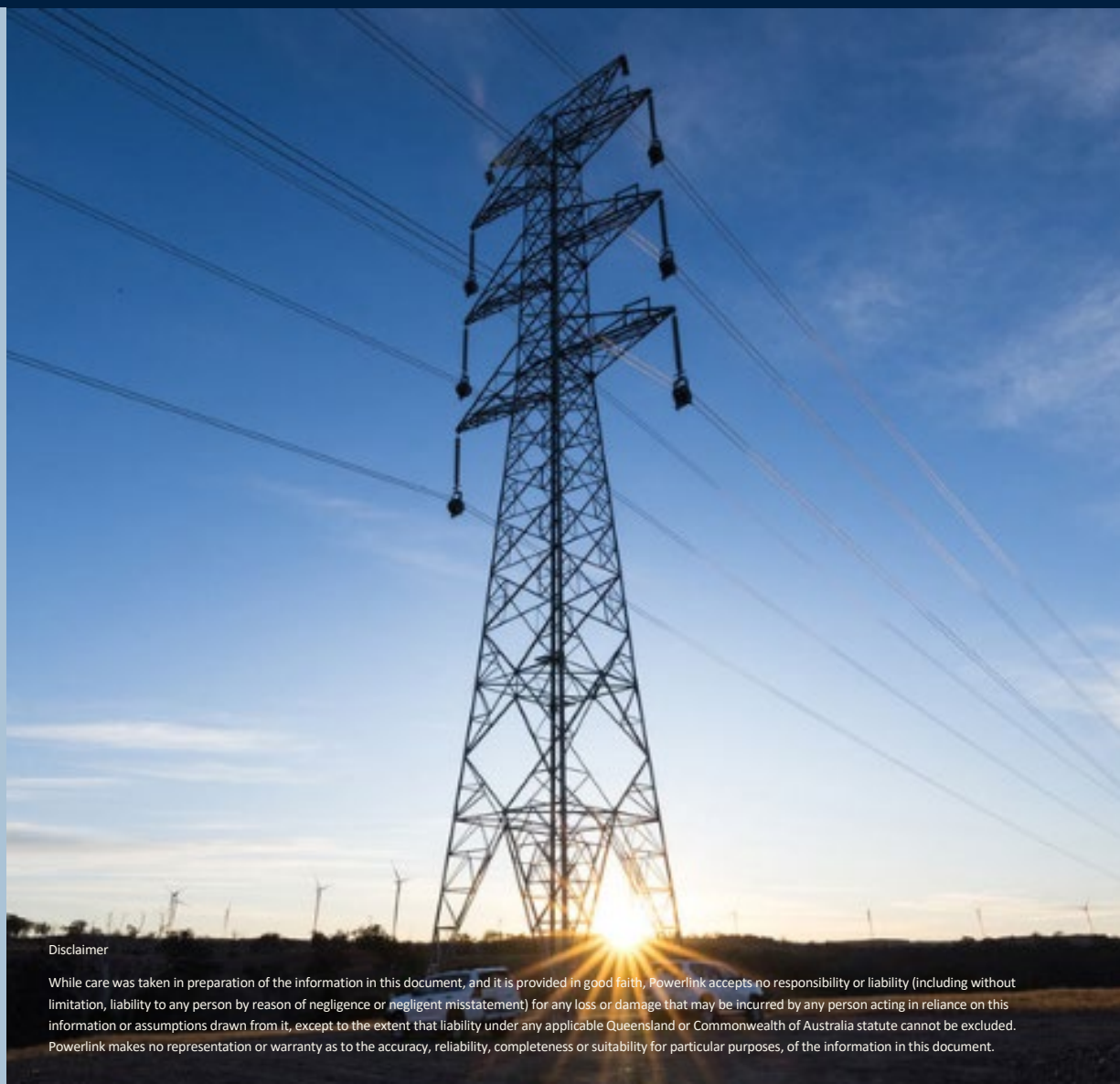
18 JULY 2024

Addressing the secondary system condition risks at Sumner

Project Assessment Conclusions 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 Assessment Conclusions Report has been prepared in accordance with version 211 of the National Electricity Rules (NER), and the Regulatory Investment Test for Transmission (RIT-T) Instrument (August 2020) and RIT-T Application Guidelines (October 2023). The RIT-T Instrument and Application Guidelines are made and administered by the Australian Energy Regulator.

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.

Powerlink also has obligations under the NER to address power system security requirements identified by the Australian Energy Market Operator in its annual System Security Reports.

The main purpose of this document is to provide details of the identified need, credible options, categories of market benefits likely to impact the ranking of credible options, and recommend the preferred option for implementation.

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 commenced this RIT-T with the publication of a Project Specification Consultation Report (PSCR) in February 2024 to outline the risks and obsolescence issues arising from the condition of the secondary systems at Sumner Substation. No submissions were received in response to the PSCR by the due date of 12 May 2024. As a result, no additional credible options have been identified as a part of this RIT-T consultation.

This Project Assessment Conclusions Report (PACR) is the final step in the RIT-T process to address secondary system risks at Sumner. The PACR contains the results of the planning investigation and the cost-benefit analysis of credible options compared to a non-credible base case where the asset condition issues are managed via operational maintenance or operational measures only. The base case is used as a reference point to compare and rank the credible options against each other, and reflects a 'state of the world' which would result in an increase in overall risk levels due to continuing deterioration of asset condition and increasing failure rectification timeframes due to obsolescence issues.[1]

[1] See AER, *Regulatory Investment Test for Transmission*, August 2020, paragraph 24 and AER, *Application Guidelines, Regulatory Investment Test for Transmission*, October 2023, pages 33-35 for a definition and discussion of states of the world in a RIT-T.

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

Evaluation and conclusion

The RIT-T requires that the preferred option maximise 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.

The cost-benefit analysis for this RIT-T demonstrates that Option 1, the in-panel replacement of selected 110kV secondary systems into existing panels, provides the lowest net economic cost in NPV terms and is therefore the preferred option. The indicative capital cost of Option 1 is $8.1 million in 2023/24 prices. Design work will commence in 2024, with installation and commissioning of the new secondary systems completed by December 2025.

Dispute Resolution

In accordance with clause 5.16B(a) of the NER, energy industry participants, the Australian Energy Market Commission, electricity consumers (including their representatives) may, by notice to the Australian Energy Regulator (AER), dispute conclusions made by Powerlink in this PACR in relation to:

- the application of the RIT-T;
- the basis on which Powerlink has classified the preferred option as a reliability corrective action; or
- Powerlink's assessment of whether the preferred option will have a material inter-network impact.

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

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 ISO 55000 Asset Management Standards.[2] 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.

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 the Australian Energy Market Operator's (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]

Powerlink commenced this RIT-T with publication of a Project Specification Consultation Report (PSCR) on 13 February 2024. The PSCR identified Option 1, involving the in-panel replacement of selected 110kV secondary systems into existing panels, as the preferred option to address the risks at Sumner. The PSCR stated that the indicative capital cost of Option 1 was $8.1 million in 2023/24 prices, and that design work would commence in 2024 with installation and commissioning of the new secondary systems completed by December 2025.

The PSCR indicated that Powerlink would adopt the expedited process for this RIT-T, as allowed under the National Electricity Rules (NER) for RIT-T projects without material market benefits and where other conditions are met.[6] Submissions on the PSCR were due to Powerlink by 12 May 2024; as no submissions were received, no additional credible options that could deliver a material market benefit have been identified via the RIT-T consultation process. Powerlink has satisfied the conditions to expedite this RIT-T process, and not issued a Project Assessment Draft Report (PADR). This Project Assessment Conclusions Report (PACR) is the final step in the RIT-T process to address risks at Sumner.

More information on the RIT-T process is provided in Attachment 1.

[2] Refer to AS *ISO55000:2014 Asset Management – Overview, principles and terminology*.
[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] National Electricity Rules, clause 5.16.4(z1).

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 assesses Powerlink's progress against the principles of the Energy Charter and identifies opportunities for improvement.

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 applies 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

3. Identified Need

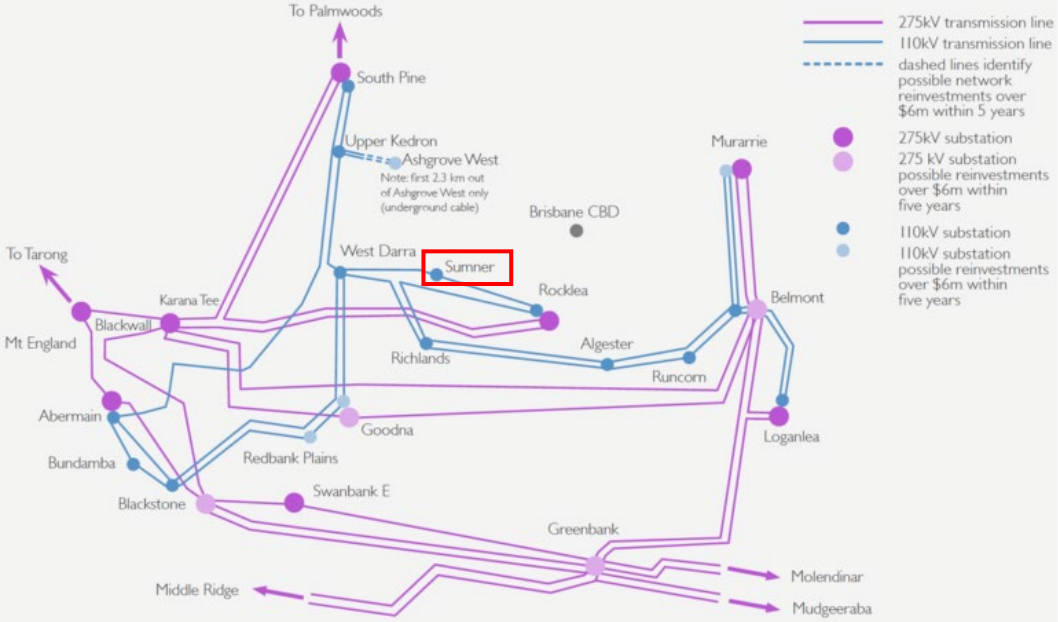
In a RIT-T, the identified need is the objective the RIT-T proponent seeks to achieve by investing in the network.[9] The identified need should be framed in terms of why an investment is required, rather than as a description of a particular solution to a network need. The AER's RIT-T Application Guidelines note that network and non-network options can address an identified need.[10]

[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.
[9] National Electricity Rules, chapter 10 (definition of 'identified need').
[10] AER, *Application Guidelines, Regulatory Investment Test for Transmission*, October 2023, page 15.

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.[11] 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.[12]

Schedule 5.1 of the NER sets minimum standards for network service providers on the availability and operation of protection systems. Schedule 5.1 specifically requires Powerlink to:

- 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[13]; and

[11] Transmission Authority No. T01/98, section 6.2(c).
[12] *Electricity Act 1994* (Qld), section 34(1)(a).
[13] National Electricity Rules, Schedule 5.1.9(c).

- 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[14].

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.[15]

Further, 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.[16] 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 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.

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.

3.3. Assumptions and requirements underpinning the identified need

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.

[14] National Electricity Rules, Schedule 5.1.2.1(d).
[15] 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 as per clause 4.10.2(b).
[16] 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.

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.[17] 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.[18]

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.

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.

[17] 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).

[18] AEMO, *Power System Operating Procedure SO_OP_3715*, Power System Security Guidelines, Version 103, November 2023.

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.[19]

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.

[19] National Electricity Rules, clause 7.8.10.

4. Credible Options to Address the Identified Need

4.1. Credible options

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 Site Acceptance Tests 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 4.1.

Table 4.1: 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.

4.2. Material inter-network impact

Powerlink does not consider that any of the credible options being considered will have a material inter-network impact, based on AEMO's screening criteria.[20]

[20] 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.

5. 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.[21]

5.1. 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 may impact the ranking of the credible options under consideration in this RIT-T 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.

5.2. 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.
- **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

[21] 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.

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. Base Case

6.1. 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 activities.[22]

The assessment undertaken in this RIT-T 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.[23]

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.

6.2. 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.

6.3. 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:

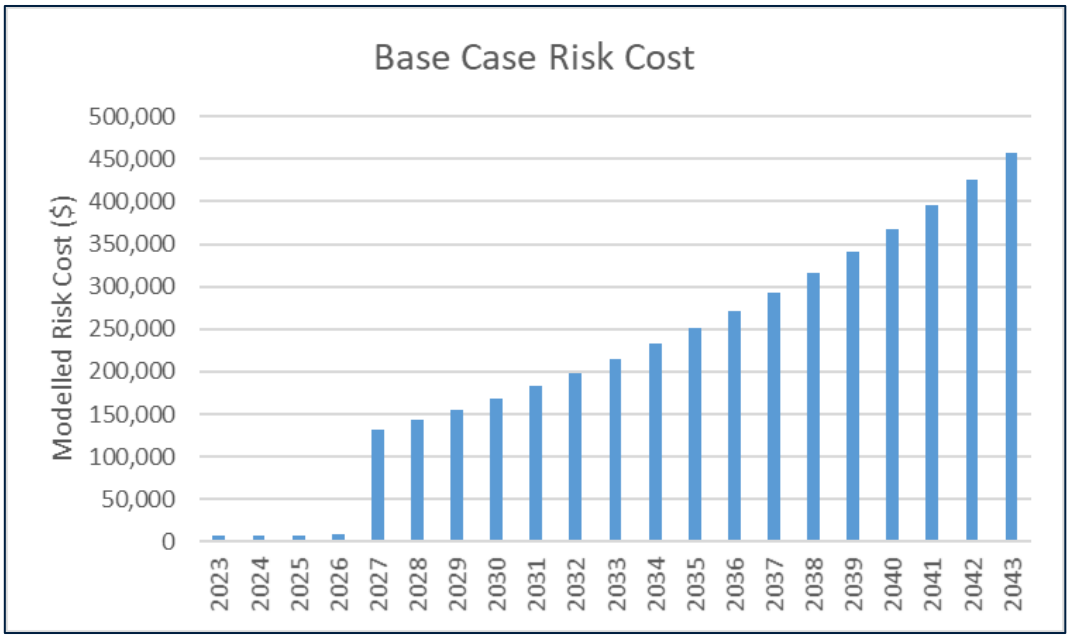
- Spares for secondary system equipment items are assumed available prior to the point of expected spares depletion, which coincides with the expected technical asset life. After this point the cost and time to return the secondary system back to service increases significantly.
- Historical load profiles have been used when assessing the likelihood of USE under failure events.

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

- 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.
- 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 6.1.

Figure 6.1: Modelled base case risk costs



Based on 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[24] 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.

6.4. 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.

[24] 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.

7. 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 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. Further, the 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:

- methodologies and processes applied to derive the cost estimate (basis of estimation);
- key inputs and assumptions adopted;
- main components of the cost estimate; and
- the level of, and basis for, any contingency allowance that has been included in the cost estimate.[25]

At the PSCR stage of a RIT-T, information for each credible option is only required on total indicative capital and operating and maintenance costs, to the extent practicable.[26] At the PADR and PACR stages, RIT-T proponents must include a quantification of costs, including a breakdown of operating and capital expenditure for each credible option.[27]

7.1. Basis of Estimation

The basis for the estimation for the preferred option presented in this PACR aligns with Powerlink's Cost Estimation Methodology[28] which provides context to the classes of estimate discussed in this section.

7.2. Key inputs and assumptions

A Class 3 Project Proposal Estimate has been produced for the preferred option (Option 1 – In-panel replacement) 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;
- remote end equipment replacement; and
- construction works performed by Powerlink.

7.3. Main components of the capital cost estimate of credible options

The capital costs for this project are shown in Table 7.1.

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

Table 7.1: Summary of capital costs of credible options

Cost Estimate Components	Option 1 ($m)	Option 2 ($m)
Design	1.48	1.60
Materials	1.08	1.96
Construction	1.52	3.26
Commissioning	3.01	3.32
Other[29]	1.02	1.16
Total	**8.10**	**11.30**

7.4. Contingency allowance

For proposed transmission investments subject to the RIT-T, known and unknown delivery risk costs are excluded from the cost of the option. This approach aligns with that of the RIT-T Instrument which requires that the cost of the options considered include only direct costs, apart from any other costs the AER has agreed to in writing.[30]

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.[31]

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.[32]

[29] Generally comprises project management, design and commissioning coordination, project governance, administrative support, cost estimation and RIT-T consultation costs.
[30] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraph 5.
[31] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraphs 18 and 19.
[32] This indicative commercial discount rate of 7.0% is based on AEMO, *2023 Inputs, Assumptions and Scenarios Report*, July 2023, page 123.

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).[33]

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.[34] The number and choice of reasonable scenarios must be appropriate to the credible options under consideration and, where the identified need is reliability corrective action, reflect any variables or parameters that are likely to affect the ranking of the credible options.[35]

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, Powerlink has 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.

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

9. Cost-benefit Analysis and Identification of Preferred Option

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.[36] 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.[37]

[33] A discount rate of 3.04% pre-tax Weighted Average Cost of Capital (WACC) is based on AER, *Transgrid 2023–28 Final Determination*, April 2023. Powerlink notes that the AER's Final Determination for TasNetworks' (Transmission) determination for 2024-29 included a pre-tax WACC of 3.41%. As the TasNetworks WACC relates to 2024/25, Powerlink has retained the lower bound discount rate of 3.04% from the Transgrid 2023-28 determination.
[34] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraph 22.
[35] AER, *Regulatory Investment Test for Transmission*, August 2020, paragraph 23.
[36] National Electricity Rules, clause 5.10.2 (definition of 'reliability corrective action').
[37] National Electricity Rules, clause 5.15A.1(c).

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)

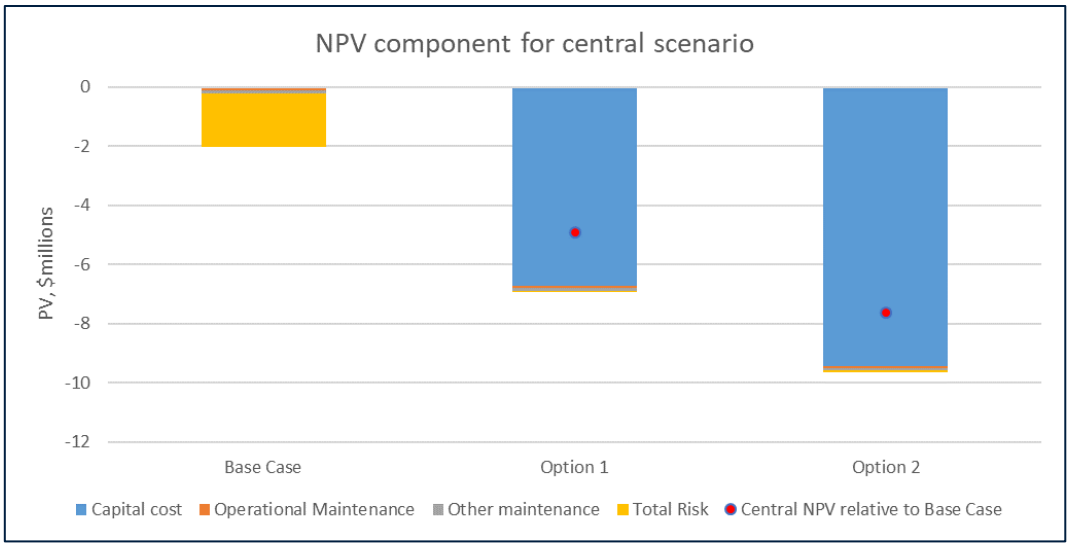


Figure 9.1 illustrates that both credible options will reduce the risk cost compared to the base case. Due to the lower capital cost component, Option 1 results in the highest NPV outcome relative to the base case when compared to other credible options. Sensitivity analysis also concluded that Option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

10. Final Recommendation

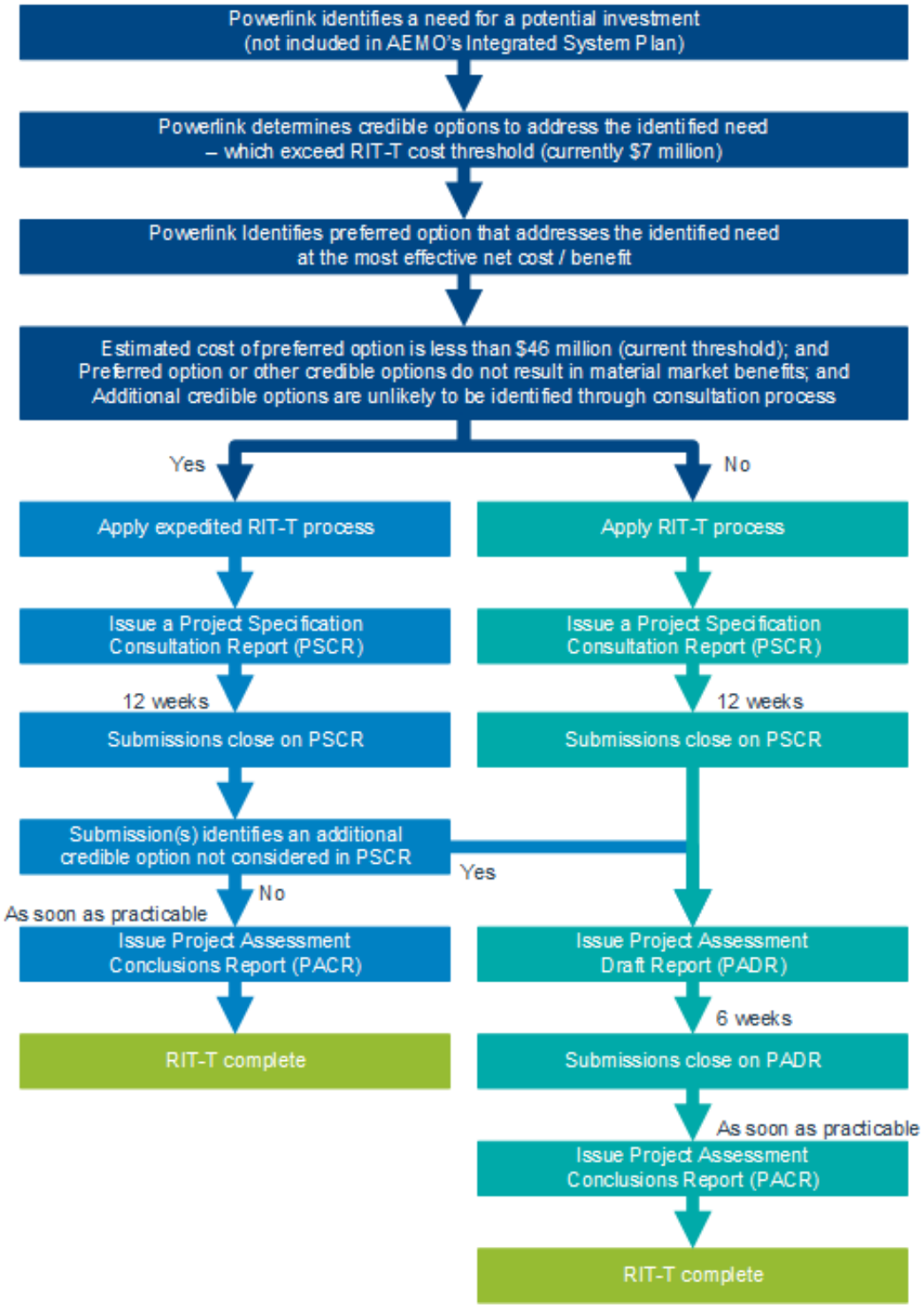
Based on the conclusions drawn from the NPV analysis and regulatory requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 1 be implemented to address the risks associated with the deteriorated condition of the aged and obsolete secondary systems 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.

Powerlink will now proceed with the necessary processes to implement the preferred option.

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 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.[38]

Powerlink may adopt the expedited process for a RIT-T for investments without material market benefits. Specifically, Powerlink may publish a PACR following public consultation on a PSCR and apply the exemption from publishing a PADR if:

- the preferred option has an estimated capital cost of less than $46 million;
- Powerlink has identified its preferred option in this PSCR (together with the supporting quantitative cost-benefit analysis) and indicated that the investment has the benefit of the expedited process;
- 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 not aware of any non-network options that could be adopted. The PSCR provides a further opportunity for providers of feasible non-network options to submit details of their proposals for consideration.[39]

Powerlink will however publish a PADR if submissions to a 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.

A PADR and a PACR for a RIT-T must include:

- a description of each credible option assessed;
- a summary of and commentary on submissions received in response to the PSCR or PADR (as relevant);
- a quantification of the costs, including a breakdown of operating and capital expenditure, and classes of material market benefit for each credible option;

[38] National Electricity Rules, clause 5.16.4(b).

[39] National Electricity Rules, clause 5.16.4(z1). Paragraph (1) in clause 5.16.4(z1) sets the threshold for the estimated capital cost of the preferred option at $35 million. The AER's latest cost threshold review increased the threshold to $46 million for three years from 1 January 2022.

- reasons why Powerlink has determined that a class or classes of market benefit are not material;
- the results of NPV analysis for each credible option assessed, together with accompanying explanatory statements;
- the identification of the proposed preferred option, including details of the technical characteristics and the estimated construction timetable and commissioning date; and
- RIT-T reopening triggers if the estimated capital cost of the preferred option is greater than $100 million (as varied via AER cost threshold determinations).[40]

[40] National Electricity Rules, clauses 5.16.4(k) and (v).

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 of the PSCR, 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.

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 of the PSCR. The Monte Carlo simulation also confirmed that Option 1 is robust over a range of input parameters in combination.

Attachment 3: Compliance Checklist

Clause 5.16.4(v) of the NER states that a PACR must include the matters detailed in the PADR, and summarise and comment on submissions received on the PADR. This attachment outlines Powerlink's compliance with PADR/PACR content requirements in each sub-paragraph of clause 5.16.4(k).

Table A3.1: Compliance Checklist

Sub-para	Requirement	Section of PACR
(1)	Description of each credible option	4.1
(2)	Summary of and commentary on submissions to the PSCR/PADR[41]	N/A
(3)	Quantification of costs, including breakdown of operating and capital expenditure Classes of material market benefit for each credible option	4.1 & 7.3 5.1
(4)	Description of methodologies used to quantify each class of material market benefit and cost	5.1
(5)	Reasons why a class/classes of market benefit are not material	5.2
(6)	Identification and quantification of any class of market benefit estimated to arise outside Queensland	N/A
(7)	Results of NPV analysis for each credible option, and explanation of results	9.1 – 9.2
(8)	Identification of preferred option	10
(9)	For the preferred option: (i) details of the technical characteristics (ii) the estimated construction timetable and commissioning date (iii) an augmentation technical report from AEMO (iv) a statement that the preferred option satisfies the RIT-T	 4.1 10 N/A 9.2
(10)	RIT reopening triggers	N/A

N/A denotes not applicable.

[41] Paragraph (v)(2) in clause 5.16.4 requires the PACR to include a response to submissions on the PADR.

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