18 FEBRUARY 2026

Maintaining Reliability of Supply and Addressing Condition Risks at Ingham South

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 243 of the National Electricity Rules (NER), the Regulatory Investment Test for Transmission (RIT-T) Instrument (November 2024) and RIT-T Application Guidelines (November 2024). 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 augmentation 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 how Powerlink applies the RIT-T process 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).

Disclaimer

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.

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Executive Summary

Ageing and obsolete secondary systems and primary plant at Ingham South Substation require Powerlink to take action

Ingham South Substation was established in 2005 to replace the original Ingham substation equipment and provide an injection point into the Ergon Energy (part of the Energy Queensland Group) distribution network. Planning studies have confirmed there is an enduring need for Ingham South Substation to maintain the supply of electricity to the Ingham area and meet regulatory requirements of reliable supply.

The primary plant and secondary systems at Ingham South Substation have been identified as being in poor condition or at the end of their technical service lives, with identified obsolescence issues. The condition of the substation's primary plant – the equipment through which the electrical power passes – has significantly deteriorated, with a high number of associated defects and obsolescence issues, increasing the risk to supply in the Ingham area. Manufacturer support for the type of primary plant used at the site has ceased and there are now limited spares available. This poses a significant risk to Powerlink's ability to undertake emergency replacement works as there is no direct like-for-like replacement option.

Secondary systems are the control, protection and communications equipment that are necessary to operate the transmission network and prevent damage to primary plant when adverse events occur. Much of the secondary systems equipment at Ingham South Substation is nearing the end of technical service life and has become or will soon become obsolete, where manufacturer support is no longer available and spares are limited or not available. The National Electricity Rules (NER) require Powerlink to provide sufficient secondary systems, including redundancies, to ensure the transmission system is adequately protected.

Powerlink must therefore take action to avoid the increasing likelihood of loss of power supply arising from failure of the aging equipment at Ingham South Substation and to ensure customers are provided with a reliable and safe supply of electricity.

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 and primary plant risks at Ingham South Substation meets the minimum threshold (currently $8 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. As the identified need is a reliability corrective action, the preferred option may have a net economic cost.

Powerlink commenced this RIT-T with the publication of a Project Specification Consultation Report (PSCR) in June 2025 to outline the risks and obsolescence issues arising from the condition of the equipment at Ingham South Substation. No submissions were received in response to the PSCR by the due date of 5 September 2025. 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 the primary plant and secondary system risks at Ingham South Substation. 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 situation 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.

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 ($m, 2025)	NPV relative to base case ($m)	Ranking
1	Replace hybrid switchgear modules in-situ with air insulated switchgear. Replace secondary systems in a new control building on existing substation platform by 2028.	25.60	-17.58	1
2	Extend substation platform and replace hybrid switchgear modules with air insulated switchgear using adjacent spare bay locations. Replace secondary systems in a new control building by 2028.	31.62	-22.10	2

Note: Total costs exclude risk and contingency.

Evaluation and conclusion

The RIT-T requires that the preferred option maximise the present value of economic benefits. 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 replacement of hybrid switchgear modules in-situ with air insulated switchgear and replacement of secondary systems in a new control building, provides the lowest net economic cost in NPV terms and is therefore the preferred option. The indicative capital cost of Option 1 is $25.6 million in 2024/25 prices. Detailed design work will commence in early 2026, with installation and commissioning of the new primary plant and secondary systems to be completed by February 2028.

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. Powerlink requests a copy of any dispute notice be sent by email (NetworkAssessments@powerlink.com.au) and marked for the attention of the Head of Legal Services.

1. Introduction

1.1. Powerlink asset management and obligations

Powerlink's asset management approach ensures assets are managed in a manner consistent with overall corporate objectives to deliver safe, reliable and cost-effective transmission services. 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.

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.[1]

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 $8 million.[2]

Powerlink commenced this RIT-T with publication of a Project Specification Consultation Report (PSCR) on 10 June 2025. The PSCR identified Option 1, involving the replacement of hybrid switchgear modules in-situ with air insulated switchgear and replacement of secondary systems in a new control building, as the preferred option to address the risks at Ingham South Substation. The PSCR stated that the indicative capital cost of Option 1 was $25.6 million in 2024/25 prices, and that design work would commence in late 2025 with installation and commissioning of the new primary plant and secondary systems completed by February 2028.

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.[3] Submissions on the PSCR were due to Powerlink by 5 September 2025; 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 therefore 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 Ingham South Substation. The PACR includes:

- a description of each credible option assessed;
- a quantification of the costs, including a breakdown of operating and capital expenditure, and classes of material market benefit for each credible option;
- reasons why Powerlink has determined that a class or classes of market benefit are not material;
- the results of Net Present Value (NPV) analysis for each credible option assessed, together with accompanying explanatory statements; and

[1] National Electricity Rules (NER), clause 5.15A.1(c) and chapter 10, glossary ('net economic benefit').
[2] NER, 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 $8 million for three years from 1 January 2025.
[3] NER, clause 5.16.4(z1).

- the identification of the proposed preferred option, including details of the technical characteristics and the estimated construction timetable and commissioning date.[4]

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

1.3. Consumer and Non-network 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.

Additionally, Powerlink takes a proactive approach to engagement generally. This includes:

- The Transmission Network Forum – Powerlink's annual customer engagement event.
- Collaboratively working with Powerlink's customers, including regular consultation on RIT-Ts with our Customer Panel (Powerlink Customer Panel | Powerlink)
- Transparency on future network requirements, such as our Transmission Annual Planning Report (TAPR)

Appendix 2 provides more detail on Powerlink's engagement approach.

[4] NER, clause 5.16.4(v).

2. Identified Need

In a RIT-T, the identified need is the objective the RIT-T proponent seeks to achieve by investing in the network.[5] 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 Australian Energy Regulator's (AER) RIT-T Application Guidelines note that network and non-network options can address an identified need.[6]

The primary driver for reinvestment at Ingham South Substation is plant reliability leading to loss of power supply to the Ingham area or reduction in reliability of the 132kV network supplying North Queensland, because of the condition of secondary and primary plant assets.

2.1. Geographical and network need

Ingham South Substation is approximately 110 kilometres (km) north of Townsville, and 1.6km south of Ingham city centre. The substation was established in 2005 to replace the original Ingham substation equipment and provide an injection point into the Ergon Energy (part of the Energy Queensland Group) distribution network. Planning studies have confirmed there is an enduring need for Ingham South Substation to maintain the supply of electricity to the Ingham area.

As shown below, Ingham South Substation is located in the Ross zone of Powerlink's Northern Queensland region.

Figure 2.1: Northern Ross Zone Transmission Network

[5] NER, chapter 10 (definition of 'identified need').
[6] AER, *Application Guidelines, Regulatory Investment Test for Transmission*, November 2024, page 13.

2.2. 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.[7] 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.[8]

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

Secondary systems are used to control, monitor, protect and secure communication to facilitate safe and reliable network operation.[9] 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.[10]

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.[11]

AEMO's Power System Security Guidelines and Power System Data Communication Standard require Powerlink to be able to safely resolve all protection, remote control and monitoring system problems and defects within 24 hours.

The primary plant and secondary systems at Ingham South Substation have been identified as being in poor condition or at the end of their technical service lives, with identified obsolescence issues. The condition of the substation's primary plant – the equipment through which the electrical power passes – has significantly deteriorated, with a high number of associated defects and obsolescence issues, increasing the risk to supply in the Ingham area. The site utilises a type of switching equipment (gas insulated hybrid modules for all switching bays) for which manufacturer support has ceased and there are now limited spares available. This poses a significant risk to Powerlink's ability to undertake emergency replacement works as there is no direct like for like replacement option.

The secondary systems at Ingham South Substation are also nearing the end of their technical service lives and have become or are becoming obsolete, where they are no longer supported by the manufacturer and have only limited, or no, spares available.

[7] Transmission Authority No. T01/98, section 6.2(c).
[8] *Electricity Act 1994* (Qld), section 34(1)(a).
[9] NER, Schedule 5.1.
[10] NER, Schedule 5.1.9(c).
[11] NER, Schedule 5.1.2.1(d).

Powerlink must therefore take action to avoid the increasing likelihood of loss of power supply arising from failure of the aging equipment at the substation and to ensure customers are provided with a reliable and safe supply of electricity.

As the proposed investment is to meet 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.[12] 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.[13]

2.3. Description of asset condition and risks

Primary Plant

The hybrid switchgear modules were installed at Ingham South in 2005 and enclose all functions of a complete switchgear bay in a single gas insulated module. Each three-phase module includes the circuit breaker, disconnector and earthing switches, voltage transformers and current transformers.

The condition of the hybrid switchgear modules has significantly deteriorated, resulting in numerous defects, some of which have caused maloperations. Despite increased maintenance activities and refurbishment projects to address these issues, the number of ongoing defects has not reduced. A recent condition assessment indicates that condition driven risks associated with the existing hybrid switchgear modules should be addressed by 2028 in order to maintain the current network reliability and availability.

A comprehensive condition assessment of the hybrid switchgear modules at Ingham South Substation identified that these modules will reach the end of their technical service lives by 2028. The at-risk primary plant at Ingham South Substation is summarised in the table below.

Table 2.1: At-risk 132kV primary plant

Bay	Construction Year
Feeder Bay D06 Hybrid Module	2005
Feeder Bay D03 Hybrid Module	2005
Coupler Bay D05 Hybrid Module	2005

Secondary Systems

The secondary systems were installed around 2005, with some equipment added between 2005 and 2013. A recent condition assessment indicates that condition driven risks associated with existing secondary systems equipment should be addressed by 2028 in order to maintain the current network reliability and availability.

Powerlink has undertaken a comprehensive condition assessment of the secondary systems at Ingham South Substation. This has identified that a significant amount of the 132kV secondary system equipment at Ingham

[12] NER, clause 5.10.2 (definition of 'reliability corrective action').
[13] NER, clause 5.15A.1(c).

South will reach the end of their technical service lives by 2028. The at-risk secondary systems at Ingham South Substation is summarised in the table below.

Table 2.2: At-risk 132kV secondary systems

Panel	Construction Year
Metering	2005
2x Feeder Bays Protection and Control	2005, 2013
1x Coupler Bay Protection and Control	2005
Non-bay Secondary Systems (includes OpsWAN, SCADA, RTUs)	2005
2x Transformer Bays Protection and Control	2005

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

2.4. Consequences of failure of primary plant

Poor asset condition increases the risk and frequency of faults, while obsolescence increases the time needed for Powerlink to undertake any necessary repairs, prolonging the return to service time. Due to the substation's configuration, utilising the same breakers for feeder and transformer protection, failure of a breaker to operate to clear a fault, could result in loss of supply to Ingham Substation and thereby the Ingham township and surrounding area. The potential in-service failure of ageing primary plant at Ingham South presents Powerlink with a range of unacceptable safety, network and financial risks, and the inability to meet legislative obligations and customer service standards. The condition and consequences of failure of the main at-risk items of equipment is summarised in the table below.

Table 2.3: Summary of primary plant condition issues and potential consequences of failure

Equipment	Condition / Issue	Potential Consequences of Failure
Hybrid Switchgear Modules	• Obsolescence and limited availability of spares; no longer supported by the manufacturer. • No direct like for like replacement option • Increasing failure rates of circuit breakers, current transformers and disconnectors/earth switches due to deteriorated components. • Sulfur Hexafluoride (SF6) leaks, corrosion and moisture ingress issues	• Failure to operate to clear a fault, resulting in slower clearance times and additional plant being taken out of service to clear the fault, increasing supply risk. • Extended time to restore supply to customers due to a limited availability of spares • Environmental impacts from SF6 gas release • Increased maintenance resulting in less reliable and more costly supply to customers

2.5. Consequences of failure in an obsolete secondary 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 24 hours, the timeframe specified by AEMO for resolution. 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 Ingham South Substation, there is a significant risk of breaching the mandated obligations and requirements if the secondary systems are left to operate beyond February 2028. A summary of the equipment condition issues and associated potential consequences of failure of the equipment is shown in the table below.

Table 2.4: Summary of secondary systems 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 to clear a fault, resulting in slower clearance times and additional plant being taken out of service to clear the fault, increasing supply risk. • 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.[14]

[14] NER, clause 7.8.10.

In addition to the site-specific impacts of obsolescence at Ingham South 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. Powerlink is resolving several secondary system obsolescence risks across its network involving ageing equipment of the same make and model as the equipment at Ingham South. Due to the limited spares available to service the fleet of assets, running multiple secondary systems to failure across the network results in an increased likelihood of concurrent systemic faults. If sites such as Ingham South are not addressed, there is the risk that concurrent faults would overwhelm Powerlink's capacity to undertake corrective maintenance or replacement projects. This would result in broader risk of loss of power supply, leaving Powerlink in breach of the NER, the AEMO standards and jurisdictional obligations.

3. Potential Credible Network Options to Address the Identified Need

Powerlink has developed two credible network options to maintain reliability of supply and to address condition risks at Ingham South Substation:

- Option 1 – replace hybrid switchgear modules in-situ with air-insulated switchgear and replace secondary systems equipment within a new control building installed on the existing Ingham South Substation footprint by 2028; and
- Option 2 – extend substation footprint and replace hybrid switchgear modules with air-insulated switchgear utilising adjacent spare bay locations where possible (designed to minimise outage durations) and replace secondary systems equipment within a new control building by 2028.

Option 1 seeks to minimise civil works and environmental impacts by installing new equipment in-situ to avoid having to extend the substation footprint. Under Option 1, detailed design work will commence in early 2026, construction works will commence in late 2026, and commissioning will be completed by February 2028.

Option 2 seeks to minimise return to service times and outage requirements for civil construction works. Under Option 2, detailed design work will commence in early 2026, construction works will commence in late 2026, and commissioning will be completed by February 2028.

A summary of these options is shown in the table below.

Table 3.1: Summary of credible options

Option	Description	Total costs ($m, 2025)	Indicative annual O&M costs ($m, 2025)
1	Replace hybrid switchgear modules in-situ with air insulated switchgear. Replace secondary systems in a new control building on existing substation platform by 2028.	25.60	0.03
2	Extend substation platform and replace hybrid switchgear modules with air insulated switchgear using adjacent spare bay locations. Replace secondary systems in a new control building by 2028.	31.62	0.03

Note: O&M denotes operations and maintenance.

Each credible option addresses the risks resulting from the ageing of primary plant and secondary systems at Ingham South 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 equipment.

4. Economic Analysis of the Base Case

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 monetised risk, termed risk costs, in the National Electricity Market context for the Ingham South base case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

4.1. Modelling a base case under the RIT-T

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.[15]

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 situation in which the condition and obsolescence issues arising from the ageing assets are only addressed through standard operational activities, with resultant safety, financial, environmental and network risks.[16]

To develop the base case, the existing condition and obsolescence issues are managed by undertaking operational maintenance or operational measures only. This results in higher overall risk levels as the condition and availability of the asset deteriorates over time. These 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 reference point in the cost-benefit analysis to compare and rank the credible options against each other over the same timeframe.

4.2. Quantifiable Risk Costs for the Base Case

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.[17] In line with Powerlink's framework, three key risk costs have been quantified in the cost benefit analysis in response to the identified need:

- **Network risk cost** – this is the cost of loss of supply that results from an in-service failure of the identified equipment and is typically known as unserved energy. This generally accrues under concurrent failure events, and consideration has been given to potential feeder trip events within the wider area at the same time as the failure of an element of the identified equipment. Ingham South Substation supplies a mixture of residential, industrial and agricultural load types. Historical load data has been analysed to approximate the

[15] AER, *Regulatory Investment Test for Transmission*, November 2024, glossary ('base case').
[16] AER, *Application Guidelines, Regulatory Investment Test for Transmission*, November 2024, page 21. See AER, *Regulatory Investment Test for Transmission*, November 2024, paragraph 24 and AER, *Application Guidelines, Regulatory Investment Test for Transmission*, November 2024, pages 32-35 for a definition and discussion of states of the world in a RIT-T.
[17] NER, clauses 5.15A.2(b)(4), (5) and (6). See also AER, *Regulatory Investment Test for Transmission*, November 2024, paragraphs 10 to 13.

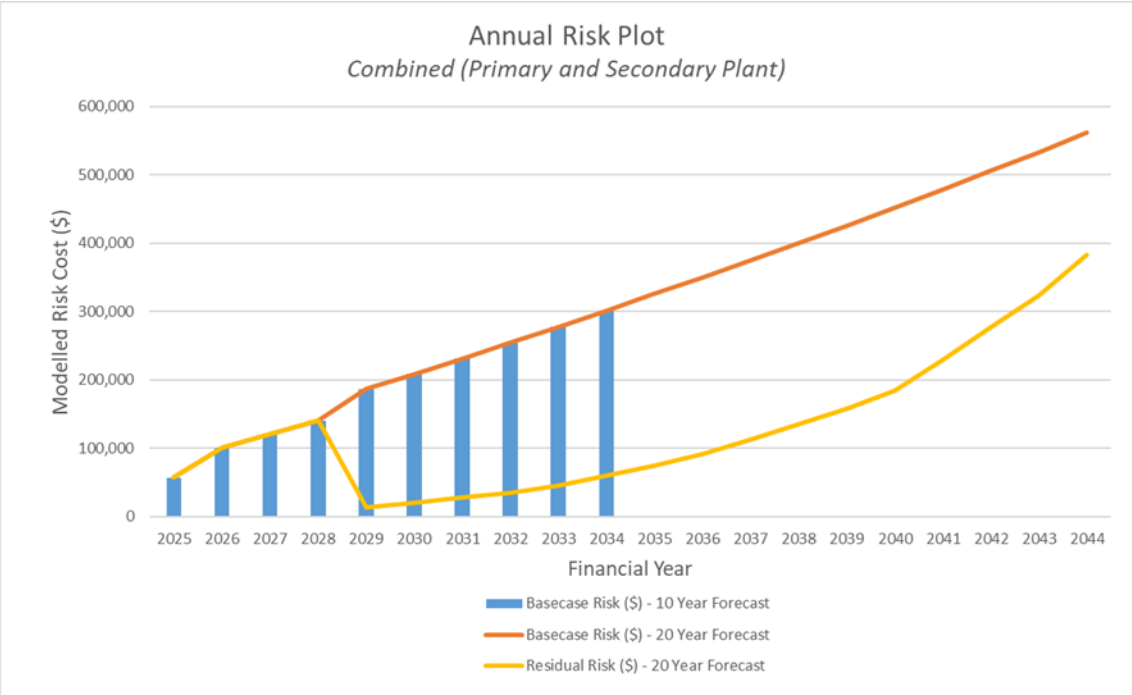
ratio of the load types, resulting in a Value of Customer Reliability (VCR) of $36,598/MWh, published within the 'Value of customer reliability – Final report on VCR values' by the AER (updated in December 2024).

- **Financial risk cost** – this is the cost associated with rectifying an in-service failure of the identified equipment. Spares for secondary system equipment items are assumed available prior to the point of expected spares depletion (at around 2032), and after this point the cost and time to return the secondary system back to service increases significantly.
- **Safety risk cost** – this is the assessed safety impact that may result from the unlikely event of a catastrophic in-service failure of the identified equipment. Powerlink utilises guidance from the Department of Prime Minister and Cabinet to assess and quantify this risk.

Appendix 3 outlines the market benefits that Powerlink has assessed as not having a material impact on the options analysis.

The 15-year forecast of risk costs for the base case is shown in Figure 4.1.

Figure 4.1: Modelled base case and option residual risk costs



Based upon the assessed condition of the ageing secondary systems and primary plant at Ingham South, the total value of monetised risk is projected to increase from around $57,000 in 2025 to $560,000 in 2044.

The main areas of risk costs for both the primary plant and secondary systems are network risks that involve reliability of supply through the failure of deteriorated equipment modelled as probability weighted USE[18] 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.

[18] USE is modelled using a VCR consistent with that published by the AER in its *Values of Customer Reliability, Final Report and Appendices A-D*, 2024.

5. Cost-benefit Analysis and Identification of Preferred Option

5.1. Cost estimation

Basis of Estimation

The basis for the estimation for the credible options presented in this PACR are outlined in the methodologies and processes used to derive cost estimates as described in Powerlink's Cost Estimation Methodology. The estimates are informed by the level of specific project information available at the time of PACR preparation. Powerlink's Cost Estimation Methodology also provides context to the classes of estimate discussed in this section.[19]

Key inputs and assumptions

Option 1: Replace hybrid switchgear modules in-situ with air insulated switchgear. Replace secondary systems in a new control building on existing substation platform by 2028.

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:

- Powerlink can continue to utilise the existing Energy Queensland owned building for telecommunications equipment and amenities;
- All existing equipment in good condition and working order, the site is accessible and there are no restricted access zones (RAZ);
- All resources will be available including necessary resources to complete design, construction, testing and commissioning activities;
- Availability of site access for works as required;
- Existing ground conditions are suitable for the construction of standard foundations;
- Laydown area is located within the substation yard;
- Outages will be available, based on appropriate contingency arrangements being put in place to ensure Return to Service requirements are met; and
- Primary and secondary system equipment is available within current agreed lead times.

Option 2: Extend substation platform and replace hybrid switchgear modules with air insulated switchgear using adjacent spare bay locations. Replace secondary systems in a new control building by 2028.

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:

- Powerlink can continue to utilise the existing Energy Queensland owned building for telecommunications equipment and amenities;
- All existing equipment in good condition and working order, the site is accessible and there are no RAZs;
- All resources will be available including necessary resources to complete design, construction, testing and commissioning activities;
- Availability of site access for works as required;
- Existing ground conditions are suitable for the construction of standard foundations;
- Laydown area is located within the substation yard;
- Outages will be available;

[19] The methodology is available on the RIT-T Consultations page of Powerlink's website.

- Local material is available for fill / platform extension;
- Environmental approvals are granted for platform extension; and
- Primary and secondary system equipment is available within current agreed lead times.

Main components of capital cost estimate of credible options

The capital costs for this project are shown in Table 5.1.

Table 5.1: Summary of capital costs of credible options

Cost Estimate Components	Option 1 ($m)	Option 2 ($m)
Design	2.78	3.00
Materials	2.93	2.57
Construction	13.25	17.20
Commissioning	4.40	6.40
Other[20]	2.24	2.45
Total	**25.60**	**31.62**

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.[21]

5.2. Modelling assumptions

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 NPV inputs.

Powerlink has undertaken the RIT-T analysis over a 20-year period, from 2025 to 2044. A 20-year period considers the size and complexity of the secondary system and primary plant replacement options. There will be remaining asset life by 2044, at which point a terminal value is calculated to account for capital costs under each credible option.

Powerlink has adopted a real, pre-tax commercial discount rate of 7.0% as the central assumption for the NPV analysis.[22] Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and

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[20] Generally, comprises project management, design and commissioning coordination, project governance, administrative support, cost estimation and RIT-T consultation costs.
[21] AER, *Regulatory Investment Test for Transmission*, November 2024, paragraph 5.
[22] This indicative commercial discount rate of 7.0% is based on AEMO, *2023 Inputs, Assumptions and Scenarios Report*, July 2023, page 123.

specifically to the adoption of a lower bound discount rate of 3.63% and an upper bound discount rate of 10.37% (i.e. a symmetrical upwards adjustment).[23]

5.3. Sensitivity Analysis

Because of the minor differences between the options in terms of operational outcomes, Powerlink has chosen to present a single reasonable scenario for comparison purposes. 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 the ranking of the results. Table 5.2 outlines the sensitivities that have been assessed.

Table 5.2: Reasonable sensitivity 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

5.4. NPV analysis

Table 5.3 outlines the NPV and the corresponding ranking of each credible option relative to the base case.

Table 5.3: NPV of credible options relative to the base case

Option	Description	NPV relative to base case ($m)	Ranking
1	Replace hybrid switchgear modules in-situ with air insulated switchgear. Replace secondary systems in a new control building on existing substation platform by 2028.	-17.58	1
2	Extend substation platform and replace hybrid switchgear modules with air insulated switchgear using adjacent spare bay locations. Replace secondary systems in a new control building by 2028.	-22.10	2

Both credible options will address the identified need on an enduring basis. Option 1 is ranked first, with Option 2 being $4.5 million more expensive compared to Option 1 in NPV terms.

Figure 5.1 sets out the NPV results, determined using a breakdown of capital cost, operational maintenance cost and monetised risk for each option 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.

[23] A discount rate of 3.63% real pre-tax Weighted Average Cost of Capital is based on *TasNetworks 2024–29* Final Determination, April 2024.

Figure 5.1: NPV of the base case and each credible option (NPV $m)

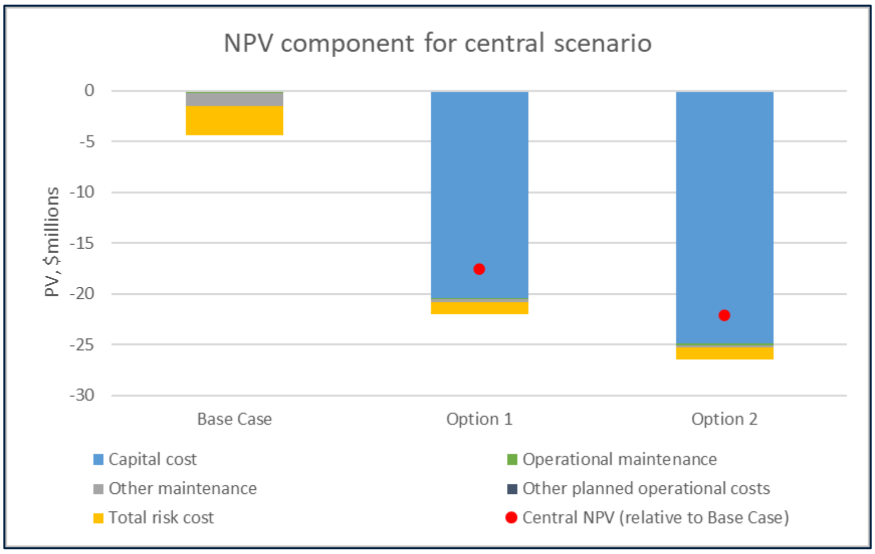


Figure 5.1 illustrates that both credible options will reduce the risk cost compared to the base case. Due to the lower capital cost component, Option 1 results in the highest NPV outcome relative to the base case when compared to other credible options. Sensitivity analysis also concluded that Option 1 is preferred to Option 2 (see Appendix 4).

5.5. 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.

6. 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 and primary plant infrastructure at Ingham South Substation. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the NER.

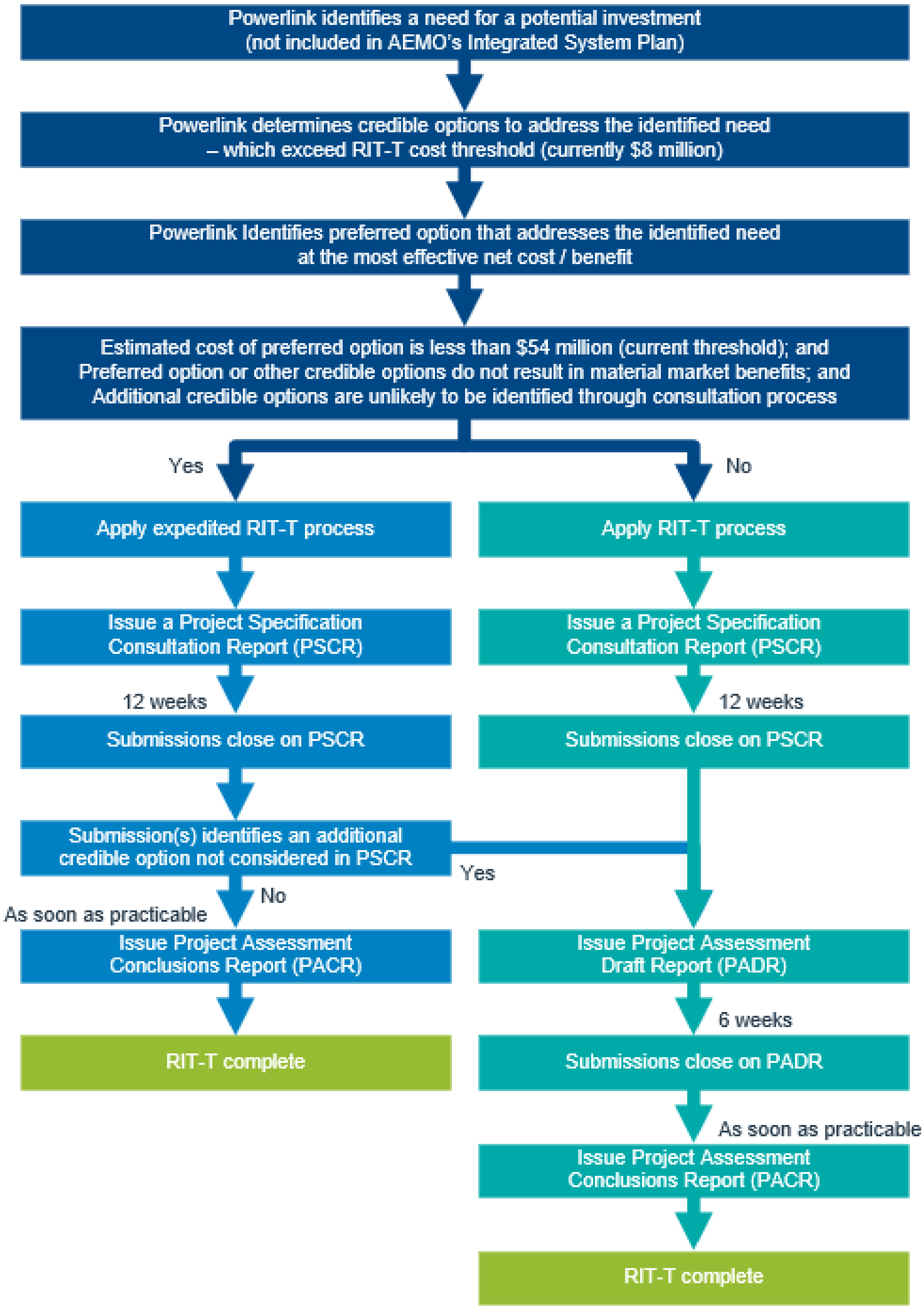
Option 1 involves the replacement of hybrid switchgear modules in-situ with air insulated switchgear and replacement of secondary systems in a new control building on the existing substation platform by 2028. The indicative capital cost of this option is $25.60 million in 2024/25 prices.

Under Option 1, detailed design work will commence in early 2026, with installation and commissioning of the new primary plant and secondary systems completed by February 2028.

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

Appendix 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.



Appendix 2: Powerlink's Approach to Engagement

More than five million Queenslanders and 241,000 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 2023/24 shows Powerlink's achievements against the principles of the Energy Charter.

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.

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.

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 customers and participants in the National Electricity Market (NEM).[24]

Community engagement

Powerlink recognises the importance of engaging with stakeholders who may reasonably be expected to be affected by the works required to meet the identified need described in this PACR.

The engagement frameworks and strategies that underpin Powerlink's engagement approach include:

- The International Association for Public Participation (IAP2) spectrum[25], noting each stakeholder group has unique needs and requires an individual assessment on the spectrum;
- Powerlink's Community Engagement Approach and Reflect Reconciliation Action Plan; and
- the Energy Charter Landholder and Community Better Practice Engagement Guide; and Better Practice Social Licence Guideline.

Powerlink assesses the requirement for community engagement based on the identified need

Powerlink undertakes an assessment of the potential for social and environmental impacts of anticipated replacement or augmentation projects well in advance of the identified need timing. Understanding if and when community engagement may be required, as well as the appropriate engagement approach, is an integral component of the early planning analysis needed to inform option identification, consideration of statutory processes (e.g. Ministerial Infrastructure Designation if required) and subsequent project development strategy and engagement plans.

Powerlink's engagement approach is tailored to maximise the accessibility of the proposed project's information to the stakeholder groups and/or communities affected by the project once the need to undertake community engagement is identified. Key stakeholders may include, but are not limited to, directly impacted and adjacent landholders, Traditional Owner groups, local residents, businesses and other organisations such as schools, community organisations and environmental groups, local government authorities and elected representatives within local and state governments.

Assessment and basis of assessment on the need for community engagement

Powerlink has assessed that minimal community engagement is required given the scope of works under consideration for any proposed network options to meet the identified need. This is due to all network options including replacement of equipment within the existing Ingham South substation. Powerlink will provide notifications to nearby residents to ensure all affected parties are appropriately informed of project activities.

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[24] The 2025 TAPR indicated the proposed commissioning date for primary plant and secondary systems replacement at the Ingham South Substation was December 2028. See Powerlink, *2025 Transmission Annual Planning Report*, October 2025, page 65.

[25] Refer to IAP2's website.

Appendix 3: 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 ageing assets under the credible options 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**: replacement of ageing assets under the credible options 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 replacement of ageing assets 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 asset 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.
- **Costs associated with social licence activities:** Powerlink does not consider that the cost of social licence activities is materially different between the credible options under consideration in this RIT-T. These costs are therefore not material to the outcome of the RIT-T assessment.

Appendix 4: Sensitivity Analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3.63% to 10.37% 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.

Appendix 5: Compliance Checklists

NER Requirements for RIT-T

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

Table A5.1: NER Compliance Checklist

Sub-para	Requirement	Section of PACR
(1)	Description of each credible option	3
(2)	Summary of and commentary on submissions to the PSCR/PADR	N/A
(3)	Quantification of costs, including breakdown of operating and capital expenditure Classes of material market benefit for each credible option	4, 5.1, 5.4
(4)	Description of methodologies used to quantify each class of material market benefit and cost	4.2
(5)	Reasons why a class/classes of market benefit are not material	Appendix 3
(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	5.4
(8)	Identification of preferred option	5.5, 6
(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 (if required) (iv) a statement that the preferred option satisfies the RIT-T	 3 3, 5.1 N/A 6
(10)	RIT reopening triggers	N/A

N/A denotes not applicable.

RIT-T Application Guidelines Compliance Checklist

The table below outlines Powerlink's compliance with binding requirements included in the RIT-T Application Guidelines.

Table A5.2: RIT-T Application Guidelines Compliance Checklist

Section of Guidelines	Topic	Requirements	Section of PACR
3.2.5	Social licence principles	Consider social licence issues in the identification of credible options and include information about when and how social licence considerations have affected the identification and selection of credible options.	Appendix 3
3.4.3	Value of emissions reduction	The VER, reported in dollars per tonne of emissions (CO2 equivalent), is used to value emissions. A RIT-T proponent is required to use the then prevailing VER under relevant legislation or, otherwise, in any administrative guidance.	N/A
3.5	Valuing costs	Costs are the present value of the following direct costs: • Constructing or providing the credible option; • Operating and maintenance costs; • Costs of complying with relevant laws, regulations and administrative requirements; and Costs of removing and disposing of existing assets (particularly for asset replacement programs).	3, 4, 5.1
3.5.3	Social licence costs	Provide the basis for any social licence costs, including any reference to best practice	N/A
3.5A.1	Cost estimation accuracy	Outline cost estimation process (as applicable to stage of the RIT-T)	5.1
3.5A.2	Cost estimation information	Details of inputs, assumptions and methodologies for each credible option (as applicable to the stage of the RIT-T)[26]	5.1
3.6	Market benefit classes	Apply market benefit classes consistently across all credible options	4.2
3.7.3	Market benefits	Calculation of changes in Australia's greenhouse gases	N/A
3.8.2	Sensitivities	Sensitivity analysis on all credible options	Appendix 4

[26] Although the provisions in section 3.5A.2 of the RIT-T Application Guidelines are not included in the table of binding requirements at Appendix C of the Guidelines, Powerlink has added them to the compliance checklist as the provisions are expressed as being binding in section 3.5A.2 of the Guidelines.

3.9.4	Contingency allowance	Details of any contingency allowance included in a cost estimate for a credible option	N/A
3.11.2	Concessional finance	Provide sufficient detail about a concessional finance agreement	N/A
4.1	Community engagement	Description of assessment of requirement for community engagement and, as applicable, how engagement has been undertaken and any relevant concerns sought to be addressed, and how the proponent plans to engage with stakeholder groups.	1.3, Appendix 2

Notes:

N/A denotes not applicable.

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