Powerlink Queensland

Project Specification Consultation Report

26 September 2023

Maintaining power transfer capability and reliability of supply at Kemmis

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 the replacement of network assets, augmentations of the transmission network and providing for power system security services such as system strength and inertia. More information on the RIT-T process and how it is applied to ensure 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.
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 and
- providing the services required to meet the system strength and inertia requirements and/or declared shortfalls identified in AEMO's latest System Strength and Inertia Reports for which Powerlink has responsibility as the relevant Transmission Network Service Provider and System Strength and Inertia Service Provider in Queensland.

Contents

Executive Summary

The condition of Transformer 1 at Kemmis Substation requires Powerlink to take action

Kemmis substation, located approximately 32km north west of Nebo, was established in 2002 to support the load growth arising from the expansion of mining in the northern Bowen Basin and to provide a bulk-supply injection point to the Ergon distribution network (part of the Energy Queensland group).

Power transformer 1 (Transformer 1) was first assembled and energised at an alternate site in 1984 and was subsequently relocated to Kemmis substation in 2003 as part of the substation's original development. Having been in-service for almost forty years, a recent condition assessment found that Transformer 1 is displaying a number of condition-based issues, indicating it is nearing the end of its technical life and, with an increasing risk of failure. The failure of a transformer or associated primary plant can result in an extensive replacement timeframe increasing the risk of loss of supply to the local area, and in extreme cases, could present a risk to the safety of personnel.

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services provided by Kemmis Substation. Powerlink must therefore take action to avoid the increasing likelihood of unserved energy arising from failure of the ageing transformer at Kemmis, and ensure customers are provided with a reliable and safe supply of electricity.

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

As the identified need of the proposed investment is to meet reliability and service standards specified in the Rules, Powerlink's Transmission Authority and applicable jurisdictional instruments, it is classified as a "reliability corrective action"[2].

The identified need is not discussed in the most recent Integrated System Plan (ISP), and is therefore subject to the application and consultation process for RIT-T projects not defined as *actionable ISP projects*[3].

Powerlink has adopted the expedited process for this RIT-T[4], as the preferred option is below $46 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[5] network option presented is catered for in the risk cost modelling and consequentially represented in the economic analysis.

This Project Specification Consultation Report (PSCR) discusses and ranks the potential credible network options, which incorporate cost effective measures over the long-term, to achieve the required service levels.

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 the credible network option 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 as the condition of the asset deteriorates over time. These increasing risk levels are assigned a monetary value and added to the ongoing maintenance costs to form the Base Case. The Base Case is then used as a benchmark against which to compare and rank the credible options designed to offset/mitigate the risks, and to ensure ongoing compliance with regulatory and jurisdictional obligations.

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[2] The Rules clause 5.10.2, Definitions, reliability corrective action.
[3] Refer to Clause 5.16.1 of the Rules.
[4] In accordance with clause 5.16.4(z1) of the Rules.
[5] Clause 5.15.2(a) of the Rules.
[6] AER, *Application guidelines, Regulatory investment test for transmission,* August 2020

Network options considered to address the identified need

Powerlink has developed one credible network option to address the identified need for maintaining power transfer capabilities and reliability of supply at Kemmis Substation. This option proposes a like for like replacement of Transformer 1 by 2026. The credible network option, along with its NPV relative to the Base Case is summarised in Table 1. The absolute NPVs of the Base Case and option 1 are shown graphically in Figure 1.

Table 1: Summary of credible RIT-T network options ($m, real 2023)

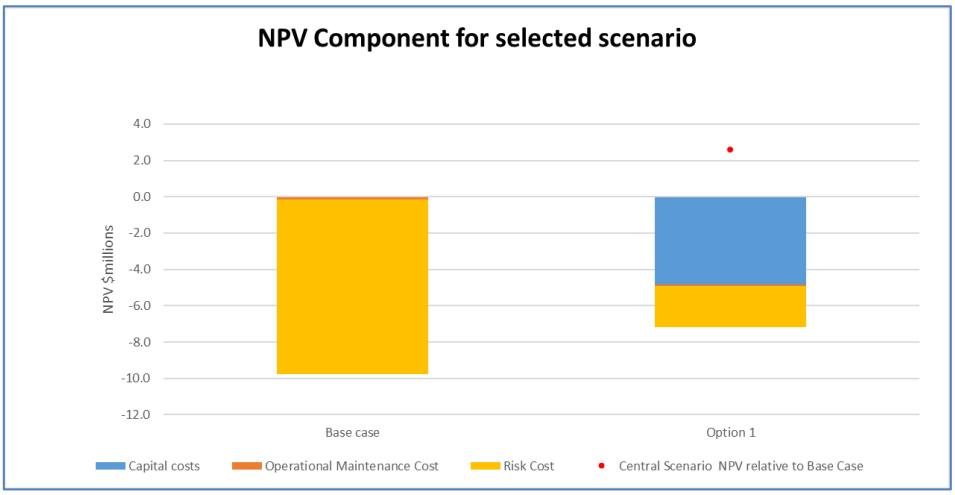
Option	Description	Total Cost ($m)	Central NPV relative to Base Case ($m)	Ranking
1	Replace 1 transformer by 2026	6.78*	2.56	1

*RIT-T Project

Option 1 is the only credible network option, which addresses the major risks resulting from the deteriorated condition of the ageing transformer at Kemmis Substation.

Figure 1 shows the breakdown of the NPV of the Base Case and option 1 for the central scenario. Option 1 reduces the total risk costs arising from the ageing transformer at Kemmis remaining in service and being managed via operational maintenance only (as in the Base Case), and hence reflects a net economic benefit when compared to the Base Case.

Figure 1: NPV component of Base Case and Options for central scenario ($m, real 2023)



Option 1 has been identified as the preferred network 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 1 provides a positive net economic benefit relative to the Base Case and is therefore the preferred option.

Option 1 involves the replacement of Transformer 1 by 2026. The indicative capital cost of the RIT-T project for the preferred option is $6.78 million in 2022/23 prices.

Under Option 1, procurement of new equipment would commence in 2024, with replacement of the existing Transformer 1 completed by 2026.

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 November 2026, on an ongoing basis.

A non-network option that avoids the proposed replacement of the ageing transformer would need to replicate, in part or full, the support that Kemmis Substation delivers to customers in the area on a cost effective basis.

Lodging a submission with Powerlink

Powerlink is seeking written submissions on this *Project Specification Consultation Report* by Friday, 22 December 2023, particularly on the credible option presented[7].

Please address submissions to:

Roger Smith
Manager Network and Alternate Solutions
Powerlink Queensland
PO Box 1193
VIRGINIA QLD 4014
Tel: (07) 3860 2328

networkassessments@powerlink.com.au

[7] 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[8], optimising performance and efficiently managing assets through the whole asset life cycle[9].

Having been in-service for almost forty years, power transformer 1 (Transformer 1) at Kemmis Substation is nearing the end of its technical service life and is increasingly at risk of failure due to its deteriorated condition.

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services currently provided by Kemmis Substation to customers in the North Queensland region.

The proposed credible network option maintains the current electricity services to customers in the area by addressing the increasing likelihood of faults arising from the condition of Kemmis Substation's ageing transformer. When developing the credible option, Powerlink has focussed on implementing cost effective solutions that ensure a reliable and safe supply, delivering positive outcomes for customers.

1.2 RIT-T Overview

The identified need referred to in this RIT-T, to maintain power transfer capability and reliability of supply at Kemmis, is not discussed in the most recent Integrated System Plan (ISP). As such, it is subject to the application and consultation process for RIT-T projects not defined as *actionable ISP projects*[10].

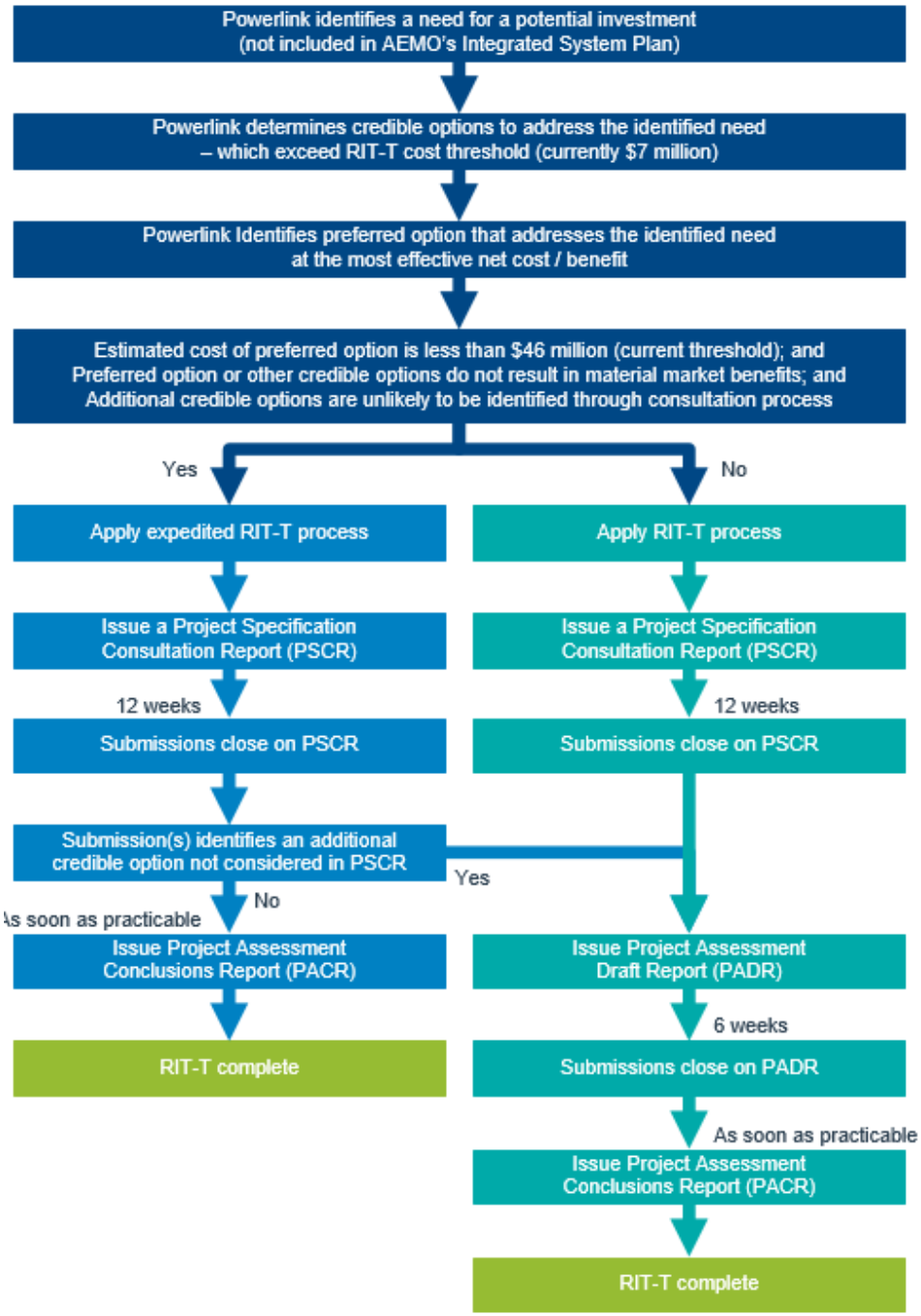
This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process[11]. It:

- 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 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 Net Present Value (NPV) assessment of each of the credible options compared to a Base Case (as well as the methodologies and assumptions underpinning these results)

[8] 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*.
[9] 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
[10] Refer to Clause 5.16.1 of the Rules.
[11] This RIT-T consultation has been prepared based on the following documents: *National Electricity Rules, Version 200,* 30 May 2023, AER, *Regulatory investment test for transmission*, August 2020 and AER, *Application guidelines, Regulatory investment test for transmission,* August 2020.
[12] As required by Clause 5.15A.2(b)(6) of the Rules.

- identifies and provides a detailed description of the credible option that best satisfies the RIT-T, and is therefore the preferred option
- describes how customers and stakeholders have been engaged 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).

Figure 1.1: RIT-T Process Overview: Need not identified as an *actionable ISP project*



Powerlink has adopted the expedited process for this RIT-T, as allowed for under the National Electricity Rules (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 $46 million
- there are no material market benefits for Option 1, other than benefits associated with changes in involuntary load shedding
- Powerlink has identified its preferred option in this PSCR (together with the supporting quantitative cost-benefit analysis)
- Powerlink does not envisage that additional credible options, which could deliver material market benefits, will be identified through the submission process, given the nature of this transformer replacement project.

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 more cost efficient outcome for customers.

2 Customer and non-network engagement

Powerlink operations stretch across Queensland and 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 Stakeholder Engagement Framework[14] guides Powerlink's interactions with individuals and organisations and ensures engagement is meaningful. In particular, Powerlink works collaboratively with its Customer Panel in the normal course of business.

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.

[13] In accordance with clause 5.16.4(z1) of the Rules
[14] Refer to the Stakeholder Engagement page on Powerlink's website.

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 (available via the TAPR portal), 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 power transfer and reliability of supply at Kemmis

Powerlink identified in its 2020-2022 TAPRs an expectation that action would be required to address the emerging power transfer and reliability of supply issues in the North 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.

2.4 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 comprises approximately 9% of the total cost of the residential electricity bill (refer to Figure 2.1).

Figure 2.1: Components of end user bills

[15] This relates to the standard geographic definitions (zones) identified within the TAPR, which is published annually by 31 October.

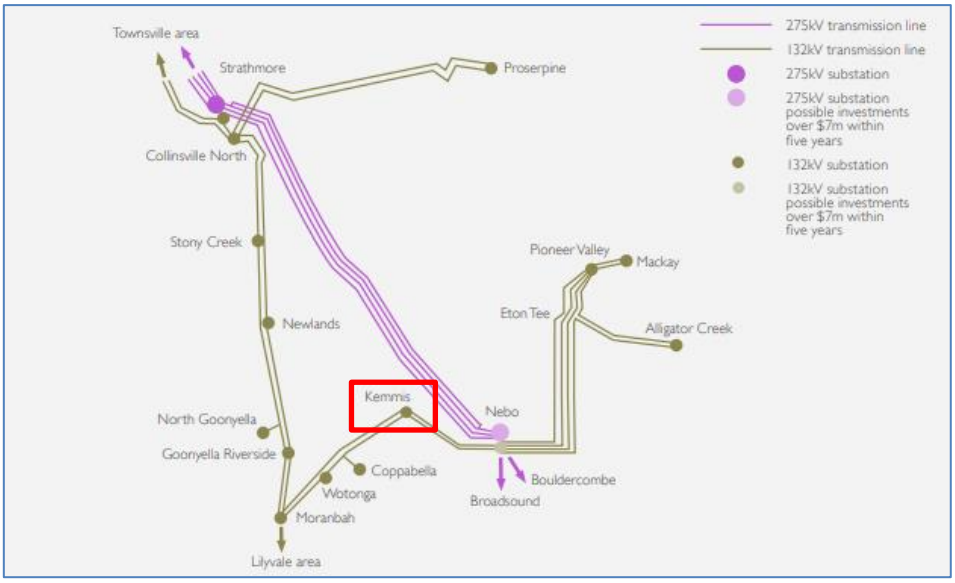
Detailed information on transmission pricing, including discussion on how Powerlink is actively engaging with customers and stakeholders on transmission pricing concerns, is available on Powerlink's website.

3 Identified need

3.1 Geographical and network need

Kemmis Substation was established in 2002 to support the load growth arising from the mining expansion in the Northern Bowen Basin and to provide a bulk supply injection point to the Ergon distribution network (part of the Energy Queensland group).

Figure 3.1: North Zone transmission network



3.2 Description of identified need

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[16].

Planning studies have confirmed that in order to continue to meet the reliability standard within Powerlink's Transmission Authority, the services currently provided by Kemmis Substation are required into the foreseeable future to meet ongoing customer requirements.[17]

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.[18]

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

Powerlink's condition assessment of the ageing transformer at Kemmis Substation has highlighted that the transformer is nearing the end of its technical service life and is operating in a deteriorated condition.

[16] Transmission Authority No. T01/98, section 6.2(c)
[17] *Powerlink's Transmission Annual Planning Report 2022*
[18] The Rules clause 5.10.2, Definitions, reliability corrective action.

The consequences of this at-risk transformer remaining in service beyond 2026, without corrective action, would result in Powerlink being exposed to 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*[19].

Removing the deteriorated asset from service will in many cases eliminate the risk of breaching these safety obligations. However, removing the asset from the Powerlink network without a suitable network or non-network alternative will result in Powerlink not complying with the Rules or its Transmission Authority, as detailed below.

The removal of Transformer 1 at Kemmis will result in the need for load shedding to ensure that the system is able to be operated without breaching clause 4.2.2(d) of the Rules:

> *"all other plant forming part of or impacting on the power system is being operated within the relevant operating ratings (accounting for time dependency in the case of emergency ratings) as defined by the relevant Network Service Providers in accordance with schedule 5.1."*

The load shedding requirement under an intact system, as well as for a credible contingency, would result in breaches of Powerlink's Transmission Authority T01/98 clause 6.2 (c), where Powerlink must plan and develop its transmission network such that:

> *"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."*

By addressing the risks arising from the condition of the ageing and obsolete transformer at Kemmis, Powerlink is seeking to ensure a safe, adequate, economic, and reliable supply of electricity to customers into the future.

3.4 Description of asset condition and risks

Powerlink has undertaken a comprehensive condition assessment of the transformer at Kemmis Substation. This has identified that the transformer is exhibiting age-related deterioration issues and reaching the end of its technical service life, with an increasing risk of failure.

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 Transformer

Transformer 1 was first assembled and energised at an alternate site in 1984 and was subsequently relocated to Kemmis substation in 2003 as part of the substation original development. The 132/66/11kV Transformer 1 is exhibiting signs of age-related deterioration. The condition assessment showed the electrical integrity of the transformer is such that it is reasonable to expect up to 5 years of reliable service. The major driver for replacement of the transformer is the paper and oil condition and condition of ancillary components.

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.

[19] 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, Division 1, Section 319(1)*, Environmental Protection Act 1994*; Section 34(1)(a) *Electricity Act 1994*; Queensland Transmission Authority T01/98

3.5 Consequences of Kemmis transformer failures

The potential in-service failure of the ageing transformer at Kemmis 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: Kemmis: at-risk assets and consequences of failure

Equipment	Condition	Consequence of failure
Power Transformers	• Aged bushings at end of technical service life • Emerging gasket failures • Poor insulation strength	• Increased susceptibility of power transformer failure during through faults leading to loss of supply with long return to service time • Risk of fire and damage to neighbouring equipment

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 has considered the operation of the existing embedded generation in the region in establishing the non-network requirement described in this Section.

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 (refer to Section 2.3.1). 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.

4.1 Criteria for proposed network support services

A non-network option that assists in minimising the overall investment could provide either a full solution that replicates the functionality of the transformer, or a partial solution that provides support to replace the transformer at risk.

A non-network option that avoids replacement of the ageing transformer would need to provide injection or demand response at Kemmis of up to 60MW during peak demand and up to 650MWh per day.

As part of its joint-planning activities with Ergon (part of the Energy Queensland Group), Powerlink investigated a potential option for a hybrid network and non-network solution. This option proposed to utilise an existing Ergon owned 66kV feeder between Broadlea and Kemmis in conjunction with additional active power supply at Kemmis to support the full load supplied normally from Kemmis substation. However, due to the low transfer capability of the Broadlea to Kemmis feeder, it has been determined that this hybrid option is not technically feasible and therefore not a credible option.

Additional options that have been considered but not progressed for technical reasons are discussed in Appendix 1, Table A1.

The exact requirements are in addition to existing embedded generation that operates in the area, and is dependent on the nature of the network support, including how quickly any response can be initiated. A non-network solution must also maintain/restore fault level (system strength) and voltage control.

Powerlink has identified the following common criteria that must be satisfied if proposed network support services are to meet supply requirements[20].

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 would 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 market price[21].
- 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, 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 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 arising from the ageing transformer at Kemmis Substation.

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

[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 non-network agreement.
[21] The 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 identified two potential network options to address the risks arising from the deteriorated condition of Transformer 1, those being upfront replacement of the transformer by 2026 or refurbishment in 2024 followed by replacement of the transformer by 2030. However, upon detailed investigation, Powerlink has identified that the option to refurbish and later replace the transformer is not credible, as it is not technically feasible due to the poor condition and age of the transformer. Powerlink is therefore proposing one credible network option to maintain the existing electricity services, ensuring a reliable, safe and cost effective supply to customers in the area. The option that has been considered but not progressed for technical reasons is discussed in Appendix 1, Table A1.

The credible network option to address the identified need for maintaining power transfer capabilities and reliability of supply at Kemmis Substation proposes a like for like replacement of Transformer 1 by 2026.

Table 5.1: Summary of credible options – capital and maintenance costs ($m, real 2023)

Option	Description	Total Cost ($m)	Annual Operational Maintenance Cost ($m)	Ranking
1	Replace 1 transformer by 2026	6.78*	0.007	1

*RIT-T Project

Powerlink is the proponent of the credible network option presented. Option 1 addresses the major risks resulting from the deteriorated condition of the ageing transformer at Kemmis Substation. This option has not been discussed by the Australian Energy Market Operator (AEMO) in its most recent ISP[22].

5.1 Material inter-network impact

Powerlink does not consider that the credible option 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 (or categories) is unlikely to be material.[24]

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

Powerlink considers that changes in involuntary load shedding under the credible network option presented could have a material market benefit. Consequently, 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 suggested that the classes of market benefit that a RIT-T proponent should consider will depend on the circumstances surrounding the individual RIT-T assessment, and the credible options under review. For example, where a credible option is not expected to affect the wholesale market, some classes of market benefit such as competition benefits and changes in fuel consumption may not be material in the RIT-T assessment, and so do not need to be estimated[25].

[22] 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.
[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] Clause 5.15A.2(b)(5)-(6) of the Rules.
[25] AER, *Application guidelines, Regulatory investment test for transmission,* August 2020, pages 29-30.

A discussion of each market benefit under the RIT-T is discussed below.

- **Changes patterns of generation dispatch**: replacement under the credible option does not by itself materially affect transmission network constraints or affect transmission flows that would change patterns of generation dispatch. It follows that changes in patterns of generation dispatch are not material to the outcome of the RIT-T assessment.
- **Changes in voluntary load curtailment**: replacement under the credible option does not by itself 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 effect of replacing the ageing assets under the credible option considered are localised to the substation they are located at and do not affect the capacity of transmission network assets and therefore is unlikely to change generation investment patterns (which are captured under the RIT-T category of 'costs for other parties').
- **Differences in the timing of expenditure**: the credible option for asset replacement does 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**: credible options are not expected to materially provide any changes in network losses.
- **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 option under consideration. These costs are therefore not material to the outcome of the RIT-T assessment.
- **Competition benefits:** Powerlink does not consider that the credible option 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 option 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 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

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. The RIT-T Instrument defines the Base Case as a situation in which no option is implemented by or on behalf of the RIT-T proponent [26].

As characterised in the RIT-T Application Guidelines, the Base Case involves the RIT-T proponent continuing with business-as-usual activities, and is not a credible option to meet the identified need.[27] Specifically, the Base Case reflects a state of the world in which the condition of the ageing asset is only addressed through standard operational activities, with escalating safety, financial, environmental and network risks.

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

The Base Case therefore includes the costs of work associated with operational maintenance (i.e. routine, condition-based and corrective maintenance) and the risk costs associated with the irreparable failure of the asset. The costs associated with irreparable failures are modelled in the risk cost analysis and are not included in the corrective 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 Kemmis Base Case risk costs

Powerlink has developed a risk modelling framework consistent with the RIT-T Application Guidelines. An overview of the framework is available on Powerlink's website[28] and this has been used to calculate the risk costs of the Kemmis Base Case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

7.2.1 Base Case assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing transformer at Kemmis, the following modelling assumptions specific to the Kemmis network configuration have been made.

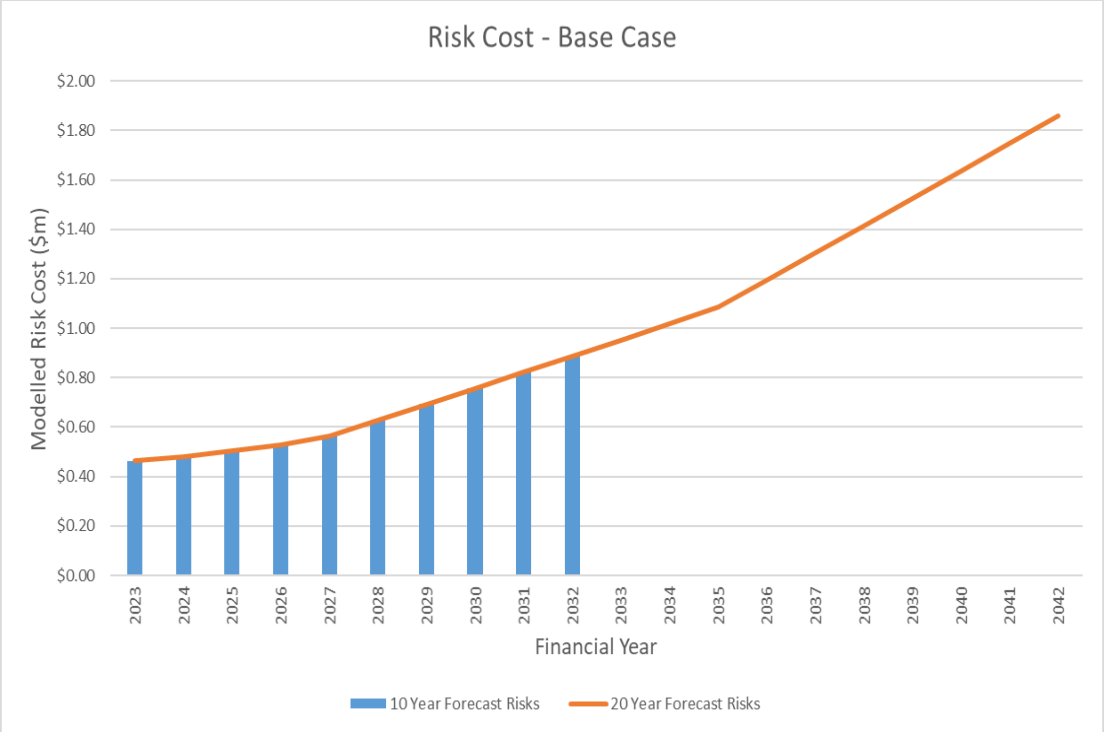
- Historical load profiles and embedded generation patterns have been used when assessing the likelihood of unserved energy under concurrent failure events.
- Unserved energy generally accrues under concurrent failure events, and consideration has been given to potential feeder trip events within the wider Kemmis area.
- Kemmis Substation supplies primarily to mines, resulting in a VCR of $39,120/MWh. The most relevant mines VCR values are published within the AER's Value of Customer Reliability Annual Adjustment (updated in 2022) and have been used to determine this VCR.
- Powerlink's business response to mitigating unserved energy under prolonged supply outage events has been incorporated within the risk cost modelling.

7.2.2 Base Case risk costs

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

[26] AER, *Regulatory investment test for transmission,* August 2020, Glossary.
[27] AER, Application guidelines, *Regulatory investment test for transmission,* August 2020, page 21.
[28] The risk costs are calculated using the principles set out in the Powerlink document, Overview of Asset Risk Cost Methodology, May 2019.

Figure 7.1: Modelled Base Case risk costs ($m, real 2023)



Based upon the assessed condition of the ageing transformer at Kemmis, the total risk costs are projected to increase from $0.46 million in 2023 to $1.86 million in 2042.

The main areas of risk cost are safety risk arising from the failure of equipment, financial risk related to the replacement of damaged or failed equipment, as well as network risk, involving reliability of supply through the failure of the deteriorated transformer, modelled as probability weighted unserved energy[29]. These risks increase over time as the condition of plant further deteriorates and the likelihood of failure rises.

7.3 Modelling of Risk in Options

Option 1 is specifically scoped to manage the major risks arising in the Base Case in order to maintain compliance with all statutory requirements. 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 20 year period, from 2023 to 2042. A 20 year period sufficiently takes into account the size and complexity of the transformer replacement investment.

As there will be remaining asset life in 2042, a terminal value[30] is calculated to account for any future benefits that would accrue over the balance of the asset's life.

[29] Unserved Energy is modelled using a Value of Customer Reliability (VCR) consistent with that published by AER in their *Value of Customer Reliability Annual Adjustment (updated in 2022)*.
[30] Terminal value was calculated based on remaining asset value using straight-line depreciation over the capital asset life.

8.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the NPV of costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 7%[31] as the central assumption for the NPV analysis presented in this report.

Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 3%[32] and an upper bound discount rate of 11% (i.e. a symmetrical upwards adjustment).

8.3 Description of reasonable scenario

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[33].

The detailed modelling of scenarios based upon AEMO's 2023 Inputs, Assumptions and Scenarios Report would represent a disproportionate cost in relation to the scale of the proposed network investment and the minor differences in residual risk between the options.

As discount rate, capital expenditure, operational maintenance expenditure and risk cost sensitivity does not impact on the sign of the option NPV, Powerlink has elected to present the NPV for the central scenario, in accordance with the provisions of the RIT-T Application Guidelines.

As noted above in Section 7, unserved energy is modelled as part of the Base Case and option risk cost.

Table 8.1: Reasonable scenario assumed

Key parameter	Central scenario
Capital cost	100% of base capital cost estimate
Maintenance cost	100% of base maintenance cost estimate
Discount rate	7%
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 for the credible option and the corresponding ranking of the credible option, relative to the Base Case.

Table 9.1: NPV of credible options ($m, real 2023)

Option	Description	Total Cost ($m)	Central NPV relative to Base Case ($m)	Ranking
1	Replace 1 transformer by 2026	6.78*	2.56	1

*RIT-T Project

[31] This indicative commercial discount rate of 7% is based on the AEMO 2023 Inputs, Assumptions and Scenarios Report, p 123.
[32] A discount rate of 3.04% pre-tax real Weighted Average Cost of Capital is based on the most recent AER determination, Final decision: Transgrid transmission determination 1 July 2023 to 30 June 2028.
[33] AER, *Regulatory Investment Test for Transmission*, August 2020, Section 23.

Option 1 will address the identified need on an enduring basis, and has a positive NPV relative to the Base Case.

Figure 9.1 sets out the central scenario NPV components of capital cost, maintenance cost and risk cost for the Base Case and the credible option. 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 components of Base Case and credible option ($m, real 2023)

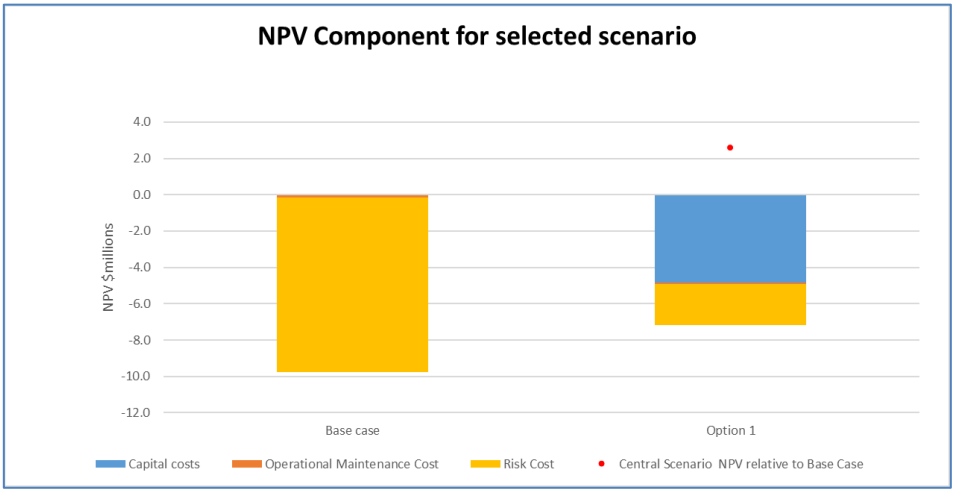


Figure 9.1 illustrates that the capital investment for the credible option that addresses risks associated with Transformer 1 at Kemmis Substation will result in benefits from a reduction in risk costs, as well as a reduction in operational maintenance costs when compared to the Base Case.

9.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3.04% to 10.96% for discount rate
- a range from 75% to 125% for capital expenditure estimates
- a range from 75% to 125% for operational maintenance expenditure estimates
- a range from 75% to 125% for total risk cost estimates.

As illustrated in Figure 9.2 – 9.4, sensitivity analysis for the NPV relative to the Base Case shows that varying the discount rate, capital expenditure, operational maintenance expenditure and risk cost does not impact on the sign of the NPV for Option 1. Therefore, Powerlink has elected to present the NPV for the central scenario.

Figure 9.2 Discount rate sensitivity

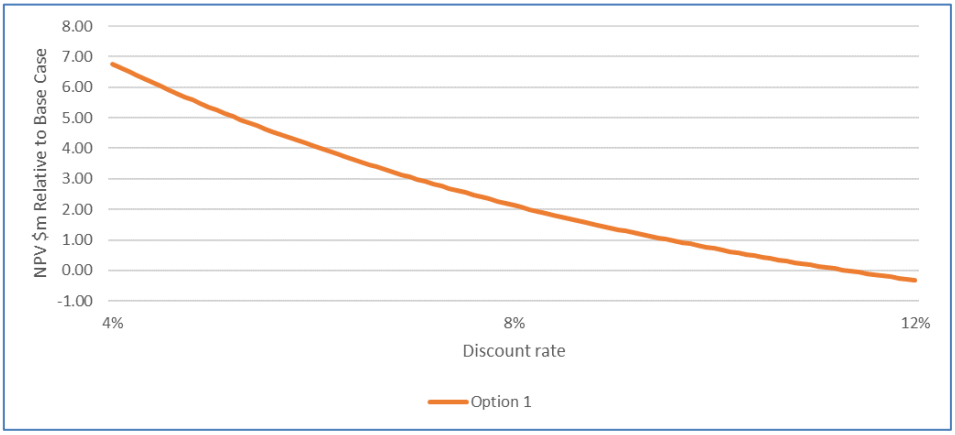


Figure 9.3 Capital cost sensitivity

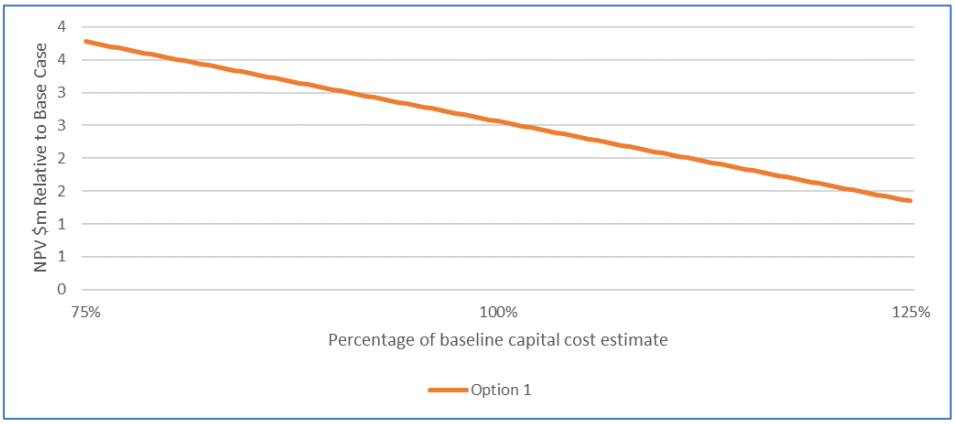


Figure 9.4 Risk cost sensitivity

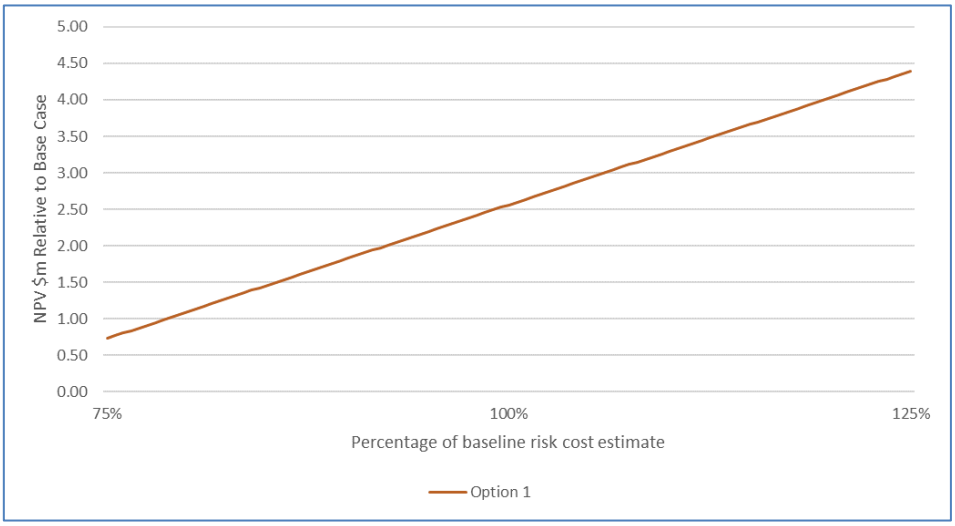
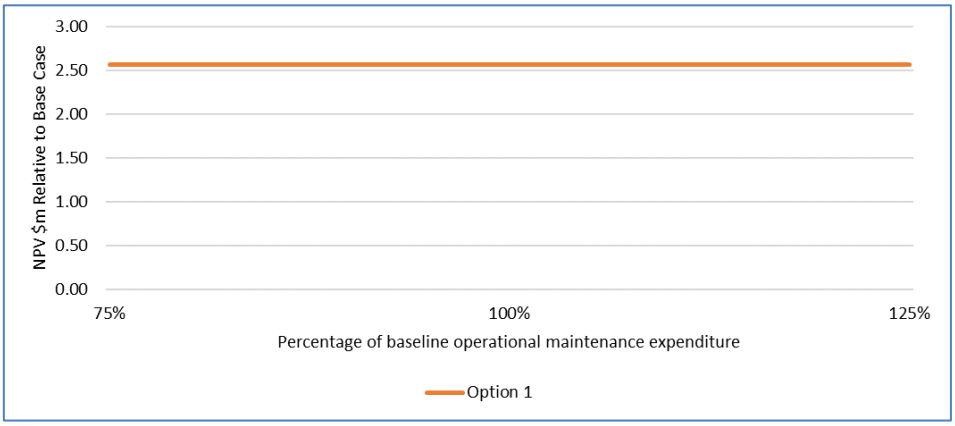


Figure 9.5 Maintenance cost sensitivity



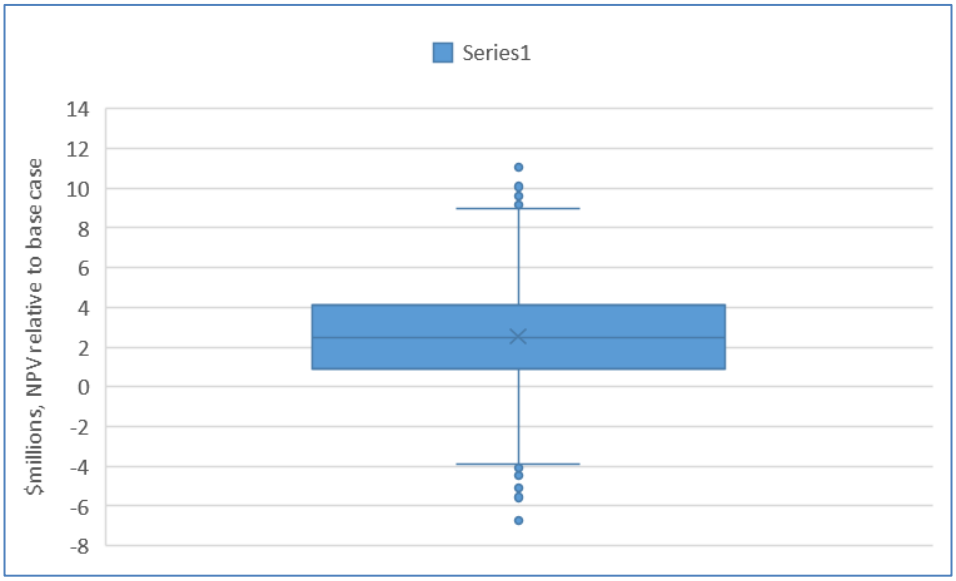
9.2.1 Sensitivity to multiple key assumptions

Monte Carlo Simulation was performed with multiple input parameters (including capital cost, discount rate, operational maintenance cost, corrective maintenance cost and total risk costs) generated for the calculation of 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 output is presented as a distribution of possible NPVs for each option, as illustrated in the boxplot presented in Figure 9.6.

It can be seen that the mean and median of Option 1 is positive relative to the base case. This confirms that the preferred option is robust over a range of input parameters in combination.

Figure 9.6: NPV sensitivity analysis of multiple key assumptions relative to the Base Case



9.3 Conclusion

The result of the cost-benefit analysis indicates that Option 1 has a positive net economic benefit relative to the base case over the 20-year analysis period. Sensitivity testing shows that the analysis is robust to variations in the capital cost, operational maintenance cost, discount rate and risk cost assumptions.

Additionally, Option 1 is the only credible network option, which addresses the major risks resulting from the deteriorated condition of the ageing transformer at Kemmis Substation. Option 1 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 1 be implemented to address the risks associated with the deteriorated condition of the ageing transformer at Kemmis Substation.

Option 1 involves the replacement of Transformer 1 by 2026. The indicative capital cost of the RIT-T project for the preferred option is $6.78 million in 2022/23 prices.

Design and procurement activities will commence in 2024, with onsite work to be completed by 2026.

11 Submission 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 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 RIT-T Application 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 stated, Powerlink will publish a PADR if submissions to this PSCR identify other credible options not yet considered, and which could provide a more cost efficient outcome for customers. The PADR will also summarise and provide comment on any submissions received in response to the PSCR.[34]

Powerlink will publish submissions on the PSCR, subject to any claim of confidentiality by the person making the submission. Where confidentiality over part or all of a submission is made, this should be clearly identified. We may also explore whether a redacted or non-confidential version of the submission can be made available.[35]

Powerlink has a general obligation to use all reasonable endeavours not to disclose any confidential information it receives. The obligation is subject to a number of exceptions, including that disclosure may be made:

- with the consent of the person providing the information; or
- to the AER, Australian Energy Market Commission or any other regulator having jurisdiction over Powerlink under the Rules or otherwise.[36]

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	26 September 2023
Part 2	Submissions due on the PSCR Have your say on the credible options and propose potential non-network options.	22 December 2023
Part 3	Publication of the PACR Powerlink's response to any further submissions received and final recommendation on the preferred option for implementation.	February 2024

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).

[34] Clause 5.16.4(k)(2) of the Rules.
[35] See AER, *Application guidelines, Regulatory investment test for transmission*, August 2020, page 63.
[36] Clauses 8.6.1(a), 8.6.2(c) and 8.6.2((i) of the Rules.

Appendix 1: Options considered but not progressed

Table A1: Options considered but not progressed

Option description	Reason for not progressing option
Replace Transformer 1 High Voltage, Low Voltage and Tertiary Voltage bushings by 2024 Undertake control terminal block replacement and conservator breather replacement by 2024 Replace Transformer 1 with a new transformer that matches the ratings of the existing transformer by 2030	The option to refurbish Transformer 1 has not been progressed, as this option is not considered technically feasible. This is primarily due to the poor insulation strength of the transformer with condition assessments indicating significant deterioration of both oil (high acidity, low resistivity, high moisture, high Dielectric Dissipation Factor) and insulating paper condition (high moisture content, low DP value). Based on this assessment, Transformer 1 is not a candidate for refurbishment.
Utilise an existing Ergon owned 66kV feeder between Broadlea and Kemmis in conjunction with additional active power supply at Kemmis to support the full load supplied normally from Kemmis substation.	Detailed investigation confirmed transfer capability of the Broadlea to Kemmis feeder is not sufficient for this option to be technically feasible.

Contact us

Registered office	33 Harold St Virginia Queensland 4014 Australia
Postal address:	GPO Box 1193 Virginia Queensland 4014 Australia
Contact:	Roger Smith Manager Network and Alternate Solutions
Telephone	(+617) 3860 2111 (during business hours)
Email	networkassessments@powerlink.com.au
Internet	www.powerlink.com.au