Powerlink Queensland

Project Specification Consultation Report

31 March 2021

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[1] 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. More information on the RIT-T process and how it is applied to ensure that safe, reliable and cost effective solutions are implemented to deliver better outcomes to customers is available on Powerlink's website.
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 customers. Final selection of the '*preferred option'* is based upon Net Present Value (NPV) analysis of each option.
3. The main purpose of this document is to provide details of the identified need, credible options, identification of the preferred option, technical characteristics of non-network options, and categories of market benefits impacting selection of the preferred option. In particular, it encourages submissions from potential proponents of feasible non-network options to address the identified need.

[1] Such requirements include, but are not limited to, addressing any emerging reliability of supply issues or relevant *ISP actionable projects* identified in the Australian Energy Market Operator's (AEMO) latest Integrated System Plan (ISP), for which Powerlink has responsibility as the relevant Transmission Network Service Provider (TNSP).

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Executive Summary

Overview

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 'run of the river' 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.

Powerlink has identified an opportunity to consider a staged approach

Given the non-homogenous condition of the approximately 384km of 275kV transmission lines supplying the Cairns region, and subject to the submissions received and cost-benefit analysis undertaken as part of this RIT-T consultation, there is 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 37steel 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 increasing likelihood of faults and outages arising from the condition of these structures remaining in service without corrective action exposes customers to the risks and consequences of an unreliable electricity supply. The increasing susceptibility of the line to conductor drop and tower failure during major weather events also exposes the Wet Tropics World Heritage Area to unacceptable environmental risks.

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. Powerlink is proposing that as the potential reinvestment for this section is not anticipated until around 2026-27, it will be assessed under a subsequent Stage 2 RIT-T (Maintaining reliability of supply in the Cairns region).

Identified need

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.

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

The deteriorating condition of the steel lattice towers between Davies Creek and Bayview Heights puts at risk Powerlink's ongoing compliance with the reliability and service standards set out in the National Electricity Rules (the Rules), Powerlink's Transmission Authority and applicable regulatory instruments[2].

Powerlink must therefore take action to maintain existing electricity services, ensuring an ongoing reliable, safe and cost effective supply to customers in the area.

Powerlink is required to apply the RIT-T to this investment

The proposed investment is to meet reliability and service standards specified within applicable regulatory instruments and Schedule 5.1 of the Rules and it is classified as a "reliability corrective action"[3].

As the identified need is not discussed in the most recent Integrated System Plan (ISP), it is subject to the application and consultation process for RIT-T projects not defined as *actionable ISP projects*[4].

The most expensive credible network option identified in this PSCR meets the capital expenditure cost threshold of $6 million, initiating public consultation under the Rules. Powerlink has adopted the expedited process for this RIT-T[5], as the preferred option is below $43 million and is unlikely to result in any material market benefits, other than those arising from a reduction in involuntary load shedding. The reduction in involuntary load shedding under the credible network options is catered for in the risk cost modelling and consequentially represented in the economic analysis of the options.

A non-credible Base Case has been developed against which to compare credible options

Consistent with the Australian Energy Regulator's (AER's) RIT-T Application Guidelines[6], the assessment undertaken in this PSCR compares and ranks the net present value (NPV) of credible network options designed to address the emerging risks, relative to a Base Case.

The Base Case is modelled as a non-credible option where the existing condition issues associated with an asset are managed via operational maintenance only, resulting in an increase in risk levels due to deterioration of asset condition and rectification of failures taking longer due to obsolescence issues. These increasing risk levels are assigned a monetary value and added to the ongoing maintenance costs to form the Base Case.

Two credible network options have been developed to address the identified need

Table 1 details the two credible network options and their net present values (NPVs) relative to the non-credible Base Case[7]. Overall Option 2 is ranked first in NPV terms.

[2] Electricity Act 1994, Electrical Safety Act 2002 and Electricity Safety Regulation 2013 (See Appendix 2 for further detail)
[3] The Rules clause 5.10.2, Definitions, reliability corrective action.
[4] Refer to Clause 5.16.2 of the NER.
[5] In accordance with clause 5.16.4(z1) of the Rules
[6] AER, Application guidelines, Regulatory investment test for transmission, August 2020
[7] Both options are modelled with an annual Operating and Maintenance budget of $4,500 for the 37 towers.

Table 1: Summary of credible network options

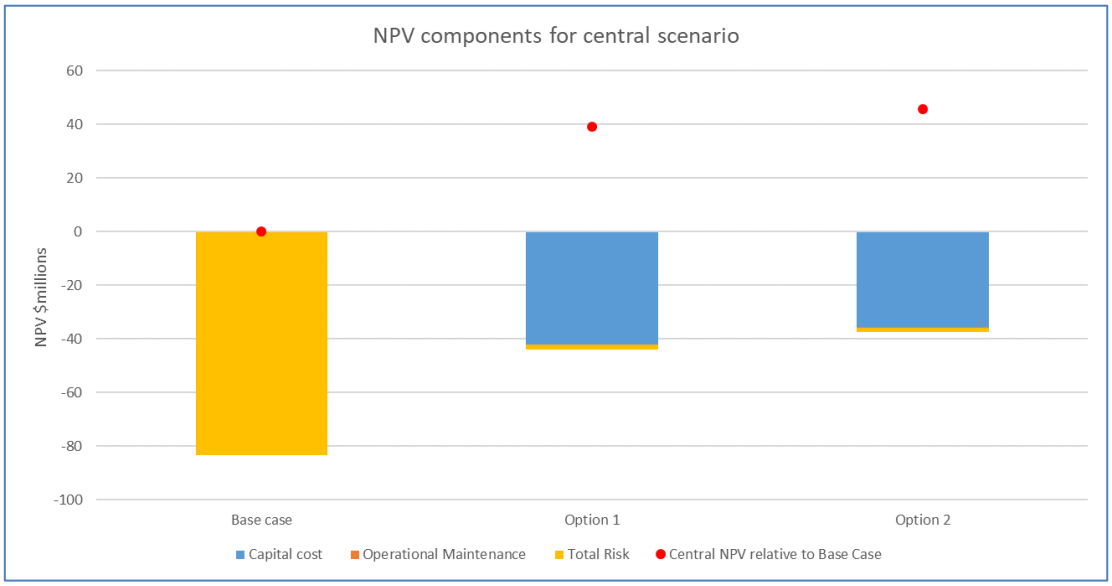
Option	Description	Total Cost ($m 2020/21)	Central NPV relative to Base Case ($m)	Ranking
Option 1 Staged Line refit without painting	Replace critical components and members displaying advanced and early onset of corrosion by October 2023*	**20.23***	39.29	**2**
	Replace critical components and members displaying early onset of corrosion by 2033*	29.73†		
	Replace critical components and members displaying early onset of corrosion by 2038†	23.25†		
	Replace critical components and members displaying early onset of corrosion by 2043†	9.25†		
	Total Capital Cost	82.46		
Option 2 Line refit with painting	Replace all critical components displaying advanced corrosion and repaint towers by October 2023*	**38.37***	45.74	**1**
	Repaint of selected structural components and minor works by 2039†	5.38†		
	Total Capital Cost	43.75		

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

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.

Figure 1: NPV of Base Case and Credible Network Options



Option 2 has been identified as the preferred option.

The Base Case is not a credible option, in that it does not allow Powerlink to continue to maintain compliance with relevant standards, applicable regulatory instruments and the Rules.

The economic analysis demonstrates that Option 2 provides the highest net economic return relative to the Base Case of the two credible options and is therefore the preferred option.

Option 2 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 October 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 commence in late-2021, with contractors deployed to site in mid-2022 and work completed by October 2023.

Powerlink welcomes the potential for non-network options to form part or all of the solution

Powerlink welcomes submissions from proponents who consider that they could offer a credible non-network option that is both economically and technically feasible by October 2023, on an ongoing basis. A non-network option that avoids reinvestment in ageing structures would need to replicate, in part or full, the support that the Chalumbin to Woree transmission line provides to customers in the Cairns region, on a cost effective basis.

Lodging a submission with Powerlink

Powerlink is seeking written submissions on this *Project Specification Consultation Report* by Thursday, 8 July 2021, particularly on the credible options presented[8].

Please address submissions to:

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[8] Powerlink's website has detailed information on the types of engagement activities, which may be undertaken during the consultation process. These activities focus on enhancing the value and outcomes of the RIT-T engagement process for customers and non-network providers.

1. Introduction

1.1 Powerlink Asset Management and Obligations

Powerlink Queensland is a Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM) that owns, develops, operates and maintains Queensland's high-voltage electricity transmission network. This network transfers bulk power from Queensland generators to electricity distributors Energex and Ergon Energy (part of the Energy Queensland Group), and to a range of large industrial customers.

Powerlink's approach to asset management includes a commitment to sustainable asset management practices that ensure Powerlink provides valued transmission services to its customers by managing risk[9], optimizing performance and efficiently managing assets through the whole asset life cycle[10].

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services currently provided by the Chalumbin to Woree transmission line to customers in far north Queensland.

The steel lattice towers and attachment hardware on the 37 structures located within the Wet Tropics area are nearing the end of their technical service lives and are increasingly at risk of failure.

The proposed network options maintain the current electricity services to customers in the area by addressing the increasing likelihood of faults arising from the condition of the line's deteriorating structures. When developing the options, Powerlink has focussed on implementing technically feasible solutions that ensure a reliable and safe supply, delivering better outcomes for customers.

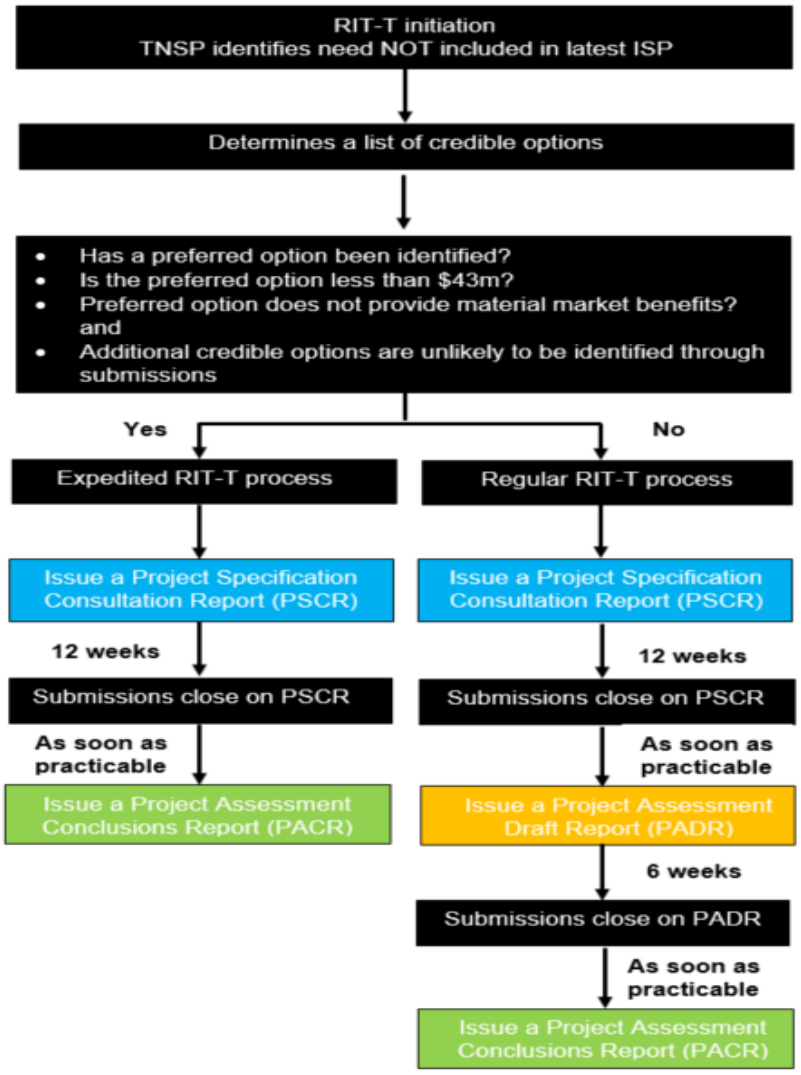
1.2 RIT-T Overview

This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process[11]. It:

- describes the reasons why Powerlink has determined that investment is necessary (the 'identified need'), together with the assumptions used in identifying this need
- provides potential proponents of non-network options with information on the technical characteristics that a non-network solution would need to deliver, in order to assist proponents in considering whether they could offer an alternative solution
- describes the credible options that Powerlink currently considers may address the identified need
- discusses why Powerlink does not expect specific categories of market benefit to be material for this RIT-T[12]
- presents the NPV assessment of each of the credible options compared to a Base Case (as well as the methodologies and assumptions underlying these results)
- identifies and provides a detailed description of the credible option that satisfies the RIT-T, and is therefore the preferred option
- describes how customers and stakeholders have been engaged with regarding the identified need
- provides stakeholders with the opportunity to comment on this assessment so that Powerlink can refine the analysis (if required) as part of the Project Assessment Conclusions Report (PACR)

[9] Risk assessments are underpinned by Powerlink's corporate risk management framework and the application of a range of risk assessment methodologies set out in AS/NZS ISO31000:2018 *Risk Management Guidelines*.
[10] Powerlink aligns asset management processes and practices with AS ISO55000:2014 *Asset Management – Overview, principles and terminology* to ensure a consistent approach is applied throughout the life cycle of assets
[11] This RIT-T consultation 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.
[12] As required by clause 5.16.1(c)(iv) of the Rules.

Figure 1.1: RIT-T process overview: Need not defined as an *actionable ISP project*



Powerlink has adopted the expedited process for this RIT-T, as allowed for under the Rules for investments of this nature[13]. Specifically, Powerlink will publish a PACR following public consultation on this PSCR and apply the exemption from publishing a Project Assessment Draft Report (PADR) as:

- the preferred option has an estimated capital cost of less than $43 million
- none of the credible options have material market benefits, other than benefits associated with changes in involuntary load shedding[14]
- Powerlink has identified its preferred option in this PSCR (together with the supporting quantitative cost-benefit analysis)

Powerlink will however publish a PADR if submissions to this PSCR identify other credible options that have not yet been considered and which could provide a material market benefit.

[13] In accordance with clause 5.16.4(z1) of the Rules
[14] Section 4.3 Project Assessment Draft Report, Exemption from preparing a draft report, AER, Application Guidelines, Regulatory investment Test for Transmission, August 2020

2. Customer and non-network engagement

With five million Queenslanders and 236,000 Queensland businesses depending on Powerlink's 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 effective, timely and transparent information with customers and stakeholders within the broader community.

Powerlink's annual Transmission Network Forum (TNF) is a primary vehicle used to engage with the community, understand broader customer and industry views and obtain feedback on key topics.

It also provides Powerlink with an opportunity to further inform its business network and non-network planning objectives. TNF participants include customers, landholders, environmental groups, Traditional Owners, government agencies, and industry bodies.

Engagement activities such as the TNF 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, providing an ongoing opportunity for:

- the Customer Panel to ask questions and provide feedback to further inform RIT-Ts
- Powerlink to better understand the views of customers when undertaking the RIT-T consultation process.

Powerlink will continue providing updates to and request input from the Customer Panel throughout the RIT-T consultation process.

2.3 Transparency on future network requirements

Powerlink's annual planning review findings are published in the 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. Powerlink undertakes engagement activities, such as a webinar and/or forum, to share with customers and stakeholders the most recent TAPR findings and respond to any questions that may arise.

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).

2.3.1 Maintaining reliability of supply in the Cairns region

Powerlink identified in its 2019-2020 TAPRs, an expectation that action would be required to address the emerging reliability of supply issues in the Far North Queensland transmission zone[15].

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

2.3.2 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) and refine timings if required, associated with other at-risk assets remaining in service.

2.4 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.

2.5 The transmission component of electricity bills

Powerlink's contribution to electricity bills reduced is approximately 9% of the total cost of the residential electricity bill (refer to Figure 2.1).

Figure 2.1: Components of end user bills

Detailed information on transmission pricing, including discussion on how Powerlink is actively engaging with customers and stakeholders on transmission pricing concerns, is available on Powerlink's website.

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

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

This section sets out the near-term requirements for maintaining reliability of supply in the Cairns region. It provides an overview of the existing network arrangements between the Chalumbin and Woree Substations and describes the increasing risk to Powerlink of being unable to maintain compliance with relevant standards, applicable regulatory instruments and the Rules, which are designed to ensure Powerlink's customers continue to receive safe, reliable and cost effective electricity services.

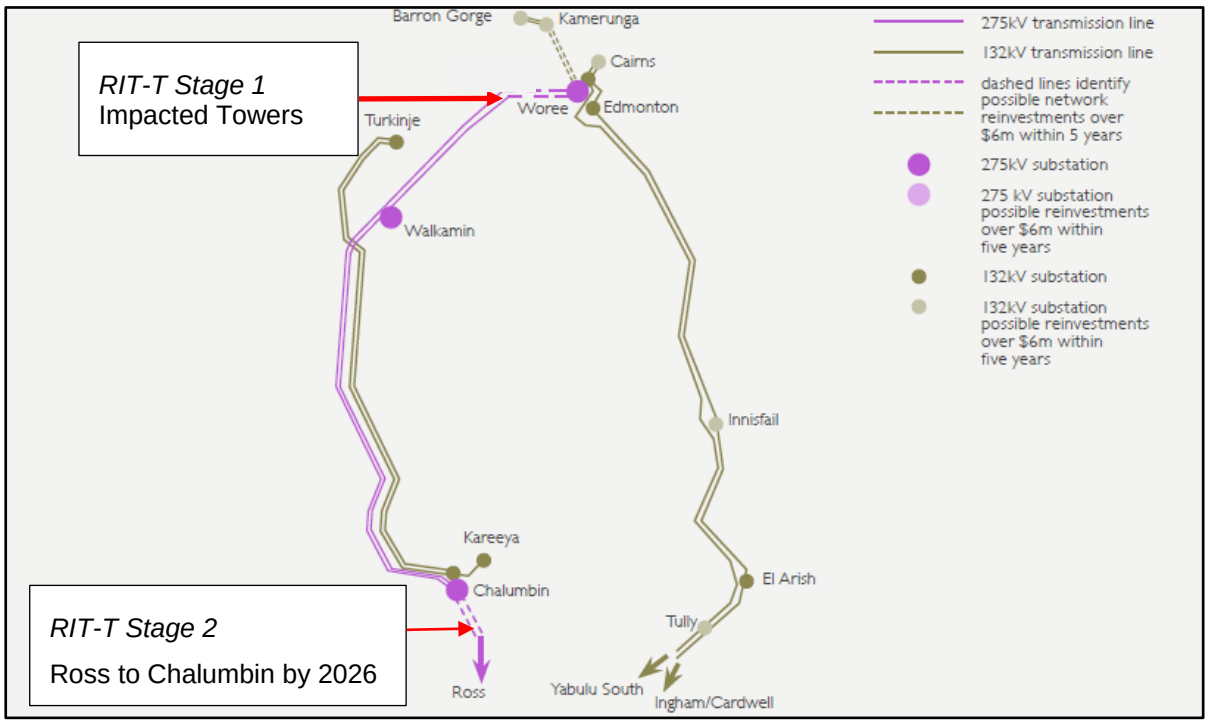
3.1 Geographical and network overview

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 onto to Chalumbin Substation, and finally to Woree on the outskirts of Cairns.

The double circuit 275kV transmission line between Ross and Woree substations that traverse through 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.

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.

Appendix 1 identifies the key electrical safety legislation, in addition to the Electrical Act 1994, mandating the need to address the condition of the 275kV transmission lines Davies Creek and Bayview Heights, and provides further detail on the main at-risk components and the consequences of their failure.

3.3 Reliability and service standards

With peak demand forecast to remain steady in the area for the next ten years[16], 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"[17]. 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[18].

> *"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.

[16] Powerlink Transmission Annual Planning Report 2020
[17] .Electricity Act 1994, Chapter 2, Part 4, S34(1)(a)
[18] Transmission Authority No. T01/98, section 6.2(c)

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 (see Appendix 2), 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. Required technical characteristics for non-network options

The information provided in this section is intended to enable interested parties to formulate and propose genuine and practicable non-network solutions such as, but not limited to, local generation and Demand Side Management (DSM) initiatives.

Powerlink identified in its Transmission Annual Planning Reports (TAPRs) of 2020, an expectation that action would be required on the Davies Creek to Bayview Heights towers to maintain reliability of supply to the Cairns region[19].

Powerlink has consulted with Registered Participants, Powerlink's Non-Network Engagement Stakeholder Register and interested parties on the proposed investment on these transmission lines as part of the TAPR publication and associated engagement activities. No submissions proposing credible and genuine non-network options were received from prospective solution providers in the normal course of business or in response to the TAPRs. As a result, Powerlink is currently not aware of any non-network options that could be adopted, but will investigate the feasibility of any potential non-network option proposed or otherwise identified.

This PSCR provides a further opportunity for providers of feasible non-network options to submit details of their proposals for consideration.

4.1 Criteria for proposed network support services

A non-network solution that avoids a network reinvestment to address the risks arising from the condition of ageing structures between Davies Creek and Bayview Heights, would need to replicate in full or part the capacity, reliability, functionality and operability of the line on an enduring basis at a cost that is lower than the network options currently under consideration.

Potential non-network solutions would need to provide reliable supply to the Cairns area loads. To meet the demand of the combined FNQ loads, the non-network solution must be capable of delivering up to 268MW of power at peak and up to 910MWh per day. The non-network solution must be capable of operating on a continuous basis.

It should be noted that the current network configuration facilitates the provision of voltage control and system strength from local synchronous generation. This would need to be taken into consideration for all non-network solutions.

Powerlink has identified the following common criteria that must be satisfied if any proposed non-network solutions are to meet supply requirements[20]. Notwithstanding this, the specific requirements for individual non-network solutions will rely on the type of technology proposed, associated technical characteristics and capability to maintain current network requirements. If a potential non-network solution appears technically feasible, these criteria and network requirements would be refined through collaboration between Powerlink and the proposed non-network provider as part of the RIT-T consultation process.

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[19] Powerlink Transmission Annual Planning Report 2020

[20] Powerlink's Network Support Contracting Framework has been developed as a general guide to assist potential non-network solution providers. This framework outlines the key contracting principles that are likely to appear in any Powerlink non-network support agreement.

Size and location

- Proposed solutions must be large enough, individually or collectively, to provide the size of injection or demand response set out above. However, the level of support is dependent on the location, type of network support and load forecasts.
- Due to the bulk nature of the transmission network, aggregation of sub 10MW non-network solutions will be the sole responsibility of the non-network provider.
- Notwithstanding the location of any solution, each proposal would require assessment in relation to technical constraints pertinent to the network connection, such as impacts on intra-regional transfer limits, fault level, system strength, maintaining network operability and quality of supply.[21]

Operation

- A non-network option would need to be capable of operating continuously 24 hours per day on an ongoing basis.
- If a generation service is proposed (either standalone or in conjunction with other services), such operation will be required regardless of the pool price.[22]
- Proponents of generation services are advised that network support payments are intended for output that can be demonstrated to be additional to the plant's normal operation in the NEM.
- Where there are material network costs associated with a proposed non-network option, including but not limited to asset decommissioning, protection schemes, equipment to support maintenance outages, these costs form part of the scope of a non-network option and will be included in the overall cost of a non-network option as part of the RIT-T cost-benefit analysis.

Reliability

- Proposed services must be capable of reliably meeting electricity demand under a range of conditions and, if a generator must meet all relevant National Electricity Rules requirements related to grid connection.
- Powerlink has obligations under the National Electricity Rules, its Transmission Authority and connection agreements to ensure supply reliability is maintained to its customers. Failure to meet these obligations may give rise to liability. Proponents of non-network options must also be willing to accept any liability that may arise from its contribution to a reliability of supply failure.

Timeframe and certainty

- Proposed services must be able to be implemented in sufficient time to meet the identified need using proven technology and, where not already in operation, provision of information in relation to development status such as financial funding and development timeline to support delivery within the required timeframe must be provided.

Duration

- The agreement duration for any proposed service will provide sufficient flexibility to ensure that Powerlink is pursuing the most economic long run investment to address the risks arising from the ageing Davies Creek to Bayview Heights transmission towers.

Powerlink welcomes submissions from potential proponents who consider that they could offer a credible non-network option that is both economically and technically feasible.

[21] Where the proposed non-network option is generation, further guidance on technical consideration for the connection of new generation onto the transmission network is available in Powerlink's most recent Generation Capacity Guide published in August 2020.

[22] The National Electricity Rules prevent a generator that is providing network support from setting the market price.

5. Potential credible options to address the identified need

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 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 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'.

Additional options that have been considered but not progressed, for technical or economic reasons, are listed in Appendix 1.

5.1 Option 1: Line refit without painting

Powerlink is the proponent of this option.

This option seeks to optimise the life of the towers through an initial replacement of those critical components and members displaying signs of advanced and early on set corrosion by 2023, followed by the progressive replacement of corroded components and members over-time.

This option avoids the need to paint any towers in the Wet Tropics

Table 5.1: Main project components for the Option 1

Project Type	Description	Indicative cost ($m 2020/21)
Option 1 Line refit without painting	Replace critical components and members displaying advanced and early onset of corrosion by October 2023*	20.23*
	Replace up to 15% of bolts/ 43% light members/ 0.6% Heavy by 2033†	29.73†
	Replace up to 32% light members and 6% of heavy members by 2038†	23.25†
	Replace critical components and members displaying early onset of corrosion by 2043†	9.25†
	TOTAL	**82.46**

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

5.2 Option 2: Line refit with Paint

Powerlink is the proponent of this option.

This option seeks to optimise the life of existing structures and reduce the number of mobilisations and required outages, through a one-off replacement of critical components displaying signs of advanced corrosion, followed by the complete painting of each tower.

Table 5.2: Main project components for the Option 2

Option	Description	Indicative cost ($m 2020/2021)
Line refit with painting	Replace all critical components displaying advanced corrosion and repaint towers by October 2023*	38.37*****
	Repaint of selected structural components and minor works by 2039**†**	5.38**†**
	TOTAL	**43.75**

*RIT-T Project
†Modelled network project

5.3 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[23].

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 to the option rankings.[24]

As set out in the Rules, credible options must be ranked by NPV value relative to a Base Case. Powerlink considers that changes in involuntary load shedding (i.e. the reduction in expected unserved energy) between options and a Base Case, may impact the relativity of credible options to the Base Case, and that this class of market benefit could be material. These benefits have been quantified and included as network risk in NPV analysis of credible options.

6.1 Consideration of market benefits for non-network options

Powerlink notes that non-network options may impact the wholesale electricity market. Accordingly, it is possible that several classes of market benefits will be material where there are credible non-network options, depending on the specific form of the option.

Where credible non-network options are identified as part of the consultation process on this PSCR, Powerlink intends on assessing the materiality of market benefits arising from these options as part of the Project Assessment Draft Report. Where the market benefits are considered material, these will be quantified as part of the RIT-T assessment of these options.

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

A discussion of each market benefit under the RIT-T is included below:

- **changes in patterns of generation dispatch**: under modelled contingency outages the proposed network options are unlikely to result in a material difference in patterns of generation dispatch. It follows that changes in patterns of generation dispatch are not material to the outcome of the RIT-T assessment

[23] 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.
[24] S3.6.1 Material classes of market benefits, AER, Regulatory investment test for transmission application guidelines, August 2020,

- **changes in voluntary load curtailment:** the proposed options do not in themselves affect prices in the wholesale electricity market. It follows that changes in voluntary load curtailment will not be material for the purposes of this RIT-T
- **changes in costs for other parties**: as the work proposed under both options is designed to achieve a 2049 end-of-life it is unlikely there would be a material difference between the options in costs to other parties in the network.
- **differences in the timing of expenditure**: proposed work under the credible options considered do not affect the capacity of transmission network assets, the way they operate, or transmission flows. Accordingly, differences in the timing of expenditure of unrelated transmission investments are unlikely to be affected
- **changes in network losses**: planning studies have concluded differences in network losses between the two options are considered not material
- **changes in ancillary services cost**: there is no expected change to the costs of Frequency Control Ancillary Services (FCAS), Network Control Ancillary Services (NCAS), or System Restart Ancillary Services (SRAS) due to the credible options under consideration. These costs are therefore not material to the outcome of the RIT-T assessment
- **competition benefits:** Powerlink does not consider that either of the credible options will materially affect competition between generators, and generators' bidding behaviour and, consequently, considers that the techniques required to capture any changes in such behaviour would involve a disproportionate level of effort compared to the additional insight it would provide
- **option value**: Powerlink does not consider that the identified need for the options considered in this RIT-T is affected by uncertain factors about which there may be more clarity in future, therefore option value is not a relevant consideration for this RIT-T.

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 PSCR compares the costs and benefits of credible options to address the risks arising from an identified need, with a Base Case[25].

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 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.

[25] 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[26]. An overview of the framework is available on Powerlink's website[27] 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:

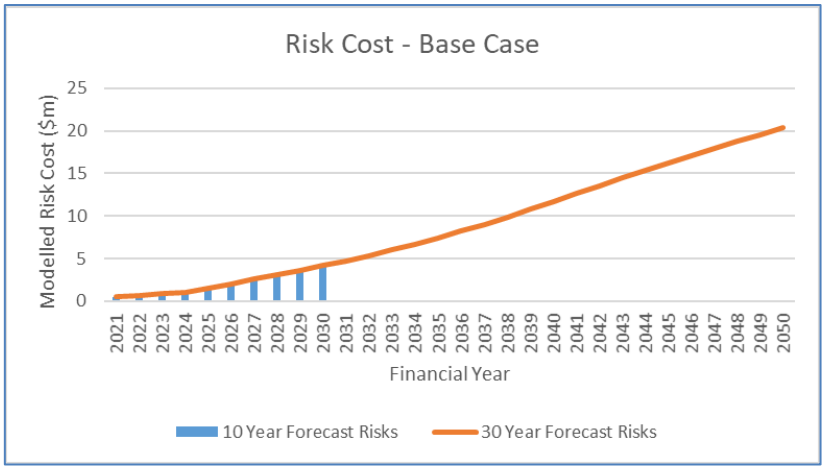
- historical load profiles have been used when assessing the likelihood (likely magnitude) of unserved energy under concurrent failure events;
- unserved energy generally accrues under concurrent failure events, and consideration has been given to potential failure events within the wider far north Queensland 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 $28,064/MWh; and
- The most relevant residential and commercial VCR values published within the AER's 2019 Value of Customer Reliability Review Final Report have been used to determine the VCR.

The probability that a structures 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.

Figure 7.1: Modelled Base Case risk costs



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

Based upon the assessed condition of the ageing structures between Davies Creek and Bayview Heights, the total risk costs are projected to increase from $0.5m in 2021 to $20.38m in 2050. The main areas of risk are safety, network and financial. Network risk is modelled as probability weighted unserved energy[28] 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 5.90%[29] as the central assumption for the NPV analysis presented in this report.

8.3 Description of reasonable scenarios

The RIT-T analysis is required to incorporate a number of different reasonable scenarios, which are used to estimate market benefits and rank options. 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[30].

8.3.1 Reasonable Scenarios

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[31].

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 [32] and in accordance with the provisions of the RIT-T Application Guidelines[33].

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[28] Unserved Energy is modelled using a Value of Customer Reliability (VCR) consistent with that published by AER in their *Value of Customer Reliability Review, Final Report*, 2019.
[29] This indicative commercial discount rate has been calculated on the assumptions that a private investment in the electricity sector would hold an investment grade credit rating and have a return on equity equal to an average firm on the Australian stock exchange, as well as a debt gearing ratio equal to an average firm on the Australian stock exchange.
[30] AER, Regulatory investment test for transmission, August 2020, Section 23
[31] AER, Final: RIT–T, August 2020, sub-paragraph 20(b)
[32] AER, Final: RIT–T, August 2020, sub-paragraph 22
[33] S3.8.1 Selecting reasonable scenarios, RIT-T Application Guidelines, August 2020

Table 8.1: Reasonable scenarios assumed

Key parameter	Central Scenario
Capital costs	100% of base capital cost estimate
Discount Rate	5.90%
Maintenance cost	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 ($m)

Option	Central Scenario NPV relative to Base Case ($m)	Ranking
Option 1 Refit without Paint	39.29	2
Option 2 Refit with paint	45.74	1

Both credible options will address the identified need on an enduring basis. Option 2 is ranked first, with Option 1 being $6.46 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.

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

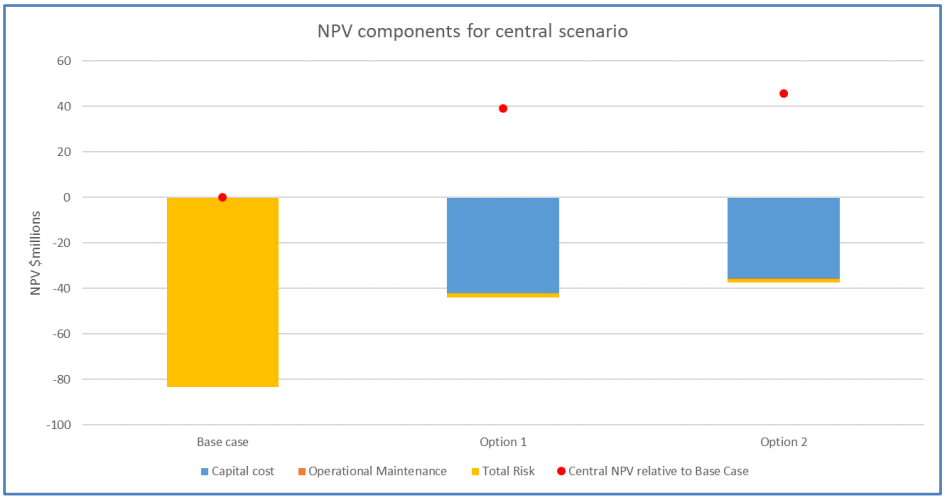


Figure 9.1 illustrates that both credible options will significantly reduce the risk cost compared to the Base Case. Due to the lower capital and risk cost components, Option 2 results in the highest NPV relative to the Base Case of the two credible options.

9.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3.47% to 8.33% 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 Figure 9.2.1 – 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

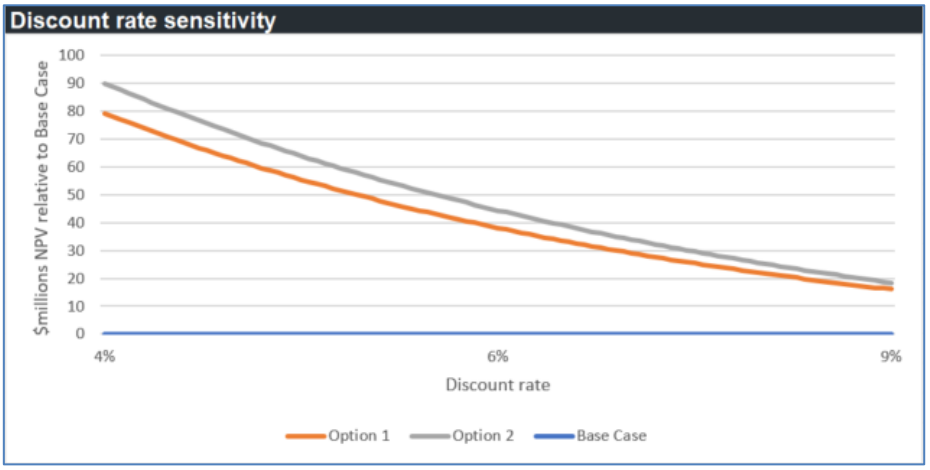


Figure 9.2.2 Capital cost sensitivity

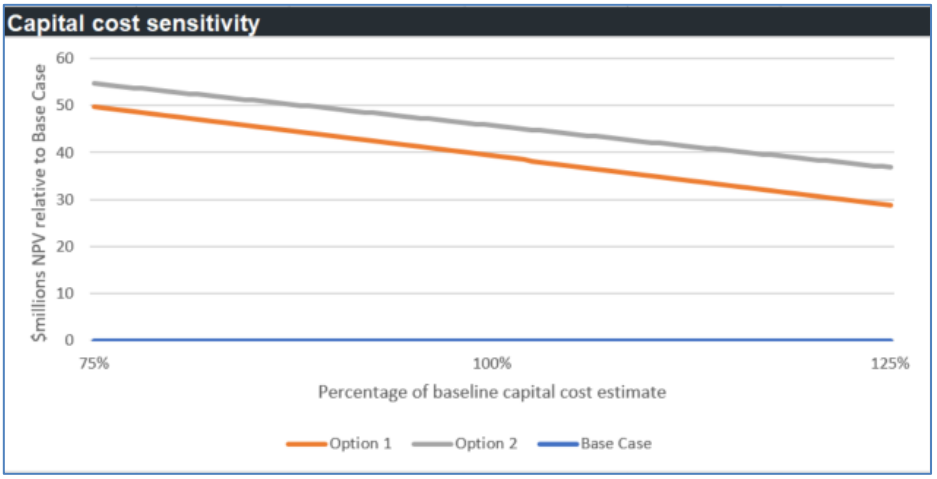


Figure 9.2.3 Maintenance cost sensitivity

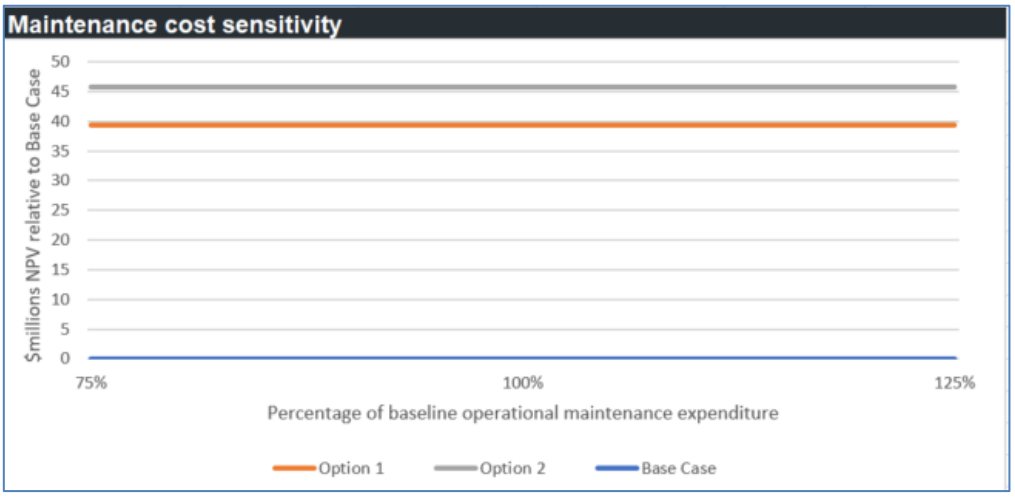
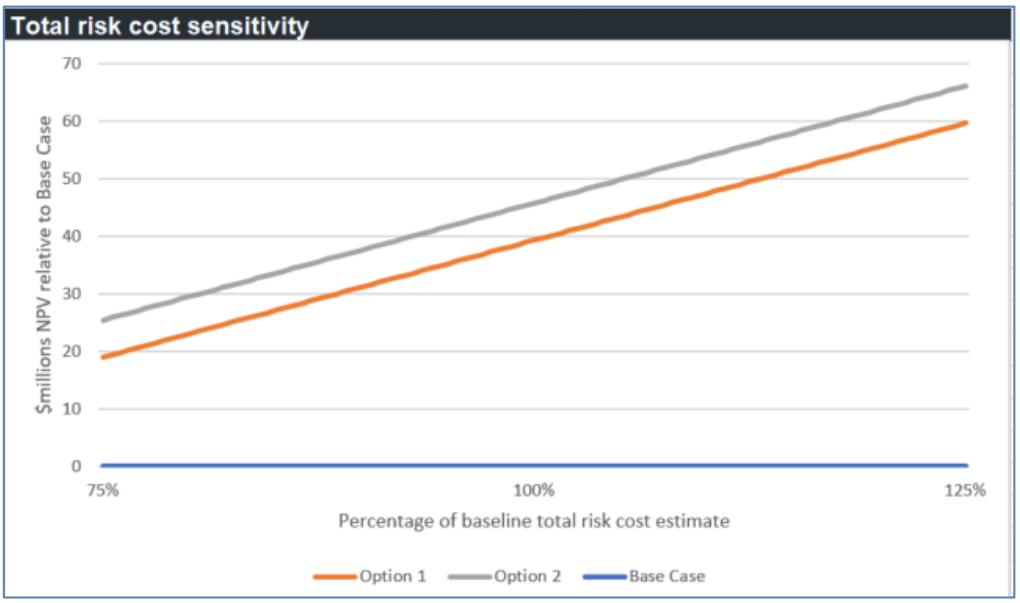


Figure 9.2.4 Risk cost sensitivity

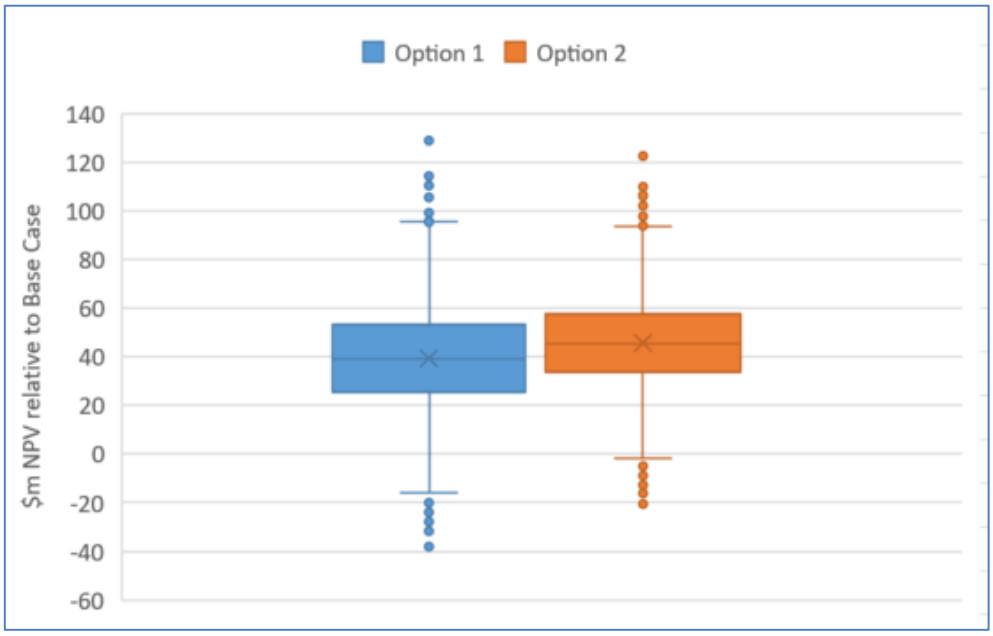


9.3 Sensitivity to multiple parameters

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



9.4 Conclusion

The result of the cost benefit analysis indicates that Option 2 provides the highest net economic benefit relative to base case over the 30 year analysis period. Sensitivity testing shows the analysis is robust to variations in the capital cost, operational maintenance cost, and risk cost and discount rate assumptions.

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

10. Draft 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 associated with the deteriorated condition of the steel lattice structures between Davies Creek and Bayview Heights.

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 refurbishment of the 37 towers through the selective replacement of corroded members and components, along with the painting of all 37 towers by October 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 commence in late-2021, with contractors deployed to site in mid-2022 and work completed by October 2023.

11. Submissions requirements

Powerlink invites submissions and comments in response to this PSCR from Registered Participants, AEMO, potential non-network providers and any other interested parties.

Submissions should be presented in a written form and should clearly identify the author of the submission, including contact details for subsequent follow-up if required. If parties prefer, they may request to meet with Powerlink ahead of providing a written response.

11.1 Submissions from non-network providers

This is not a tender process – submissions are requested so that Powerlink can fulfil its regulatory obligations to analyse non-network options. In the event that a non-network option appears to be a genuine and practicable alternative that could satisfy the RIT-T, Powerlink will engage with that proponent or proponents to clarify cost inputs and commercial terms.

Submissions from potential non-network providers should contain the following information:

- details of the party making the submission (or proposing the service)
- technical details of the project (capacity, proposed connection point if relevant, etc.) to allow an assessment of the likely impacts on future supply capability
- sufficient information to allow the costs and benefits of the proposed service to be incorporated in a comparison in accordance with AER RIT-T guidelines
- an assessment of the ability of the proposed service to meet the technical requirements of the Rules
- timing of the availability of the proposed service
- other material that would be relevant in the assessment of the proposed service.

As the submissions will be made public, any commercially sensitive material, or material that the party making the submission does not want to be made public, should be clearly identified.

It should be noted that Powerlink is required to publish the outcomes of the RIT-T analysis. If parties making submissions elect not to provide specific project cost data for commercial-in-confidence reasons, Powerlink may rely on cost estimates from independent specialist sources.

11.2 Assessment and decision process

Powerlink intends to carry out the following process to assess what action, if any, should be taken to address future supply requirements:

Part 1	PSCR Publication	31 March 2021
	Submissions due on the PSCR Have your say on the credible options and propose potential non-network options.	8 July 2021
Part 3	Publication of the PACR Powerlink's response to any further submissions received and final recommendation on the preferred option for implementation.	September 2021

Powerlink reserves the right to amend the timetable at any time. Amendments to the timetable will be made available on the Powerlink website (www.powerlink.com.au).

12. Appendix

12.1 Appendix 1: Options considered but not progressed

The following option was progressed to the stage where it proved not to be technically feasible in terms of meeting the required time frames for action.

Table A1: Options considered but not progressed

Option description	Reason for not progressing option
Rebuild line adjacent to exiting line	Obtaining and clearing additional tower sites and access tracks to rebuild the line within the Wet Tropics is inconsistent with Australia's ongoing obligations relating to the listing of the Wet Topics in the World Heritage list, (Wet Tropics World Heritage Protection and Management Act 1993)

12.2 Appendix 2: Summary of the main limiting conditions, key legislation and consequences of failure

Table A2 indicates the key legislation, in addition to the Electrical Safety Act 1994, governing the need to address the condition of the 275kV transmission towers between Davies Creek and Bayview Heights in the Wet Tropics area of Far North Queensland. The Table also identifies the key limiting items of equipment and the potential consequences of their failure.

Table A1 Summary of main limiting condition, key legislation and consequences of failure

Main Limiting Condition	Key Legislation In addition to the Electricity Act 1994	Main Deteriorated Element	Consequence of failure
Structural integrity	Electrical Safety Act 2002, section 29 Electrical Safety Regulation 2013, section 198(a) Electrical Safety Regulation 2013, section 198(d)	Light members - advanced corrosion with loss of steel cross section and strength by 2023 Structure bolts - advanced corrosion with loss of steel cross section and strength by 2023	Advanced corrosion or degradation of structural components can lead to mechanical failure under normal operating conditions, worsened by adverse weather events, which can lead to failure of the structure (including cascading effects on adjacent structures) with significant safety risks and loss of supply
Conductor support hardware integrity	Electrical Safety Act 2002, section 29 Electrical Safety Regulation 2013, section 198(a) Electrical Safety Regulation 2013, section 198(d)	Hanger bracket bolts / hardware - advanced corrosion with loss of steel cross section and strength by 2023. Accelerated corrosion of the fasteners supporting the conductor weight to the tower.	Advanced corrosion or degradation of the bolts /hardware can lead to mechanical failure potentially resulting in a conductor drop, with significant safety risks and loss of supply

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