Powerlink Queensland

Project Assessment Conclusions Report

6 September 2023

Addressing the secondary systems condition risks at Tangkam

Document purpose

For the benefit of those not familiar with the National Electricity Rules (the Rules) and the National Electricity Market (NEM), Powerlink offers the following clarifications on the purpose and intent of this document:

1. The Rules require Powerlink to carry out forward planning to identify future reliability of supply requirements[1] and consult with interested parties on the proposed solution as part of the Regulatory Investment Test for Transmission (RIT-T). This includes replacement of network assets in addition to augmentations of the transmission network and providing for power system security services such as system strength and inertia. More information on the RIT-T process and how it is applied to ensure that safe, reliable and cost effective solutions are implemented to deliver better outcomes to customers is available on Powerlink's website.
2. Powerlink must identify, evaluate and compare network and non-network options (including, but not limited to, generation and demand side management) to identify the '*preferred option*' which can address future network requirements at the lowest net cost to electricity customers. This assessment compares the net present value of all credible options to identify the option that provides the greatest economic benefit to the market.
3. The main purpose of this document is to provide details of this evaluation, and a final recommended solution to address the risks arising from the secondary systems at Tangkam Substation.

[1] Such requirements include, but are not limited to, addressing any emerging reliability of supply issues or relevant *ISP actionable projects* identified in the Australian Energy Market Operator's (AEMO) latest Integrated System Plan (ISP), for which Powerlink has responsibility as the relevant Transmission Network Service Provider (TNSP).

Contents

Executive Summary

Tangkam Substation is located approximately 30km north west of Toowoomba. The site was established in 1999 as part of the Oakey Gas Turbine Power Station connection. Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services provided by Tangkam Substation.

The secondary systems at Tangkam broadly perform the functions of transmission element protection, data collection, and remote and local control and monitoring. The majority of Tangkam's secondary systems 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 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 (the Rules).

Powerlink must therefore address the emerging risks arising from the condition of the secondary systems at Tangkam Substation. 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 Rules, it is classified as a 'reliability corrective action'[2].

This Project Assessment Conclusions Report (PACR) represents the final step in the Regulatory Investment Test for Transmission (RIT-T) process prescribed under the Rules, undertaken by Powerlink to address the condition risks arising from the secondary systems at Tangkam Substation. It contains the results of the planning investigation and the cost-benefit analysis of credible options compared to a non-credible Base Case where the emerging risks are left to increase over time. In accordance with the RIT-T, the credible option that maximises the present value of net economic benefit, or minimises the net cost, is recommended as the preferred option.

Credible options considered

Powerlink has developed three credible network options to maintain the existing electricity services, ensuring a reliable, safe and cost effective supply to customers in the area. The major difference between the credible options relates to whether to stage replacement of the secondary systems or perform a complete replacement of the secondary systems.

By addressing the condition risks, all options allow Powerlink to meet the identified need and continue to meet the reliability and service standards specified within Powerlink's Transmission Authority, Schedule 5.1 of the Rules, AEMO guidelines and standards and applicable regulatory instruments.

Powerlink Published a Project Specification Consultation Report (PSCR) on 4 October 2022 to address the risks and obsolescence issues arising from the condition of the secondary systems at Tangkam Substation. No submissions were received in response to the PSCR that closed on 6 January 2023. As a result, no additional credible options have been identified as a part of this RIT-T consultation.

The three credible network options, along with their NPVs relative to the Base Case are summarised in Table 1. The absolute NPVs of the Base Case and the Options are shown graphically in Figure 1. All options have a negative NPV relative to the non-credible Base Case, as allowed for under the Rules for 'reliability corrective actions'. Of the credible network options, Option 2 has the highest NPV relative to Base Case.

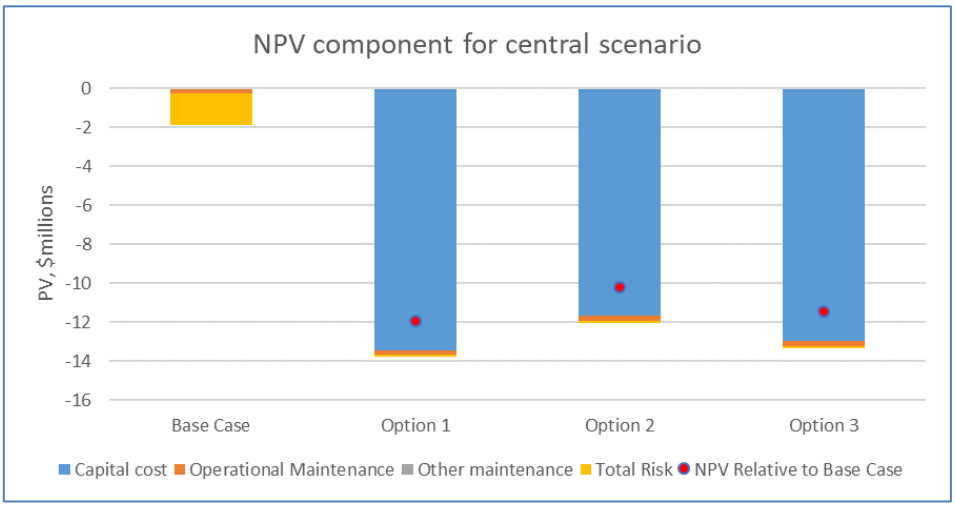
[2] The Rules clause 5.10.2, Definitions, reliability corrective action.

Table 1: Summary of credible network options

Option	Description	Total costs ($m, 2023)	NPV relative to Base Case ($m, 2023)	Ranking
1	Staged replacement of selected 110kV secondary systems into a new- demountable building by June 2025 Replacement of the remaining bays by June 2028	19.7	-11.9	3
2	Single stage replacement of all 110kV secondary systems into a new demountable building by June 2025	14.6	-10.2	1
3	Single stage replacement of all 110kV secondary systems into the existing building by June 2025	16.2	-11.5	2

The absolute NPVs of the Base Case and the credible options are negative, shown graphically in Figure 1, with Option 2 being the least negative of the credible options. All options reduce the risk cost arising from the condition of the ageing and obsolete secondary systems at Tangkam Substation remaining in service, enabling Powerlink to continue to meet reliability and service standards specified within its Transmission Authority. They also ensure Powerlink's ongoing compliance with Schedule 5.1 of the Rules and guidelines and standards published by AEMO.

Figure 1: NPV of Base Case and Credible Network Options



Evaluation and Conclusion

The RIT-T requires that the preferred option maximises the present value of net economic benefit, or minimises the net cost, to all those who produced, consume and transport electricity. The cost benefit analysis demonstrates that Option 2 provides the least net economic cost in NPV terms and is therefore the preferred option.

In accordance with the expedited process for the RIT-T, the PSCR made a draft recommendation to implement option 2, which involves the full secondary systems replacement with new panels in a new building by 2025. The indicative capital cost of this option is $14.6 million in 2022/23 prices. Under Option 2, initial design work will commence in early 2024, with installation and commissioning of the new secondary systems now completed by June 2025.

As the outcome of the cost benefit analysis contained in this PACR and identification of the preferred option remains unchanged from that published in the PSCR, the draft recommendation has been adopted as the final recommendation, and will now be implemented.

Dispute Resolution

In accordance with the provision of clause 5.16B(a) of the NER, Registered Participants, the AEMC, Connection Applicants, Intending Participants, AEMO and interested parties may, by notice to the AER, dispute conclusion in this report in relation to:

- the application of the RIT-T
- the basis upon which the preferred option was classified as a reliability corrective action, or
- the assessment of whether the preferred option has a material inter-regional impact or not.

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 the RIT-T proponent.

1 Introduction

This Project Assessment Conclusions Report (PACR) represents the final step of the Regulatory Investment Test for Transmission (RIT-T) process[3] prescribed under the National Electricity Rules (the Rules), undertaken by Powerlink address the condition risks and obsolescence issues arising from the secondary systems at Tangkam Substation. It follows the publication of the Project Specification Consultation Report (PSCR) on 4 October 2022.

The PSCR:

- described the identified need that Powerlink is seeking to address, together with the assumptions used in identifying this need
- set out the technical characteristics that a non-network option would be required to delivery in order to address the identified need
- described the credible options that Powerlink considered may address the identified need
- discussed specific categories of market benefit that in the case of this RIT-T assessment are unlikely to be material
- presented the Net Present Value (NPV) economic assessment of each of the credible options (as well as the methodologies and assumptions underlying these results) and identified the preferred option
- noted that Powerlink was claiming an exemption from producing a Project Assessment Draft Report (PADR)
- invited submissions and comments in response to the PSCR and the credible options presented from registered participants, the Australian Energy Market Operator (AEMO), potential non-network providers and any other interested parties.

Powerlink identified Option 2, involving the single stage replacement of all 110kV secondary systems at Tangkam Substation into a new demountable building by June 2025, as the preferred option to address the identified need. The indicative capital cost of the RIT-T project for the preferred option is $14.6 million in 2022/23 prices.

The Rules clause 5.16.4(z1) provide for a Transmission Network Service Provider (TNSP) to claim exemption from producing a Project Assessment Draft Report (PADR) from a particular RIT-T application if all of the following conditions are met:

- the estimated capital cost of the preferred option is less than $46 million[4]
- the preferred option is identified in the PSCR noting exemption form publishing a PADR
- the preferred option, or other credible options do not have material market benefits, other than benefits associated with changes in involuntary load shedding
- submissions to the PSCR did not identify additional credible options that could deliver a material market benefit.

There were no submissions received in response to the PSCR that closed for consultation on 6 January 2023. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation. As the conditions for exemption are now satisfied, Powerlink has not issued a PADR for this RIT-T.

Subsequent to the publication of the PSCR, the risk cost analysis has been updated to reflect the AER's most recent Value of Customer Reliability (VCR) annual adjustment. Consequently, the cost benefit analysis has been updated to reflect these more recent parameters.

Powerlink is now publishing this PACR, which:

[3] This RIT-T consultation has been prepared based on the following documents: National Electricity Rules, Version 200, 30 May 2023 and AER, Application guidelines, Regulatory Investment Test for Transmission, August 2020.
[4] AER, Costs threshold review for the regulatory investment tests, October 2021.

- describes the identified need and the credible options that Powerlink considers address the identified need
- discusses the consultation process followed for this RIT-T together with the reasons why Powerlink is exempt from producing a PADR
- provides a quantification of costs and reasons why specific classes of market benefit are not material for the purposes of this RIT-T assessment
- provides the results of the cost benefit analysis for each credible option assessed, together with accompanying explanatory statements
- identifies the preferred option for investment by Powerlink and details the technical characteristics and proposed commissioning date of the preferred option.

2 Consumer and non-network engagement

With more than five million Queenslanders and 253,000 Queensland businesses depending on Powerlink's performance, Powerlink recognises the importance of engaging with a diverse range of customers and stakeholders who have the potential to affect, or be affected by, Powerlink activities and/or investments. Together with our industry counterparts from across the electricity and gas supply chain, Powerlink has committed to The Energy Charter.

2.1 Powerlink takes a proactive approach to engagement

Powerlink regularly hosts a range of engagement forums and webinars, sharing information with customers and stakeholders within the broader community. These engagement activities help inform the future development of the transmission network and assist Powerlink in providing services that align with the long-term interests of customers. Feedback from these activities is also incorporated into a number of publicly available reports.

2.2 Working collaboratively with Powerlink's Customer Panel

Powerlink's Customer Panel provides a face-to-face opportunity for customers and consumer representative bodies to give their input and feedback about Powerlink's decision making, processes and methodologies. It also provides Powerlink with a valuable avenue to keep customers and stakeholders better informed, and to receive feedback about topics of relevance, including RIT-Ts.

The Customer Panel is regularly advised on the publication of Powerlink's RIT-T documents and briefed quarterly on the status of current RIT-T consultations, as well as upcoming RIT-Ts. 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.

2.3 Transparency on future network requirements

Powerlink's annual planning review findings are published in the Transmission Annual Planning Report (TAPR) and TAPR templates, providing early information and technical data to customers and stakeholders on potential transmission network needs over a 10-year outlook period. The TAPR plays an important part in planning Queensland's transmission network and helping to ensure it continues to meet the needs of Queensland electricity consumers and participants in the National Electricity Market.

In addition, beyond the defined TAPR process, Powerlink's associated engagement activities provide an opportunity for non-network alternatives to be raised, further discussed or formally submitted for consideration as options to meet transmission network needs, well in advance of the proposed investment timings and commencement of regulatory consultations (where applicable).

2.3.1 Addressing the secondary systems condition risks at Tangkam Substation

Powerlink identified in its 2022 TAPR, that action would be required to address the emerging power transfer and reliability of supply issues in the South West transmission zone[5].

Powerlink advised members of its Non-network Engagement Stakeholder Register (NNESR) of the publication of the TAPR and the PSCR.

No submissions proposing credible and genuine non-network options have been received from prospective non-network solution providers in the normal course of business, in response to the publication of the TAPR or as a result of stakeholder engagement activities.

2.4 Powerlink applies a consistent approach to the RIT-T stakeholder engagement process

Powerlink undertakes a considered and consistent approach to ensure an appropriate level of stakeholder engagement is undertaken for each individual RIT-T. Please visit Powerlink's website for detailed information on the types of engagement activities that may be undertaken during the consultation process. These activities focus on enhancing the value and outcomes of the RIT-T process for customers, stakeholders and non-network providers. Powerlink welcomes feedback from all stakeholders to help improve the RIT-T stakeholder engagement process.

2.5 The transmission component of electricity bills

Powerlink's contribution to electricity bills comprises approximately 9% of the total cost of the residential electricity bill (refer to Figure 2.1).

Figure 2.1:

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

3 Identified need

This section provides an overview of the existing arrangements at Tangkam Substation and describes the increasing risk to Powerlink of being unable to maintain compliance with relevant standards, applicable regulatory instruments and the Rules, which are designed to ensure Powerlink's customers continue to receive safe, reliable and cost effective electricity services.

3.1 Geographical and network need

The Tangkam Substation, located approximately 30 kilometres northwest of Toowoomba, was originally established in the 1999 as part of a radial transmission line connecting the Oakey Gas Turbine Power Station into the Queensland transmission network.

The South West zone transmission network is shown in Figure 3.1.

[5] This relates to the standard geographic definitions (zones) identified within the TAPR. See section 6.11.4 of the 2022 TAPR.

Figure 3.1: South West zone transmission network

3.2 Description of identified need

Powerlink's Transmission Authority requires it to plan and develop the transmission network "in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services". It allows load to be interrupted during a critical single network contingency, provided the maximum load and energy:

- will not exceed 50MW at any one time; or
- will not be more than 600MWh in aggregate[6].

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

The ageing and obsolete secondary systems at Tangkam 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.

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

As the proposed investment is for meeting reliability and service standards arising from Powerlink's Transmission Authority and to ensure Powerlink's ongoing compliance with Schedule 5.1 of the Rules, it is a 'reliability corrective action' under the Rules[7].

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. The identified need is described in greater detail in the PSCR published in October 2022.

[6] Transmission Authority No. T01/98, section 6.2(c)
[7] The Rules clause 5.10.2 ,Definitions, reliability corrective action

4 Submissions Received

There were no submissions received in response to the PSCR that was open for consultation until 6 January 2023. As result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation.

5 Credible options assessed in this RIT-T

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

- Option 1: Selected staged replacement in a new building by June 2025, and the remainder of the equipment replaced by June 2028
- Option 2: Single stage replacement in new building by June 2025
- Option 3: Single stage replacement in existing building by June 2025

Option 1 seeks to minimise mobilisation costs by having all installation and site acceptance testing (SAT) work completed prior to the completed building being shipped to site, while deferring capital expenditure of two bays.

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

Option 3 seeks to optimise existing infrastructure by installing the replacement systems into the existing building.

A summary of these options is given in Table 5.1.

Table 5.1: Summary of credible options

Option	Description	Total costs ($m, 2023)	Indicative annual average O&M costs ($m, 2023)
1	Staged replacement of selected 110kV secondary systems into a new demountable building by June 2025 Replacement of the remaining bays by June 2028	19.7	0.023
2	Single stage replacement of all 110kV secondary systems into a new demountable building by June 2025	14.6	0.026
3	Single stage replacement of all 110kV secondary systems the existing building by June 2025	16.2	0.023

All the credible options address the major risks resulting from the deteriorated condition of ageing and obsolete secondary systems at Tangkam Substation, allowing Powerlink to meet its reliability of supply and safety obligations under its Transmission Authority, the Electricity Act 1994 and Section 5.1 of the Rules.

None of these options has been discussed by AEMO in its most recent Integrated System Plan (ISP)[8].

[8] Clause 5.16.4(b)(4) of the Rules requires Powerlink to advise whether the identified need and or solutions are included in the most recent ISP. The most recent ISP was published in June 2022.

5.1 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[9].

6 Materiality of market benefits

The Rules require that all categories of market benefits identified in relation to a RIT-T be quantified, unless the TNSP can demonstrate that a specific category is unlikely to be material.

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

Powerlink considers that changes in involuntary load shedding (i.e. the reduction in expected unserved energy) between options, set out in this PACR, may impact the ranking of the credible options under consideration and that this class of market benefit could be material. These benefits have been quantified and included within the cost-benefit and risk cost analysis as network risk.

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

The AER has recognised a number of classes of market benefits may not be material in the RIT-T assessment and so do not need to be estimated[10]. Other than market benefits associated with involuntary load shedding, Powerlink does not consider any other category of market benefits to be material, and had not estimated them as part of this RIT-T.

More information on consideration of individual classes of market benefits can be found in the PSCR.

7 Base Case

7.1 Modelling a Base Case under the RIT-T

Consistent with the RIT-T Application Guidelines the assessment undertaken in this RIT-T compares the costs and benefits of credible options to address the risks arising from an identified need, with a Base Case[11].

As characterised in the RIT-T Application Guidelines, the Base Case itself is not a credible option to meet the identified need. Specifically, the Base Case reflects a state of the world in which the condition and obsolescence issues arising from the ageing assets are only addressed through standard operational activities, with escalating safety, financial, environmental and network risks.

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

[9] In accordance with Rules clause 5.16.4(b)(6)(ii). AEMO has published guidelines for assessing whether a credible option is expected to have a material inter-network impact.
[10] AER, *Application guidelines, Regulatory Investment Test for Transmission*, August 2020
[11] AER, *Application guidelines, Regulatory Investment Test for Transmission*, August 2020

7.2 Tangkam Base Case risk costs

Powerlink has developed a risk modelling framework consistent with the RIT-T Application Guidelines and the AER Industry practice application note[12]. An overview of the framework is available on Powerlink's website[13] and the principles of the framework have been used to calculate the risk costs of the Tangkam Base Case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

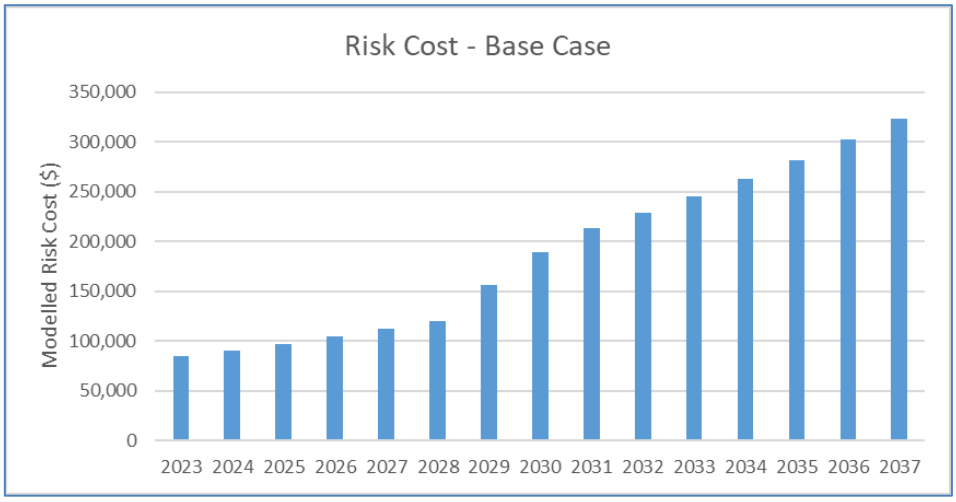
7.3 Base Case assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing and obsolete secondary systems at the Tangkam Substation, the following modelling assumptions have been made:

- 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 unserved energy under failure events;
- Due to the network and substation configuration, unserved energy generally accrues under concurrent failure events and consideration has been given to potential feeder trip events within the wider Queensland area;
- Tangkam Substation supplies a mixture of residential, agricultural and commercial loads within the South Western Queensland area. The most relevant residential, agricultural and commercial VCR values published within the AER's Value of Customer Reliability update summary 2022 have been used within this risk cost assessment.
- Historical load data has been analysed to approximate the proportionate ratio of the load types, resulting in a Value of Customer Reliability (VCR) of $28,367/MWh.

The 15-year forecast of risk costs for the Base Case is shown in Figure 7.1.

Figure 7.1: Modelled Base Case risk costs



Based upon the assessed condition of the ageing secondary systems at Tangkam, the total risk costs are projected to increase from $84,338 in 2023 to $322,878 in 2037. 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 unserved energy[14] and financial risk costs associated with the replacement of failed assets in an emergency.

[12] AER Industry Practice Application Note, Asset Replacement Planning, January 2019.
[13] The risk costs are calculated using the principles set out in the Powerlink document, Overview of Asset Risk Cost Methodology, May 2019
[14] Unserved Energy is modelled using a VCR consistent with that published by AER in their *Value of Customer Reliability* update summary 2022.

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

7.4 Modelling of Risk in Options

Each option is scoped to manage the major risks arising in the Base Case and to maintain compliance with all statutory requirements, the Rules and AEMO standards. The residual risk is calculated for each option based upon the individual implementation strategy of the option. This is included with the capital and operational maintenance cost of each option to develop the NPV inputs.

8 General modelling approach adopted for net benefit analysis

8.1 Analysis period

The RIT-T analysis has been undertaken over a 15-year period, from 2022 to 2036. A 15-year period sufficiently takes into account the size and complexity of the secondary system investment.

As there will be remaining asset life by 2036, a terminal value[15] is calculated to account for capital costs under each credible option.

8.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the NPV of the costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 7%[16] as the central assumption for the cost benefit analysis presented in this report.

Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 3%[17] and an upper bound discount rate of 11% (i.e. a symmetrical upwards adjustment).

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. The number and choice of reasonable scenarios must be appropriate to the credible options under consideration and reflect any variables or parameters that are likely to affect the ranking of the credible options, where the identified need is reliability corrective action[18].

Given the specific and localised nature of the condition issues, the ISP scenarios from the most recent Inputs, Assumptions and Scenarios Report are also not relevant to this RIT-T[19]. The detailed market modelling of future generation and consumption patterns represents a disproportionate cost in relation to the scale of the proposed network investment, and will not materially impact the ranking of options.

Powerlink has considered capital cost, discount rate, maintenance cost and risk cost sensitivities individually and in combination and found that these variables do not affect the relative rankings of the credible options or the identification of the preferred option. As sensitivities do not affect ranking results, Powerlink has elected to present the one central scenario in Table 8.1.

[15] Terminal value was calculated based on remaining asset value using straight-line depreciation over the capital asset life.
[16] This indicative commercial discount rate of 7% is based on the AEMO 2023 Inputs, Assumptions and Scenarios Report, p123.
[17] A discount rate of 3.04% pre-tax real Weighted Average Cost of Capital is based on the most recent AER determination, Final decision: Transgrid transmission determination 1 July 2023 to 30 June 2028.
[18] *AER, Regulatory investment test for transmission,* August 2020, Section 23.
[19] AER, *Regulatory investment test for transmission*, August 2020, Section 20(b).

Table 8.1: Reasonable scenario assumed

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

9 Cost-benefit analysis and identification of the preferred option

9.1 NPV Analysis

Table 9.1 outlines the NPV and the corresponding ranking of each credible option and the corresponding ranking of each credible option, relative to the Base Case.

Table 9.1: NPV of credible options relative to base case ($m)

Option	Central Scenario NPV relative to Base Case ($m)	Ranking
Option 1: Staged Replacement in new building. Stage 1 by June 2025 and Stage 2 by June 2028	-11.9	3
Option 2: Single Stage Replacement in new building by June 2025	-10.2	1
Option 3: Single Stage Replacement in existing building by June 2025	-11.5	2

All credible options will address the identified need on an enduring basis. Option 2 is ranked first, with Option 3 being $1.3 million more expensive compared to Option 2 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: Central scenario NPV components of the Base Case and each credible options ($m, real 22/23)

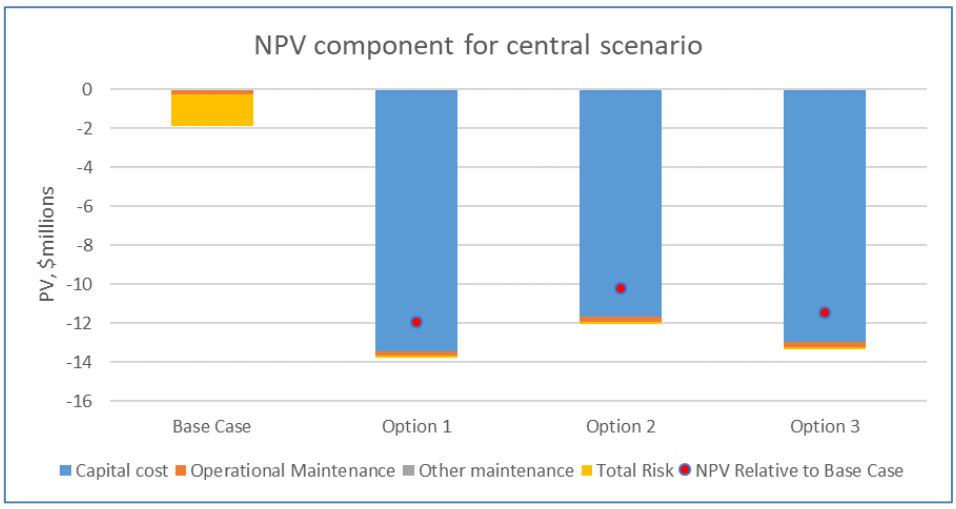


Figure 9.1 illustrates that all credible options will reduce the risk cost compared to the Base Case. Due to the lower capital cost component, Option 2 results in the highest NPV outcome relative to the Base Case when compared to other credible options.

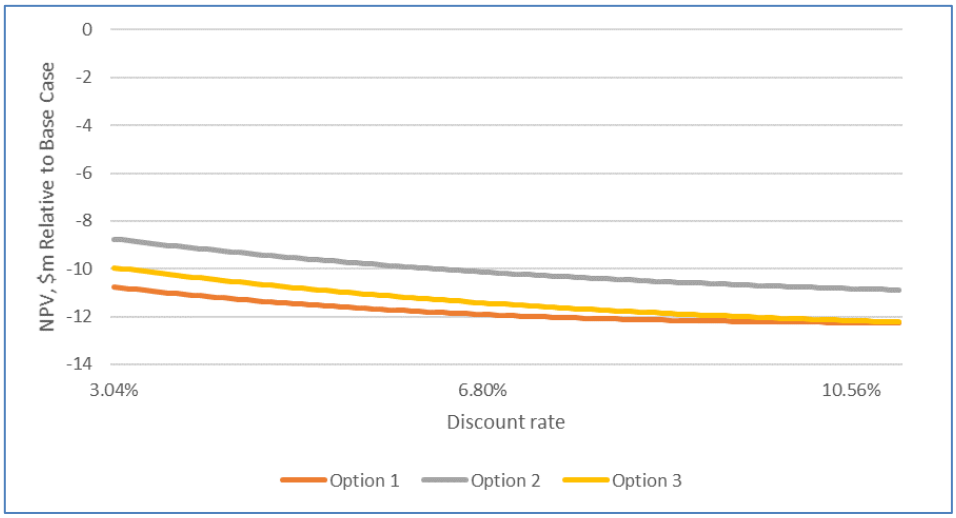
9.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3.04% to 10.96% for discount rate[20]
- a range from 75% to 125% of base capital expenditure estimates.
- a range from 75% to 125% of base risk cost estimates.
- a range from 75% to 125% of base operational maintenance expenditure.

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

Figure 9.2.1 Discount rate sensitivity



[20] Discount rates have been updated from when the PSCR was published in line with the most recent publications referenced. This has had no impact on the relative ranking of options.

Figure 9.2.2 Capital cost sensitivity

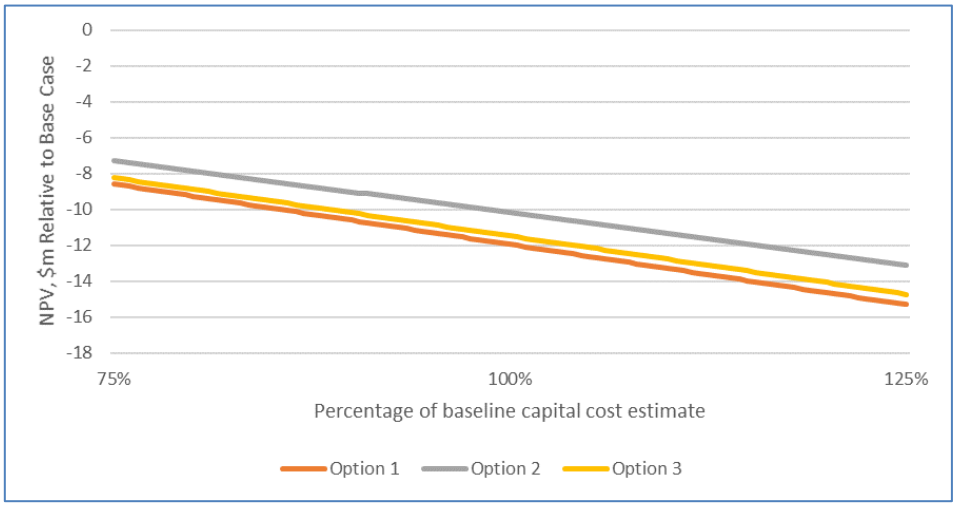


Figure 9.2.3 Risk cost sensitivity

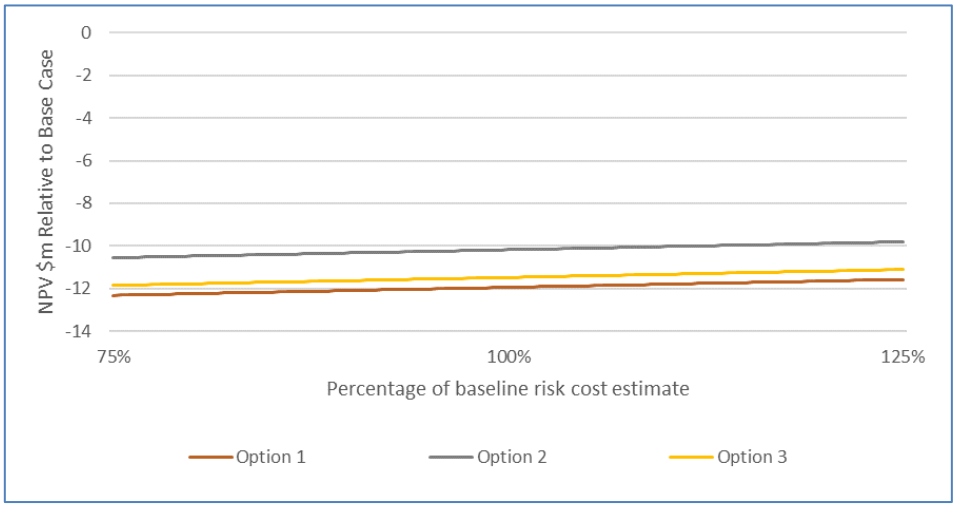
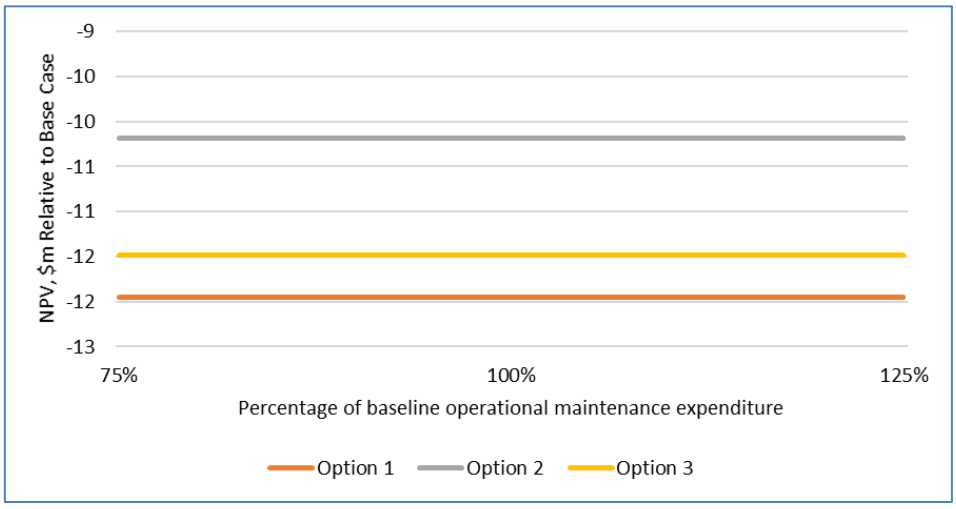


Figure 9.2.4 Maintenance cost sensitivity



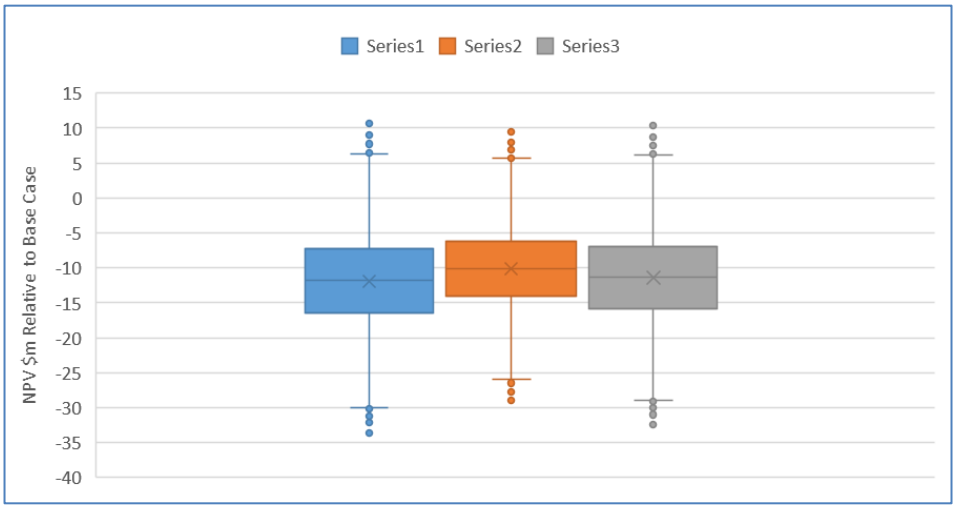
9.3 Sensitivity to multiple parameters

A Monte Carlo simulation was performed 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 is 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 9.3.

The Monte Carlo simulation results identify that Option 2 has similar statistical dispersion in comparison to other credible option and its mean and median is the highest of the three credible options. This confirms that the preferred option, Option 2, is robust over a range of input parameters in combination.

Figure 9.3 NPV sensitivity analysis of multiple key assumptions relative to the Base Case



10 Preferred Option

Based on the conclusions drawn from the cost benefit analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks associated with the deteriorated condition of the aged and obsolete secondary systems infrastructure at Tangkam Substation. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the Rules.

The result of the cost-benefit analysis indicates that Option 2 is the credible option with the lowest net economic cost over the 15-year analysis period. Sensitivity testing shows that the analysis is robust to variations in capital cost, operational maintenance cost, risk cost and discount rate assumptions. Option 2 is therefore considered to satisfy the requirement of the RIT-T and is the preferred option.

11 Conclusion

The following conclusions have been drawn from the analysis presented in this report:

- Powerlink has identified condition risks arising from the ageing and obsolete secondary systems equipment at Tangkam Substation as requiring action.
- S5.1.9(c) of the Rules requires a TNSP to provide sufficient primary protection systems and back-up protection systems (including breaker-fail protection systems) to ensure that a fault of any type anywhere on its transmission system is automatically disconnected.
- TNSPs must also ensure that all protection systems for lines at a voltage above 66kV are well maintained so as to be available at all times other than for short periods (less than eight hours), while the maintenance of a protection system is being carried out.

- The increasing likelihood of faults arising from the condition of the ageing secondary systems and their obsolescence compels Powerlink to undertake reliability corrective action at Tangkam Substation to continue to meet the reliability standards set out in its Transmission Authority. Such action will also ensure Powerlink's ongoing compliance with the Rules' standards for protection system availability and avoiding the impacts of taking primary systems out of service.
- Studies were undertaken to evaluate three credible options. All options were evaluated in accordance with the AER's RIT-T.
- Powerlink published a PSCR in 4 October 2022 requesting submissions from Registered Participants, AEMO and interested parties on the credible options presented, including alternative credible non-network options, which could address the risk of the secondary systems at Tangkam.
- The PSCR also identified the preferred option and that Powerlink was adopting the expedited process for this RIT-T, claiming exemption from producing a PADR as allowed for under the Rules Clause 5.16.4(z1) for investments of this nature.
- There were no submissions received in response to the PSCR, which was open for consultation until 6 January 2023. As result, no additional credible options that could deliver a material market benefits have been identified as part of this RIT-T consultation. The conditions specified under the Rules for exemption have now been fulfilled.
- The result of the cost-benefit analysis under the RIT-T identified that Option 2 provides the least net economic cost over the 15-year analysis period. Sensitivity testing showed the analysis is robust to variations in discount rate, capital expenditure, operational maintenance expenditure and risk cost assumptions. As result, Option 2 is considered to satisfy the RIT-T.
- The outcomes of the cost-benefit analysis contained in this PACR is materially unchanged from those published in the PSCR. Consequently, the draft recommendation has been adopted as the final recommendation and will now be implemented.

12 Final Recommendation

Based on the conclusions drawn from the cost-benefit analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks arising from the condition of the ageing and obsolete secondary systems at Tangkam Substation. Option 2 allows Powerlink to continue to maintain compliance with relevant AEMO standards, Powerlink's Transmission Authority and Schedule 5.1 of the Rules. Powerlink is the proponent of this network project.

Option 2 involves the single stage replacement of all 110kV secondary systems at Tangkam Substation into a new demountable building by June 2025. The indicative capital cost of this option is $14.6 million in 2022/23 prices. Under Option 2, design work will commence in early 2024, with installation and commissioning of the new secondary systems completed by June 2025.

Powerlink will now proceed with the necessary processes to implement this recommendation.

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