Powerlink Queensland

Project Specification Consultation Report

24 August 2021

Maintaining reliability of supply in the Tarong and Chinchilla local areas

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 likely to impact 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).

Contents

Executive Summary

Tarong Substation was commissioned in 1982 and forms part of the 275kV backbone servicing South East Queensland, as well as local loads in the Tarong and Chinchilla areas. The Tarong local area load includes auxiliary supply to Tarong Power Station. Chinchilla Substation was commissioned in 1986 to supply bulk electricity to the distribution network in the area, via a double circuit 132kV transmission line from Tarong Substation.

Two 275/66/11kV transformers at Tarong Substation supply the local area load while two 275/132kV transformers provide back-up supply to Chinchilla. All four transformers at Tarong are nearing the end of their respective service lives, with recent condition assessments revealing a range of increasing network and safety risks arising from their continued operation. In addition, the fault level rating of these original transformers may be exceeded in the event of certain credible contingency events.

Chinchilla's secondary systems and the majority of its primary plant are also approaching the end of their respective technical lives. In particular, the secondary systems and circuit breakers are now obsolete and no longer supported by their manufacturers, with only limited spares available.

As planning studies have confirmed an enduring need for the supply of existing electricity services to the area, there is a requirement for Powerlink to address the emerging condition risks in order to maintain compliance with Schedule 5.1 of the Rules, its Transmission Authority and applicable regulatory instruments.

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"[2].

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[3], 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.

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].

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

Consistent with the Australian Energy Regulator's (AER's) RIT-T Application Guidelines for non-ISP projects, the assessment undertaken in this PSCR compares the net present value (NPV) of the credible network options identified to address the emerging risk-costs of a "do-nothing" Base Case.

The Base Case is modelled as a **non-credible** option where 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. The Base Case for the transformers, primary plant and secondary systems at Tarong and Chinchilla, as well as the transmission line between Tarong and Chinchilla includes the costs of work associated with operational maintenance and the risk costs associated with the failure of the assets forms the market costs of the "do nothing" Base Case.

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[2] The Rules clause 5.10.2, Definitions, reliability corrective action.
[3] In accordance with clause 5.16.4(z1) of the Rules.
[4] The Rules, clause 5.16.2.

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

Powerlink has developed two credible network options to maintain the existing electricity services, ensuring a reliable, safe and cost effective supply to customers in the area. Both options retain the opportunity to allow for future growth and potential new connections in the area.

Option 1 maintains the existing topology and includes replacement of all at-risk transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla on a like-for-like basis.

Option 2 seeks to optimise the benefits of the 275kV network established to service the Surat Basin. This option involves reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems and replacing only two of the four transformers at Tarong. The Chinchilla to Tarong transmission line will be mothballed under this option.

Details of each option are summarised in Table 1.

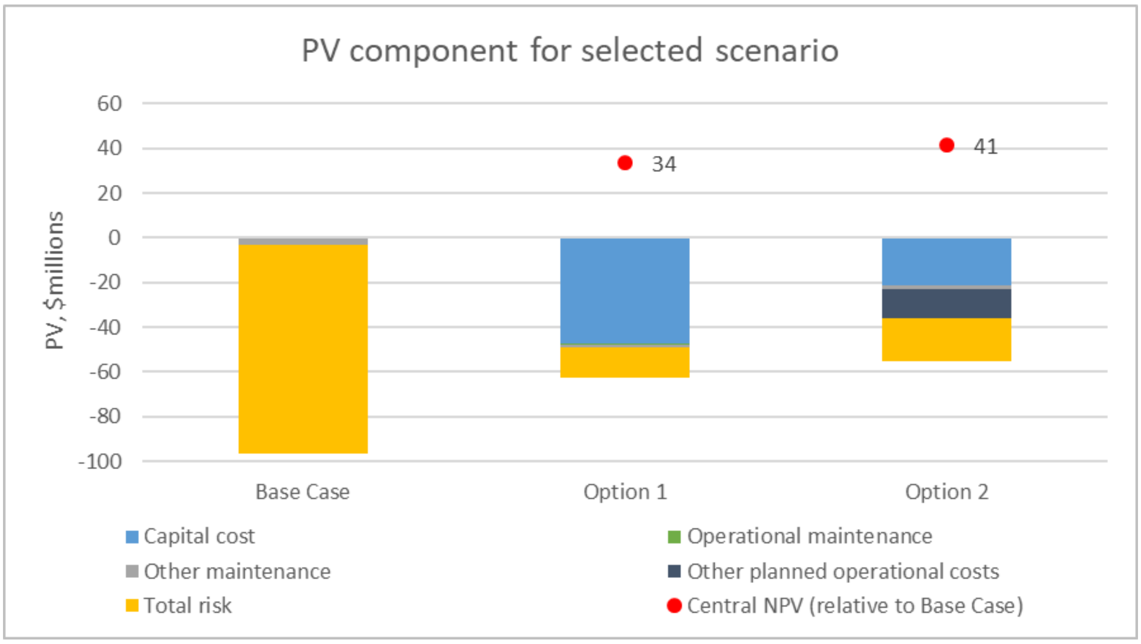
Table 1: Summary of credible options

Option	Description	Indicative capital cost ($m, 20/21)	Indicative annual O&M costs ($m, 20/21)	Rank
Maintain existing network topology				
Option 1 Replace all at-risk assets like-for-like by June 2025	Replace selected primary plant and all secondary systems at Chinchilla by June 2025*	13.38	0.14	**2**
	Replace four transformers and selected primary plant at Tarong by June 2025*	29.50		
	Refit Tarong to Chinchilla transmission line by 2035†	49.44		
Reconfigure network topology				
Option 2 Reconfigure Chinchilla and replace selected assets by June 2025	Replace selected primary plant and secondary systems at Chinchilla by June 2025*	10.06	0.16	**1**
	Replace two transformers and selected primary plant at Tarong by June 2025*	17.84		
	Decommission Chinchilla transformer bays at Tarong by 2026†	3.76		
	Mothball Tarong to Chinchilla transmission line by 2026†	3.00		
	Decommission the Tarong to Chinchilla transmission line by 2040†	23.43		

***** Proposed RIT-T capital project
† Modelled capital and operational projects

Figure 1 illustrates the results of the economic assessment, comparing both options to the non-credible Base Case.

Figure 1: Present value 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 both credible options significantly reduce risk cost relative to the Base Case and result in positive NPV relative to Base Case. Option 1 provides the greatest reduction in risk costs, but at higher capital cost, while Option 2 provides the highest net economic return relative to the Base Case of the two credible options. Option 2 is therefore the preferred option.

Option 2 involves reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong. The Chinchilla to Tarong transmission line will be mothballed under this option. The indicative capital cost of the RIT-T project for the preferred option is $27.9 million in 2020/21 prices.

Option 2 delivers additional benefit in that it provides for the potential connection of renewable generation in the area by enabling the re-use of a section of the existing easement between Tarong and Chinchilla for the construction of a 275kV line from Halys Substation.

Under this option design work will commence in 2023, with all work completed by 2025.

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 June 2025, on an ongoing basis.

To replace the functionality of both of the existing (275k/66kV) transformers a non-network solution would be required to provide up to 50MW and up to 850MWh per day on an ongoing basis to meet the requirements of Powerlink's planning criteria. The non-network solution must also be able to provide auxiliary supply to Tarong Power Station, of up to 38MVA.

Lodging a submission with Powerlink

Powerlink is seeking written submissions on this *Project Specification Consultation Report* by Monday, 22 November 2021, particularly on the credible options presented. Please address submissions to:

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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[5], optimizing performance and efficiently managing assets through the whole asset life cycle[6].

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services currently provided by the Tarong and Chinchilla substations.

The ageing transformers, primary plant and secondary systems at Tarong and Chinchilla 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 ageing assets. When developing the options, Powerlink has focussed on implementing technically feasible solutions that ensure an ongoing reliable and safe supply for customers.

1.2 RIT-T Overview

This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process[7]. 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[8]
- 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).

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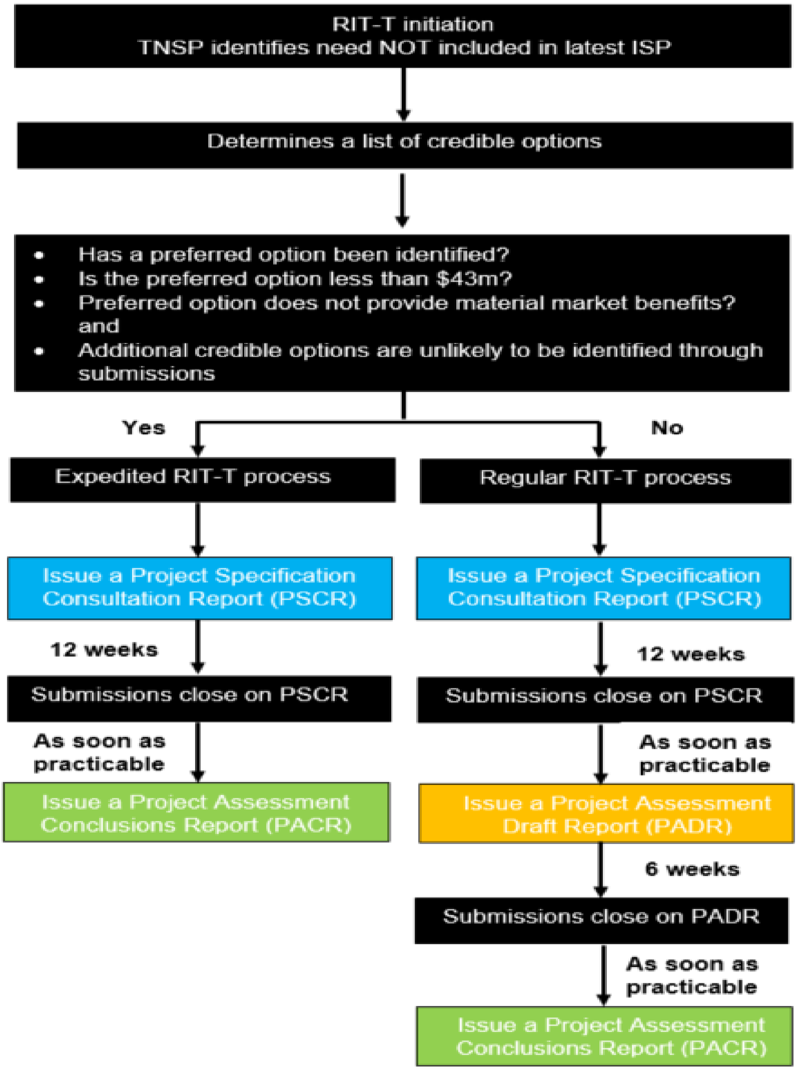
[5] Risk assessments are underpinned by Powerlink's corporate risk management framework and the application of a range of risk assessment methodologies set out in AS/NZS ISO31000:2018 *Risk Management Guidelines*.

[6] 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

[7] This RIT-T consultation has been prepared based on the following documents: National Electricity Rules, Version 165, 27 May 2021 and AER, Application guidelines, Regulatory Investment Test for Transmission, August 2020.

[8] 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[9]. 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[10]
- Powerlink has identified its preferred option in this PSCR (together with the supporting quantitative cost-benefit analysis)
- Powerlink is currently not aware of any non-network options that could be adopted. This PSCR provides a further opportunity for providers of feasible non-network options to submit details of their proposals for consideration.

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.

[9] In accordance with clause 5.16.4(z1) of the Rules
[10] 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 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. 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 Tarong and Chinchilla local areas

Powerlink identified in its 2018-2020 TAPRs, an expectation that action would be required to address the emerging reliability of supply issues in the South West transmission zone[11].

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 associated stakeholder engagement activities.

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.

3 Identified need

This section provides an overview of the existing supply arrangements at Tarong and Chinchilla 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

Tarong Substation was commissioned in 1982 and forms part of the 275kV backbone servicing South East Queensland, as well as local loads in the Chinchilla and Tarong areas

Chinchilla Substation was commissioned in 1986 to supply bulk electricity to the distribution network in the area, via a double circuit 132kV transmission line from Tarong Substation.

In 2014, Powerlink established a new 275kV substation at Columboola as part of an expanded Surat Basin North West area transmission network. This new 275kV substation provided additional support to the existing 132kV Columboola Substation, and in turn to Chinchilla.

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

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.

The locations of the substations are shown in Figures 3.1.1 and 3.1.2.

Figure 3.1.1: South West area network

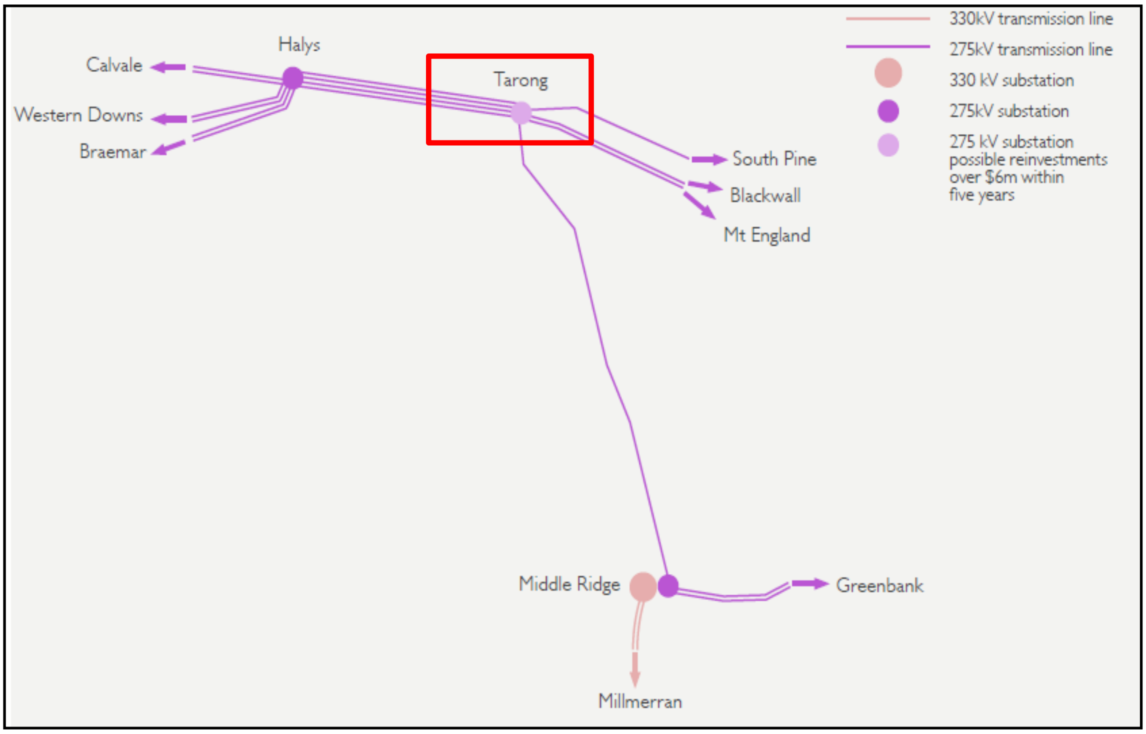
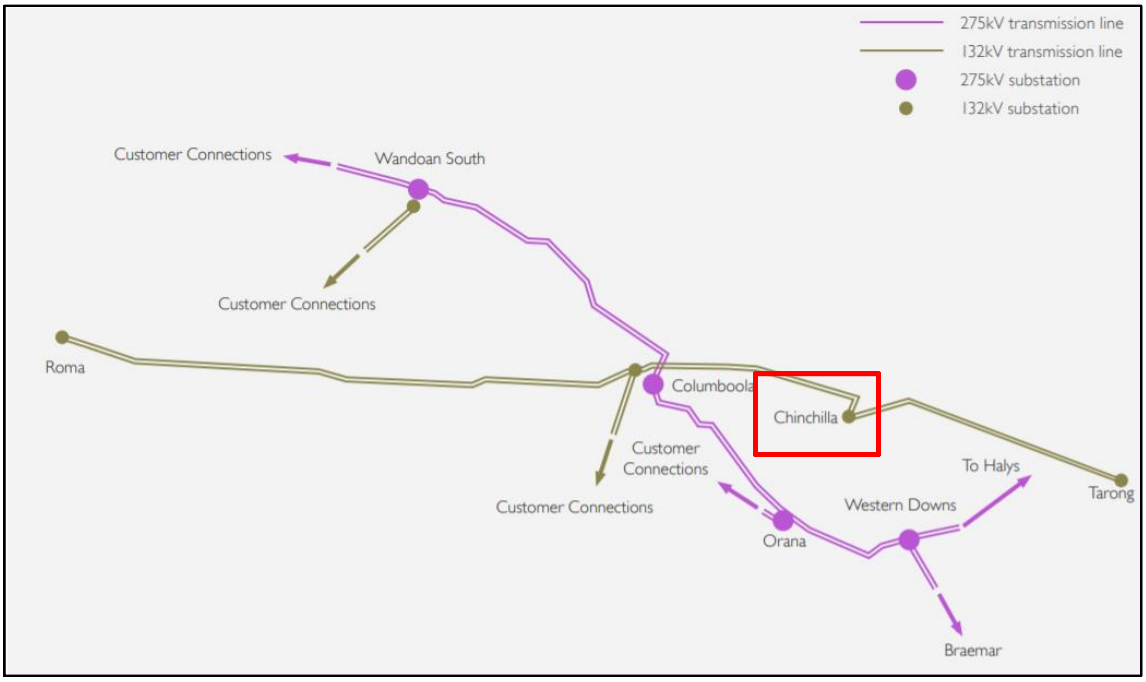


Figure 3.1.2: Surat Basin North West area transmission network



[12] Powerlink Transmission Annual Planning Report 2020

3.2 Description of identified need

There is a need for Powerlink to address the emerging risks from the ageing Tarong and Chinchilla assets to ensure ongoing compliance with the relevant standards and applicable regulatory instruments as well as Schedule 5.1 of the Rules, which are designed to ensure Powerlink's customers continue to receive safe, reliable and cost effective electricity services.

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:

- will not exceed 50MW at any one time; or
- will not be more than 600MWh in aggregate[13].

Planning studies have confirmed that in order to continue to meet the reliability standard within Powerlink's Transmission Authority, the services currently provided by Chinchilla and Tarong Substations are required into the foreseeable future to meet ongoing customer requirements.

As the proposed investment is for meeting reliability and service standards arising from Powerlink's Transmission Authority and to ensure Powerlink's ongoing compliance with Schedule 5.1 of the Rules, it is a 'reliability corrective action' under the Rules[14].

A reliability corrective action differs from that of an increase in producer and consumer surplus (market benefit) driven need in that the preferred option may have a negative net economic outcome because it is required to meet an externally imposed obligation on the network business.

3.3 Assumptions and requirements underpinning the identified need

3.3.1 Transformers and Primary Plant

The need to invest is driven by Powerlink's obligations to address the increasing risks to supply, safety and property arising from the condition of ageing and obsolete primary plant assets at Tarong and Chinchilla Substations. If not addressed, these risks can lead to plant failures and extend the time taken to recover from faults, due to the plant no longer being supported by manufacturers, with limited spare parts available.

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"*[15].

Powerlink's obligations as a TNSP under the Rules require it to maintain and operate all equipment on its network in accordance with relevant laws, the requirements of the Rules and good electricity industry practice and relevant Australian Standards[16]. Further, the requirements of the Rules in respect of network reliability mean that Powerlink must plan, design, maintain and operate its transmission network such that transfer of power may be maintained even with elements out of service[17].

It follows that the increasing likelihood of faults arising from ageing primary plant and transformer assets remaining in service at Tarong and Chinchilla Substations compels Powerlink to undertake reliability corrective actions if it is to continue to meet its jurisdictional obligations and the standards for reliability of supply set out in the Rules.

[13] Transmission Authority No. T01/98, section 6.2(c)
[14] The Rules, clause 5.10.2, Definitions, reliability corrective action
[15] Electricity Act 1994, S34(1)a.
[16] The Rules, clause 5.2.1.
[17] The Rules, S5.1.2.1 credible contingency events.

3.3.2 Secondary Systems

The secondary systems at Chinchilla broadly perform the functions of transmission element protection, data collection, remote (and local) control and monitoring. In performing these functions secondary systems:

- protect the public, the environment, the transmission network and substation primary plant from damage due to faults or mal operation
- allow remote and local automatic or manual control of primary plant
- enable the remote and local monitoring of primary and secondary plant and equipment.

Protection systems are critical to the safe and effective operation of the transmission network with the Electricity Act 1994 requiring Powerlink 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"*[18].

The Rules place specific requirements on Powerlink as a Transmission Network Service Provider (TNSP) to:

> *"Provide sufficient primary protection systems and back-up protection systems (including breaker fail protection systems) to ensure that a fault of any fault type anywhere on its transmission system or distribution system is automatically disconnected"*[19].

The importance of protection systems is further reinforced in the Rules, which require TNSPs to ensure:

> "*all protection systems for lines at a voltage above 66 kV, including associated intertripping, are well maintained so as to be available at all times other than for short periods (not greater than eight hours) while the maintenance of a protection system is being carried out"*[20].

As required by the Rules[21], AEMO has published the Power System Security Guidelines (PSS Guidelines) to clarify the Rules regarding unplanned outages of the protection systems. In the event of an unplanned outage of a secondary system, AEMO's PSS Guidelines require that the primary network assets be taken out of service if the fault cannot be rectified within 24 hours[22]. Both the Rules and the AEMO PSS Guidelines indicate that exceeding 24 hours to rectify a protection fault is not good practice, obligating Powerlink to take action to ensure the restoration period of unplanned outages of secondary systems does not reasonably exceed 24 hours.

Similar to protection requirements, AEMO's Power System Data Communication Standard specifies that the total period of critical outages over a 12-month period must not exceed 24 hours for remote control and monitoring functions[23]. This relates to both the reliability of the equipment (i.e. how often the device fails) and the repair time. It follows that the repair time for any single fault on this equipment must not exceed 24 hours if there are no other faults during the 12-month period.

Powerlink must therefore plan (have systems and processes in place) to safely resolve all protection, remote control and monitoring system problems and defects within 24 hours.

Analysis has shown that operating a secondary system beyond 20 years of effective age significantly impacts its ability to perform within acceptable limits[24]. Delaying replacement of secondary system assets beyond this optimal 20-year timeframe places the network at risk due

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[18] Electricity Act 1994 (Queensland), Chapter 2, Part 4, S34(1)(a)

[19] The Rules clause S5.1.9(c)

[20] The Rules clause S5.1.2.1 (d)

[21] The Rules clause 4.11.2 (c)

[22] AEMO, Power System Operating Procedure SO_OP_3715, Power System Security Guidelines, V94, 23 April 2019 (the Rules require AEMO to develop and publish Power System Operating Procedures pursuant to clause 4.10.1(b) of the Rules, which Powerlink must comply with per clause 4.10.2(b)).

[23] AEMO, Power System Data Communication Standard, Section 3 Reliability and Section 6 Maintenance (This standard has been made by AEMO under clause 4.11.2(c) of the Rules and incorporates the standards and protocols referred to in clause 4.11.1)

[24] CIGRE, Study Committee B3, Paper B3_205_2018, "Modelling Substation Control and Protection Asset Condition for Optimal Reinvestment Decision Based on Risk, Cost and Performance" by T. Vu, M. Pelevin, D. Gibbs, J. Horan, C. Zhang (Powerlink Queensland)

to the limited supply of suitable spares, which prolongs the duration of any emergency corrective maintenance associated with replacing failed obsolete components beyond the 24-hour limit. In the case of protection systems, extended outages beyond 24 hours will result in the need to switch out network assets, placing the supply of electricity to customers at risk[25].

With an increasing likelihood of faults and longer rectification periods arising from the ageing and obsolete 132kV secondary systems remaining in service at Chinchilla Substation, Powerlink must undertake reliability corrective action if it is to continue to meet its jurisdictional obligations and the standards for reliability of supply set out by AEMO and in the Rules.

3.4 Primary Plant and Transformers - Asset condition and risks

Powerlink has undertaken a comprehensive condition assessment of the primary plant and transformers at Tarong and Chinchilla substations. This has identified that a significant amount of equipment is exhibiting age-related deterioration issues and reaching the end of its technical service life, with an increasing risk of failure.

This deteriorated primary plant is requiring additional maintenance and displaying reduced performance due to increased failures and an increased number of outages for repairs. The time taken for repairs is increasing significantly, as much of this plant is no longer supported by the manufacturer, with only limited spares available.

Notwithstanding the assessed condition of the asset, Powerlink's ongoing operational maintenance practices are designed to monitor plant condition and ensure any emerging safety risks are proactively managed.

Power Transformers

Commissioned between 34-38 years ago, the original transformers at Tarong substation are all exhibiting signs of age-related deterioration.

Protective galvanised coatings have begun to break down on several components including radiators, connecting pipework, control system cabinets, bushing mountings and flanges. The sealing integrity of numerous joints and valves has been compromised, resulting in an increased observation of oil leaks at the main and conservator tanks, radiators and bushings.

All four transformers were manufactured in the early to mid-1980s using oil impregnated paper bushings for terminal connections, with design lives of 25-30 years. While calculations based upon oil quality, as well as dissolved gas and moisture values suggest the insulation ages of the transformers is up to 10 years below their nameplate ages, the bushings will require replacement within the next 2-4 years.

As the consequences of a major failure of a power transformer are high, the asset management strategy employed is to plan and execute reinvestment before an actual failure occurs, given an ongoing future need. In addition, the fault level rating of these original may be exceeded should certain credible contingency events occur, which could present additional safety risks to personnel and adjacent plant within the substation.

Primary Plant

At-risk primary plant comprises circuit breakers, current and voltage transformers, isolators, earth switches and surge arrestors at Chinchilla Substation.

Circuit Breakers

Installed in the 1980s, the substation's ageing circuit breakers are no longer supported by their manufacturers and sourcing spare parts has become a major issue. Low air pressure in the breakers' compressor systems has resulted in a number of outages.

The deteriorated state of these original circuit breakers has resulted in an increasing frequency of unplanned outages and prolonged repair times due to the lack of spares and no manufacturer support. Some of these circuit breakers also contain friable asbestos that requires additional safety precautions when working on the units.

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[25] AEMO, Power System Operating Procedure SO_OP_3715, Power System Security Guidelines, V94, 23 April 2019

With limited spares available from the manufacturers, it is becoming increasingly difficult for Powerlink to service this ageing population of circuit breakers more broadly across the Powerlink transmission network.

Current and Voltage Transformers

Insulation breakdown and oil leaks pose the biggest risk to the ongoing operation of the ageing current and voltage transformers at Chinchilla Substation. The ageing process results in deterioration of the oil seals, which leads to moisture ingress into the insulating oil causing it to break down. As the transformer's insulating oil breaks down it releases a combination of combustible gases and loses its insulating properties. This moisture also migrates into the paper insulation causing its rapid degradation.

The insulating paper degradation combined with continuing degradation of the oil ultimately results in an increased probability of catastrophic failure, whereby the porcelain housings can rupture. This presents safety risks, reliability of supply impacts, and potential damage to adjacent equipment and plant requiring repairs and incurring financial costs. Three Capacitor Voltage Transformers (CVTs) have already been replaced due to failures in 2016.

3.4.1 Consequences of primary plant and transformer failures

Poor asset condition increases the risk and frequency of faults, while obsolescence increases the time needed for Powerlink to undertake any necessary repairs prolonging the return to service time. The potential in-service failure of ageing and obsolete primary plant and transformers at Tarong and Chinchilla presents Powerlink with a range of unacceptable safety, network and financial risks, and the inability to meet legislative obligations and customer service standards.

The condition and consequences of failure of the main at-risk items of equipment is summarised in Table 3.1.

Table 3.1: At-risk assets and consequences of failure

Equipment	Condition/Issue	Consequence of failure
Power Transformers	• Degraded oil and paper insulation • Deteriorated cooling fans and radiators • Significant oil leaks. • Reduced clamping pressure due to clamp design • Loss of insulating paper strength • Limited availability of spares	• Increased susceptibility of power transformer failure during through faults leading to loss of supply with long return to service time. • Risk of fire and environmental damage.
Current Transformers	• Degraded oil and paper insulation inside porcelain housings • Oil leaks.	• Significant safety, financial, environmental and loss of supply risks • Potential for explosive failure modes leading to damage of other equipment and extended loss of supply
Voltage Transformers	• Degraded oil and paper insulation inside porcelain housings • Oil leaks and overheating	• Significant safety, financial, environmental and loss of supply risks • Potential for explosive failure modes leading to damage of other equipment and loss of supply • Loss of protection signals resulting in disconnection of supply • Breach of metering requirements[26]

[26] Chapter 7, Part D, Metering Installation and Schedule 7.2 Metering Provider, AER

Notwithstanding the assessed condition of the asset, Powerlink's ongoing operational maintenance practices are designed to monitor plant condition and ensure any emerging safety risks are proactively managed.

3.4.2 Rules, Jurisdictional and Legislative Compliance – Transformers and Primary Plant

The consequences of Tarong and Chinchilla's at-risk primary plant and transformers remaining in service beyond 2025, without corrective action, would result in Powerlink being exposed to an increasing risk of breaching a number of its jurisdictional network, safety, environmental and Rules' obligations - resulting in poor customer, safety and environmental outcomes.

The failure of the circuit breakers to operate or clear faults in sufficient time to avoid damage to the power system may leave Powerlink unable to meet its public safety and supply obligations to its customers. Corrective action is also required to prevent the failure of deteriorated current and voltage transformers, in order to ensure the safety of personnel and that the plant operates as designed in accordance with the requirements of the *Electrical Safety Regulations 2013 Part 1 Section 3 and Part 9 Section 198*.

Allowing the ageing and obsolete transformers to remain in service without corrective action increases the potential risk of catastrophic failure. This would lead to a breach of Powerlink's obligations under the *Electrical Safety Act and Regulations, Work Health and Safety Act* and *Environmental Protection Act*, as well as its service standards under the *Electricity Act* and *Regulations and its Queensland Transmission Authority*[27].

By addressing the risks arising from the condition of ageing and obsolete assets at Tarong and Chinchilla, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to its customers into the future.

3.5 Secondary Systems - Asset condition and risks

Powerlink has undertaken a comprehensive condition assessment of the 132kV secondary systems at Chinchilla Substation using an asset health index modelled from zero to ten, where zero represents new assets and ten indicates that the asset requires immediate action to address its increasing risk of unavailability and unreliable operation.

This has identified that a significant amount of 132V secondary systems equipment is at or reaching the end of its technical service life, with the condition of this equipment summarised in Table 3.2.

Table 3.2: At-risk Chinchilla secondary systems

Bay	Construction year	Health index range (average)
2x Feeder Bays (Tarong-Chinchilla Feeders)	1985 - 2009	5.5 - 10 (9.2)
2x Bus Bays	1986	10.00

Most of the 132kV secondary systems were installed in the mid-1980s as part of the original installation. There have also been a number of selective secondary system component installations in later years due to capital works at remote substation ends, or the replacement of failed components, thereby reducing the average health index.

The impact of equipment obsolescence is an important consideration when determining if remedial action is required. Currently, over 75% of the secondary systems equipment is obsolete. This is expected to increase to an unsupportable level beyond June 2025.

[27] *Section 29, Electrical Safety Act 2002*; Part 1, Section 3, and Part 9, Section 198, Electrical Safety Regulations 2013; Section 19, Work Health and Safety Act 2011*; *Chapter 7, Part 1, Division1 Section 319(1), Environmental Protection Act 1994*; *Section 34 (1)a Electricity Act 1994*; Queensland Transmission Authority T01/98

Notwithstanding the assessed condition of the asset, Powerlink's ongoing operational maintenance practices are designed to monitor plant condition and ensure any emerging safety risks are proactively managed.

3.5.1 Consequences of failure in an obsolete system

The duration of a fault is not only dependent on the nature and location of the fault, but also on the availability of a like for like replacement of the failed component. If a like for like replacement is available (i.e. same hardware and firmware as the failed device), then the replacement is often not complex and can generally be rectified within the timeframes specified by AEMO. If a like for like replacement is not available, then replacement is operationally and technically more complex due to:

- physical differences with the mounting and installation
- development and testing of new configurations and settings
- cabling, connectivity and protocol differences
- interoperability between other devices on site, and with remote ends (if applicable)
- non-standard settings / configuration requirements
- legislative requirements for professional engineering certification.

All of the above complexities add time to fault resolution, typically resulting in a fault duration and rectification well in excess of 24 hours.

Given the specific nature of the Rules' obligations and the AEMO requirements relating to protection, control and monitoring systems, accepted good industry practice is often to replace the current ageing and obsolete secondary systems when they reach the end of technical service life, rather than adopting a run to failure approach. Due to the condition and obsolescence issues with the secondary systems at Chinchilla, there is a significant risk of breaching the mandated obligations and requirements if the secondary systems remain in operation beyond June 2025.

A summary of the equipment condition issues and associated possible consequences of failure of the equipment is given in Table 3.3.

Table 3.3: Summary equipment condition issues and potential consequences of failure

Equipment	Condition/Issue	Potential consequence of failure
Protection and Control for High Voltage Bays	• Obsolescence and limited availability of spares; no longer supported by the manufacturer • Increasing failure rates due to ageing electronic components	• Failure to operate or slow clearance resulting in rules violation, plant damage, safety and supply risks • Prolonged outages of equipment placing load at risk and resulting in less reliable supply to customers • Unable to comply with Power System Data Communication Standard • Unable to comply with the Power System Security Guidelines • Increased failures resulting in less reliable supply to customers

3.5.2 Fleet-wide implications of obsolescence

In addition to the site specific impacts of obsolescence at Chinchilla Substation, it is also important to note the compounding impact of equipment obsolescence occurring across the fleet of secondary systems assets installed in the Powerlink network. When a particular equipment type or model is no longer supported by the manufacturer, and limited spares are available to service the fleet of assets, running multiple secondary systems to failure across the network increases the likelihood of concurrent systemic faults that would overwhelm Powerlink's capacity to undertake corrective maintenance or replacement projects. This would leave Powerlink in breach of the Rules, the AEMO standards and its jurisdictional obligations.

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 2018 to 2020 an expectation that action would be required in the Tarong area to maintain reliability of supply requirements in the South West transmission zone.[28] Powerlink has considered the operation of the existing embedded generation in the area in establishing this requirement.

Powerlink has consulted with Registered Participants, Powerlink's Non-Network Engagement Stakeholder Register and interested parties on the proposed investment at this substation 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

To replace the functionality of both of the existing (275k/66kV) transformers a non-network solution would be required to provide up to 50MW and up to 850MWh per day on an ongoing basis to meet the requirements of Powerlink's planning criteria. The non-network solution must also be able to provide auxiliary supply to Tarong Power Station, of up to 38MVA.

To replace the functionality of one of the existing transformers, a non-network solution would be required to provide up to 50MW and up to 850MWh per day on a continuous basis following an outage of the remaining transformer, and to be in-service within six hours following a contingency to meet the requirements of Powerlink's reliability criteria. The network support would also be required to provide supply for planned outages. The non-network solution must also be able to provide auxiliary supply to Tarong Power Station, of up to 38MVA.

Table 4.1: Summary of non-network requirements

Non-network solution	Criteria specific to this RIT-T
Replace the functionality of both of the existing 275/66kV transformers	• up to 50MW and up to 850MWh per day on a continuous basis and • auxiliary supply to Tarong Power Station of up to 38MVA
Replace the functionality of one of the existing 275/66kV transformers	• up to 50MW and up to 850MWh per day on a continuous basis following an outage of the remaining transformer • in-service within six hours following a contingency • provide supply for planned outages and • auxiliary supply to Tarong Power Station of up to 38MVA

Non-network solutions should meet the requirements of Powerlink's planning criteria individually or in combination with other solutions (network and/or non-network). Powerlink would also consider proposals from non-network providers that can significantly contribute to reducing the requirement in this area, as this may present opportunities in reconfiguring the network that could otherwise not be considered due to Powerlink's planning standard and obligations.

[28] This relates to the standard geographic definitions (zones) identified within the Powerlink's Transmission Annual Planning Report, which is published annually by 30 June.

Non-network solutions may include, but are not limited to local generation and/or demand side management initiatives in the area, and would be required to be available on a firm basis. In addition, Powerlink has identified the following common criteria that must be satisfied if proposed network support services are to meet supply requirements[29].

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.

Operation

- A non-network option may need to be capable of operating continuously 24 hours per day over a period of years.
- If a generation service is proposed (either standalone or in conjunction with other services), such operation will be required regardless of the pool price[30].
- 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 network costs associated with a proposed non-network option, including asset decommissioning, these costs will form part of the option economic assessment

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 condition risks at Tarong and Chinchilla substations.

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

[29] 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 non-network support agreement.

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

5 Potential credible network options to address the identified need

Powerlink has developed two credible network options to address the condition risks and compliance obligations at Tarong and Chinchilla substations.

Option 1: Replacement of all at-risk transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla by June 2025.

Option 2: Reconfigure Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong by June 2025. The Chinchilla to Tarong transmission line will be mothballed under this option.

A summary of the credible options is given in Table 1.

Table 1: Summary of credible options

Option	Indicative capital cost ($million, 2020/21)	Indicative annual O&M costs ($million, 2020/21)
Maintain existing network topology		
Option 1 Replace all at-risk assets like-for-like by June 2025	42.88	0.14
Reconfigure network topology		
Option 2: Reconfigure Chinchilla and replace selected assets by June 2025	27.90	0.16

Both credible options address the major risks resulting from the deteriorated condition of ageing and obsolete assets at Tarong and Chinchilla substations to allow Powerlink to meet its reliability of supply and safety obligations under applicable jurisdictional instruments and Schedule 5.1 of the Rules.

None of these options has been discussed by the Australian Energy Market Operator (AEMO) in its most recent Integrated System Plan (ISP).[31]

Additional options that were considered but not progressed are outlined in Appendix 1, with the reason that they were no longer considered.

5.1 Option 1: Replace all at risk assets by June 2025

Powerlink is the proponent of this option.

This option maintains the existing topology and includes replacement of all at-risk transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla on a like-for-like basis. This option offers a greater degree of operational flexibility to address potential outage constraints into the future by retaining the Tarong to Chinchilla transmission line for the foreseeable future. As such, this option includes a modelled project to undertake a future refit of the transmission line to extend its life when we anticipate that this will be required.

[31] 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

Table 5.3: Main project components for the Option 1

Option	Description	Indicative capital cost ($m, 20/21)	Indicative annual O&M costs ($m, 20/21)
Maintain existing network topology			
Replace all at-risk assets like-for-like by June 2025	Replace selected primary plant and all secondary systems at Chinchilla by June 2025*	13.38	0.14
	Replace four transformers and selected primary plant at Tarong by June 2025*	29.50	
	Refit the Tarong to Chinchilla transmission line by 2035†	49.44	

***** Proposed RIT-T capital project
† Modelled capital project

5.2 Option 2: Transformer-end Chinchilla Substation & replace selected assets by 2025

Option 2 seeks to optimise the benefits of the more recently commissioned 275kV network established to service the Surat Basin. Powerlink is the proponent of this option.

This option involves reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong. The Chinchilla to Tarong transmission line will be mothballed under this option. A future modelled project is included to decommission the transmission line when it is no longer economic to maintain it in a mothballed state.

Option 2 delivers additional benefit in that it provides for the potential connection of renewable generation in the area by enabling the re-use of a section of the existing easement between Tarong and Chinchilla for the construction of a 275kV line from Halys Substation.

Table 5.4: Main project components for Option 2

Option	Description	Indicative capital cost ($m, 20/21)	Indicative annual O&M costs ($m, 20/21)
Reconfigure network topology			
Reconfigure Chinchilla and replace selected assets by June 2025	Replace selected primary plant and secondary systems at Chinchilla by June 2025*	10.06	0.16
	Replace two transformers and selected primary plant at Tarong by June 2025*****	17.84	
	Decommission Chinchilla transformer bays at Tarong by 2026†	3.76	
	Mothball the Tarong to Chinchilla transmission line by 2026†	3.00	
	Decommission Tarong to Chinchilla transmission line by 2040†	23.43	

***** Proposed RIT-T capital project
† Modelled operational projects

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[32].

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.

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, set out in this PSCR, may impact the ranking of the credible options under consideration 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[33].

A discussion of each market benefit under this RIT-T considered not to be material is presented below.

- **Changes in patterns of generation dispatch**: the credible options do not affect transmission network constraints or affect transmission flows that would change patterns of generation dispatch. It follows that changes through different patterns of generation dispatch are not material to the outcome of the RIT-T assessment.
- **Changes in voluntary load curtailment**: the credible options do not 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:** the credible options are localised and do not affect the capacity of the transmission network materially, and therefore are unlikely to change generation investment patterns (which are captured under the RIT-T category of 'costs for other parties'). The disconnection of the Tarong to Chinchilla transmission line is possible due to the strong network connection of Chinchilla via the 275kV network at Columboola.
- **Differences in the timing of expenditure**: the credible options 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**: the credible options are not expected to provide any changes in network losses as replacing secondary systems does not affect the characteristics of primary transmission assets.
- **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 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 any 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.

[32] 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.

[33] AER, Application guidelines, Regulatory investment test for transmission, December 2018

- **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. As a consequence, option value is not a relevant consideration for this RIT-T.

6.3 Consideration of market benefits for non-network options

Powerlink notes that non-network options may impact the wholesale electricity market (for example by displacing generation output). Accordingly, it is possible that several of the above 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 will assess the materiality of market benefits associated with these options. Where the market benefits are considered material, these will be quantified as part of the RIT-T assessment of these options.

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[34].

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 manage these risk costs.

The Base Case for the transformers, primary plant and secondary systems at Tarong and Chinchilla, as well as the transmission line between Tarong and Chinchilla 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.

7.2 Tarong - Chinchilla 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[35]. An overview of the framework is available on Powerlink's website[36] and the principles of the Framework have been used to calculate the risk costs of the Base Case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

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[34] AER, Application Guidelines, Regulatory Investment Test for Transmission, August 2020.
[35] AER Industry practice application note, Asset Replacement Planning, January 2019
[36] The risk costs are calculated using the principles set out in the Powerlink document, Overview of Asset Risk Cost Methodology, May 2019

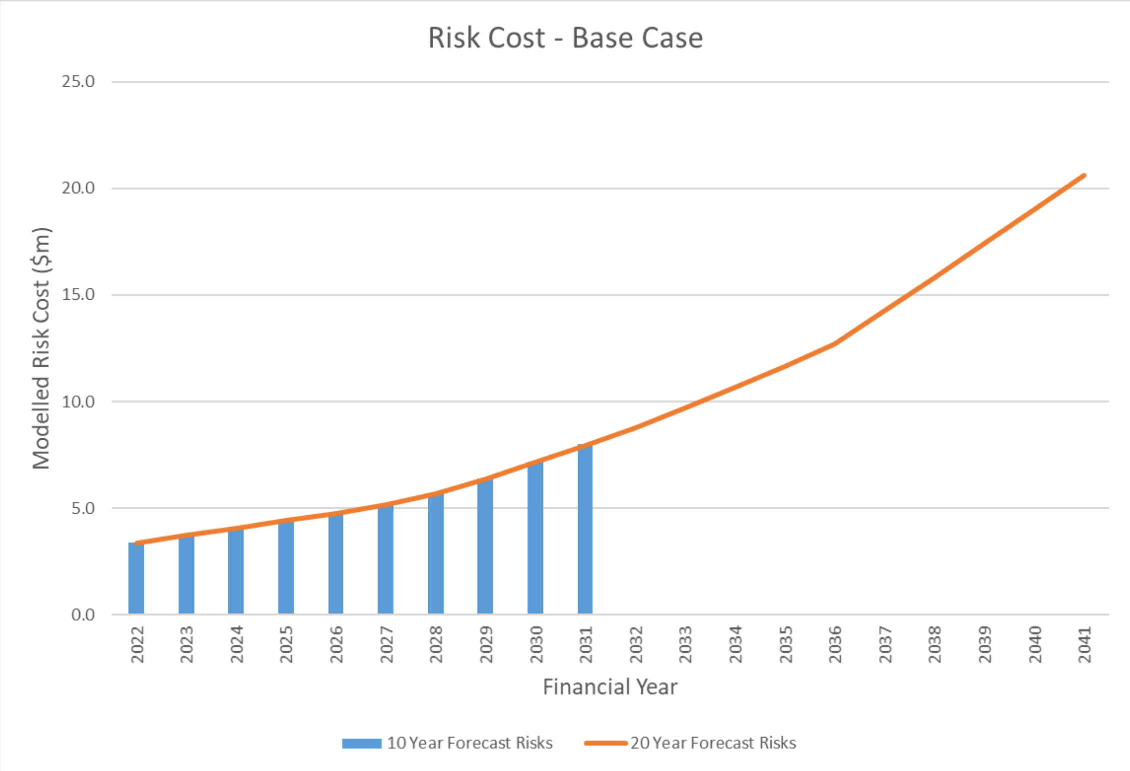
7.3 Base Case assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing and obsolete assets at Tarong and Chinchilla substations, the following modelling assumptions have been made:

- Spares for secondary system items have been assumed to be available prior to the point of forecast spares depletion. After this point, the cost and time to return the secondary system back to service increases significantly.
- Historical load profiles have been used when assessing the likelihood of unserved energy under concurrent failure events.
- Peak demand for the greater Tarong and Chinchilla load areas consistent with medium demand forecasts published within Powerlink's 2020 Transmission Annual Planning Report have been used.
- Unserved energy generally accrues under concurrent failure events, and consideration has been given to potential feeder trip events within the wider area.
- The network risk cost models have used the Queensland regional VCR published within the AER's 2019 Value of Customer Reliability Review Final Report ($25,501/MWh).

The 20-year forecast of risk costs for the Base Case is shown in Figure 7.1.

Figure 7.1: Modelled Base Case risk costs



Based upon the assessed condition of the ageing assets at Chinchilla and Tarong, the total risk costs are projected to increase from $3.4 million in 2022 to $20.6 million in 2041. The main areas of risk cost are associated with network risks that arise through failure of the deteriorated secondary systems modelled as probability weighted unserved energy[37], and financial risk costs associated mainly with the replacement of failed assets in an emergency manner. These risks increase over time as the condition of equipment further deteriorates, more equipment becomes obsolete and the likelihood of failure rises.

[37] 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, December 2019*.

7.4 Modelling of Risk in Options

Each option is scoped to manage the key 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 20-year period, from 2022 to 2041. A 20-year period takes into account the size and complexity of the transformer replacement options.

There will be remaining asset life by 2041, 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%[38] as the central assumption for the NPV analysis presented in this report.

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 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[39].

8.3.1 Reasonable Scenarios

Based upon the minor differences between the options in terms of operational outcomes, Powerlink has chosen to present a single reasonable scenario for comparison purposes.

The detailed market modelling of future generation and consumption patterns required to assess alternative scenarios relating to connection of renewable generation represents a disproportionate cost in relation to the scale of the proposed network investment.

Notwithstanding this, we have considered capital cost, discount rate and risk cost sensitivities individually and in combination and found that none of the parameters has an impact on ranking of results. Hence, Powerlink has chosen to present a central scenario, as illustrated in Table 8.1.

Table 8.1: Reasonable scenario assumed

Key parameter	Central scenario
Capital cost	100% of baseline capital cost estimate
Discount rate	5.90%
Maintenance cost	100% of baseline maintenance cost estimate
Risk Cost	100% of baseline risk cost forecast

[38] 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.

[39] AER, Regulatory investment test for transmission, August 2020, Section 23.

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, 2020/21)

Option	Central Scenario NPV relative to Base Case ($m)	Ranking
Option 1 Replace all at-risk assets like-for-like by June 2025	33.7	2
Option 2: Reconfigure Chinchilla and replace selected assets by June 2025	41.3	1

Both credible options will address the identified need on an enduring basis. Option 2 is ranked first with a net benefit of $41.3 million compared to the Base Case, with Option 1 resulting in $7.6 million less net benefit that Option 2.

Figure 9.1 sets out the breakdown of capital cost, operational maintenance cost and total 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: Present value of Base Case and credible network options

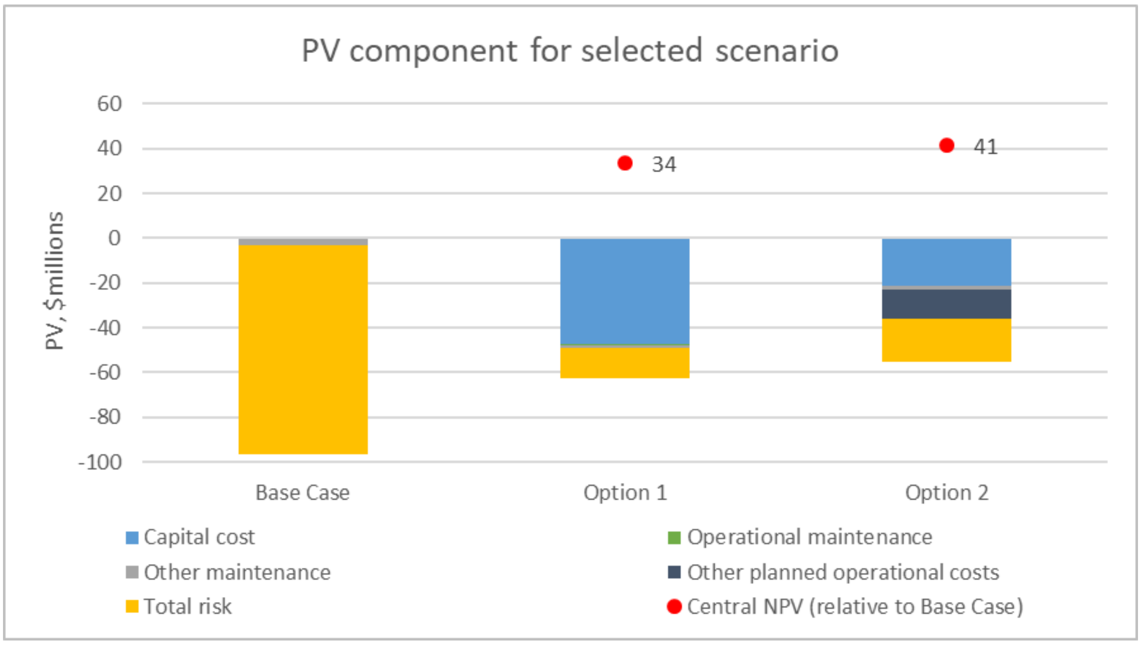


Figure 9.1 shows that both credible options significantly reduce risk cost relative to the Base Case and result in positive NPV relative to Base Case. Option 1 provides the greatest reduction in risk costs, but at higher capital cost, while Option 2 provides the highest net economic return relative to 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 maintenance expenditure estimates.
- a range from 75% to 125% of total risk cost estimates.

As illustrated in Figure 9.2.1 to Fig 9.2.4, sensitivity analysis for the NPV relative to the Base Case shows that varying the discount rate, capital expenditure, operational maintenance expenditure and total risk costs has no impact on the preferred option. Option 2 has the highest NPV under all sensitivities tested.

Figure 9.2.1 Discount Rate Sensitivity

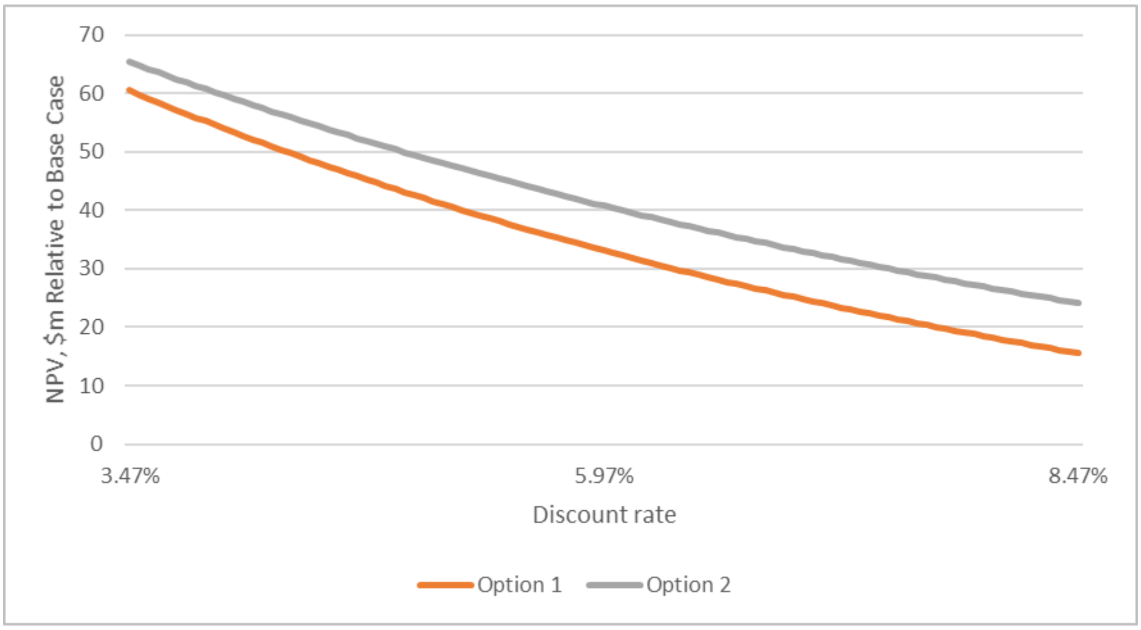


Figure 9.2.2 Capital cost sensitivity

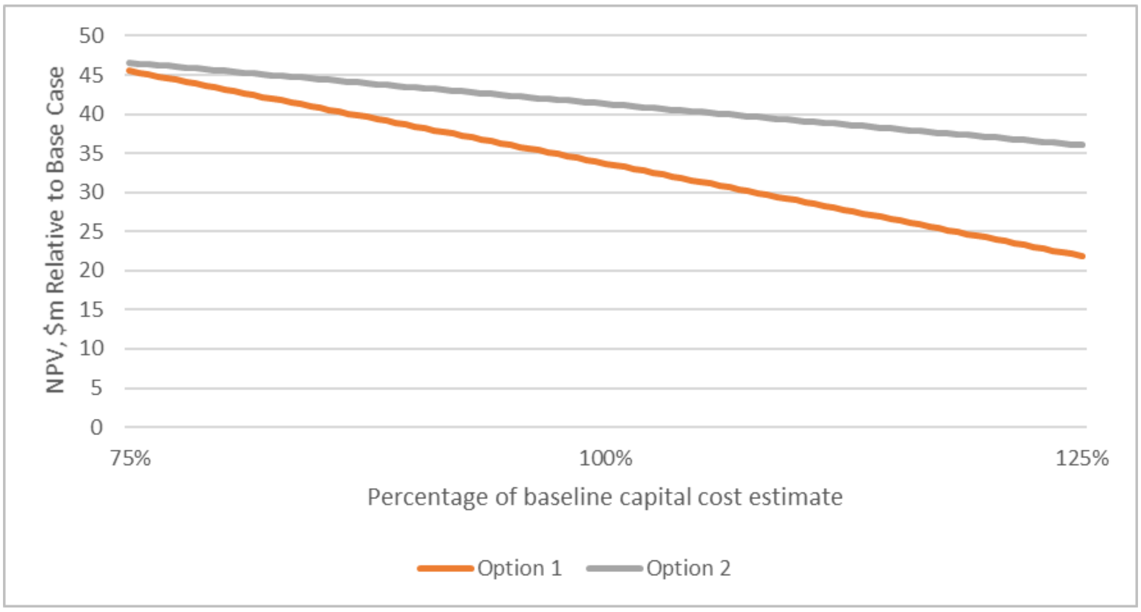


Figure 9.2.3 Maintenance cost sensitivity

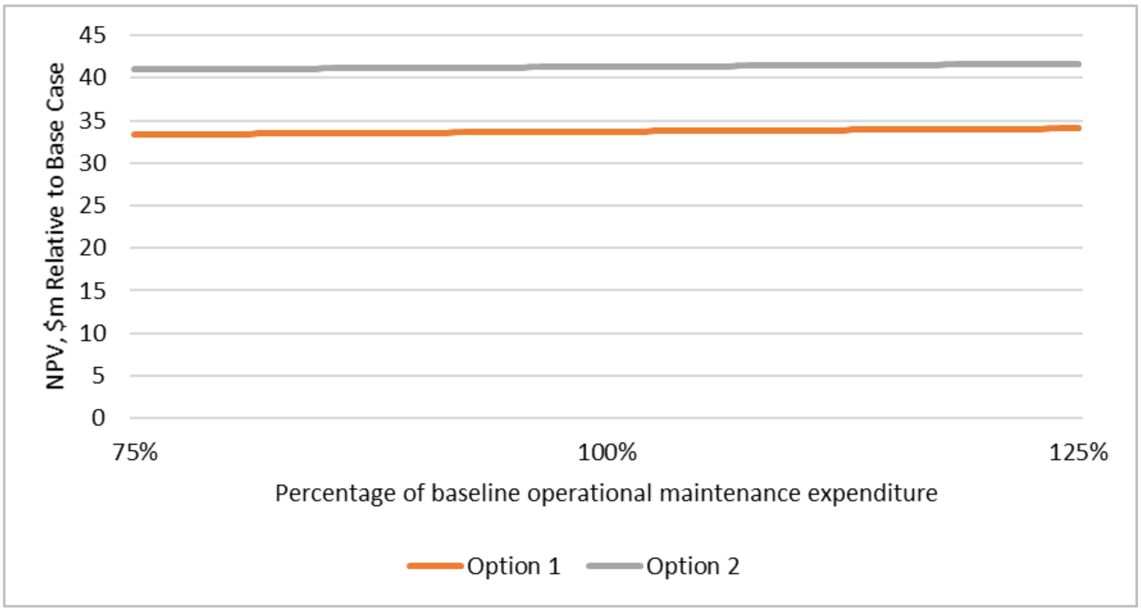
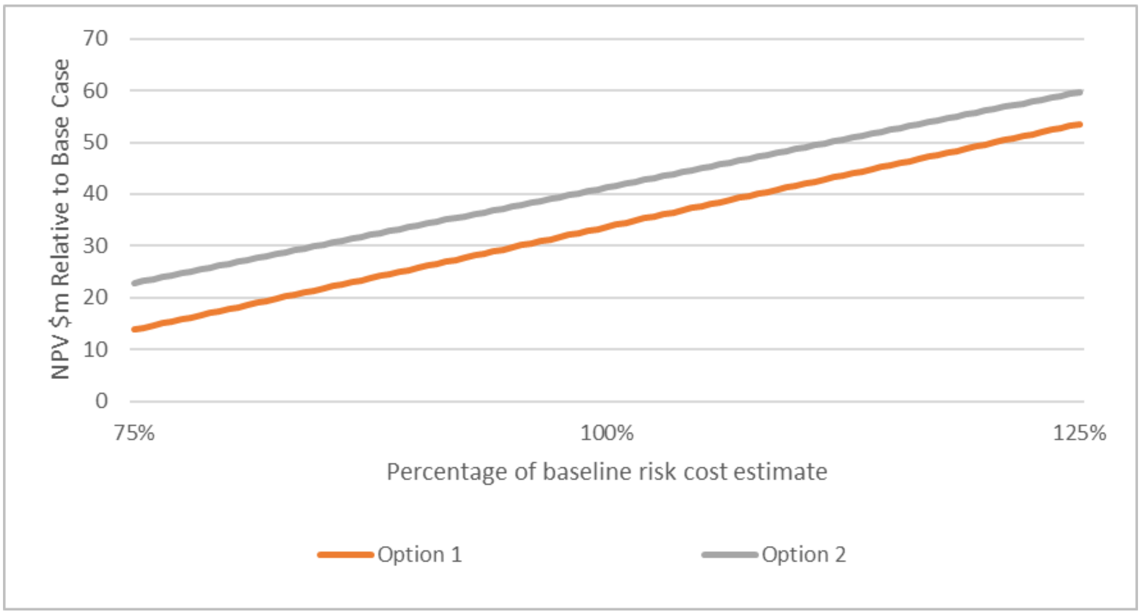


Figure 9.2.4 Risk cost sensitivity

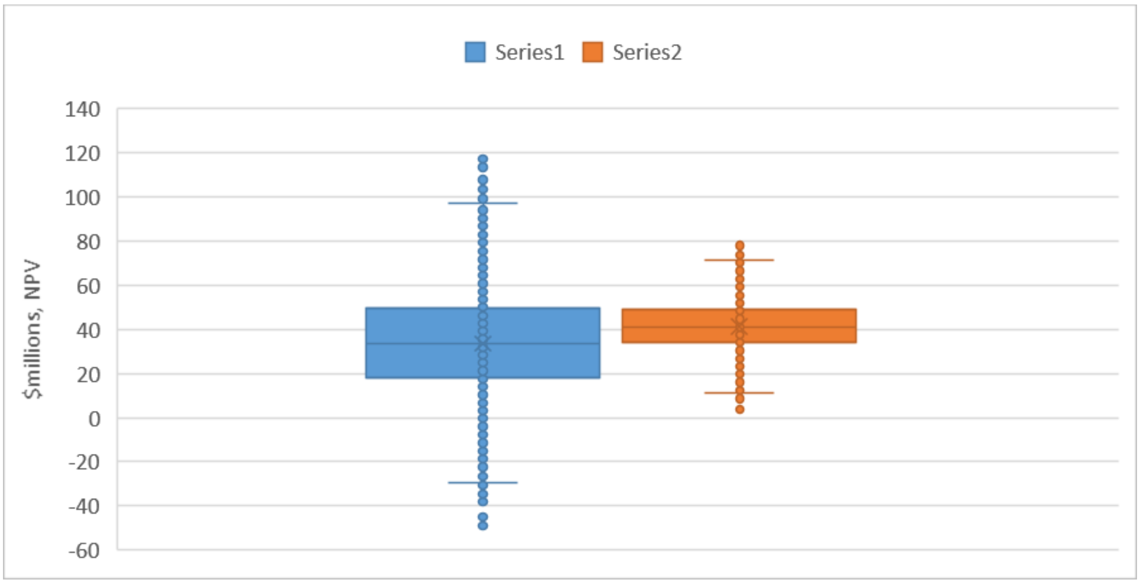


9.3 Sensitivity to multiple parameters

A Monte Carlo simulation was performed with multiple input parameters (including capital cost, discount rate, operational maintenance cost and total risk cost) for the calculation of the NPV of each option. This process was repeated, in this case with over 5000 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 results of the Monte Carlo simulation, identifies that Option 2 has less statistical dispersion in comparison to Option 1. The mean and median Option 2 is also 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 Sensitivity to multiple parameters (NPV relative to Base Case $m, 2020/21)



9.4 Conclusion

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. As the investment is classified as a ‘reliability corrective action’ under the Rules, the purpose of the RIT-T is to identify the credible option that minimises the total cost to customers.

The result of the economic analysis indicates that both credible options significantly reduce risk cost relative to the Base Case and results in positive NPV relative to Base Case. Option 2 is the credible option with the lowest cost to customers, in NPV terms, over the 20-year analysis period. Consequently, Option 2 satisfies the requirements of the RIT-T and is the preferred option.

10 Draft recommendation

Based on the conclusions drawn from the NPV analysis, it is recommended that Option 2 be implemented to address the risks associated with deteriorated condition of the ageing transmission assets at Tarong and Chinchilla substations. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the Rules.

Option 2 involves reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong by June 2025. The Chinchilla to Tarong transmission line will be mothballed under this option. The indicative capital cost of the RIT-T project for the preferred option is $27.9 million in 2020/21 prices.

Option 2 delivers additional benefit in that it provides for the potential connection of renewable generation in the area by enabling the re-use of a section of the existing easement between Tarong and Chinchilla for the construction of a 275kV line from Halys Substation.

Under this option design work will commence in 2023, with all work completed by 2025.

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	24 August 2021
Part 2	Submissions due on the PSCR Have your say on the credible options and propose potential non-network options.	22 November 2021
Part 3	Publication of the PACR Powerlink's response to any further submissions received and final recommendation on the preferred option for implementation.	December 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).

Appendix 1: Options considered but not progressed

Powerlink considered two further network options that have not been progressed. These options are described in Table A1.

Table A1: Options considered but not progressed

Option description	Reason for not progressing option
Replace primary plant and secondary systems at Chinchilla, and refurbish four transformers at Tarong to extend their life by 15 years until to match the anticipated end of life of the Tarong to Chinchilla transmission line.	Refurbishment does not address fault level ratings of existing transformers. Hence, this is not a credible option.
Reconfigure Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong, and decommission the Tarong to Chinchilla transmission line.	The early decommissioning of the Tarong to Chinchilla transmission line is considerably more expensive than the minor operational cost to mothball the transmission line in both nominal and NPV terms, given the anticipated remaining life of the transmission line. Therefore, this option is anticipated to be materially more expensive than Option 2 modelled in the RIT-T.

Contact us

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