13 FEBRUARY 2024

Addressing the secondary system condition risks at Sumner

Project Specification Consultation Report

Preface

Powerlink Queensland is a Transmission Network Service Provider (TNSP) that owns, develops, operates and maintains Queensland's high-voltage electricity transmission network. The 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.

This Project Specification Consultation Report has been prepared in accordance with version 205 of the National Electricity Rules (NER), and the Australian Energy Regulator's Regulatory Investment Test for Transmission (RIT-T) Instrument (August 2020) and RIT-T Application Guidelines (October 2023).

The NER requires Powerlink to carry out forward planning to identify future reliability of supply requirements, which may include replacement of network assets or augmentations of the transmission network. Powerlink must then 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.

The main purpose of this document is to provide details of the identified need, credible options, 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.

This document also provides customers, stakeholders and communities with information on the potential investment/s (network and non-network) that are required in the near-term to meet an identified need, and offers the opportunity to provide input into the future development of the transmission network in Queensland.

More information on the RIT-T process and how Powerlink applies it to ensure that safe, reliable and cost-effective solutions are implemented to deliver better outcomes to customers is available on Powerlink's website.

A copy of this report will be made available to any person within three business days of a request being made. Requests should be directed to the Manager Network and Alternate Assessments, by phone ((07) 3860 2111) or email (networkassessments@powerlink.com.au).

Powerlink acknowledges the Traditional Owners and their custodianship of the lands and waters of Queensland and in particular, the lands on which we operate. We pay our respect to their Ancestors, Elders and knowledge holders and recognise their deep history and ongoing connection to Country.

Contents

Executive Summary

Ageing and obsolete secondary systems at Sumner Substation require Powerlink to take action

Sumner Substation was established in 2006 as a 110 kilovolt (kV) switching station to meet the increasing demand in the western suburbs of Brisbane. Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services provided by Sumner Substation.

The secondary systems at Sumner broadly perform the functions of transmission element protection, data collection, remote (and local) control and monitoring. The majority of Sumner's secondary systems will reach the end of their technical service lives by June 2026, with only limited manufacturer support and spares available after this time. Over 80% of the 110kV secondary systems equipment is expected to reach an unsupportable level by June 2026.

Increasing failure rates, along with the increased time to rectify faults due to the obsolescence of the equipment, significantly affects the availability and reliability of these systems and their ability to continue to meet the requirements of the National Electricity Rules (NER). Powerlink must therefore take action to ensure ongoing compliance with the NER.

Powerlink is required to apply the Regulatory Investment Test for Transmission

The estimated capital cost of the most expensive credible option to address secondary system risks at Sumner meets the minimum threshold (currently $7 million) to apply the Regulatory Investment Test for Transmission (RIT-T). As the identified need for the proposed investment is to meet reliability and service standards specified within Powerlink's Transmission Authority, guidelines and standards published by the Australian Energy Market Operator (AEMO), and Powerlink's ongoing compliance with Schedule 5.1 of the NER, it is classified as a reliability corrective action under the NER. The identified need is not discussed in AEMO's most recent Integrated System Plan (ISP) and is therefore subject to the application and consultation process for RIT-T projects that are not actionable ISP projects.

Powerlink will adopt the expedited process for non-ISP projects for this RIT-T, as the estimated capital cost of 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 network options is included in the risk cost modelling and consequentially represented in the economic analysis of the options.

Powerlink has developed a non-credible base case against which to compare credible options

Powerlink has modelled a non-credible option where the asset condition issues are managed via operational maintenance or operational measures only. This results in an increase in overall risk levels due to continuing deterioration of asset condition and increasing failure rectification timeframes due to obsolescence issues. These increasing risk levels are assigned a monetary value and added to the ongoing maintenance costs to form the base case

Powerlink has developed two credible network options to address the identified need

The table below details the credible network options and shows that both options have a negative Net Present Value (NPV) relative to the base case, as allowed for under the NER for reliability corrective actions. Of the credible network options, Option 1 has the highest NPV relative to the base case.

Summary of Credible Options

Option	Description	Total Costs ($m, 2023)	NPV relative to base case ($m, 2023)	Ranking
1	In-panel replacement of selected 110kV secondary systems into existing panels by December 2025	8.1	–4.9	1
2	Single stage replacement of all 110kV secondary systems into a new demountable building by December 2025	11.3	–7.6	2

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

To enhance engagement outcomes, Powerlink proactively applies an engagement strategy to each RIT-T consultation. The scope of engagement activities undertaken is dependent upon various considerations, such as the characteristics and complexity of the identified need and potential credible options outlined in the RIT-T stakeholder engagement matrix. Due to the nature of secondary systems, Powerlink is of the view that it is unlikely for there to be an economically and technically feasible non-network option to meet the identified need in this RIT-T. As such, Powerlink will apply the 'minor' engagement level to this RIT-T.

A non-network option that avoids the proposed replacement of the ageing and obsolete secondary systems would need to replicate, in part or full, the support that Sumner Substation delivers to customers in the area on a cost-effective basis. Powerlink welcomes submissions from proponents who consider they could offer a potential non-network option that is both economically and technically feasible by June 2026, on an ongoing basis.

Lodging a submission with Powerlink

Powerlink is seeking written submissions on this Project Specification Consultation Report (PSCR), on or before **Friday, 17 May 2024**, particularly on the credible options presented in this PSCR.

Please address submissions to:

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1. Introduction

1.1. Powerlink asset management and obligations

Powerlink is committed to sustainable asset management practices. To ensure a consistent approach that delivers cost-effective and efficient services, Powerlink's Asset Management System is adapted from the Institute of Asset Management and aligns with ISO55000 Asset Management Standards.[1] Powerlink's approach to asset management delivers value to customers and stakeholders by optimising whole of life cycle costs, benefits and risks, while ensuring compliance with relevant legislation, regulations and standards. This is underpinned by Powerlink's corporate risk management framework and international risk assessment guidelines and methodologies.

Substation secondary systems broadly perform the functions of transmission element protection, data collection, remote (and local) control and monitoring. At Sumner Substation, the ageing and obsolete secondary systems, are nearing the end of their technical service life and are increasingly at risk of failure, with many items of equipment no longer supported by the manufacturers with limited spares available.

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services currently provided by Sumner to customers in the South East Queensland area. If action is not taken to reduce the risks associated with the supportability of the Sumner secondary systems, Powerlink will be at risk of breaching requirements:

- in the National Electricity Rules (NER) for protection availability; and
- set down for secondary systems, as defined in the Australian Energy Market Operator's (AEMO) Power System Security Guidelines and Power System Data Communication Standard.[2]

1.2. Overview of the Regulatory Investment Test for Transmission

The purpose of a Regulatory Investment Test for Transmission (RIT-T) is to identify the preferred investment option that meets the identified network need. The preferred option maximises the present value of economic benefits, taking into account changes to Australia's greenhouse gas emissions where relevant. If the identified need is for a reliability corrective action, the preferred option may have a net economic cost.[3]

Powerlink applies the RIT-T to potential prescribed (regulated) investments in the transmission network where the estimated capital cost of the most expensive option exceeds $7 million.[4] The identified need referred to in this RIT-T – to address the risks at Sumner – is not included in AEMO's most recent Integrated System Plan (ISP), published in June 2022. As such, this RIT-T is subject to the application and consultation process for RIT-T projects that are not actionable ISP projects.[5] This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process.[6] More information on the RIT-T process is provided in Attachment 1.

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[1] Refer to AS *ISO55000:2014 Asset Management – Overview, principles and terminology*.
[2] AEMO, *SO_OP_3715 – Power System Security Guidelines*, version 103, 6 November 2023; AEMO, *Power System Data Communication Standard*, version 3, 3 April 2023.
[3] National Electricity Rules, clause 5.15A.1(c) and chapter 10, glossary ('net economic benefit').
[4] National Electricity Rules, clauses 5.15.3(a) and (b)(2) set the threshold at $5 million. The Australian Energy Regulator's (AER) latest cost threshold review increased the value to $7 million for three years from 1 January 2022.
[5] National Electricity Rules, rule 5.16.
[6] This RIT-T consultation process has been prepared in accordance with clauses 5.16.4(b) to (g) of the National Electricity Rules and AER, *Regulatory Investment Test for Transmission Application Guidelines*, October 2023.

2. Consumer and Non-network Engagement

More than five million Queenslanders and 253,000 Queensland businesses depend 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. The charter is a national CEO-led collaboration that supports the energy sector towards a customer-centric future. Powerlink joins other signatories in committing to progress the culture and solutions needed to deliver more affordable, reliable and sustainable energy systems. Powerlink's Energy Charter Disclosure Statement for 2022/23 shows Powerlink's achievements against the principles of the Energy Charter.

2.1. Powerlink takes a proactive approach to engagement

Powerlink regularly hosts a range of activities to provide timely and transparent information to 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. Powerlink also incorporates feedback from these activities 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 representatives to give their input and feedback about Powerlink's decision-making, processes and methodologies. The panel 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 is briefed quarterly on the status of current RIT-T consultations as well as upcoming RIT-Ts. This provides an ongoing opportunity for the Customer Panel to ask questions and provide feedback to further inform RIT-Ts, and for Powerlink to better understand the views of customers when undertaking the RIT-T consultation process.

Powerlink will continue to provide 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). It provides 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 National Electricity Market (NEM).

Powerlink's 2018 to 2023 TAPRs identified an expectation that action would be required at Sumner Substation to maintain reliability of supply in the Moreton zone.[7] No submissions proposing credible and genuine non-network options have been received by Powerlink from prospective non-network solution providers in the normal course of business, in response to the publication of TAPRs, or as a result of stakeholder engagement activities.

Each TAPR for between 2018 and 2023 included potential a project to replace the 110kV secondary systems at Sumner, with an indicative cost of either $4 or $5 million. As discussed in the 2023 TAPR, the external environment in which Powerlink operates continues to be complex with inflationary pressures and supply chain disruption leading to higher costs.[8] Powerlink's most recent cost estimate review indicated that the RIT-T cost threshold ($7 million) has been met for potential network options to address the identified need at Sumner Substation.

2.4. Powerlink applies a consistent approach to RIT-T engagement

Powerlink undertakes a considered and consistent approach to ensure an appropriate level of stakeholder engagement is undertaken for each individual RIT-T consultation. The scope of engagement activities is dependent upon various considerations, such as the characteristics and complexity of the identified need and potential credible options.

For all RIT-Ts, members of Powerlink's Non-network Engagement Stakeholder Register receive email notifications of publication of RIT-T reports. For projects where Powerlink identifies material or significant market benefits, additional activities such as webinars or dedicated engagement forums may be appropriate. For more information, see Powerlink's RIT-T stakeholder engagement matrix.

2.5. Transmission component of electricity bills

Powerlink's contribution to electricity bills comprises approximately 9% of the total cost of the residential electricity bill in Queensland.

Figure 2.1: Transmission component of residential electricity bills in Queensland

[7] This relates to the standard geographic definitions (zones) identified within Powerlink's TAPRs.
[8] Powerlink, *2023 Transmission Annual Planning Report*, October 2023, page 81.

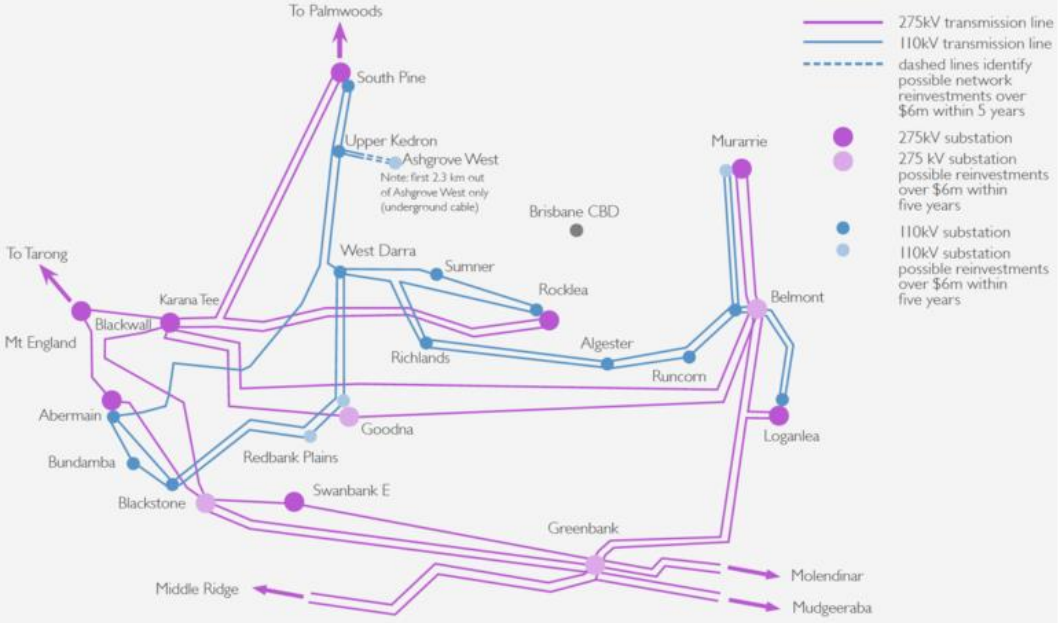
3. Identified Need

This section provides an overview of the existing arrangements at Sumner Substation and describes the increasing risk of Powerlink being unable to maintain compliance with relevant standards, applicable regulatory instruments and the NER.

3.1. Geographical and network need

Sumner Substation, located approximately 13 kilometres southwest of the Brisbane central business district, was established in 2006 to meet the increasing demand in the western suburbs of Brisbane. Planning studies have confirmed there is an enduring need for an ongoing supply of bulk electricity to the Greater Brisbane transmission zone. The Greater Brisbane zone transmission network is shown in Figure 3.1.

Figure 3.1: Greater Brisbane 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 50 megawatts (MW) at any one time, or will not be more than 600 megawatt hours (MWh) in aggregate.[9] The Transmission Authority is also subject to a broader obligation under the *Electricity Act 1994* (Qld) (the Electricity Act) that Powerlink operate, maintain (including repair and replace if necessary) and protect its transmission grid to ensure the adequate, economic, reliable and safe transmission of electricity.[10]

[9] Transmission Authority No. T01/98, section 6.2(c).
[10] *Electricity Act 1994* (Qld), section 34(1)(a).

Secondary systems are used to control, monitor, protect and secure communication to facilitate safe and reliable network operation.[11] Schedule 5.1 of the NER sets minimum standards for network service providers on the availability and operation of protection systems. Schedule 5.1.9(c) specifically requires Powerlink provide sufficient primary and back-up protection systems (including breaker fail protection systems) to ensure that a fault anywhere on the transmission system is automatically disconnected.[12]

Protection systems are also important for maintaining power transfer following a credible contingency event, such as the disconnection of a generating unit or transmission line. Powerlink is required to ensure that all protection systems for lines at voltages above 66kV, including associated inter-tripping, are well maintained so as to be available at all times other than for periods not greater than eight hours while maintenance of a protection system is being carried out.[13]

AEMO's Power System Security Guidelines clarify the Registered Participant response to unplanned outages of the protection systems. In the event of an unplanned outage of a secondary system, the guidelines require that the primary network assets be taken out of service if the fault cannot be rectified within 24 hours, obligating Powerlink to take action to ensure the restoration period of unplanned outages of secondary systems does not exceed 24 hours.[14]

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.[15] 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.

The secondary systems at Sumner are nearing the end of their technical service lives and are increasingly at risk of failure, with many items of equipment no longer supported by the manufacturers and limited spares available. Increasing failure rates, along with the increased time to rectify the faults due to equipment obsolescence, significantly affects the availability and reliability of these systems.

There is a need for Powerlink to address this emerging risk to ensure ongoing compliance with Schedule 5.1 of the NER, relevant standards and applicable regulatory instruments, which are designed to ensure Powerlink's customers continue to receive safe, reliable and cost effective electricity services.

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 NER, it is a reliability corrective action under the NER.[16] A reliability corrective action differs from that of an increase in producer and consumer

[11] National Electricity Rules, Schedule 5.1.
[12] National Electricity Rules, Schedule 5.1.9(c).
[13] National Electricity Rules, Schedule 5.1.2.1(d).
[14] AEMO, *Power System Operating Procedure SO_OP_3715*, Power System Security Guidelines, Version 103, November 2023, section 13.3 (Unplanned Outage of One Protection of a Duplicated Scheme). AEMO develops and publishes the Power System Operating Procedures pursuant to clause 4.10.1(b) of the NER, which Powerlink must comply with per clause 4.10.2(b).
[15] AEMO, *Power System Data Communication Standard*, Version 3.0, April 2023, section 3 (Reliability) and section 6 (Maintenance, planning and testing). AEMO makes the standard under clause 4.11.2(c) of the NER and incorporates the standards and protocols referred to in clauses 4.11.1 and 4.11.2.
[16] National Electricity Rules, clause 5.10.2 (definition of 'reliability corrective action').

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.[17]

3.3. Assumptions and requirements underpinning the identified need

The secondary systems at Sumner Substation 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; and
- enable the remote and local monitoring of primary and secondary plant and equipment.

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

Powerlink analysis, based on historical equipment performance, has shown that operating a secondary system beyond 20 years of effective age significantly impacts its ability to perform within acceptable limits.[18] Delaying replacement of secondary system assets beyond this optimal 20-year timeframe places the network at risk due 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.[19]

With an increasing likelihood of faults and longer rectification periods arising from the ageing and obsolete secondary systems remaining in service at Sumner 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 NER.

3.4. Description of asset condition and risks

Powerlink has undertaken a comprehensive condition assessment of the secondary systems at Sumner Substation using an asset health index modelled from zero (0) to ten (10), where zero represents new assets and ten indicates that the asset requires urgent action to address the increasing risk of unavailability and unreliable operation. This has identified that a significant amount of the 110kV secondary system equipment at Sumner will reach the end of their technical service lives by 2026. The condition of the at-risk secondary systems at Sumner Substation is summarised in Table 3.1.

[17] National Electricity Rules, clause 5.15A.1(c).
[18] CIGRE (International Council on Large Electric Systems), 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).
[19] AEMO, *Power System Operating Procedure SO_OP_3715*, Power System Security Guidelines, Version 103, November 2023.

Table 3.1: At-risk 100kV secondary systems

Bay	Construction Year	Average Health Index
2x Bus Bays Protection and Control	2006	8.1
4x Feeder Bays Protection and Control	2006	7.7
1x Coupler Bay Protection and Control	2006	8.1
Non-bay Secondary Systems (includes OpsWAN, SCADA, RTUs, Battery Systems)	2006	8.1
Metering	2006	8.0

Most of the current 110kV secondary systems at Sumner were installed in 2006 as part of the original builds. 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, which have lowered the overall average age of the systems.

Powerlink expects over 80% of the 110kV secondary systems equipment to reach an unsupportable level by June 2026. Work will also involve the replacement of Current Transformers and Capacitive VTs with known failure risks at Sumner Substation.

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

3.5. 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; and
- legislative requirements for professional engineering certification.

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

Given the specific nature of the NER obligations and the AEMO requirements relating to protection, control and monitoring systems, accepted good industry practice is often to replace the ageing and obsolete secondary systems when they reach the end of their technical service lives, rather than letting them run to failure. Due to the condition and obsolescence issues with the secondary systems at Sumner, there is a significant risk of breaching the mandated obligations and requirements if the secondary systems are left to operate beyond

June 2026. A summary of the equipment condition issues and associated potential consequences of failure of the equipment is shown in Table 3.2.

Table 3.2: Summary of equipment condition issues and potential consequences of failure

Equipment	Condition / Issue	Potential Consequences of Failure
Protection and Control for High Voltage Bay	• 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 NER 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.
SCADA System	• Obsolescence and limited availability of spares; no longer supported by the manufacturer. • Increasing failure rates due to ageing electronic components.	• Unable to comply with the Power System Security Guidelines. • Increased failures resulting in less reliable supply to customers.
Metering	• Obsolescence and limited availability of spares; no longer supported by the manufacturer. • Increasing failure rates due to ageing electronic components.	• Unable to restore metering installation upon malfunction within the two business days – requirement of the NER.[20]

In addition to the site-specific impacts of obsolescence at Sumner 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 NER, the AEMO standards and 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 has considered the operation of the existing embedded generation in the region in establishing this requirement.

[20] National Electricity Rules, clause 7.8.10.

Due to the nature of secondary systems, Powerlink considers that it is unlikely for there to be an economically and technically feasible non-network option. However, Powerlink welcomes submissions from proponents who consider that they could offer a non-network solution in full or in part by June 2026 on an ongoing basis, and will investigate the feasibility of any potential non-network option proposed or otherwise identified.

4.1. Criteria for proposed network support services

Non-network solutions would need to replicate, in part or full, the support that Sumner Substation delivers to customers in the area on a cost-effective basis.

Such support may include, but is not limited to, local generation or DSM initiatives, and would be required to be available on a firm basis. The location(s) of any proposed non-network solution will determine the exact levels of support required and be considered on a case-by-case basis.

Under system normal, to maintain required reliability standards, a non-network local generation solution would need inject up to a peak of 35MW, and up to a peak 500MWh per day on a continuous basis to supply the 110kV network.

Powerlink has identified the following common criteria that must be satisfied if proposed network support services are to meet supply requirements.[21]

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.[22]
- Proponents of generation services are advised that network support payments are intended for output that can be demonstrated to be additional to the plant's normal operation in the NEM.
- Where there are network costs associated with a proposed non-network option, including asset decommissioning, 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.

[21] Powerlink's Network Support Contracting Framework provides a general guide to assist potential non-network solution providers. This framework outlines the key contracting principles that are likely to appear in any network support agreement.
[22] National Electricity Rules, clause 3.9.7 prevents a generator that is providing network support from setting the market price.

Reliability

- Proposed services must be capable of reliably meeting electricity demand under a range of conditions and, if a generator must meet all relevant NER requirements related to grid connection.
- Powerlink has obligations under the NER, 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 secondary systems at Sumner 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.

5. Potential Credible Network Options to Address the Identified Need

Powerlink has developed two credible network options to address the secondary system condition risks and compliance obligations at Sumner Substation:

- Option 1 – In-panel replacement of selected 110kV secondary systems equipment into the existing panels by December 2025; and
- Option 2 – Single stage replacement of all 110kV secondary systems in a new building by December 2025.

Option 1 seeks to minimise procurement and site works by installing new protection and control equipment in the existing panels.

Option 2 seeks to minimise mobilisation costs by having all installation and SAT work completed prior to the completed building being shipped to site, with all bays replaced at the same time.

A summary of these options is shown in Table 5.1.

Table 5.1: Summary of credible options

Option	Description	Total costs ($m, 2023)	Indicative annual O&M costs ($m, 2023)
1	In-panel replacement of selected 110kV secondary systems into the existing panels by December 2025.	8.1	0.014
2	Single stage replacement of all 110kV secondary systems into a new demountable building by December 2025.	11.3	0.014

Note: O&M denotes operations and maintenance.

Each credible option addresses the major risks resulting from the deteriorated condition of ageing and obsolete secondary systems at Sumner Substation to allow Powerlink to meet its reliability of supply and safety obligations under its Transmission Authority, the Electricity Act and Schedule 5.1 of the NER, by the replacement of the deteriorated protection systems and associated equipment.

Powerlink does not consider that any of the credible options being considered will have a material inter-network impact, based on AEMO's screening criteria.[23]

6. Materiality of Market Benefits

The NER requires RIT-T proponents to quantify a number of classes of market benefits for each credible option, unless the proponent can demonstrate that a specific category(ies) is/are unlikely to materially affect the outcome of the assessment of credible options.[24]

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

Powerlink considers that changes in involuntary load shedding – that is, the reduction in expected unserved energy (USE) – 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. Powerlink has quantified and included these benefits in the cost-benefit and risk cost analysis as network risk.

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

A discussion of each market benefit under the RIT-T that Powerlink considers not to be material is presented below.

- **Changes in patterns of generation dispatch**: replacement of secondary systems by itself does 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.

[23] National Electricity 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] National Electricity Rules, clauses 5.15A.2(b)(4), (5) and (6). See also AER, *Regulatory Investment Test for Transmission*, August 2020, paragraphs 10 to 13.

- **Changes in voluntary load curtailment**: a secondary systems fault by itself does 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 effect of replacing secondary systems under the credible options considered are localised to the substation they are located at and do not affect the capacity of transmission network assets and therefore are 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**: credible options for secondary systems replacement 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**: 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.
- **Changes in Australia's greenhouse gas emissions**: Powerlink does not consider that any of the credible options will materially affect Australia's greenhouse gas emissions, and the cost of quantifying any greenhouse gas emission benefits would involve a disproportionate level of effort compared to the additional insight it would provide.
- **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.
- **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

In a RIT-T that is not an actionable ISP project, the base case is the situation in which the RIT-T proponent does not implement a credible option to meet the identified need, and continues with business-as-usual (BAU) activities.[25]

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. As characterised in the RIT-T Application Guidelines, 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.[26]

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

The base case therefore includes the costs of work associated with operational maintenance and the risk costs associated with the failure of the assets. The costs associated with equipment failures are modelled in the risk cost analysis and are not included in the operational maintenance costs.

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

7.2. Sumner 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 and the principles of the framework have been used to calculate the risk costs of the Sumner base case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

7.3. Base case assumptions

To calculate the potential USE arising from a failure of the ageing and obsolete secondary systems at the Sumner Substation, Powerlink has made the following modelling assumptions:

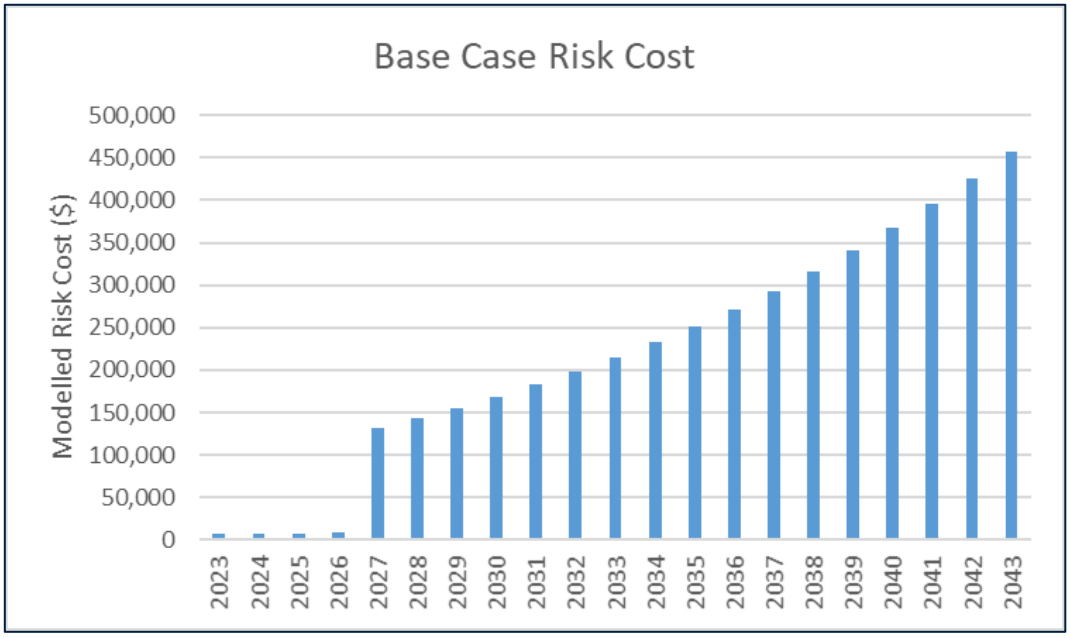
- Spares for secondary system equipment items are assumed available prior to the point of expected spares depletion, which coincides with the expected technical asset life. After this point the cost and time to return the secondary system back to service increases significantly.
- Historical load profiles have been used when assessing the likelihood of USE under failure events.
- Due to the network and substation configuration, USE generally accrues under concurrent failure events and consideration has been given to potential feeder trip events within the wider Queensland area.

[25] AER, *Regulatory Investment Test for Transmission*, August 2020, glossary ('base case').
[26] AER, *Application Guidelines, Regulatory Investment Test for Transmission*, October 2023, page 22.

- Sumner Substation supplies a mixture of residential and commercial loads within the Brisbane western suburbs area. Historical load data has been analysed to approximate the proportionate ratio of the load types, resulting in a Value of Customer Reliability (VCR) of $36,957/MWh. The most relevant residential and industrial VCR values published within the AER's Value of Customer Reliability Annual Adjustment (updated in December 2023) and have been used to determine this VCR.

The 15-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 secondary systems at Sumner, the total risk costs are projected to increase from $7,122 in 2024 to $456,645 in 2043. The main areas of risk cost are network risks that involve reliability of supply through the failure of deteriorated secondary systems modelled as probability weighted USE[27] and financial risk costs associated with the replacement of failed assets in an emergency.

These risks increase over time as the condition of equipment further deteriorates, more equipment becomes obsolete and the likelihood of failure rises.

7.4. Modelling of risk in options

Each option is scoped to manage the major risks arising in the base case and to maintain compliance with all statutory requirements, the NER 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 Net Present Value (NPV) inputs.

[27] USE is modelled using a VCR consistent with that published by the AER in its *Value of Customer Reliability Review, Final Report and Appendices A-E*, 2020.

8. General Modelling Approach for Net Benefit Analysis

8.1. Analysis period

Powerlink has undertaken the RIT-T analysis over a 20-year period, from 2023 to 2042. A 20-year period takes into account the size and complexity of the secondary system replacement options. There will be remaining asset life by 2042, at which point a terminal value is calculated to account for capital costs under each credible option.

8.2. Discount rate

Under the RIT-T Instrument:

- RIT-T proponents must adopt the discount rate from AEMO's most recent Inputs, Assumptions and Scenarios Report unless the proponent can demonstrate why variation is necessary; and
- the present value calculations of the costs and benefits of credible options must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector.[28]

In this RIT-T Powerlink has adopted a real, pre-tax commercial discount rate of 7.0% as the central assumption for the NPV analysis.[29]

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 3.0% and an upper bound discount rate of 11.0% (i.e. a symmetrical upwards adjustment).[30]

8.3. Description of reasonable scenarios

The RIT-T analysis is required to incorporate a number of different reasonable scenarios, which are used to estimate market benefits and rank options.[31] 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.[32]

Based on 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 illustrated in Table 8.1.

[28] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraphs 18 and 19.
[29] This indicative commercial discount rate of 7.0% is based on AEMO, *2023 Inputs, Assumptions and Scenarios Report*, July 2023, page 123.
[30] A discount rate of 3.04% pre-tax Weighted Average Cost of Capital is based on AER, *Transgrid 2023–28 Final Determination*, April 2023.
[31] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraph 22.
[32] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraph 23.

Table 8.1: Reasonable scenario parameters

Key parameter	Central Scenario
Capital cost	100% of base capital cost estimate
Maintenance cost	100% of base maintenance cost estimate
Discount rate	7.0%
Risk cost	100% of base risk cost forecast

8.4. Cost estimation

In October 2023, additional information requirements were added to the RIT-T Application Guidelines in cases where the estimated capital cost of the preferred option exceeds $100 million. The RIT-T Application Guidelines also encourage RIT-T proponents, where the estimated capital cost of the preferred option is less than $100 million, to outline the process undertaken to ensure cost estimates are as accurate as possible.

The Application Guidelines require that, for each credible option, RIT-T must specify to the extent practicable and in a manner that is fit-for-purpose for the stage of the RIT-T:

- key inputs and assumptions adopted;
- main components of the cost estimate;
- methodologies and processes applied to derive the cost estimate; and
- the level of, and basis for, any contingency allowance that has been included in the cost estimate.[33]

At the Project Assessment Draft Report (PADR) and Project Assessment Conclusions Report (PACR) stages of a RIT-T, RIT-T proponents must include a quantification of costs, including a breakdown of operating and capital expenditure for each credible option.[34] At the PSCR stage, information for each credible option is only required on total indicative capital and operating and maintenance costs, to the extent practicable.[35]

Basis of Estimation

The basis for the estimation for the credible options presented in this PSCR, addressing the methodologies and processes, is aligned with Powerlink's Cost Estimation Methodology[36] which provides context to the classes of estimate discussed in this section.

[33] AER, *Application Guidelines, Regulatory Investment Test for Transmission*, October 2023, page 30.
[34] National Electricity Rules, clauses 5.16.4(k)(3) and (v)(1).
[35] National Electricity Rules, clause 5.16.4(b)(6)(v).
[36] The methodology is available on the RIT-T Consultations page of Powerlink's website.

Key inputs and assumptions

Option 1: In-panel replacement

A Class 3 Project Proposal Estimate has been produced for Option 1 with an accuracy range of -20% to +30%. Powerlink has made the following scope assumptions in producing this estimate:

- selected replacement of the control and protection relays;
- relocation of associated equipment to facilitate maintenance safety requirements;
- additional network panels to meet the current secondary system standard design;
- selected primary equipment replacement; and
- remote end equipment replacement.

Option 2: Single stage replacement

A Class 5 Concept Estimate has been produced for Option 2 with an accuracy range of -50% to +100%. Powerlink has made the following assumptions in producing this estimate:

- complete replacement of the secondary systems in a new demountable building:
- replacement of field cabling from the control building;
- selected primary equipment replacement; and
- remote end equipment replacement.

9. Cost-benefit Analysis and Identification of 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 the base case

Option	Description	Central scenario NPV ($m)	Ranking
1	In-panel replacement of selected 110kV secondary systems into the existing panels by December 2025.	–4.9	1
2	Single stage replacement of all 110kV secondary systems into a new demountable building by December 2025.	–7.6	2

Both credible options will address the identified need on an enduring basis. Option 1 is ranked first, with Option 2 being $2.7 million more expensive compared to Option 1 in NPV terms.

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

Figure 9.1: NPV of the base case and each credible option (NPV $m)

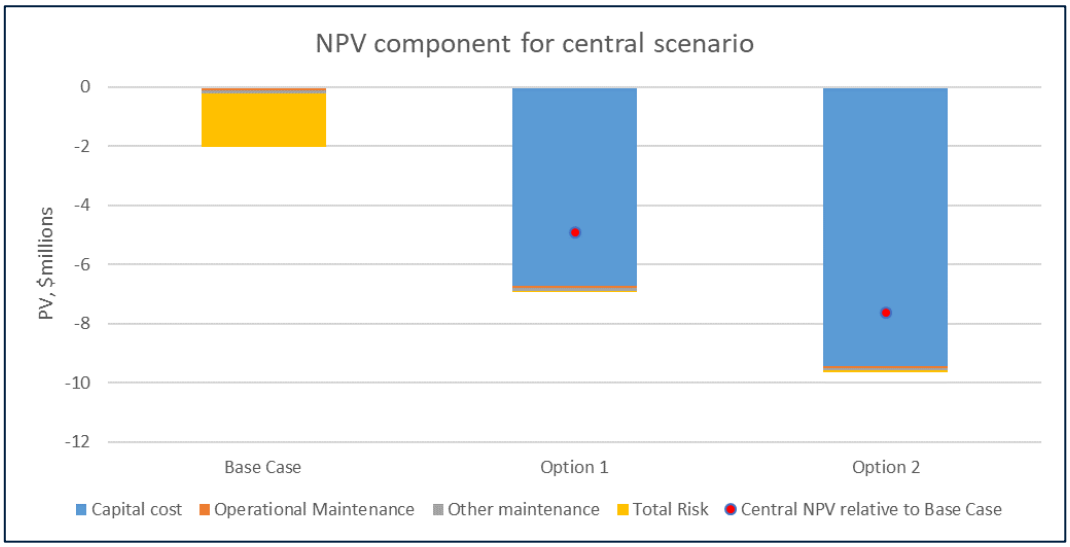


Figure 9.1 illustrates that both credible options will reduce the risk cost compared to the base case. Due to the lower capital cost component, Option 1 results in the highest NPV outcome relative to the base case when compared to other credible options. Sensitivity analysis also concluded that Option 1 is preferred to Option 2 (see Attachment 2).

9.2. Conclusion

The result of the cost-benefit analysis indicates that Option 1 provides the highest net economic benefit (lowest cost in NPV terms) over the 20-year analysis period. Sensitivity testing shows the analysis is robust to variations in the capital cost, risk cost and discount rate assumptions. Powerlink therefore considers Option 1 satisfies the requirements of the RIT-T and is the proposed preferred option.

10. Draft Recommendation

Based on the conclusions drawn from the NPV analysis and regulatory 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 aged and obsolete secondary systems infrastructure at Sumner Substation. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the NER.

Option 1 involves the in-panel replacement of selected 110kV secondary systems equipment at Sumner Substation by December 2025. The indicative capital cost of this option is $8.1 million in 2023/24 prices.

Under Option 1, design work will commence in 2024, with installation and commissioning of the new secondary systems completed by December 2025.

11. Submission Requirements and Next Steps

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

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 confirm cost inputs and commercial terms.

11.1. Submissions from non-network providers

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.

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's RIT-T Application Guidelines;
- an assessment of the ability of the proposed service to meet the technical requirements of the NER;
- timing of the availability of the proposed service; and
- other material that would be relevant in the assessment of the proposed service.

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.[37]

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. Powerlink may also explore whether a redacted or non-confidential version of the submission can be made available.[38]

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 NER or otherwise.[39]

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.

[37] National Electricity Rules, clause 5.16.4(k)(2).
[38] AER, *Application Guidelines, Regulatory Investment Test for Transmission*, October 2023, page 69.
[39] National Electricity Rules, rule 8.6.

11.2. Next steps

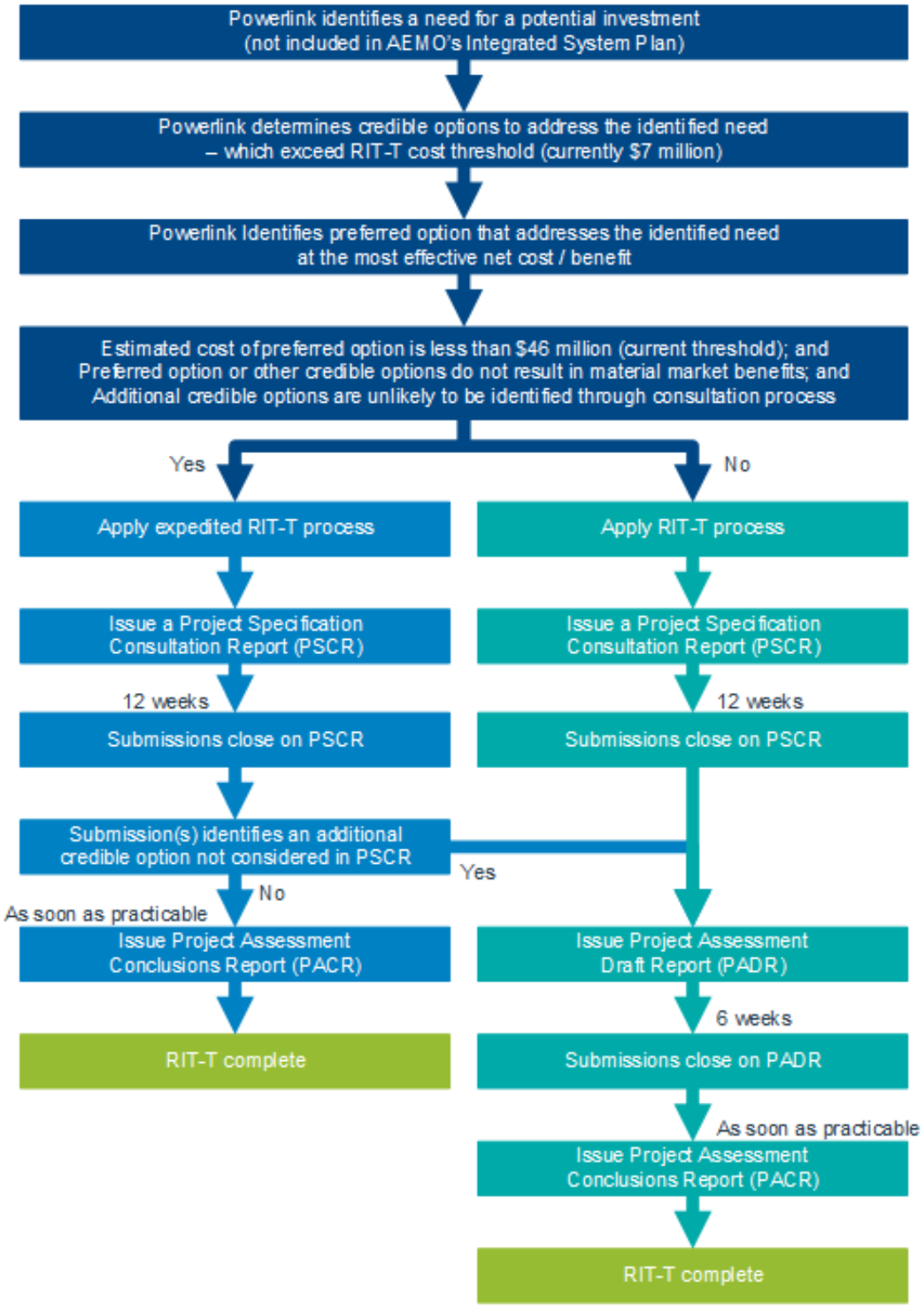
Powerlink intends to carry out the following process to assess what action, if any, should be taken to address future supply requirements.

Part 1	PSCR Publication	13 February 2024
Part 2	Submissions due on PSCR Have your say on the credible options and propose non-network options	17 May 2024
Part 3	Publication of PACR Powerlink's response to any further submissions received and final recommendation on the preferred option for implementation	June 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/rit-t-consultations).

Attachment 1: RIT-T Process

The flow chart below illustrates the RIT-T process where the need is not identified as an actionable project in AEMO's ISP.



As stated, this PSCR is the first step in the RIT-T process. The PSCR:

- describes the reasons why Powerlink has determined that investment is necessary (the identified need), together with the assumptions used in identifying this need, including whether the need is as an actionable project in AEMO's latest ISP;
- 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 to consider 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;
- 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;
- provides information about Powerlink's estimation of costs for each credible option;
- describes how customers and stakeholders have been engaged with regarding the identified need; and
- provides stakeholders with the opportunity to comment on this assessment so that Powerlink can refine the analysis (if required) as part of the PACR.

Powerlink will adopt the expedited process for this RIT-T, as allowed for under the NER for investments of this nature.[40] Specifically, Powerlink will publish a PACR following public consultation on this PSCR and apply the exemption from publishing a PADR as:

- the preferred option has an estimated capital cost of less than $46 million;[41]
- none of the credible options have material market benefits, other than benefits associated with changes in involuntary load shedding, which have been catered for in the risk cost modelling and consequentially represented in the economic analysis of the options;
- 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 secondary systems replacement project; and
- 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.

As stated, 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 or a more cost-efficient outcome for customers.

[40] National Electricity Rules, clause 5.16.4(z1).
[41] National Electricity Rules, clause 5.16.4(z1)(1) sets the threshold at $35 million. The AER's latest cost threshold review increased the threshold to $46 million for three years from 1 January 2022.

Attachment 2: Sensitivity Analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3.0% to 11.0% discount rate;
- a range from 75% to 125% of base capital expenditure estimates;
- a range from 75% to 125% of base risk cost estimates; and
- a range from 75% to 125% of base operational maintenance expenditure.

As illustrated in Figures A2.1 – A2.4, 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 identification of the preferred option. Option 1 is the preferred option under all scenarios tested.

Figure A2.1: Discount rate sensitivity

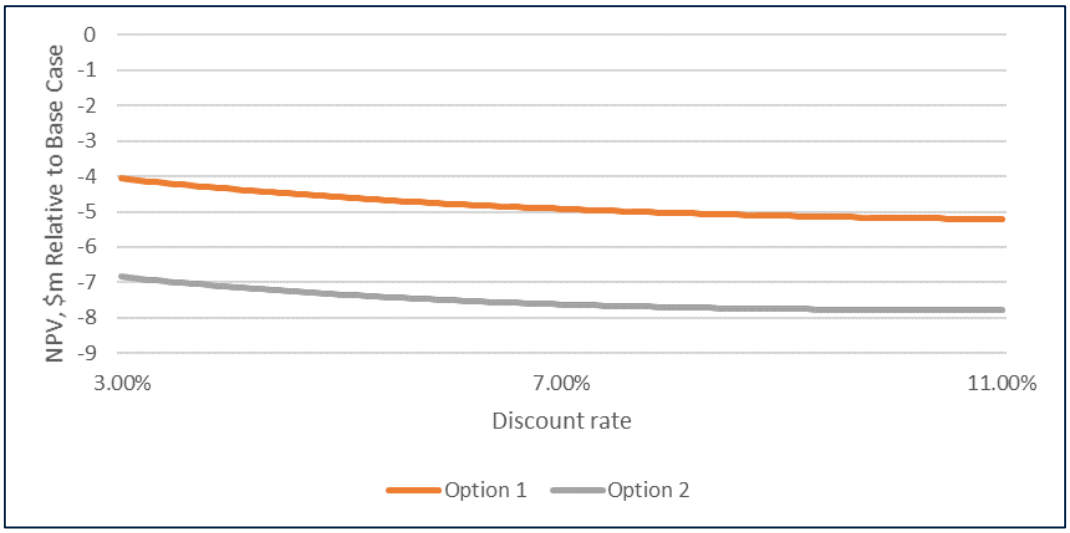


Figure A2.2: Capital cost sensitivity

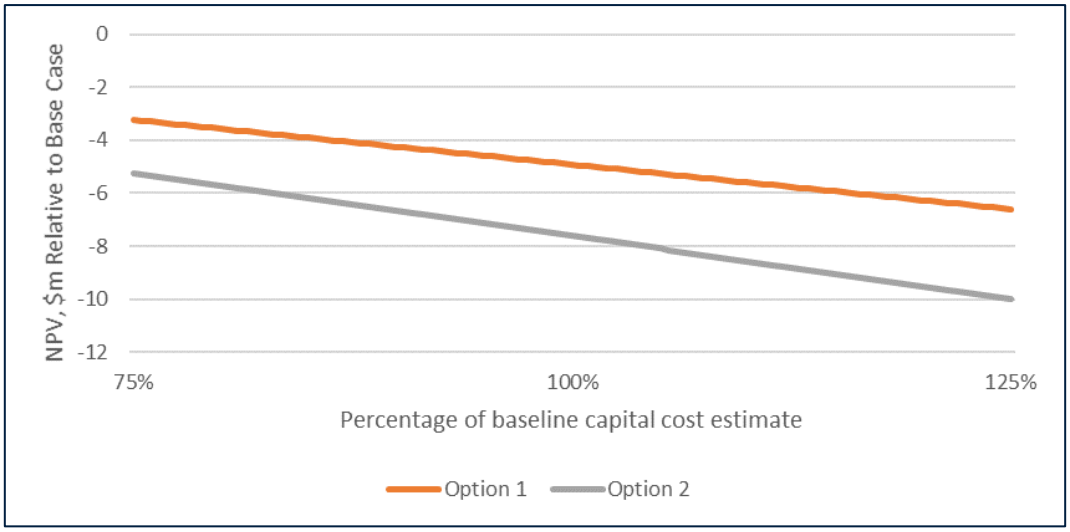


Figure A2.3: Risk cost sensitivity

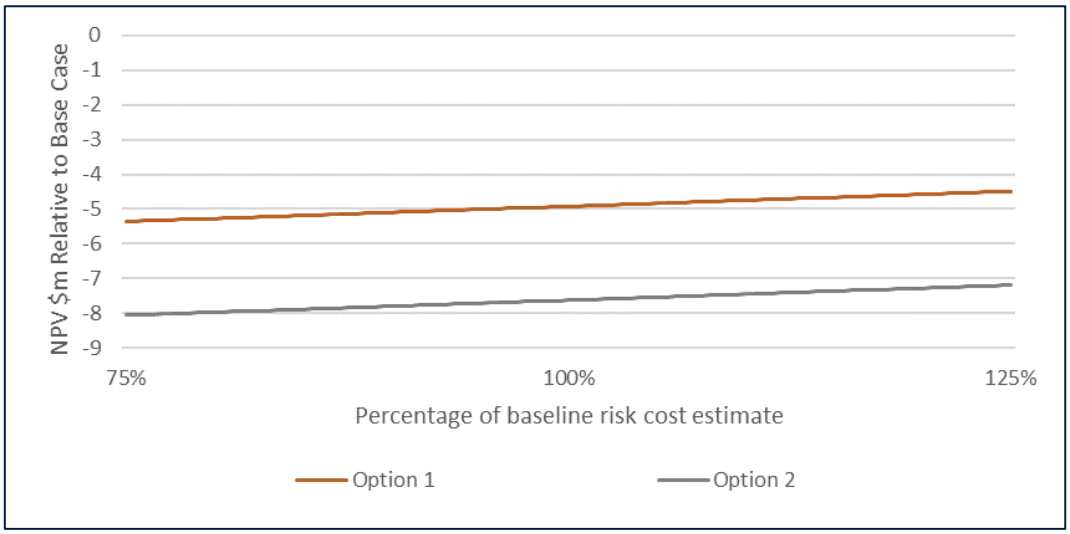
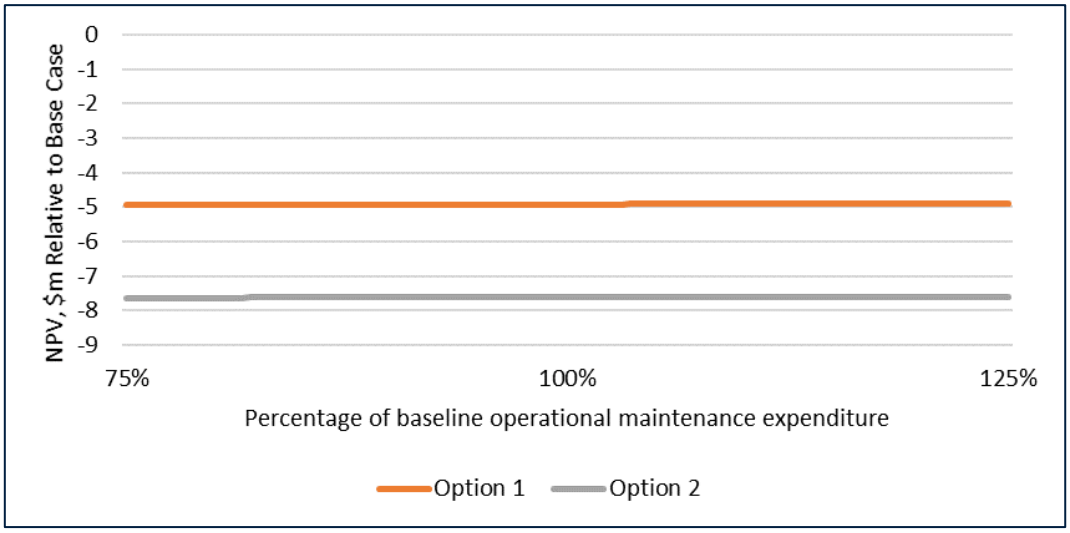
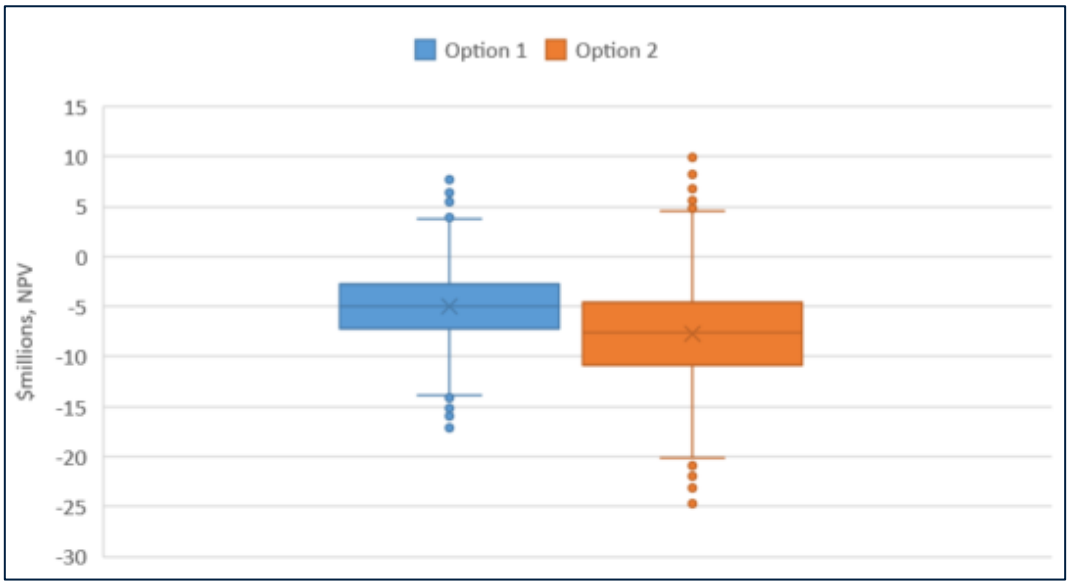


Figure A2.4: Maintenance cost sensitivity



Powerlink also performed a Monte Carlo simulation with multiple input parameters (including capital cost, discount rate and total risk cost) generated for the calculation of the NPV for each option. This process was repeated over 5,000 iterations, each time using a different set of random variables from the probability function. The sensitivity analysis output is presented as a distribution of possible NPVs for each option, as illustrated in Figure A2.5.

Figure A2.5: NPV sensitivity analysis of multiple key assumptions relative to the base case



Note: The box represents the interquartile interval, where 50% of the data is found. The horizontal line through the box is the median and the mean is represented by the cross (X). The two lines outside the box extend to 1.5 times the interquartile range. Data points that are outside of this interval are shown as dots on the graph.

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

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