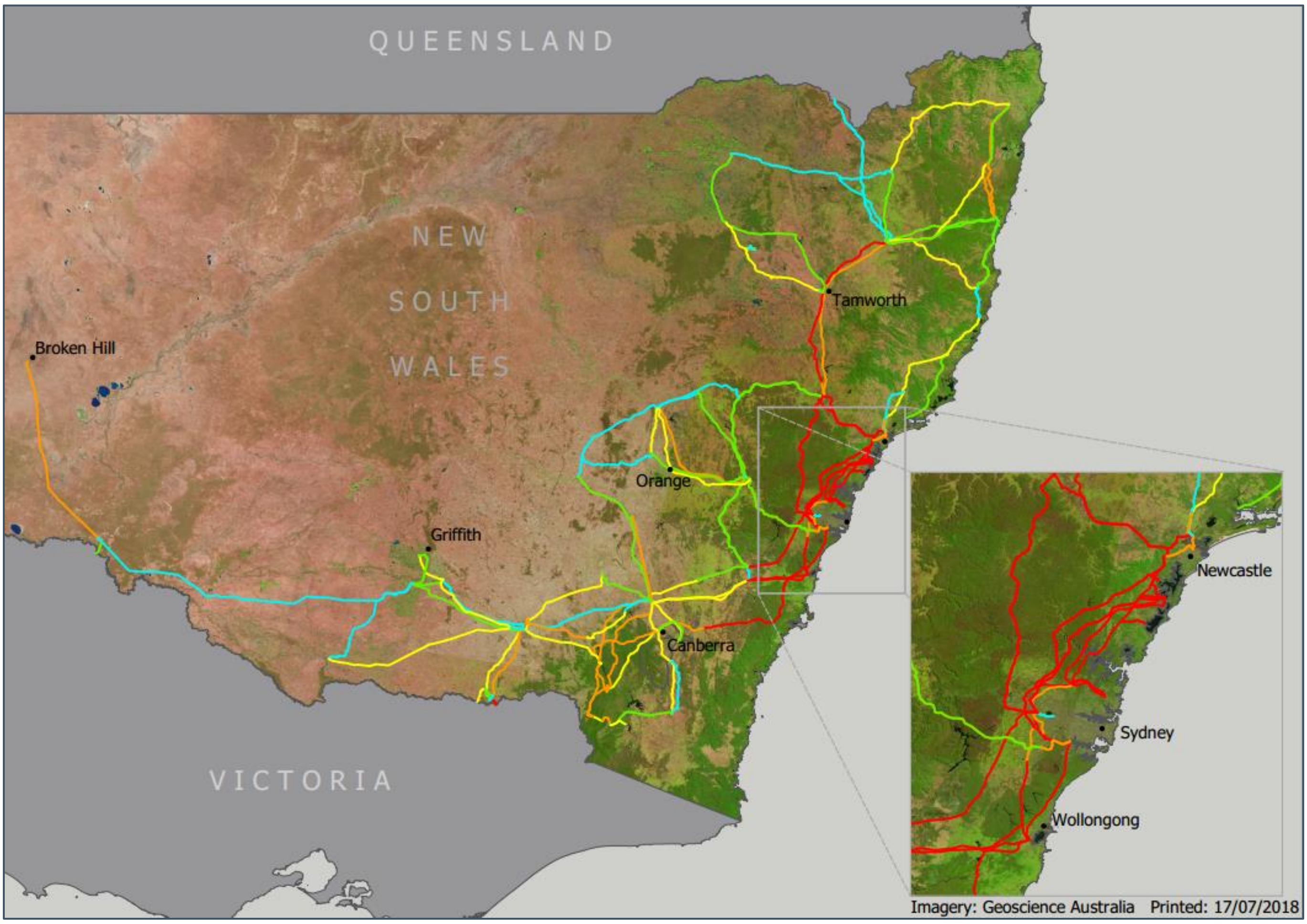
[6] The extent and quantities shown in this table are accurate as at the time of preparing TransGrid's 2018-23 Revenue Proposal, based off onsite inspections by field staff. These numbers are subject to change (increase) after future inspections are undertaken.

2.3.3 Avoiding bushfire risks are the most substantial driver of this RIT-T

Structural failure of towers and conductor drops due to corrosion of steel are significant contributors to bushfire and safety risks. Given the line traverses through bushland, this poses significant bushfire and safety risks.

The figure below shows a map of total estimated transmission line risk for all of TransGrid's transmission lines (ie, the PoF multiplied by the CoF and LoC) and, while it includes all risk contributors, bushfire is the general primary driver. It has been developed based on an assessment of risk factors in specific places and shows that Line 22 has one of the highest estimated risks of all lines.

Figure 4 Indication of the relative risk of all of TransGrid's lines



TransGrid has calculated the total risk cost if nothing is done to address the asset condition issues on Line 22 to be approximately $2.2 million per year, which is predominantly made up of a bushfire risk.[7]

If nothing is actively done to resolve these risks, the condition of the line is expected to continue to deteriorate and the number of defects will likely grow over time as the line ages. This will increase the probability of asset failure and results in this expected cost of $2.2 million increasing over time.

While noting this escalating risk going forward, TransGrid has simply modelled a constant $2.2 million of risk each year going forward. This effectively assumes that the failure rates, and consequent costs associated bushfires, has been assumed to be constant going forward. This approach is considered to give a lower

[7] This determination of per annum risk cost is based on TransGrid's Network Asset Risk Assessment Methodology and incorporates variables such as likelihood of failure/exposure, various types of consequence costs and corresponding likelihood of occurrence.

bound of the risk cost (as, in reality, failure rates and expected costs would increase going forward if nothing is done as the assets further deteriorate) but has been adopted as a proportionate approach for this RIT-T (in particular, estimating escalating failure rates to a higher degree of detail will not change the outcome of the RIT-T in terms of the identified preferred option).

In addition, the economic assessment shown in this PSCR demonstrates that there are strong net benefits from refurbishing the line under this conservative assumption, even under 30 per lower avoided cost of bushfires assumptions (as shown in section 7 below). In fact, the assessment in section 7 below shows that the assumed bushfire risks would need to be approximately 61 per cent *lower* than the central estimates to result in no net benefits from refurbishing the line. TransGrid considers it extremely unlikely that the bushfire risk costs would fall outside this sensitivity, particularly in light of the conservative assumption of constant risk each year going forward.

3. Options that meet the identified need

TransGrid considers that there is only one feasible option from a technological and project delivery perspective, ie, replacing or refurbishing the identified corroded components in one stage.

This section provides more information on the scope and cost of this option. It also outlines options considered but not progressed and how Option 1 is not expected to have a material inter-network impact.

Option 1 below is considered to be both technically and commercially feasible and able to be implemented in sufficient time to meet the identified need.[8] In addition, all works under this option is assumed to be completed in accordance with the relevant standards and components shall be replaced or refurbished with the objective of minimal modification to the wider transmission assets.

3.1 Description of the 'base case'

Consistent with the RIT-T, the assessment undertaken in this PSCR compares the costs and benefits of the option to a base case 'do nothing' option.

Under this base case, the existing condition issues associated with the line will not be remediated and Line 22 will continue to operate, with an increasing risk level. Specifically, the base case considers no investment in the network asset other than continuing the maintenance regime.

3.2 Option 1 – Refurbish the existing line

Option 1 involves the remediation of Line 22, including the treatment of corrosion of tower steelwork and replacement of components which have reached end of life due to corrosion. By undertaking the remediation works, the life of the asset will be extended by approximately 20 years.

It is expected that the remediation works will be undertaken in various stages between 2018/19 and 2020/21. The two broad stages to replacing all corroded elements are:

- Stage 1 (2018/19 and 2019/20) – Planning and procurement (including completion of the RIT-T); and
- Stage 2 (2020/21) – Project delivery and construction.

While physical delivery and replacement of the identified assets is planned to occur over 2020/21, it will be delivered in a staged fashion over the course of the year with replacement targeted on asset condition.[9] All work is expected to be completed by 2021/22.

The existing line is already in service, and outages will be planned as necessary in order to complete the works.

The estimated capital cost of this option is approximately $9.08 million. Routine operating and maintenance cost are approximately $30,000/annum in 2018/19 (around 0.3 per cent of the capital expenditure) but are expected to be the same under the base case as these costs relate to planned routine checks of the line by TransGrid field staff.

The preferred option to refurbish the line reduces the bushfire and safety risk to acceptable levels and this risk reduction outweighs the capital expenditure. The results of this assessment are shown in section 6 below.

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8 In accordance with the requirements of NER clause 5.15.2(a).

9 Appendix C provides a breakdown of the specific remediation measures included in this option, by issue.

While Option 1 is the only feasible option from a technological and project delivery perspective, we have investigated alternate timings for delivery (as illustrated in section 7.4.1). This assessment has confirmed that the optimal commissioning of Option 1 is as soon as possible, ie, 2021/22.

3.3 Options considered but not progressed

TransGrid has also considered whether there are other credible options that would meet the identified need. However, the identified need is to address bushfire and safety risks associated with corroding components of an otherwise operational transmission line and so it does not lend itself to other technological solutions other than to replace or refurbish these components as the only technically and economically feasible option.

The table below summarises three other options TransGrid has considered as part of this RIT-T, and its earlier asset condition and replacement planning. The table also outlines the reasons why these options were not progressed any further and have not been explicitly modelled alongside Option 1.

Table 2 Options considered but not progressed

Option	Reason(s) for not progressing
Stage the delivery of Option 1 over multiple years	There are cost efficiencies associated with replacing all identified components in one year, as opposed to spreading this replacement out over more than one year. In addition, delaying the replacement of any components comes with a greater expected risk value. The combination of greater costs and less expected benefits (in terms of avoided risk costs) has led TransGrid to consider this option commercially infeasible relative to Option 1 and so it has not been progressed.
Replacing Line 22	The option of replacing the entire line, as opposed to just the corroded components, is estimated to have a capital cost in the order of $90 million. This cost is significantly more than Option 1 (10 times greater) and is not expected to provide any additional market benefits. In addition, the condition of other components that make up Line 22 is such that they do not require replacement in coming years.

Option	Reason(s) for not progressing
Decommissioning and dismantling the line, and procure a non-network solution (or solutions)	TransGrid have considered the option of decommissioning and dismantling Line 22 and procuring non-network solutions to provide the requisite level of reliability to electricity consumers. Decommissioning and dismantling of Line 22 involves physical disconnection of the transmission line from the 330 kV switchbays at Vales Point and Sydney North substations respectively. In addition, the dismantling of transmission line structures, fittings and conductors is required and rehabilitation of the easement. This work is required as TransGrid is responsible for maintaining its asset portfolio in a safe manner so that safety risks to workers, public, environment including bushfire, and its own and public properties are managed. De-energising Line 22 without dismantling it would leave the line unmonitored, which is not a prudent asset management practice as the condition of the de-energised line will remain unknown and the chances of an asset in this circumstance creating safety hazards are high and increasing. The direct decommissioning cost is estimated to be between $19 million to $25 million (depending on access and clearing costs), which is significantly higher than Option 1 and is not expected to provide any additional market benefits. In addition, TransGrid would need to procure significant quantities of non-network technologies to ensure compliance with the New South Wales transmission reliability standards, which would further increase the cost of this option. This is discussed further in section 4 below.

In addition, as set out in section 4 below, TransGrid does not consider that non-network solutions can address, or help address, the identified need to undertake network investment. This is driven by the fact that the identified need is centred on reducing bushfire and safety risks, as opposed to reducing expected unserved energy.

While TransGrid has not been able to identify a non-network option that is capable of addressing the safety and bushfire risks that are key drivers for this project, TransGrid remains open to considering credible non-network options that will reduce the safety and bushfire risks.

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

TransGrid has considered whether Option 1 is expected to have a material inter-regional impact.[10]

A 'material inter-network impact' is defined in the NER as:

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

AEMO's suggested screening test to indicate that a transmission augmentation has no material inter-network impact is that it satisfies the following:[11]

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

[11] The screening test is set out in Appendix 3 of the Inter-Regional Planning Committee's Final Determination: Criteria for Assessing Material Inter-Network Impact of Transmission Augmentations, Version 1.3, October 2004.

- a decrease in power transfer capability between the transmission networks or in another TNSP's network of no more than the minimum of 3 per cent of the maximum transfer capability and 50 MW;
- an increase in power transfer capability between transmission networks of no more than the minimum of 3 per cent 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.

TransGrid notes Option 1 does not involve either a series capacitor or modification in the vicinity of an existing series capacitor. Option 1 is not expected to result in change in power transfer capability between New South Wales and neighbouring transmission networks. In addition fault levels are not expected to increase at any substation in another TNSP's network.

As a consequence, by reference to AEMO's screening criteria, there are no material inter-network impacts associated with Option 1.

4. Non-network options

TransGrid does not consider that non-network solutions can assist with meeting the identified need for this RIT-T. This is driven by the fact that the network investment proposed in Option 1 is targeted at reducing the risk of bushfires occurring from physical failure of elements of Line 22 (as opposed to reducing expected unserved energy), as well as the relatively low overall cost of refurbishing the line (ie, $9.08 million in capital cost to replace or refurbish all identified components).

Notwithstanding, this section sets out the required technical characteristics for a non-network options, consistent with the requirements of the RIT-T.

4.1 Required technical characteristics of non-network options

Line 22 forms part of the meshed network supplying Sydney, which meets the reliability standard of N-1 and N-2 redundancies, and so unserved energy is not a key driver for this RIT-T (in fact, it is expected to be immaterial under the base case and so has not been estimated).

TransGrid and AEMO are required by the NER to operate the power system securely.[12] This means that at all times, the power system must be operated such that it will remain within safe and stable limits following any single credible contingency event.[13] Following any contingency event, AEMO is required to take action to return the power system to a secure operating state as soon as practical, and in any case, within 30 minutes.[14]

Analysis of the transmission network in the absence of Line 22 was completed to assess the ability to operate the power system securely. The analysis showed that a trip of a single transmission line (in this case, Line 2M) would place the power system in an insecure operating state at times of high demand. A demand reduction at Sydney North, Sydney East and Tuggerah of approximately 300 MW at peak demand would be required to return the power system to a secure operating state.

Of the demand reduction required:

> approximately 200 MW could be achieved by transferring loads within the distribution networks to other transmission supply points;[15] while

> the remaining approximately 100 MW would be made up from demand management and/or load shedding.

As outlined in section 3.3 above, TransGrid has considered the option of decommissioning and dismantling Line 22, which would also require the procurement of non-network solutions to ensure reliable supply to end consumers during any such contingency events.

TransGrid therefore estimates that, as part of a wider decommissioning option, non-network solutions would need to:

> reduce peak load by approximately 100MW to return the power system to a secure state;

> this load reduction would need to be in the areas of Sydney North, Sydney East and Tuggerah; and

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12 Secure operation of the power system refers to operation within safe and stable limits; see NER Clauses 4.2.4, 4.2.2 and 4.2.5 for further details

13 A single credible contingency event includes a trip of any generator, transmission line, power transformer or item of reactive plant

14 NER Clause 4.2.6

15 TransGrid notes that, depending on the extent of spare capacity on the distribution network and the load forecasts, a load transfer of 200 MW may have significant effects on the investment plans of Ausgrid, ie, it may bring forward augmentation investment.

> be available to operate at very short-notice (within 30 minutes) and on an ongoing basis at times of daily peak demand to provide this level of support while Line 2M is returned to service.

However, in light of the significant direct costs associated with decommissioning Line 22 (expected to be in the order of $19 million to $25 million), TransGrid has not pursued this option further. Any non-network solution is expected to only add to the costs of this option.

In summary, TransGrid consider that non-network options are unlikely 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; and
> while non-network options could technically form part of a wider decommissioning option, this option has been ruled out on account of the significant costs associated with it and the fact that the condition of the vast majority of Line 22's components are such that they do not require replacement in coming years.

5. Materiality of market benefits

The section outlines the categories of market benefits prescribed in the NER and whether they are considered material for this RIT-T.[16]

5.1 Market benefits relating to the wholesale market are not material

The AER has recognised that if the credible options considered will not have an impact on the wholesale 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.[17]

Option 1 outlined above does not addresses network constraints between competing generating centres and are therefore not expected to result in any change in dispatch outcomes and wholesale market prices.

TransGrid therefore considers 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 for TransGrid (since there will be no deferral of generation investment);
> changes in ancillary services costs;
> competition benefits; and
> Renewable Energy Target (RET) penalties.

5.2 All other categories of market benefits are also not material

In addition to the classes of market benefits listed above, NER clause 5.16.1(c)(4) requires TransGrid to consider the following classes of market benefits in relation to each credible option: changes in in involuntary load curtailment; differences in the timing of transmission investment; option value; and changes in network losses.

TransGrid considers that none of the four classes of market benefits listed above are material for this RIT-T assessment for the reasons set out below.

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[16] The NER requires that all categories of market benefit identified in relation to the RIT-T are included in the RIT-T assessment, unless the TNSP can demonstrate that a specific category (or categories) is unlikely to be material in relation to the RIT-T assessment for a specific option – NER clause 5.16.1(c)(6). Under NER clause 5.16.4(b)(6)(iii), the PSCR should set out the classes of market benefit that the NSP considers are not likely to be material for a particular RIT-T assessment.

[17] AER, *Final Regulatory Investment Test for Transmission Application Guidelines*, 18 September 2017, pp. 13-14.

Table 3 Reasons why non-wholesale market benefit categories are considered immaterial

Market benefits	Reason
Changes in in involuntary load curtailment	Line 22 forms part of the meshed network supplying Sydney, which is required to have N-1 and N-2 redundancies. As a consequence, if Line 22 fails due to the corroded assets, there is an extremely low chance of this resulting in unserved energy. As outlined in section 2 above, this RIT-T is not being undertaken to avoid expected unserved energy from corroded assets but instead to mitigate the risk of bushfires.
Differences in the timing of expenditure	Option 1 is being undertaken to mitigate rising risk due to deteriorating asset condition and as the line is an existing asset, material market benefits will neither be gained nor lost due to timing of expenditure.
Option value	TransGrid notes the AER's view that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change and the credible options considered by the TNSP are sufficiently flexible to respond to that change.[18] TransGrid also notes 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. TransGrid notes that changes in future demand levels are not relevant for this RIT-T, since the need for and timing of the required investment is being driven by asset condition rather than future demand growth. As a result, it is not relevant to consider different future demand scenarios in undertaking the RIT-T analysis. The estimation of any option value benefit would require a significant modelling assessment, which would be disproportionate to any additional option value benefit that may be identified for this specific RIT-T assessment. Therefore, TransGrid has not estimated any additional option value market benefit for this RIT-T assessment.
Changes in network losses	As there is no change to the capacity of the line or the destination of the line under Option 1, there will not be any material market benefits associated with changed to network losses.

18 AER, *Final Regulatory Investment Test for Transmission Application Guidelines*, 18 September 2017, pp. 37 & 74.

6. Overview of the assessment approach

This section outlines the approach that TransGrid has applied in assessing the net benefits associated with refurbishing Line 22.

6.1 General overview of the assessment framework

As outlined in section 3.1, all costs and benefits for Option 1 have been measured against a base case in which TransGrid is assumed to incur regular and reactive maintenance activates going forward as well as the cost of any bushfires that are caused by the corroded equipment resulting in a physical failure (eg, a conductor drop).

The RIT-T analysis has been undertaken over a 20-year period, from 2018/19 to 2038/39. TransGrid considers that a 20-year period takes into account the size, complexity and expected life of the refurbishment option to provide a reasonable indication of the benefits and costs this option. While the capital components of the new components under Option 1 have asset lives greater than 20 years, TransGrid has taken a terminal value approach to incorporate capital costs in the assessment, which ensures that the capital cost of long-lived assets is appropriately captured in the 20-year assessment period.

TransGrid has adopted a central real, pre-tax 'commercial'[19] discount rate of 7.04 per cent as the central assumption for the NPV analysis presented in this report. TransGrid considers that this is a reasonable contemporary approximation of a commercial discount rate, consistent with the RIT-T.

TransGrid has also tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound real, pre-tax discount rate of 4.60 per cent (equal to the latest AER Final Decision for a TNSP's regulatory proposal at the time of preparing this PSCR[20]), and an upper bound discount rate of 9.48 per cent (ie, a symmetrical adjustment upwards).

6.2 Approach to estimating project costs

TransGrid has estimated the capital costs of the refurbishment option by considering the scope of works necessary together with costing experience from previous projects of a similar nature. TransGrid considers the central capital cost estimate of approximately $9.08 million to be estimated to within +/- 25 per cent of the actual cost.

Routine operating and maintenance costs are expected to be approximately $30,000/annum in 2018/19 (around 0.3 per cent of the capital expenditure) but are expected to be the same under the base case as these costs relate to planned routine checks of the line by TransGrid field staff.

Reactive maintenance costs under the base cost have been estimated by considering both the:

> level of reactive maintenance required to restore assets to working order following a physical failure; and

> probability and expected level of network asset faults, which translates to the level of corrective maintenance costs.

All options reduce the incidence of asset failures relative to the base case, and hence the expected operating and maintenance costs associated with restoring supply.

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19 The use of a 'commercial' discount rate is consistent with the RIT-T and is distinct from the regulated cost of capital (or 'WACC') that applies to network businesses like TransGrid.

20 See TransGrid's PTRM for the 2018-23 period, available at: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/transgrid-determination-2018-23

6.3 Three different 'scenarios' have been modelled to address uncertainty

RIT-T assessments are required to be based on cost-benefit analysis that includes an assessment of 'reasonable scenarios', which are designed to test alternate sets of key assumptions and whether they affect identification of the preferred option.

TransGrid has constructed three alternative scenarios for this PSCR assessment – namely:

> a 'low benefit' scenario, involving a number of assumptions that give rise to a lower bound NPV estimate for the refurbishment option, in order to represent a conservative future state of the world with respect to potential benefits that could be realised;

> a 'central' scenario, which consists of assumptions that reflect TransGrid's central set of variable estimates which, in TransGrid's opinion, provides the most likely scenario; and

> a 'high benefit' scenario – this scenario reflects an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected net benefits.

A summary of the key variables in each scenario is provided in the table below.

Table 4 Summary of the three scenarios investigated

Variable / Scenario	Central	Low benefits	High benefits
Network capital costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Avoided bushfire risk	Base estimate	Base estimate - 25%	Base estimate + 25%
Avoided corrective maintenance	Base estimate	Base estimate - 25%	Base estimate + 25%
Discount rate	7.04 per cent	9.48 per cent	4.60 per cent

The three scenarios do not involve different assumptions about load forecasts (or the VCR) for this RIT-T as avoided unserved energy is expected to be immaterial and the wider identified need is not affected by demand (or the value consumers place on it).

TransGrid considers that the central scenario is the most likely, since it is based primarily on a set of expected/central assumptions. TransGrid has therefore assigned this scenario a weighting of 50 per cent, with the other two scenarios being weighted equally with 25 per cent each. However, TransGrid notes that, on account of their only being one credible option, the identification of the preferred option is the same across all three scenarios, ie, the result is insensitive to the assumed scenario weights.

7. Assessment of credible options

This section outlines the assessment TransGrid has undertaken of the credible network option.

The assessment compares the costs and benefits of the option to a base case 'do nothing' option, where the existing condition issues associated with the line will not be remediated and Line 22 will continue to operate, with an increasing risk level.

7.1 Gross benefits estimated

The table below summarises the gross benefit estimated for Option 1 relative to the 'do nothing' base case in present value terms. The gross benefit has been calculated for each of the three reasonable scenarios outlined in the section above.

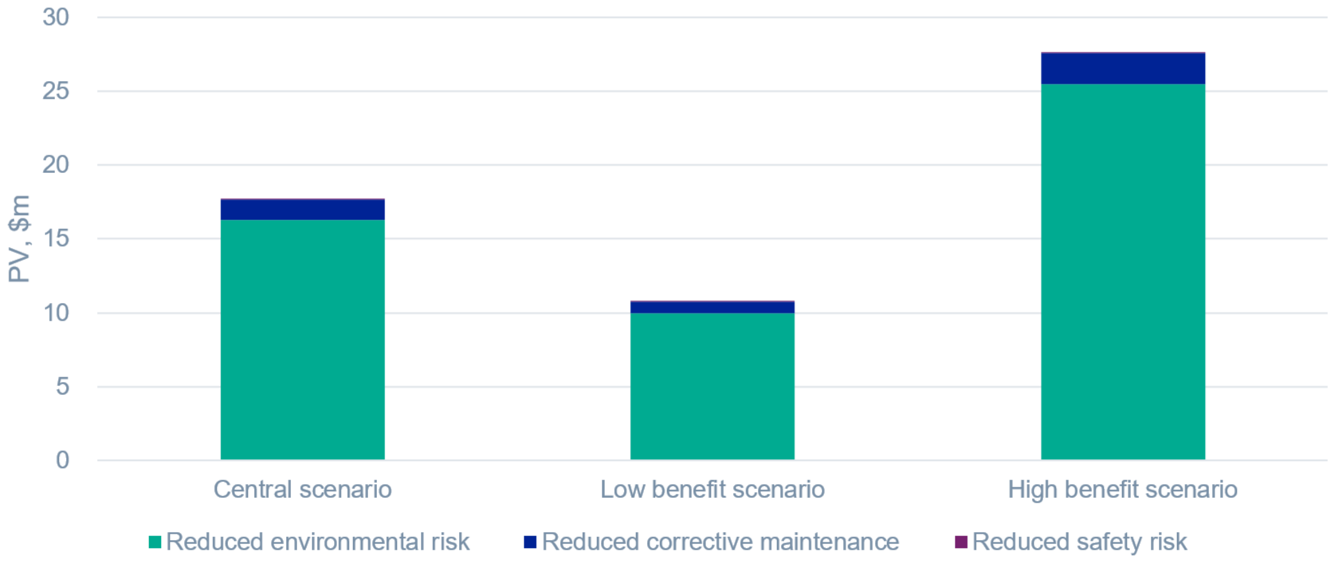
While TransGrid considers there are no material 'market benefits' under the RIT-T for this assessment (as outlined in section 5), there are significant benefits in terms of avoided expected costs, ie, costs associated with bushfires. All of these costs are *expected* costs in that the actual cost (if an event occurs) has been multiplied by the chance of it occurring. The 'low' and 'high' scenarios reflect lower and upper bounds on TransGrid's expectations regarding these expected benefits.

Table 5 Present value of gross economic benefits of option 1 relative to the base case, PV $m

Option/scenario	Central	Low benefit	High benefit	Weighted
Scenario weighting	*50%*	*25%*	*25%*	
Option 1	17.64	10.76	27.56	18.40

The figure below provides a breakdown of benefits estimated for Option 1, showing almost all of the benefits for each option are derived from avoided risk of bushfires (ie, 'environmental risk'), while other avoided costs contribute relatively small amounts to overall gross benefits.

Figure 5 Breakdown of gross economic benefits Option 1 relative to the base case, PV $m



7.2 Estimated costs

The table below summarises the costs of Option 1, relative to the base case, in present value terms. The cost of Option 1 has been calculated for each of the three reasonable scenarios.

Table 6 Present value of costs of option 1 relative to the base case, PV $m

Option/Scenario	Central	Low benefit	High benefit	Weighted
Scenario weighting	*50%*	*25%*	*25%*	
Option 1	-7.61	-9.27	-5.82	-7.58

7.3 Net market benefits

The table below summaries the net market benefit in NPV terms for Option 1 across the three scenarios, as well as on a weighted basis. The net market benefit is the gross benefits (as set out in section 6.1 above) minus the costs (as outlined in section 6.2 above), all in present value terms.

The table shows that Option 1 is found to have positive net market benefits for all scenarios investigated. On a weighted basis, Option 1 is expected to deliver approximately $11 million in net market benefits.

Table 7 Present value of net benefits relative to the base case, PV $m 2017/18

Option/Scenario	Central	Low benefit	High benefit	Weighted
Option 1	10.03	1.49	21.74	10.82

While the estimated net market benefits are marginally positive under the low benefit scenario, TransGrid notes that this scenario is comprised of an extreme combinations of assumptions designed to investigate a reasonable lower bound on the expected net market benefits. The assumptions feeding into the low scenario include:

- 25 per cent higher network capital costs;
- a discount rate of 9.48 per cent;
- 25 per cent lower expected environmental risks; and
- 25 per cent lower avoided corrective maintenance costs.

In addition, as set out in section 2 above, the approach taken to estimating failure rates, and consequent costs associated bushfires, has been to assume that this is constant going forward. This approach is considered to give a lower bound of the risk cost by (as, in reality, failure rates and expected costs would increase going forward if nothing is done as the assets further deteriorate) but has been adopted as a proportionate approach for this RIT-T (it will not change the outcome of the RIT-T in terms of the identified preferred option).

7.4 Sensitivity testing

TransGrid has undertaken thorough sensitivity testing exercise 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 – namely:

> 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.

TransGrid has therefore undertaken sensitivity analysis to first determine the optimal timing of the project, to conclude that a particular year represents the 'most likely' date at which the project will be needed. This analysis of optimal timing is an economic test, and does not consider TransGrid's obligation to manage and mitigate bushfire and safety risks to 'ALARP', which may change the optimal timing.

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

We outline how each of these two steps have been applied to test the sensitivity of the key findings below.

7.4.1 Step 1 – Sensitivity testing of the assumed optimal timing for the credible option

TransGrid has estimated the optimal timing for Option 1 based on the year in which the NPV is maximised. This process was undertaken for both the central set of assumptions and also a range of alternative assumptions for key variables.

This section outlines the sensitivity of the identification of the commissioning year to changes in the underlying assumptions. In particular, the optimal timing of the option is found to be invariant to the assumptions of:

> a 25 per cent increase/decrease in the assumed network capital costs;

> lower discount rate of 4.60 per cent as well as a higher rate of 9.48 per cent;

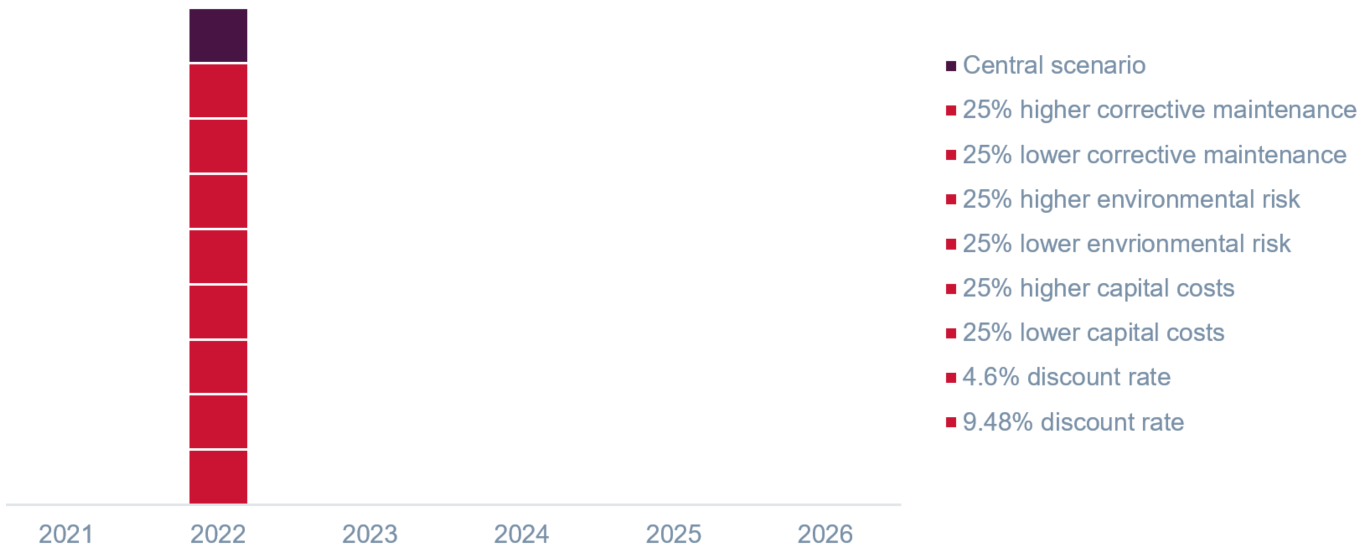
> lower (or higher) assumed environmental (ie, bushfire) risk; and

> lower (or higher) benefits associated with avoided corrective maintenance costs.

No sensitivity tests have been undertaken on load forecasts (or the VCR) for this RIT-T as avoided unserved energy is expected to be immaterial and the wider identified need is not affected by demand (or the value consumers place on it).

The figure 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 2021/22 for all of the sensitivities investigated.

Figure 6 Distribution of optimal project commissioning year for Option 1 under each sensitivity



7.4.2 Step 2 – Sensitivity of the overall net market benefit

TransGrid has also conducted sensitivity analysis on the overall NPV of the net market benefit, based on the optimal option timing established in step 1.

Specifically, TransGrid has investigated the same sensitivities under this second step as in the first step, ie:

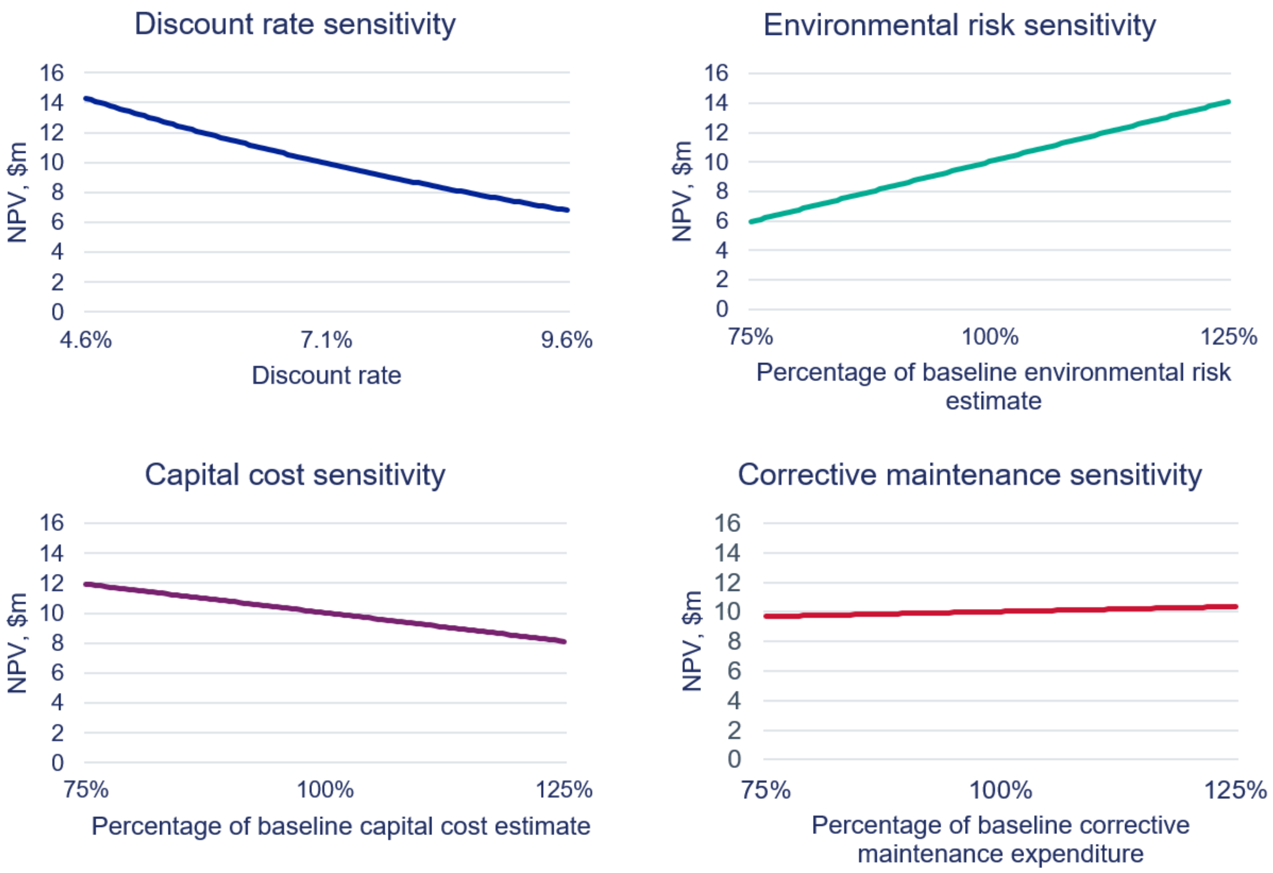
> a 25 per cent increase/decrease in the assumed network capital costs;
> lower discount rate of 4.60 per cent as well as a higher rate of 9.48 per cent;
> lower (or higher) assumed environmental (ie, bushfire) risk; and
> lower (or higher) benefits associated with avoided corrective maintenance costs.

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

The four figures below illustrate the estimated net market benefits for each option if we vary four separate key assumptions in the central scenario individually. Importantly, for all sensitivity tests shown below, the estimated net benefits of Option 1 are found to be positive.

The results are found to be most sensitive to the assumed bushfire risk avoided. We have extended this sensitivity exercise and found that there would need to be an approximate 61 per cent reduction in the central avoided environmental risk estimate to result in no net market benefits (ie, a NPV of zero), holding all else constant. TransGrid considers it extremely unlikely that the central estimate of bushfire risk would fall outside this sensitivity.

Figure 7 Sensitivity testing of Option 1



8. Draft conclusion and exemption from preparing a PADR

Option 1 is the preferred option at this draft stage and involves refurbishing the existing Line 22 by replacing or refurbishing the identified corroded components in one-go.

In particular, Option 1 involves the remediation of Line 22, including the treatment of corrosion of tower steelwork and replacement of components which have reached end of life due to corrosion. By undertaking the remediation works, the life of the Line 22 is expected to be extended by approximately 20 years.

It is expected that this remediation works will be undertaken in various stages between 2018/19 and 2020/21. The two broad stages to replacing all corroded elements are:

> Stage 1 (2018/19 and 2019/20) – Planning and procurement (including completion of the RIT-T); and
> Stage 2 (2020/21) – Project delivery and construction.

While physical delivery and replacement of the identified assets is planned to occur over 2020/21, it will be delivered in a staged fashion over the course of the year with replacement targeted on asset condition.[21] All work is expected to be completed by 2021/22.

The estimated capital cost of this option is approximately $9.08 million. Routine operating and maintenance cost are approximately $30,000/annum in 2018/19 (around 0.3 per cent of the capital expenditure), which is the same as the base case as these costs relate to planned routine checks of the line by TransGrid field staff.

The preferred option to refurbish the line reduces the bushfire risk to acceptable levels and this risk reduction outweighs the capital expenditure.

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 $41 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.

TransGrid considers that its investment in relation to Option 1 is 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 TransGrid considers that an additional credible option that could deliver a material market benefit is identified during the consultation period.

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

[21] Appendix C provides a breakdown of the specific remediation measures included in this option, by issue.

Should TransGrid consider that no additional credible options were identified during the consultation period, TransGrid intends to produce a PACR that addresses all submissions received including any issues in relation to the proposed preferred option raised during the consultation period.[22]

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

Appendix A – Compliance checklist

This appendix sets out a compliance checklist which demonstrates the compliance of this PSCR with the requirements of clause 5.16.4(b) of the Rules version 111.

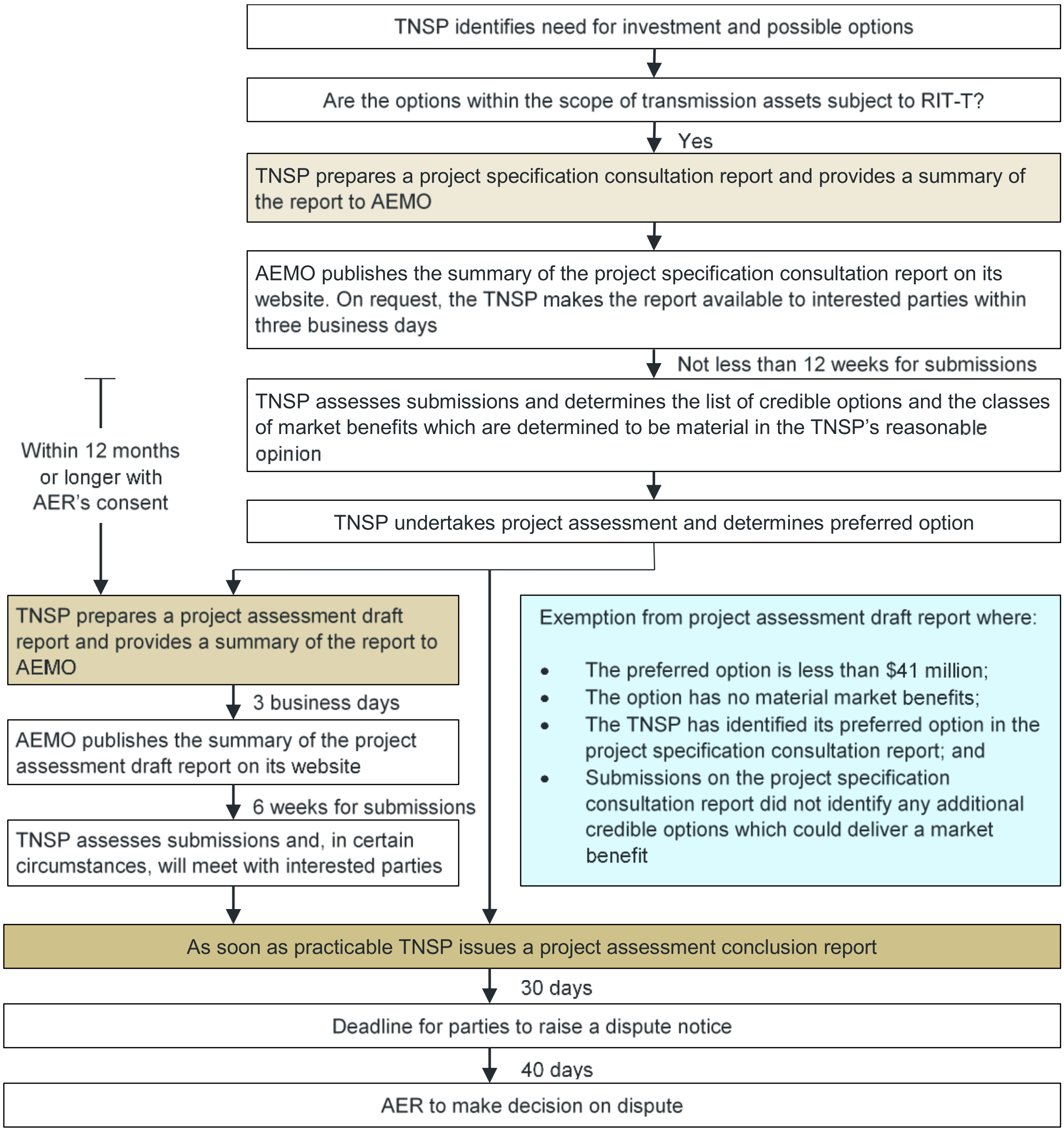
Rules clause	Summary of requirements	Relevant section(s) in PSCR
5.16.4 (b)	A RIT-T proponent must prepare a report (the project specification consultation report), which must include:	–
	(1) a description of the identified need;	2
	(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-T proponent considers reliability corrective action is necessary);	2.3
	(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	3 & 5

	(v) to the extent practicable, the total indicative capital and operating and maintenance costs.	
5.16.4(z1)	A RIT-T proponent is exempt from paragraphs (j) to (s) if: 1. the estimated capital cost of the proposed preferred option is less than $35 million (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; 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.	8

Appendix B – RIT-T process overview

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

Figure 8 The RIT-T assessment and consultation process



Source: AER, Final Regulatory investment test for transmission application guidelines, 18 September 2017, p. 42.

Appendix C – Summary of the specific remediation works under Option 1

The table below summarises the twelve key issues on Line 22 that require remediation, as well as how this is proposed to be done under Option 1.

Table 8 Transmission Line 22 Option 1 – Remediation works under Option 1

Issue	Remediation
Ground line corrosion of steel at footing	> Abrasive blast cleaning of steelwork to remove any corrosion > Application of coating and concrete encasement to mitigate against future corrosion
Buried concrete foundations	> Dig out tower legs, abrasive blast cleaning of steelwork to remove any corrosion, application of coating and establishment of drainage channel
Corrosion of earth straps	> Replacement of earth straps in line with current standard
Corrosion of tower members	> Abrasive blast cleaning of steelwork to remove any corrosion, application of coating
Corrosion of tower fasteners	> Replacement of fasteners
Insulator pin corrosion – suspension insulators	> Replacement with composite longrod insulators
Insulator pin corrosion – tension insulators	> Replacement with composite longrod insulators > Replacement of tension hot and cold end fittings
Corrosion of conductor fittings	> Replacement of conductor fittings
Corrosion of earthwire fittings	> Replacement of earthwire fittings
Corrosion of earthwire	> Like for like replacement of galvanised steel (SC/GZ) earthwire
Damaged conductor vibration dampers	> Replacement of vibration dampers
Damaged of earthwire vibration dampers	> Replacement of vibration dampers