Powerlink Queensland

Project Assessment Conclusions Report

3 June 2022

Maintaining reliability of supply in the Cairns region – Stage 1

Addressing the condition risks of the transmission towers between Davies Creek and Bayview Heights

Document Purpose

For the benefit of those not familiar with the National Electricity Rules (the Rules) and the National Electricity Market (NEM), Powerlink offers the following clarifications on the purpose and intent of this document:

1. The Rules require Powerlink to carry out forward planning to identify future reliability of supply requirements and consult with interested parties on the proposed solution as part of the Regulatory Investment Test for Transmission (RIT-T). This includes replacement of network assets in addition to augmentations of the transmission network.
2. Powerlink must identify, evaluate and compare network and non-network options (including, but not limited to, generation and demand side management) to identify the '*preferred option*' which can address future network requirements at the lowest net cost to electricity consumers. This assessment compares the net present value (NPV) of all credible options to identify the option that provides the greatest economic benefits to the market.
3. This document contains the results of this evaluation, and a final recommended solution to address the condition-based risks associated with the transmission towers between Davies Creek and Bayview Heights.

Contents

Executive Summary

The bulk supply of electricity to the Cairns region in Far North Queensland is provided by generators in Central and Northern Queensland, via a 132kV coastal network and a 275kV inland network, as well as a hydro power station north of Cairns at Barron Gorge, which is connected to the 132kV network.

The majority of supply to the Cairns region is delivered through the inland 275kV network to Ross, near Townsville. From Ross it is transferred via a 275kV transmission line to Chalumbin, continuing via a second 275kV transmission line from Chalumbin to the Woree Substation on the outskirts of Cairns. These 275kV transmission lines also provide connections to the Mt Emerald Wind Farm and Kareeya Power Station.

The 275kV transmission line between Ross and Chalumbin substations was constructed in 1989, is 244km in length and for the majority of its route, lies to the west of the Great Dividing Range.

The Chalumbin to Woree section of the transmission line was constructed in 1998 and is approximately 140km in length. While the condition of the majority of this line is consistent with its age, it is not the case for the final 16km into Cairns, which is in a deteriorated condition. This section of the transmission line, which traverses the environmentally sensitive World Heritage Wet Tropics area terminating near Trinity Inlet Marine Park, has required a comprehensive ongoing maintenance program due to its heightened exposure to highly corrosive coastal winds.

Emerging condition risks due to structural corrosion on the 275kV transmission lines between Ross, Chalumbin and Woree substations require action to maintain reliability of supply in the Cairns region by December 2026.

Powerlink has identified an opportunity to apply a staged approach

Given the non-homogenous condition of the approximately 384km of 275kV transmission lines supplying the Cairns region, Powerlink identified an opportunity to optimise potential reinvestments by applying a prudent and staged approach to address higher risk components in the nearer term based on deteriorating condition.

In particular, the deteriorating condition of 16km of the 275kV Chalumbin to Woree transmission line, from Davies Creek to Bayview Heights, in the government gazetted Wet Tropics World Heritage Area, poses a risk to the ongoing safe and reliable supply of electricity to the Cairns region. The existing 37 steel lattice towers require priority action to address their more complex and advanced condition risks and have been proposed under Stage 1 of this RIT-T (Addressing the condition risks of the transmission towers between Davies Creek and Bayview Heights).

The section of the transmission line between Ross and Chalumbin is deteriorating at a slightly slower rate due to its location on the western side of the Great Dividing Range. The potential reinvestment for this section is not anticipated until around 2026-27 and will be assessed under a subsequent Stage 2 RIT-T (Maintaining reliability of supply in the Cairns region).

Stage 1: *Addressing the condition risks of the transmission towers between Davies Creek and Bayview Heights* by 2023

As the identified need for the proposed investment is to maintain compliance with the reliability and service standards set out in the National Electricity Rules (the Rules), Powerlink's Transmission Authority and applicable regulatory instruments[1], the proposed investment is classified as a 'reliability corrective action'[2].

This Project Assessment Conclusions Report (PACR) represents the final step of the RIT-T process prescribed under the Rules undertaken by Powerlink to address the condition risks arising from the deteriorating condition of the steel lattice towers between Davies Creek and Bayview Heights. It contains the results of the planning investigation, cost benefit analysis of credible options and identifies the preferred option.

[1] Electricity Act 1994, Electrical Safety Act 2002 and Electricity Safety Regulation 2013
[2] The Rules clause 5.10.2, Definitions, reliability corrective action

Credible options considered

Powerlink has developed two credible network options to maintain the existing electricity services, ensuring an ongoing reliable, safe and cost effective supply to customers in the area. The major difference between the credible options relates to a 'with' or 'without' approach to repainting of the 37 steel lattice towers between Davies Creek and Bayview Heights.

Powerlink published a Project Specification Consultation Report (PSCR) in March 2021 with respect to maintaining reliability of supply in the Cairns region – Stage 1. No submissions were received in response to the PSCR that closed on 8 July 2021. As a result, no additional credible options have been identified as a part of this RIT-T consultation.

The two credible network options, along with their net present values (NPVs) relative to the non-credible Base Case are summarised in Table 1. Overall Option 2 results in the greater value in NPV terms and is ranked first.

Table 1: Summary of credible network options

Option	Description	Total costs ($m, 2020/21)	NPV relative to base case ($m, 2020/21)
1	Replace critical components displaying advanced and early onset of corrosion by December 2023*	20.23	47.62
	Replace critical components displaying early onset of corrosion by 2033†	29.73	
	Replace critical components displaying early onset of corrosion by 2038†	23.25	
	Replace critical components displaying early onset of corrosion by 2043†	9.25	
2	Replace critical components displaying advanced corrosion and repaint towers by December 2023*	38.37	55.18
	Repaint of selected structural components and minor works by 2039†	5.38	

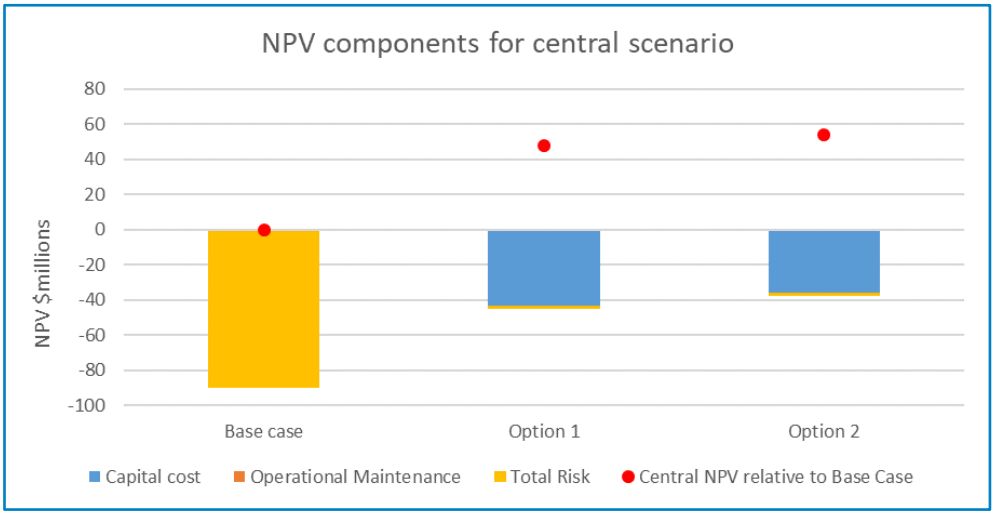
*RIT-T Project
†Modelled network projects including future RIT-T consultations

By addressing the condition risks, both options allow Powerlink to meet the identified need and continue to meet the reliability and service standards set out in the National Electricity Rules (the Rules), Powerlink's Transmission Authority and applicable regulatory instruments[3]. As a minimum, both options achieve a further 25 years asset life and reduce the risk costs compared to the Base Case.

Figure 1 illustrates that by reducing the risk costs arising from the condition of the 37 towers between Davies Creek and Bayview Heights, both credible options have a positive NPV relative to the Base Case, with Option 2 providing the greatest reduction in risk costs.

[3] Electricity Act 1994, Electrical Safety Act 2002 and Electricity Safety Regulation 2013 (See Appendix 2 for further detail)

Figure 1: NPV of Base Case and Credible Network Options



Evaluation and conclusion

The RIT-T requires that the proposed preferred option maximises the present value of net economic benefit, or minimises the net cost, to all those who produce, consume and transport electricity. The economic analysis demonstrates that Option 2 provides the greatest net economic benefit in NPV terms and is therefore the preferred option.

In accordance with the expedited process for the RIT-T, the PSCR made a draft recommendation to implement Option 2, which involves the refurbishment of the 37 towers through the selective replacement of corroded members and components, along with the painting of all 37 towers by December 2023. The indicative capital cost of the RIT-T project for the preferred option is $38.37 million in 2020/21 prices. Powerlink is the proponent of this network option.

Under Option 2, consultation and joint planning with Wet Tropics' stakeholders will be undertaken in late-2022, with contractors deployed to site in 2022/23 and work completed by December 2023.

As the outcomes of the economic analysis contained in this PACR remain unchanged from those published in the PSCR, the draft recommendation has been adopted without change as the final recommendation for implementation.

Dispute Resolution

In accordance with the provisions of clause 5.16B.(a) of the NER, Registered Participants, the AEMC, Connection Applicants, Intending Participants, AEMO and interested parties may, by notice to the AER, dispute conclusions in this report in relation to:

- the application of the RIT-T,
- the basis upon which the preferred option was classified as a reliability corrective action or
- the assessment of whether the preferred option has a *material inter-regional impact* or not

Notice of a dispute must be given to the AER within 30 days of the publication date of this report. Any parties raising a dispute are also required to simultaneously provide a copy of the dispute notice to the RIT-T proponent.

1. Introduction

This Project Assessment Conclusions Report (PACR) represents the final step of the RIT-T process[4] prescribed under the National Electricity Rules (the Rules) undertaken by Powerlink to address the condition risks arising from the condition of transmission lines between Davies Creek and Bayview Heights. It follows the publication of the Project Specification Consultation Report (PSCR) in March 2021.

The Project Specification Consultation Report (PSCR):

- described the identified need that Powerlink is seeking to address, together with the assumptions used in identifying this need
- set out the technical characteristics that a non-network option would be required to deliver in order to address the identified need
- described the credible options that Powerlink considered may address the identified need
- discussed specific categories of market benefit that in the case of this RIT-T assessment are unlikely to be material
- presented the Net Present Value (NPV) economic assessment of each of the credible options (as well as the methodologies and assumptions underlying these results) and identified the preferred option
- noted that Powerlink was claiming an exemption from producing a Project Assessment Draft Report (PADR)
- invited submissions and comments, in response to the PSCR and the credible options presented, from Registered Participants, The Australian Energy Market Operator (AEMO), potential non-network providers and any other interested parties.

Powerlink identified Option 2, line refit with painting as the preferred option to address the identified need. The indicative capital cost of the RIT-T project for the preferred option is $38.37 million in 2020/21 prices.

The Rules clause 5.16.4(z1) provides for a Transmission Network Service Provider to claim exemption from producing a PADR for a particular RIT-T application if all of the following conditions are met:

- the estimated capital cost of the preferred option is less than $43 million[5]
- the preferred option is identified in the PSCR noting exemption from publishing a PADR
- the preferred option, or other credible options, do not have a material market benefit, other than benefits associated with changes in involuntary load shedding[6]
- submissions to the PSCR did not identify additional credible options that could deliver a material market benefit.

There were no submissions received in response to the PSCR that closed for consultation on 8 July 2021. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation. As the conditions for exemption are now satisfied, Powerlink has not issued a PADR for this RIT-T and is now publishing this PACR, which:

- describes the identified need and the credible options that Powerlink considers address the identified need
- discusses the consultation process followed for this RIT-T together with the reasons why Powerlink is exempt from producing a PADR

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[4] This RIT-T consultation commenced on 31 March 2021 and has been prepared based on the following documents: *National Electricity Rules, Version 161*, 31 March 2021, and AER, *Application Guidelines*, *Regulatory investment test for transmission*, August 2020.
[5] AER, *Costs threshold review for the regulatory investment tests 2018* in place at the commencement of this RIT-T consultation.
[6] Section 4.3 Project assessment draft report, Exemption from preparing a draft report, AER, *Application Guidelines*, *Regulatory investment test for transmission*, August 2020.

- provides a quantification of costs and reasons why specific classes of market benefit are not material for the purposes of this RIT-T assessment
- provides the results of the net present value (NPV) analysis for each credible option assessed, together with accompanying explanatory statements
- identifies the preferred option for investment by Powerlink and details the technical characteristics and proposed commissioning date of the preferred option.

2. Customer and stakeholder engagement

With almost five million Queenslanders and 236,000 Queensland businesses depending on Powerlink's network performance, Powerlink recognises the importance of engaging with a diverse range of customers and stakeholders who have the potential to affect, or be affected by, Powerlink activities and/or investments. Together with our industry counterparts from across the electricity and gas supply chain, Powerlink has committed to The Energy Charter.

2.1 Powerlink takes a proactive approach to engagement

Powerlink regularly hosts a range of engagement forums and webinars, sharing information with customers and stakeholders in the broader community. These engagement activities help inform the future development of the transmission network and assist Powerlink in providing services that align with the long-term interests of customers. Feedback from these activities is also incorporated into a number of publicly available reports.

2.2 Working collaboratively with Powerlink's Customer Panel

Powerlink's Customer Panel provides a face-to-face opportunity for customers and consumer representative bodies to give their input and feedback about Powerlink's decision making processes and methodologies. It also provides Powerlink with a valuable avenue to keep customers and stakeholders better informed, and to receive feedback about topics of relevance, including RIT-Ts.

The Customer Panel is regularly advised on the publication of Powerlink's RIT-T documents and briefed quarterly on the status of current RIT-T consultations, as well as upcoming RIT-Ts. This provides an ongoing opportunity for the Customer Panel to ask questions and provide feedback to further inform RIT-Ts, and for Powerlink to better understand the views of customers when undertaking the RIT-T consultation process.

2.3 Transparency on future network requirements

Powerlink's annual planning review findings are published in the Transmission Annual Planning Report (TAPR) and TAPR templates, providing early information and technical data to customers and stakeholders on potential transmission network needs over a 10-year outlook period. The TAPR plays an important part in planning Queensland's transmission network and helping to ensure it continues to meet the needs of Queensland electricity consumers and participants in the NEM.

In addition, beyond the defined TAPR process, Powerlink's associated engagement activities provide an opportunity for non-network alternatives to be raised, further discussed or formally submitted for consideration as options to meet transmission network needs, well in advance of the proposed investment timings and commencement of regulatory consultations (where applicable).

2.4 Maintaining reliability of supply in the Cairns region

Powerlink identified in its 2019-2021 TAPRs, an expectation that action would be required to address the emerging reliability of supply issues in the Far North Queensland transmission zone[7].

Powerlink advised members of its Non-network Engagement Stakeholder Register (NNESR) of the publication of the TAPR.

[7] This relates to the standard geographic definitions (zones) identified within the TAPR.

No submissions proposing credible and genuine non-network options have been received from prospective non-network solution providers in the normal course of business, in response to the publication of the TAPR or as a result of stakeholder engagement activities.

2.4.1 Powerlink is undertaking a staged approach for this RIT-T

Recent TAPRs identified emerging risks associated with the condition of the towers in the Wet Tropics area, as well as risks related to the condition of the towers between Ross and Chalumbin Substations, which are driving the need for reinvestment in the Cairns region over the next several years.

The extent of the overall proposed reinvestment required to maintain reliability of supply in the Cairns region by 2026 is anticipated to be significant (whether in the form of network/non-network or a combination of both). In this instance, the non-homogenous condition of the transmission lines provide an opportunity to maximise positive outcomes for customers by undertaking any potential reinvestment utilising a prudent, staged approach rather than committing to a large capital investment upfront.

In addition, given the non-homogeneous nature of the transmission lines, a staged approach is more economic and will also provide an opportunity to engage with customers and seek input to further explore the possible benefits, costs, options (network and non-network).

2.5 Powerlink applies a consistent approach to the RIT-T stakeholder engagement process

Powerlink undertakes a considered and consistent approach to ensure an appropriate level of stakeholder engagement is undertaken for each individual RIT-T. Please visit Powerlink's website for detailed information on the types of engagement activities that may be undertaken during the consultation process. These activities focus on enhancing the value and outcomes of the RIT-T process for customers, stakeholders and non-network providers. Powerlink welcomes feedback from all stakeholders to further improve the RIT-T stakeholder engagement process.

3. Identified need – Stage 1, Davies Creek to Bayview Heights by December 2023

To maintain compliance with the reliability and service standards set out in the Electricity Act 1994[8], Powerlink's Transmission Authority[9] , the Rules[10], and applicable regulatory instruments[11], Powerlink must address the emerging condition risks of the towers between Davies Creek and Bayview Heights on the 275kV transmission line between Chalumbin and Woree Substations.

3.1 Geographical and network overview

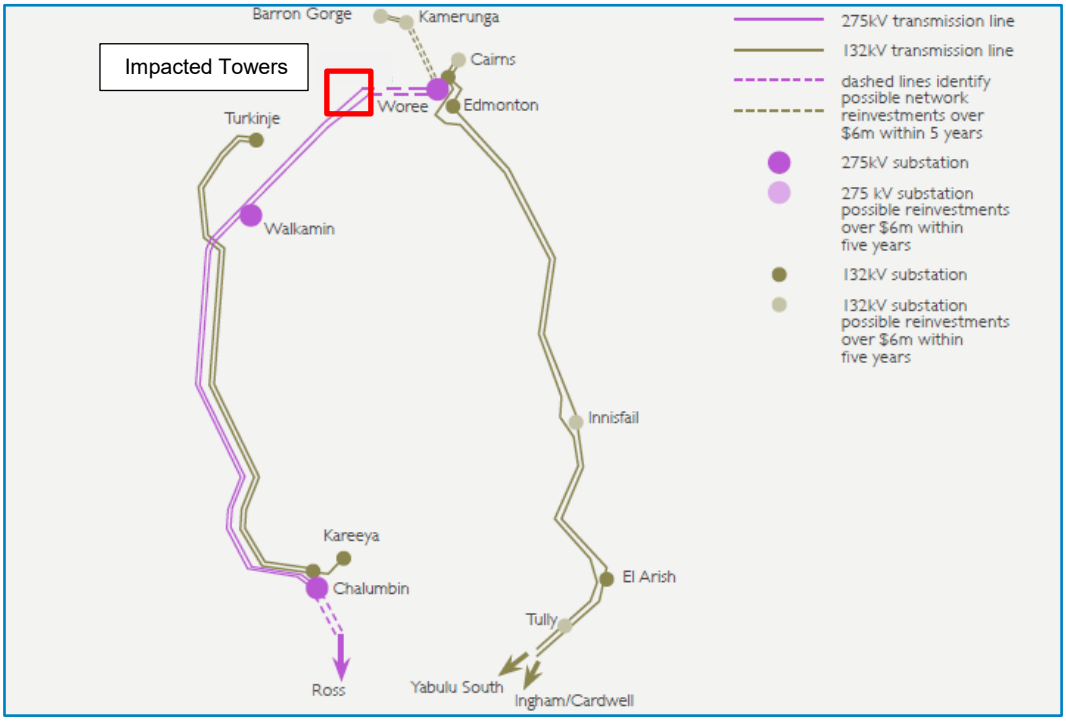
The majority of electricity used in the Cairns region is generated in central and north Queensland before being transmitted, via Powerlink's 275kV network to Ross, near Townsville, then on to Chalumbin Substation, and finally to Woree on the outskirts of Cairns.

The double circuit 275kV transmission line between Ross and Woree substations that traverses the World Heritage Wet Tropics area between Davies Creek and Bayview Heights includes 37 steel lattice towers.

The relevant transmission network is shown in Figure 3.1.

[8] Electricity Act 1994, Chapter 2, Part 4, S34(1)(a)
[9] Queensland Transmission Authority T01/98, section 6.2
[10] The Rules Schedule 5.1a and Schedule 5.1.
[11] The Rules, Chapter 10, Glossary, Applicable regulatory Instruments (5) Queensland

Figure 3.1: Far North Zone transmission network



3.2 Description of asset condition and risks

The Chalumbin to Woree section of line was built in 1998 and is approximately 140km in length. The condition of the majority of the line is consistent with its age. However, the 37 towers along approximately 16km of transmission line that traverses the environmentally sensitive World Heritage Wet Tropics area near Cairns are exhibiting extensive corrosion to tower structures and line hardware.

While these towers were designed to allow over spanning to minimise corridor clearing, their extended height and location within the wet tropics has increased their exposure to coastal winds and high rates of humidity and rainfall.

The sacrificial galvanised coating on the majority of the tower's nuts, bolts and light members has deteriorated to the point where the underlying steel has effectively begun to break down.

The line is displaying numerous instances of advanced corrosion to the nuts, bolts and light members on the towers' main bodies, superstructures, cross-arm-tips and earth wire peaks, with several examples of cross sectional steel loss.

Climbing step bolts on several towers are also exhibiting signs of advanced corrosion.

The consequence of not addressing these condition-based risks is that the asset condition will continue to decline at an accelerated rate. In the short term, this leads to costly additional and repetitive operational measures to rectify the condition and address the resulting risks. Under the worst case scenario, component parts will ultimately fail presenting serious risk to public safety and network reliability.

3.3 Reliability and service standards

With peak demand forecast to remain steady in the area for the next ten years[12], it is vital that supply is maintained to satisfy this demand, and for Powerlink to meet its reliability of supply obligations under the Electricity Act 1994, it's Transmission Authority and the Rules.

Under the Electricity Act 1994, Powerlink is required to "operate, maintain (including repair and replace if necessary) and protect its transmission grid to ensure the adequate, economic reliable and safe transmission of electricity"[13].

[12] Powerlink Transmission Annual Planning Report 2021
[13] .Electricity Act 1994, Chapter 2, Part 4, S34(1)(a)

The condition of the 275kV transmission lines between Davies Creek and Bayview Heights requires Powerlink to take action to either repair, replace or remove these lines, while taking into consideration the enduring need for the services they provide, to ensure compliance with the Electricity Act 1994.

Powerlink's Transmission Authority requires it to plan and develop the transmission network "in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services". It allows load to be interrupted during a critical single network contingency, provided the maximum load and energy does not exceed 50MW at any one time, or will not be more than 600MWh in aggregate[14].

> *"the power transfer available through the power system will be such that the forecast of electricity that is not able to be supplied during the most critical single network element outage will not exceed:*
>
> *(i) 50 megawatts at any one time; or*
>
> *(ii) 600 megawatt-hours in aggregate."*

Planning studies have confirmed an enduring demand for the services currently provided by the Davies Creek to Bayview Heights 275kV transmission line.

3.4 Impact of line removal on reliability and service standards

As the capacity of 132kV Coastal network and Barron Gorge Hydro Power Station are insufficient to meet the Cairns area load, removal of the 275kV line between Chalumbin and Woree to address emerging safety risks (without any network changes or a non-network solution) would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability of supply obligations.

In addition, the line carries an OPGW to provide critical telecommunications for the high voltage transmission network control and protection systems, which if removed without replacement would breach AEMO's Power System Data Communication Standard and Power System Security Guidelines.

3.5 Summary of Compliance Obligations

Due to the condition of the 275kV towers between Davies Creek and Bayview Heights, Powerlink is obligated to take corrective action to continue to meet safety, reliability and service standard obligations under key electrical safety legislation, the Rules and its Transmission Authority. Safety obligations could theoretically be met by removing the transmission line from service, however, to ensure Powerlink remains compliant with the Rules and its Transmission Authority, the action taken must ensure the services provided by the line are replicated, either by credible network or non-network options.

Removal of the 275kV transmission line, without additional network investment or a non-network solution, is not a technically feasible option.

4. Submissions received

There were no submissions received in response to the PSCR that was open for consultation until the 8 July 2021[15]. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation.

[14] Transmission Authority No. T01/98, section 6.2(c)
[15] Members of Powerlink's Non-network Engagement Stakeholder Register were also advised of the PSCR publication.

5. Credible options assessed in this RIT-T

Powerlink has developed two credible network options to address the safety and network risks associated with the condition of the towers in the World Heritage Wet Tropics Area. Both options extend the life of the transmission line by approximately 20 years, at which time it will have reached the end of the conductor's design life, thereby providing an opportunity to review the configuration of the wider network in the area.

Both of the credible options address the identified need and are expected to be technically feasible. They address the identified need in a timely manner and avoid a situation where corrective maintenance of ageing assets is no longer practical.

The two credible network options identified are:

- Option 1: Refit of transmission line structures, including the replacement of corroded components, by December 2023.
- Option 2: Refit of transmission line structures, including the replacement of corroded components and painting of structures, by December 2023.

The work to be committed under each option within this RIT-T is identified as a 'RIT-T project'; whilst future planned, projects are included to provide a complete view of the options and are identified as 'Modelled Projects'. Option 1 avoids the need to paint any towers in the Wet Tropics, while Option 2 includes painting to effectively defer the need for subsequent works to address emerging condition issues.

A summary of these options is given in Table 5.1.

Table 5.1: Summary of credible options

Option	Description	Total costs ($m, 2020/21)	Annual O&M Costs ($m, 2020/21)
1	Replace critical components displaying advanced and early onset of corrosion by December 2023*	20.23	0.004
	Replace critical components displaying early onset of corrosion by 2033†	29.73	
	Replace critical components displaying early onset of corrosion by 2038†	23.25	
	Replace critical components displaying early onset of corrosion by 2043†	9.25	
2	Replace all critical components displaying advanced corrosion <u>and repaint towers</u> by December 2023*	38.37	0.004
	Repaint of selected structural components and minor works by 2039†	5.38	

*RIT-T Project
†Modelled network projects including future RIT-T consultations

Powerlink is the proponent of both credible network options presented. Neither of these options in respect of the identified need has been discussed by the Australian Energy Market Operator (AEMO) in its most recent Integrated System Plan (ISP)[16].

[16]Clause 5.16.4(b)(4) of the Rules requires Powerlink to advise whether the identified need and or solutions are included in the most recent ISP. The most recent ISP was published in July 2020.

5.1 Material inter-network impact

Powerlink does not consider that any of the credible options being considered will have a material inter-network impact, based on AEMO's screening criteria[17].

6. Materiality of Market Benefits

The rules require that all categories of market benefits identified in relation to a RIT-T be quantified, unless the TNSP can demonstrate that a specific category is unlikely to be material.[18]

6.1 Market benefits that are material for this RIT-T assessment

Powerlink considers that changes in involuntary load shedding (i.e. the reduction in expected unserved energy) between options and the Base Case, set out in this PACR, may impact the ranking of the credible options under consideration, or the relativity of the credible options to the Base Case, and that this class of market benefit could be material. These benefits have been quantified and included within the cost benefit and risk cost analysis as network risk.

6.2 Market benefits that are not material for this RIT-T assessment

The AER has recognised a number of classes of market benefits may not be material in the RIT-T assessment and so do not need to be estimated[19]. Other than market benefits associated with involuntary load shedding, Powerlink does not consider any other category of market benefits to be material, and had not estimated them as part of this RIT-T.

More information on consideration of individual classes of market benefits can be found in the PSCR.

7. Base Case

7.1 Modelling a Base Case under the RIT-T

Consistent with the RIT-T Application Guidelines the assessment undertaken in this PACR compares the costs and benefits of credible options to address the risks arising from an identified need, with a Base Case[20].

As characterised in the RIT-T Application Guidelines, the Base Case itself is not a credible option to meet the identified need. Specifically, the Base Case reflects a state of the world in which the condition and obsolescence issues arising from the ageing assets are only addressed through standard operational activities, with escalating safety, financial, environmental and network risks.

To develop the Base Case, the existing condition and obsolescence issues are managed by undertaking operational maintenance only, which results in an increase in risk levels as the condition and availability of the asset deteriorates over time. These increasing risk levels are assigned a monetary value that is used to evaluate the credible options designed to offset or mitigate these risk costs.

The Base Case for the transmission towers between Davies Creek and Bayview Heights therefore includes the costs of work associated with operational maintenance and the risk costs associated with the failure of the assets. The costs associated with equipment failures are modelled in the risk cost analysis and are not included in the operational maintenance costs.

The Base Case acts as a benchmark and provides a clear reference point in the cost-benefit analysis to compare and rank the credible options against each other over the same timeframe.

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[17] In accordance with Rules clause 5.16.4(b)(6)(ii). AEMO has published guidelines for assessing whether a credible option is expected to have a material inter-network impact.
[18] S3.6.1 Material classes of market benefits, AER, Regulatory investment test for transmission application guidelines, August 2020.
[19] AER, Application guidelines, Regulatory investment test for transmission, August 2020.
[20] AER, Application Guidelines, Regulatory Investment Test for Transmission, August 2020.

7.2 Cairns Base Case risk costs

Powerlink has developed a risk modelling framework consistent with the RIT-T Application Guidelines and the AER Industry practice application note[21]. An overview of the framework is available on Powerlink's website[22] and the principles of the Framework have been used to calculate the risk costs of the Cairns Base Case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

7.3 Base Case assumptions

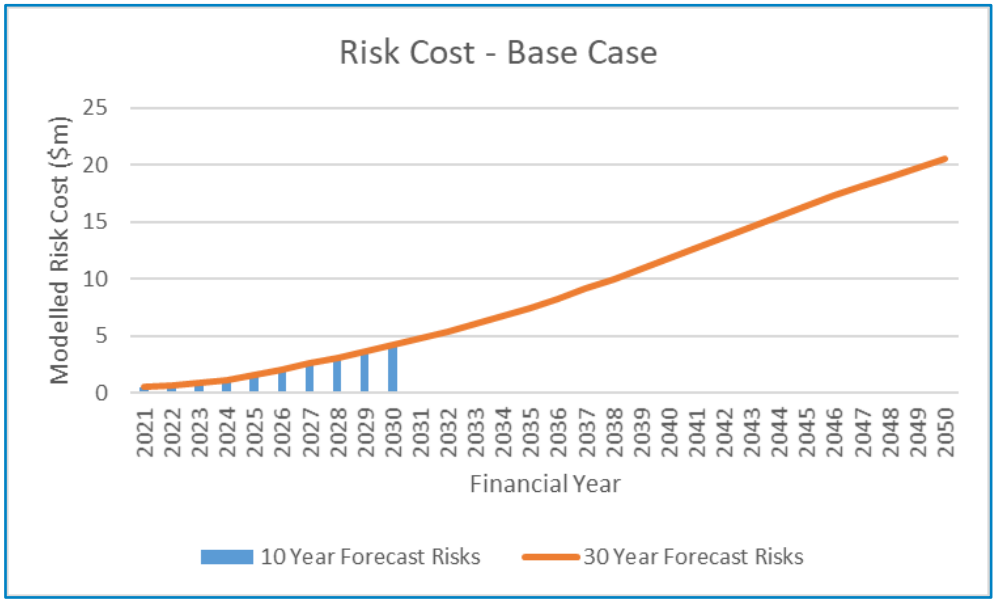
In calculating the potential unserved energy (USE) arising from a failure of the ageing structures between Davies Creek and Bayview Heights, the following modelling assumptions have been made:

- historical load profiles have been used when assessing the likelihood (likely magnitude) of unserved energy under concurrent failure events;
- unserved energy generally accrues under concurrent failure events, and consideration has been given to potential failure events within the wider far north Queensland network;
- BS1664 supplies a mixture of residential, commercial and tourist load types within the Cairns area. Historical load data has been analysed to approximate the proportion of load for each customer category, resulting in a weighted VCR of $29,108/MWh; and
- The most relevant residential and commercial VCR values published within the AER's 2019 Value of Customer Reliability Annual Adjustment (updated in 2021) have been used to determine the VCR.
- The probability that a structure will fail includes the probability that a wind event, sufficient to bring the tower down, has occurred.
- Davies Creek to Bayview Heights is a double circuit line, which means that failure of a structure will result in loss of both 275kV transmission feeders to Woree substation (i.e. n-2 event).
- In the event of a widespread outage of the greater Cairns area, generation at Barron Gorge may not be able to be dispatched. The market impacts associated with this scenario have not been included since they are not considered significant compared to the unserved energy risks.
- The built section traverses the sensitive World Heritage wet tropics area. Any emergency rectification work will need to be carried out by helicopter and aerial crews, and will incur a premium compared to rectification of transmission structures within conventional rural areas.

The 30 year forecast of risk costs for the Base Case is shown in Figure 7.1.

[21] AER Industry practice application note, Asset Replacement Planning, January 2019
[22] The risk costs are calculated using the principles set out in the Powerlink document, Overview of Asset Risk Cost Methodology, May 2019

Figure 7.1: Modelled Base Case risk costs



Based upon the assessed condition of the ageing structures between Davies Creek and Bayview Heights, the total risk costs are projected to increase from $0.5 million in 2021 to $20.6 million in 2050. The main areas of risk are safety, network and financial. Network risk is modelled as probability weighted unserved energy[23] while financial risk costs are associated with the replacement of failed assets in an emergency. These risks increase over time as the condition of the structures further deteriorates and the likelihood of failure rises.

7.4 Modelling of Risk in Options

Each option is scoped to mitigate the major risks arising in the Base Case and to maintain compliance with all statutory requirements, the Rules and AEMO standards. The residual risk is calculated for each option based upon the individual implementation strategy of the option. This is included with the capital and operational maintenance cost of each option to develop the NPV inputs.

8. General modelling approach adopted for net benefit analysis

8.1 Analysis period

The RIT-T analysis has been undertaken over a 30 year period, from 2021 to 2050. A 30 year period takes into account the size and complexity of the options. There will be remaining asset life by 2050, at which point a terminal value is calculated to correctly account for capital costs under each credible option.

8.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the NPV of the costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 5.5%[24] as the central assumption for the NPV analysis presented in this report.

Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 2.2%[25] and an upper bound discount rate of 8.8% (i.e. a symmetrical upwards adjustment).

[23] Unserved Energy is modelled using a Value of Customer Reliability (VCR) consistent with that published by AER in their 2021 Value of Customer Reliability Annual Adjustment.
[24] This indicative commercial discount rate of 5.5% is based on AEMO 2021 Inputs, Assumptions and Scenarios Report, p105.
[25] A discount rate of 2.2% pretax WACC is based on AER 2023-27 Powerlink Queensland revised revenue proposal, p21.

8.3 Description of reasonable scenarios and sensitivities

The RIT-T analysis is required to incorporate a number of different reasonable scenarios, which are used to estimate market benefits. The number and choice of reasonable scenarios must be appropriate to the credible options under consideration and reflect any variables or parameters that are likely to affect the ranking of the credible options, where the identified need is reliability corrective action[26].

Given the specific and localised nature of the identified need, the ISP scenarios from the most recent Input Assumptions and Scenario Report are not relevant to this RIT-T[27].

As discount rate, capital cost, maintenance cost and risk cost sensitivities do not impact the ranking of options, Powerlink has chosen to present a central scenario consistent with the requirements for reasonable scenarios in the RIT-T instrument [28] and in accordance with the provisions of the RIT-T Application Guidelines[29].

Table 8.1: Reasonable scenarios assumed

Key parameter	Central Scenario
Capital Costs	100% of base capital cost estimate
Discount Rate	5.5%
Maintenance Costs	100% of base maintenance estimate
Total Risk Cost	100% of base risk cost forecast

9. Cost benefit analysis and identification of the preferred option

9.1 NPV Analysis

Table 9.1 outlines the NPV and the corresponding ranking of each credible option relative to the Base Case.

Table 9.1: NPV of credible options relative to base case

Option	Description	Central Scenario NPV relative to Base Case ($m, 2020/21)	Ranking
1	Replace critical components displaying advanced and early onset of corrosion by December 2023	47.62	2
2	Replace critical components displaying advanced corrosion and repaint towers by December 2023	55.18	1

Both credible options will address the identified need on an enduring basis. Option 2 is ranked first, with Option 1 being $6.75 million more expensive compared to Option 2 in NPV terms.

Figure 9.1 sets out the breakdown of capital cost, operational maintenance cost and risk cost for each option in NPV terms under the central scenario. Note that the non-credible Base Case consists of operational maintenance and total risk costs and does not include any capital expenditure.

[26] AER, Regulatory investment test for transmission, August 2020, Section 23
[27] AER, Final: RIT–T, August 2020, sub-paragraph 20(b)
[28] AER, Final: RIT–T, August 2020, sub-paragraph 22
[29] S3.8.1 Selecting reasonable scenarios, RIT-T Application Guidelines, August 2020

Figure 9.1: NPV of the Base Case and each credible option (NPV $m)

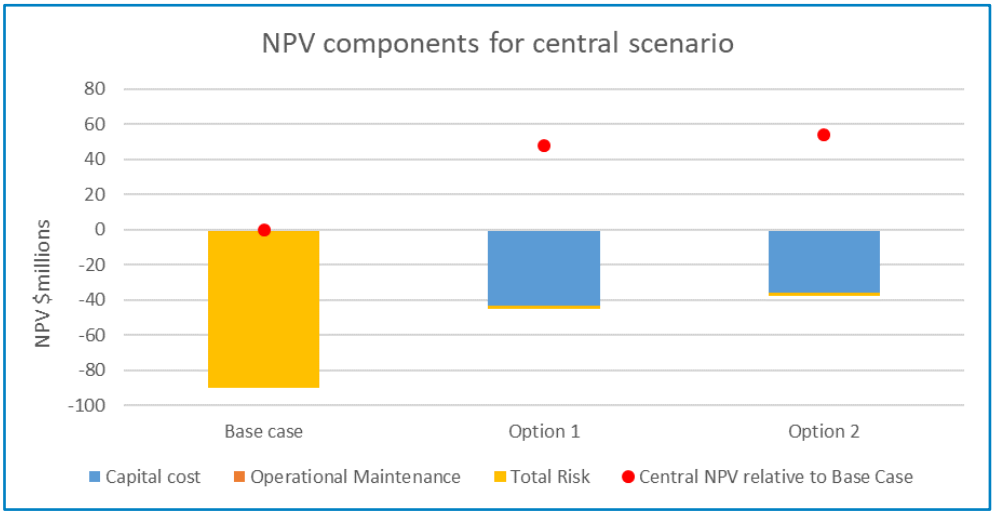


Figure 9.1 illustrates that both credible options will significantly reduce the risk cost compared to the Base Case. Due to the lower capital and risk cost components, Option 2 results in the highest NPV relative to the Base Case of the two credible options.

9.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 2.2% to 8.8% discount rate
- a range from 75% to 125% of base capital expenditure estimates
- a range from 75% to 125% of base operational maintenance expenditure estimates
- a range from 75% to 125% of base risk cost forecast

As illustrated in Figures 9.2.1 to 9.2.4, sensitivity analysis for the NPV relative to the Base Case shows that varying the discount rate, capital expenditure, operational maintenance cost and risk cost has no impact on the identification of the preferred option. Option 2 is the preferred the option under all sensitivities tested.

Figure 9.2.1: Discount rate sensitivity

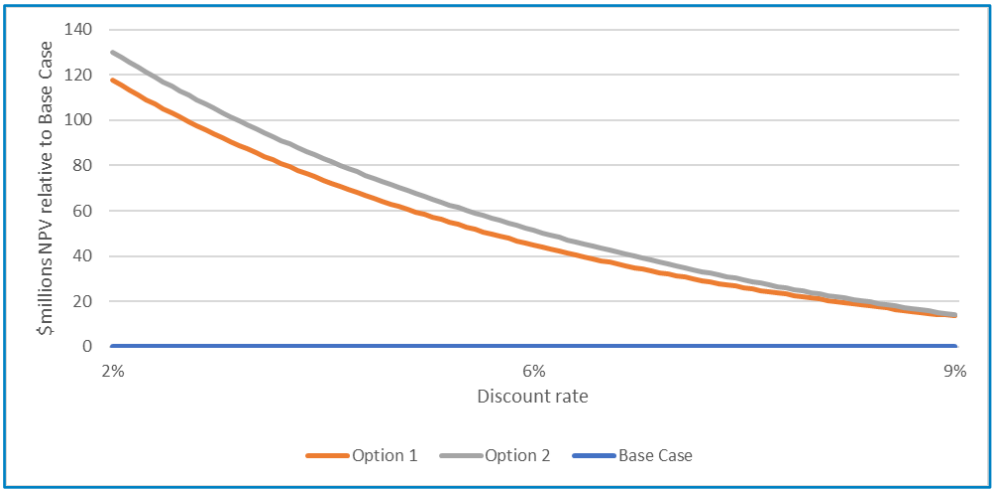


Figure 9.2.2: Capital cost sensitivity

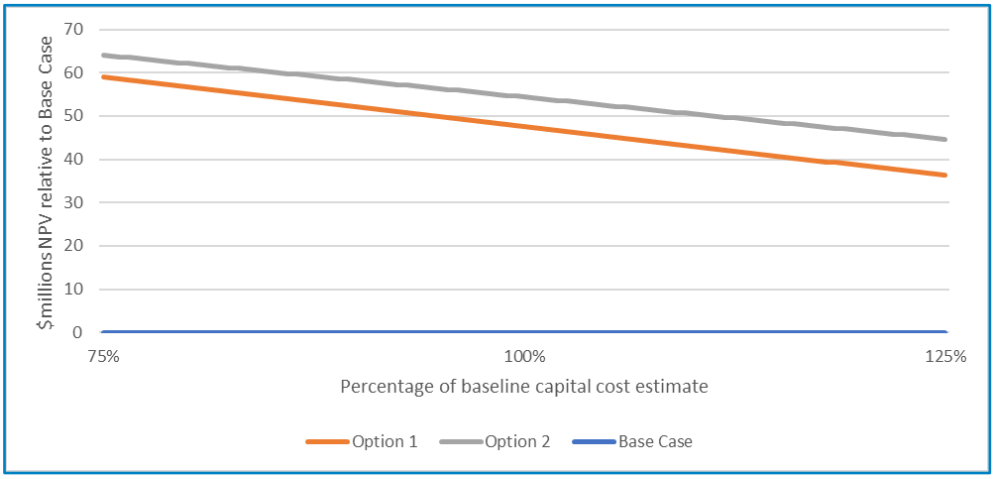


Figure 9.2.3: Maintenance cost sensitivity

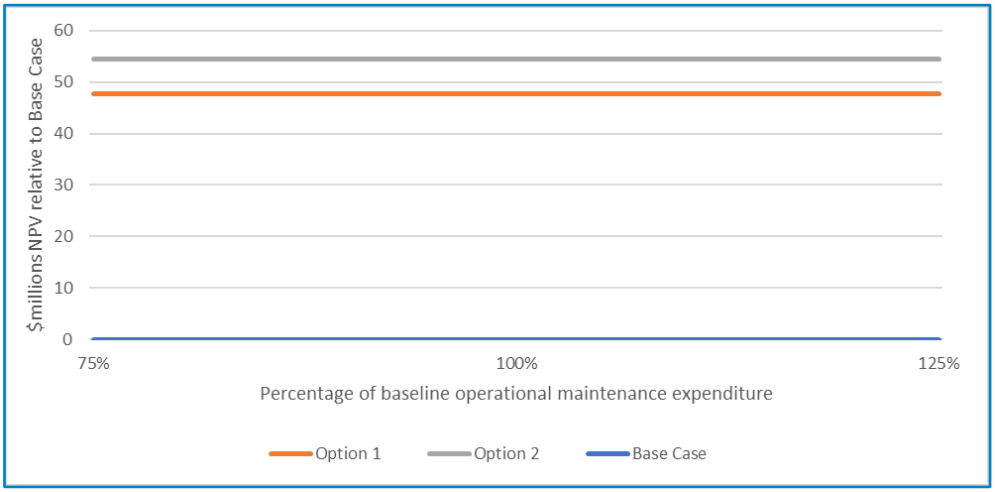
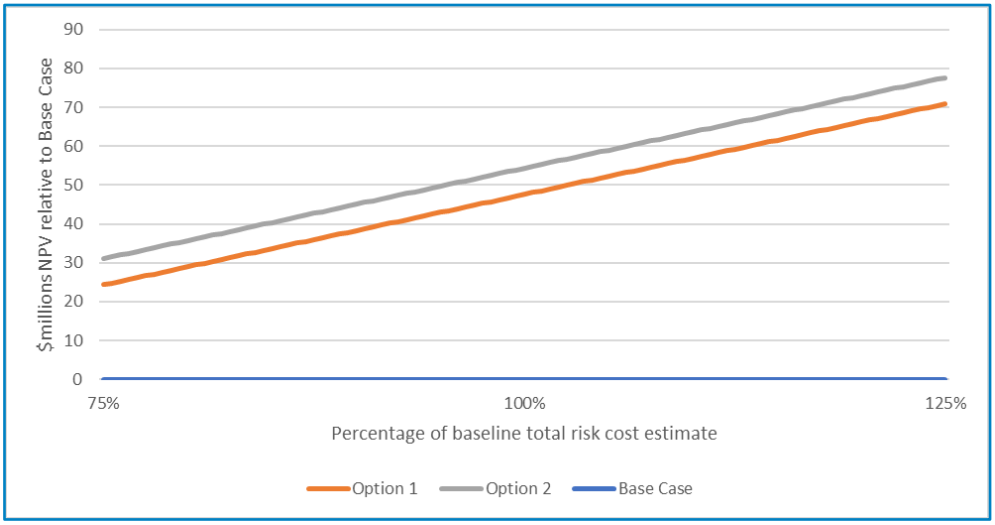


Figure 9.2.4: Risk cost sensitivity



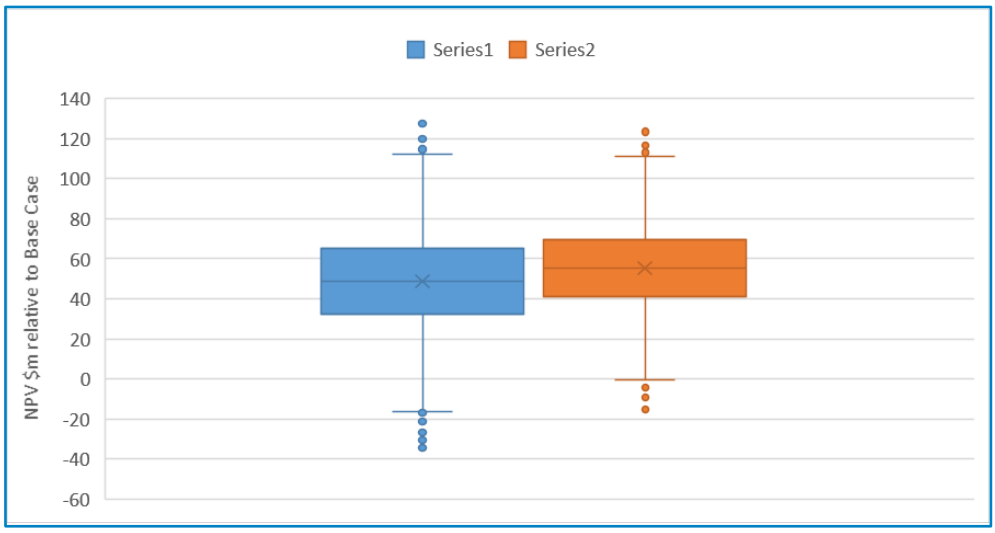
9.3 Sensitivity to multiple parameters

A Monte Carlo simulation was performed with multiple input parameters (including capital cost, discount rate and total risk cost) generated for the calculation of the NPV for each option. This process is repeated over 5,000 iterations, each time using a different set of random variables

from the probability function. The sensitivity analysis output is presented as a distribution of possible NPVs for each option, as illustrated in Figure 9.3.

The Monte Carlo simulation results identify that Option 2 has marginally less statistical dispersion in comparison to Option 1 and its mean and median is the higher of the two options. This confirms that the preferred option, Option 2, is robust over a range of input parameters in combination.

Figure 9.3: NPV sensitivity analysis of multiple key assumptions relative to the Base Case



10. Preferred option

Based on the conclusions drawn from the economic analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks associated with the deteriorated condition of the steel lattice structures between Davies Creek and Bayview Heights. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the Rules.

The result of the economic analysis indicates that Option 2 is the credible option with the lowest cost to customers, in NPV terms, over the 30 year analysis period. Sensitivity testing shows the analysis is robust to variations in the capital cost, operational maintenance cost, risk cost and discount rate assumptions.

Option 2 is therefore considered to satisfy the requirement of the RIT-T and is the preferred option.

11. Conclusions

The following conclusions have been drawn from the analysis presented in this report:

- Powerlink has identified condition risks arising from the condition of the towers between Davies Creek and Bayview Heights on the 275kV transmission line between Chalumbin and Woree Substations.
- TNSPs maintain (including repair and replace if necessary) their transmission grid to ensure the adequate, economic, reliable and safe transmission of electricity, including the ability to meet peak demand if a major element of the network was to fail.
- The increasing likelihood of faults arising from the condition of the deteriorated transmission towers compels Powerlink to undertake reliability corrective action on the transmission towers between Davies Creek and Bayview Heights to continue to meet the reliability standards set out in its Transmission Authority

- Studies were undertaken to evaluate two credible options. Both options were evaluated in accordance with the AER's RIT-T.
- Powerlink published a PSCR in March 2021 requesting submissions from Registered Participants, AEMO and interested parties on the credible options presented, including alternative credible non-network options, which could address the risks arising from the condition of the transmission towers between Davies Creek and Bayview Heights.
- The PSCR also identified the preferred option and that Powerlink was adopting the expedited process for this RIT-T, claiming exemption from producing a PADR as allowed for under the Rules Clause 5.16.4(z1) for investments of this nature.
- There were no submissions received in response to the PSCR, which was open for consultation until 8 July 2021. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation. The conditions specified under the Rules for exemption have now been fulfilled.
- The result of the cost-benefit analysis under the RIT-T identified that Option 2 is the least cost solution over the 30 year analysis period. Sensitivity testing showed the analysis is robust to variations in discount rate, capital expenditure, operational maintenance expenditure and risk costs assumptions. As a result, Option 2 is considered to satisfy the RIT-T.
- The outcomes of the economic analysis contained in this PACR remain unchanged from those published in the PSCR. Consequently, the draft recommendation has been adopted without change as the final recommendation and will now be implemented.

12. Final Recommendation

Based on the conclusions drawn from the NPV analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks arising from the deteriorated condition of the transmission towers between Davies Creek and Bayview Heights on the Chalumbin to Woree transmission line. Implementing this option will ensure Powerlink's ongoing compliance with the Rules as well as the reliability standard within Powerlink's Transmission Authority.

Option 2 involves the refit of the 37 towers through the selective replacement of corroded members and components, along with the painting of all 37 towers by December 2023. The indicative capital cost of the RIT-T project for the preferred option is $38.37 million in 2020/21 prices. Under Option 2, consultation and joint planning with Wet Tropics' stakeholders will be undertaken in late-2022, with contractors deployed to site in 2022/23 and work completed by December 2023.

Powerlink will now proceed with the necessary processes to implement this recommendation.

Contact us

Registered office	33 Harold St Virginia Queensland 4014 Australia
Postal address:	GPO Box 1193 Virginia Queensland 4014 Australia
Contact:	Roger Smith Manager Network and Alternate Solutions
Telephone	(+617) 3860 2328 (during business hours)
Email	networkassessments@powerlink.com.au
Internet	www.powerlink.com.au