Powerlink Queensland

Project Assessment Conclusions Report

10 April 2019

Addressing the secondary systems condition risks at Woree Substation

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 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.
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 consumers. This assessment compares the net present value (NPV) of all credible options to identify the option that provides the greatest economic benefits to the market.
3. This document contains the results of this evaluation, and a final recommended solution to address the secondary system condition risks at Woree Substation from December 2022.

Contents

Executive Summary

Located 6km south of the Cairns Central Business District, Woree Substation is the major 132kV injection point into the Ergon Energy distribution network for Cairns. It also forms part of the far-north zone transmission network, with direct connection to Chalumbin Substation.

As part of its configuration and role, the substation contains a Static Var Compensator (SVC), which helps improve the transfer of electricity across the network by reducing transmission losses, smoothing voltage fluctuations and stabilising power flows.

The secondary systems associated with the SVC and most of the standard substation 132kV and 275kV secondary systems at Woree Substation are reaching the end of their technical service lives, and are no longer supported by the manufacturer, with few spares available.

Secondary systems are the control, protection and communications equipment that are necessary to operate the transmission network and prevent damage to primary systems and SVCs when adverse events occur.

Under the National Electricity Rules ('the Rules'), Transmission Network Service Providers (TNSPs) are required to provide sufficient secondary systems, including redundancies, to ensure the transmission system is protected.

This increased likelihood of faults arising from the ageing and obsolete secondary systems at Woree Substation remaining in service, combined with its TNSP obligations, present Powerlink with a range of operational risks and compliance issues requiring resolution. Since consideration for this investment is driven by an obligation in the National Electricity Rules (the Rules), it is a 'reliability corrective action' under the Regulatory Investment Test for Transmission (RIT-T).

This Project Assessment Conclusions Report (PACR) represents the final step of the RIT-T process prescribed under the Rules undertaken by Powerlink to address the condition risks arising from ageing and obsolete secondary systems at Woree Substation. It contains the results of the planning investigation and cost-benefit analysis of credible options. In accordance with the RIT-T, the credible option that maximises the present value of net economic benefits is recommended for implementation.

Credible options considered

Powerlink identified three credible network options to address the identified need, as presented in Table 1.

Table 1: Summary of credible options

Option	Description	Indicative capital cost ($million, 2018/19)	Indicative average annual operating and maintenance costs ($million, 2018/19
Base Option Replacement of all SVC secondary systems by December 2022 and staged replacement of substation secondary systems in one new building and existing buildings by December 2033	Replace all SVC panels by December 2022*	5.28*	0.11
	Replace selected panels by December 2022*	6.01*	
	Replace selected panels by: December 2025† December 2028† December 2033†	 3.43† 3.03† 0.96†	

Option	Description	Indicative capital cost ($million, 2018/19)	Indicative average annual operating and maintenance costs ($million, 2018/19
Option 1 Replacement of all SVC secondary systems by December 2022 and staged replacement of substation secondary systems in one new building and existing buildings by December 2028	Replace all SVC panels by December 2022*	5.28*	0.11
	Replace selected panels by December 2022*	9.41*	
	Replace selected panels by: December 2028†	3.95†	
Option 2 Replacement of all SVC secondary systems by December 2022 and upfront replacement of all substation secondary systems into 2 new buildings and existing buildings by December 2022	Replace all SVC panels by December 2022*	5.28*	0.07
	Replace all panels by December 2022*	14.46*	

*Proposed RIT-T project
†Modelled projects

Evaluation and conclusion

The RIT-T requires that the proposed preferred option maximises the present value of net economic benefit, or minimises the net cost, to all those who produce, consume and transport electricity in the market. This RIT-T has been undertaken in accordance with the expedited process under the Rules as allowed for investments of this nature.

A Project Specification Consultation Report (PSCR) was originally published in October 2018 (subsequently re-issued in December 2018 as amended by an Addendum) containing a draft recommendation to implement the Base Option; upfront replacement of the SVC secondary systems by December 2022 with the staged replacement of the substation secondary systems by December 2033.

The RIT-T project for the Base Option involves the full replacement of the SVC secondary systems and the replacement of selected substation secondary systems by December 2022 at an estimated capital cost of $11.29 million in 2018/19 prices. Powerlink is the proponent of the proposed network project.

Given the Addendum update to the PSCR, Powerlink extended the consultation period to receive submissions from 25 January 2019 to 15 March 2019. There were no submissions received in response to the PSCR.

As the outcomes of the economic analysis contained in this PACR remain unchanged from those in the PSCR as amended by the Addendum, the draft recommendation has been adopted without change as the final recommendation, and will now be implemented.

In addition, Powerlink will:

- review and refine the timing of subsequent stages of this option, if required, based on the future condition assessments of the risks arising from the remaining substation secondary systems that were not replaced in the first stage
- undertake any necessary additional regulatory consultations at the appropriate time for future investments if required.

1. Introduction

This Project Assessment Conclusions Report (PACR) represents the final step of the RIT-T process[1] prescribed under the Rules undertaken by Powerlink to address the condition risks arising from the ageing and obsolete secondary systems at Woree Substation.

It follows the publication of the Project Specification Consultation Report (PSCR), published in October 2018 and re-issued in December 2018 as amended by an Addendum, adopting the expedited process for this RIT-T, as allowed for under the Rules for investments of this nature which:

- 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 deliver 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 specific RIT-T assessment are unlikely to be material
- identified the preferred option and that Powerlink was claiming an exemption from producing a Project Assessment Draft Report (PADR).

Powerlink identified the Base Option as the preferred option to address the identified need. The RIT-T project for the Base Option involves the full replacement of the SVC secondary systems and the replacement of selected substation secondary systems by December 2022 at an estimated capital cost of $11.29 million in 2018/19 prices.

NER clause 5.16.4(z1) provides for a Transmission Network Service Provider (TNSP) to claim exemption from producing a PADR for a particular RIT-T application if all the following conditions are met:

- the estimated capital cost of the preferred option is less than $41 million
- the preferred option has been identified in the PSCR noting exemption from publishing a PADR
- the preferred option, or other credible options, do not have a material market benefit
- 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[2] that closed on 15 March 2019. 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 all of the conditions are now satisfied, Powerlink has not issued a PADR for this RIT-T and is now publishing this PACR, which:

- describes the identified need and the credible options that Powerlink considers may address the identified need
- 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 net present value (NPV) 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 estimated commissioning date of the preferred option
- describes the consultation process followed for this RIT-T together with the reasons why Powerlink is exempt from producing a PADR.

[1] This RIT-T consultation has been prepared based on the following documents: *National Electricity Rules, Version 113,* 5 October 2018 and AER, *Final Regulatory Investment Test for Transmission Application Guidelines,* September 2017.
[2] Given the Addendum update, Powerlink extended the consultation period to receive submissions to the PSCR from 25 January 2019 to 15 March 2019.

Since this investment is driven by an obligation in the Rules, it is a 'reliability corrective action' under the RIT-T.

2. Identified need

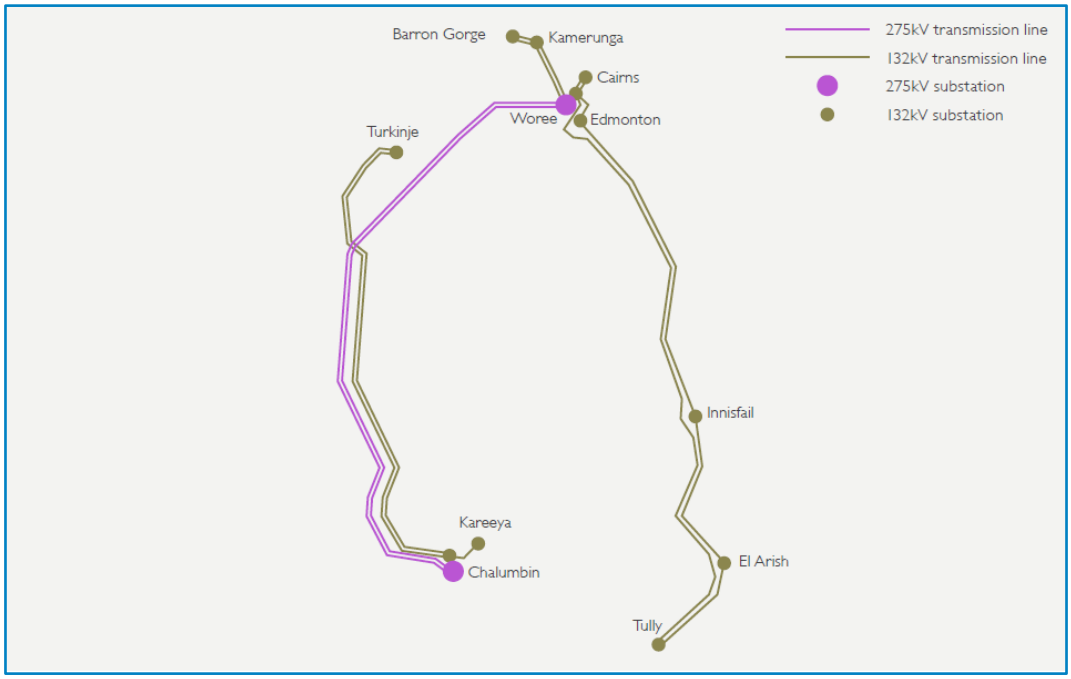
This section provides an overview of the supply arrangements at Woree Substation. It then describes the Rules' obligations relating to secondary systems and summarises the most recent assessment of asset condition and risks relating to the secondary systems at Woree Substation.

2.1 Geographical and network overview

Woree Substation is located approximately 6km south of the Cairns Central Business District (CBD) and sits within the Far North zone transmission network[3]. It was initially established in 2002 as part of a major transmission network reinforcement to meet growing demand in the Cairns area.

In 2005, a 132kV Static Var Compensator (SVC) was installed to improve the transfer of electricity across the Far North zone network by reducing losses and stabilising power flows. A second 275/132kV transformer was installed in 2007.

Figure 2.1: Far North zone transmission network



2.2 Description of identified need

With peak demand in the Cairns area forecast to remain at or slightly above current levels[4], it is vital that electricity supply is maintained to satisfy these demands and for Powerlink to meet its reliability of supply obligations and maintain reliable and safe supply to customers.

Powerlink's condition assessment of the ageing secondary systems assets at Woree has highlighted that the majority are now obsolete and nearing the end of their technical service lives. The majority of the substation's protection, control and supervisory systems are no longer supported by their respective manufacturers nor do they have spare replacement units available for purchase.

[3] This relates to the standard geographic definitions (zones) identified within the Powerlink's Transmission Annual Planning Report, (TAPR) which is published annually by 30 June.
[4] *Powerlink's Transmission Annual Planning Report* 2018

Under the Rules, TNSPs are required to provide sufficient secondary systems, including redundancies, to ensure the transmission system is adequately protected. This places an obligation on Powerlink to undertake actions that address the risks arising from obsolete and ageing secondary system assets at Woree Substation, to maintain compliance with the Rules.

2.3 Assumptions underpinning the identified need

The need to invest is a direct result of the risks arising from ageing and increasingly obsolete secondary systems remaining in service at Woree Substation, for which Powerlink has legal compliance obligations under the Rules. If not addressed, these risks can extend the time taken to recover (or even prevent recovery) from secondary system faults, due to a lack of support from manufacturers and a lack of spare parts.

Specifically, 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[5]. This requirement extends to any communications facilities on which protection systems depend[6].

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[7]. The TNSP may need to take primary systems out of service if protection systems are not restored within the required eight hour timeframe for a planned outage. In the event of an unplanned outage, AEMO's Power System Security Guidelines require that the primary network assets must be taken out of service within 24 hours[8].

Analysis has shown a significant decrease in secondary system availability and reliability at 20 years of effective age. Delaying replacement of secondary system assets beyond this optimal 20 year timeframe places the network at risk due to the prolonged duration of emergency corrective maintenance associated with replacing failed obsolete components.

It follows that the risks arising from the condition of the ageing secondary systems and their obsolescence compels Powerlink to undertake reliability corrective actions at Woree Substation if it is to continue to meet the standards for protection system availability set out in the Rules, and to avoid the impacts of taking primary systems out of service.

2.4 Description of asset obsolescence and risks

The majority of the secondary system components at Woree are approaching the end of their technical service life based on Powerlink's condition assessment. The diminishing availability of spares and the lack of manufactures' support for repairs places an obligation on Powerlink to address the obsolescence risks arising from these ageing assets remaining in service.

With many of the substation's protection and control systems nearing 20 years of age and with few or no spares are available from the respective manufacturers, it is becoming increasingly difficult for Powerlink to service this ageing population of relays, signalling equipment and remote terminal units across its network.

Moreover, the manufacturer of Woree's SVC no longer supports the technologies used in its secondary systems. Delaying replacement of these secondary systems represents a significant risk to the reliability, availability and capability of the SVC. The ability to control network voltages and provide network stability during, and post, contingency events in Cairns and Far North Queensland would be significantly compromised if Woree's SVC is out of service due to failure of obsolete secondary system components.

[5] Clause S5.1.9(c) of the Rules requires that faults are automatically disconnected in accordance with clause S5.1.9 (e) or clause S5.1.9(f)
[6] Clause S5.2.5.9 (2) of the Rules
[7] Clause S5.1.2.1 (d) of the Rules
[8] AEMO Power System Operating Procedure SO_OP_3715 – *Power System Security Guidelines* (the Rules require AEMO to develop and publish Power System Operating Procedures pursuant to clause 4.10.1(b) of the Rules, which Powerlink must comply with, per clause 4.10.2(b)).

The inability to repair, replace or otherwise resolve secondary system faults in a timely manner has operational consequences, as this reduces the overall resilience of the transmission network to subsequent forced outages.

Powerlink has undertaken a comprehensive condition assessment of the at-risk equipment using an asset health index that evaluates:

- equipment functional failure rates (failure to operate as intended)
- environmental conditions where the assets are installed and
- equipment physical and effective age.

Health indices are modelled in the range from zero (0) to ten (10), where zero represents new assets and ten indicates that the asset requires immediate action to address its increasing risk of unreliable operation. The impact of equipment obsolescence is also considered when determining if remedial action is required.

A summary of health index scores and recommended actions for the SVC secondary systems and each group of 132kV and 275kV secondary systems at Woree is set out in Table 2.1.

Table 2.1: Summary of secondary system health index scores at Woree Substation

Bay	Construction year	Health index (average)	Description
11x Feeder Bays Protection and Control	2002 - 2007	5.7 – 10.0 (7.5)	Majority of equipment is obsolete, with insufficient spares to support ongoing operation. Technologies and protocols used in these obsolete systems make substitution with new components technically and economically unviable on a network wide basis. Remedial action required
2x Transformer Bays Protection and Control	2002 - 2007	7.5 – 9.8 (7.8)	
2x Capacitor Bays Protection and Control	2005 - 2006	6.1	
2x Bus & Bus Coupler Bays Control and Circuit Breaker Fail	2002 - 2005	*6.1 – 7.5* *(6.4)*	
Non-bay secondary systems (includes OpsWAN, RTUs, SCADA)	2001 - 2004	6.1 - 10.0 (8.5)	
SVC Protection and Control	2005	5.9 – 10.0 (6.2)	Manufacturers no longer support the technologies used, with insufficient spares to support ongoing operation. Remedial action required

Obsolescence increases the time needed by Powerlink to address system faults, potentially up to several weeks as panel wiring and test plans are needed on an individual basis. The inability to repair, replace or otherwise resolve secondary system faults in a timely manner has operational consequences, as this reduces the overall resilience of the transmission network to subsequent forced outages.

3. Submissions received

Powerlink published a PSCR in October 2018, with an Addendum issued in December 2018, calling for submissions from Registered Participants, AEMO and interested parties on the credible options presented, including alternative credible non-network options that could address the risks arising from the ageing and obsolete secondary systems at Woree Substation.

There were no submissions received in response to the PSCR as amended by Addendum published in December 2018 that was open for consultation until 15 March 2019. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation.

4. Credible options assessed in this RIT-T

Powerlink has developed three credible network options to address the identified need at Woree Substation:

- Base Option: Upfront replacement of SVC secondary systems by December 2022 with staged replacement of the substation secondary systems by December 2033
- Option 1: Upfront replacement of SVC secondary systems by December 2022 with staged replacement of the substation secondary systems by December 2028
- Option 2: Upfront replacement of SVC secondary systems and substation secondary systems by December 2022.

The following systems and equipment are to be replaced by the final stage of all options.

Table 4.1 Summary of components to be replaced

System	Type
Protection and control system (Full panel replacement)	9x 132kV feeders – Woree (plus minor remote ends work) 2x 275kV feeders – Woree (plus minor remote ends work) 2x 275/132kV transformers 3x 132kV Bus Zones 2x 132kV Bus Couplers 2x 132kV Capacitor Banks 1x 132kV SVC
Ancillary systems and equipment	1x building - communication RTU 2x buildings - common RTUs Master Station, OpsWan terminals and port servers 132kV High speed monitoring system 132kV Power quality monitoring system 2x 275kV feeders - communications infrastructure 4x 132kV feeders - communications infrastructure 2x 132kV feeder metering panels AC distribution board SVC DC battery system Cable trenches and cable termination racks for new building(s)

Indicative costs for each credible option are presented in Table 4.2, and are based on Powerlink estimates[9].

[9] Powerlink has a robust estimating process that takes into consideration construction costs of recently completed projects, exchange rates on equipment and current labor market trends.

Table 4.2 Summary of credible options and indicative costs

Option	Description	Indicative capital cost ($million, 2018/19)	Indicative average annual operating and maintenance costs ($million, 2018/19
Base Option Replacement of all SVC secondary systems by December 2022 and staged replacement of substation secondary systems in one new building and existing buildings by December 2033	Replace all SVC panels by December 2022*	5.28*	0.11
	Replace selected panels by December 2022*	6.01*	
	Replace selected panels by: December 2025† December 2028† December 2033†	 3.43† 3.03† 0.96†	
Option 1 Replacement of all SVC secondary systems by December 2022 and staged replacement of substation secondary systems in one new building and existing buildings by December 2028	Replace all SVC panels by December 2022*	5.28*	0.11
	Replace selected panels by December 2022*	9.41*	
	Replace selected panels by: December 2028†	3.95†	
Option 2 Replacement of all SVC secondary systems by December 2022 and upfront replacement of all substation secondary systems into 2 new buildings and existing buildings by December 2022	Replace all SVC panels by December 2022*	5.28*	0.07
	Replace all panels by December 2022*	14.46*	

*Proposed RIT-T project
†Modelled projects

All of the credible options address the identified need and are technically and economically feasible, and able to be implemented in sufficient time. This avoids a situation where corrective maintenance of ageing and obsolete assets is no longer practical. None of these options has been discussed by the Australian Energy Market Operator (AEMO) in its most recent National Transmission Network Development Plan (NTNDP).[10]

Additional options that have been considered but not progressed, due to not being either economically or technical feasible are listed in Appendix 1 of the PSCR.

4.1 Base Option: Replacement of SVC secondary systems by December 2022 with staged replacement of substation secondary systems by December 2033

Powerlink is the proponent of this option.

The Base Option involves the upfront replacement of all of the SVC secondary systems and selected replacement of the substation 132kV and 275kV secondary systems by December 2022. A new building is required to be installed to house the 132kV secondary systems installed in this first stage.

The remainder of the obsolete and aged substation 132kV and 275kV secondary systems are replaced over three subsequent stages in 2025, 2028 and 2033.

[10] 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 NTNDP. The 2016 NTNDP is currently the most recent NTNDP.

This option seeks to maximise the life of the existing systems and remove the need for a second additional building.

Major cost components are shown in Table 4.3.

Table 4.3: Main project components for the Base Option

Component	Description	Indicative capital cost ($million, 2018/19)
RIT-T Project		
Completion December 2022	Replace SVC secondary systems	5.28
	Replace protection and control systems and ancillary equipment for the following bays: 9 feeder, 1 bus coupler, 1 transformer	6.01
Modelled Projects		
Completion December 2025	Replace protection and control systems and ancillary equipment for the following bays: 1 cap bank, 2 bus, 1 bus coupler	3.43
Completion December 2028	Replace protection and control systems and ancillary equipment, including revenue meters for the following bays:1 transformer, 2 feeder, 1 cap bank, 1 bus	3.03
Completion December 2033	Replace high speed and power quality monitoring systems	0.96

4.2 Option 1: Replacement of SVC secondary systems by December 2022 with staged replacement of substation secondary systems by December 2028

Powerlink is the proponent of this option.

Option 1 involves the upfront replacement of all of the SVC secondary systems and selected replacement of the substation 132kV and 275kV secondary systems by December 2022. A new control building is required to be installed to house the 132kV secondary systems installed in this first stage.

The remainder of the obsolete and aged substation 132kV and 275kV secondary systems are replaced in a second stage by December 2028.

This option seeks to optimise the life of existing systems as well as reducing the required number of outages and the number of times specialised resources would need to be mobilised to site.

Major cost components are shown in Table 4.4 below.

Table 4.4: Main project components for Option 1

Component	Description	Indicative capital cost ($million, 2018/19)
RIT-T Project		
Completion December 2022	Replace SVC secondary systems	5.28
	Replace protection and control systems and ancillary equipment for the following bays: 11 feeder, 1 bus, 2 bus coupler, 2 cap banks, 1 transformer	9.41
Modelled Projects		
Completion December 2028	Replace protection and control systems and ancillary equipment for the following bays: 1 transformer, 1 bus. Replace high speed and power quality monitoring systems and meters on 2 feeders.	3.95

4.3 Option 2 – Replacement of SVC secondary systems and substation secondary systems by December 2022

Powerlink is the proponent of this option.

Option 2 involves the upfront replacement of the SVC secondary systems and substation secondary systems by December 2022. This option involves the installation of two new control buildings to house the new 132kV secondary systems equipment.

This option seeks to minimise the required number of outages and maximise the effectiveness of a single mobilisation to site by using the existing building plus two modular buildings pre-fitted with all required panels and shipped to site.

Major cost components are shown in Table 4.5 below.

Table 4.5: Main project components for Option 2

Component	Description	Indicative capital cost ($million, 2018/19)
RIT-T Project		
Completion December 2022	Replace SVC secondary systems	5.28
	Replace all substation secondary systems	14.46

4.4 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[11].

[11] 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.

5. Materiality of Market Benefits

Powerlink does not consider that the replacement of secondary systems at Woree Substation will provide any market benefits due to the nature of the project.

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

None of the replacement options will have an impact on wholesale market outcomes. The Australian Energy Regulator (AER) has recognised that if the proposed investment will not have an impact on the wholesale market, then a number of classes of market benefits will not be material in the RIT-T assessment[12]. Consequently, no market benefits have been estimated as part of this RIT-T.

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

6. General modelling approach adopted to assess net benefits

6.1 Analysis period

The RIT-T analysis has been undertaken over a 15-year period, from 2021 to 2035. A 15-year period takes into account the size and complexity of the secondary systems.

As new secondary systems have an operational life of 20 years, there will be some remaining asset life by 2035 under each option, at which point a terminal value is calculated to correctly account for capital costs under each credible option.

6.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the NPV of costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 7.04%[13] as the central assumption for the NPV analysis presented in this report.

Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 3.47%[14] and an upper bound discount rate of 10.61% (i.e. a symmetrical upwards adjustment).

6.3 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.

The choice of reasonable scenarios must reflect any variables or parameters that are likely to affect the ranking of the credible options, where the identified need is reliability corrective action[15].

Powerlink has considered capital costs and discount rate sensitivities individually and in combination and found that these variables do not affect the relative rankings of credible options or identification of the preferred option. As sensitivities (both individually and in combination) do not affect ranking results, Powerlink has elected to present one central scenario in Table 6.1 below.

[12] AER, *Final Regulatory Investment Test for Transmission Application Guidelines,* September 2017, version 2, page 13.
[13] This indicative commercial discount rate has been calculated on the assumptions that a private investment in the electricity sector would hold an investment grade credit rating and have a return on equity equal to an average firm on the Australian stock exchange, as well as a debt gearing ratio equal to an average firm on the Australian stock exchange.
[14] A discount rate of 3.47 per cent is based on the AER's Final Decision for Powerlink's 2017-2022 transmission determination, which allowed a nominal vanilla WACC of 6.0 per cent and forecast inflation of 2.45 per cent that implies a real discount rate of 3.47 per cent. See AER, *Final Decision: Powerlink transmission determination 2017-2022 | Attachment 3 – Rate of return*, April 2017, p 9.
[15] AER, *Final Regulatory Investment Test for Transmission*, June 2010, version 1, paragraph 16, p. 7

Table 6.1: Reasonable scenario assumed

Key variable/parameter	Central scenario
Capital costs	100% of central capital cost estimate
Discount rate	7.04%

7. Cost-benefit analysis and identification of the preferred option

7.1 Net present values

The NPV of each credible option, along with its corresponding ranking, is summarised in Table 7.1.

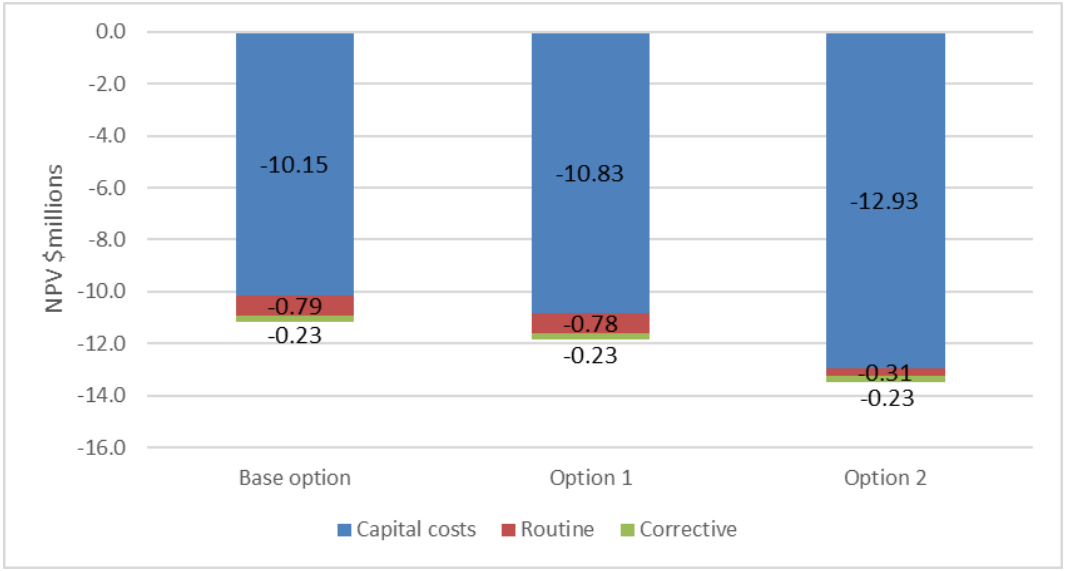
Table 7.1: NPV for each credible option (NPV, $million 2018/19)

Option	Central Scenario NPV ($m)	Ranking
Base Option	-11.16	1
Option 1	-11.83	2
Option 2	-13.47	3

When comparing Options 1 and 2 to the Base Option, Option 1 cost is $0.67 million more and Option 2 cost is $2.31 million more in NPV terms.

Figure 7.1 below sets out the breakdown of capital cost and operating costs for each option in NPV terms under the central scenario, highlighting the relatively small contribution of operating costs to the overall NPV and the impact of capital costs on the final outcome. The Base Option and Option 1 have higher maintenance due to costs associated with building structural restoration, which is not required in Option 2.

Figure 7.1: NPV component for each credible option (NPV $m, 2018/19)



7.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a 25% increase/decrease in capital costs
- a lower discount rate of 3.47% as well as a higher rate of 10.61%.

Sensitivity tests show that the Base Option is the preferred option under all sensitivities (both considered individually and in combination).

7.3 Preferred option

Based on the conclusions drawn from the NPV analysis, the technical characteristics of each option and the Rules' requirements relating to the proposed replacement of transmission network assets, it is recommended that the Base Option be implemented to address the risks arising from the ageing and obsolete secondary systems at Woree Substation.

Sensitivity testing shows the economic analysis is robust to variations in the capital cost and the discount rate assumptions. The Base Option is therefore considered to satisfy the requirements of the RIT-T and is the proposed preferred option.

8. Conclusions

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

- Powerlink has identified condition risks arising from ageing and obsolete secondary systems at Woree Substation 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 ageing secondary systems and their obsolescence compels Powerlink to undertake reliability corrective actions at Woree Substation to ensure ongoing compliance with the NER standards for protection system availability and avoid the impacts of taking primary systems out of service.
- Studies were undertaken to evaluate three credible options. All three credible options were evaluated in accordance with the AER's RIT-T.
- Powerlink published a PSCR in October 2018, followed by a PSCR as amended by Addendum issued in December 2018:

  (i) requesting submissions from Registered Participants and interested parties on the credible options presented, including alternative credible non-network options which could address the secondary systems condition risks at Woree Substation

  (ii) identifying 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 NER clause 5.16.4(z1) for investments of this nature.
- There were no submissions received in response to the extended consultation period which was open until 15 March 2019 (following the publication of the PSCR as amended by Addendum). As a result, no additional credible options that could deliver a material market benefit 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 the Base Option is the highest net benefit solution over the 15-year analysis period. Sensitivity testing showed the analysis is robust to variations in the capital cost and discount rate assumptions. As a result, the Base Option is considered to satisfy the RIT-T.
- The outcomes of the economic analysis contained in this PACR remain unchanged from those published in the PSCR as amended by Addendum. Consequently, the draft recommendation has been adopted without change as the final recommendation and will now be implemented.

9. Final Recommendation

Based on the conclusions drawn from the NPV analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that the Base Option be implemented to address the condition risks arising from ageing and obsolete secondary systems at Woree Substation.

Under the Base Option, work on designing and procuring the SVC secondary systems will commence in early 2021, with final commissioning by December 2022. Design and procurement for the substation secondary systems replacement work to be carried out under the RIT-T project will commence in late 2021, with commissioning completed by December 2022.

With this option it is currently envisaged that the remaining aged substation secondary systems will be progressively replaced in three subsequent stages; the first in 2025, the second in 2028 and the third in 2033. This staged approach allows for a review of the condition of the remaining secondary systems equipment prior to each stage, to reassess the need for remedial action at that point in time.

Powerlink will:

- review and refine the timing of subsequent stages as required at a later date based on future condition assessments of the risks arising from those assets remaining in service
- undertake any necessary additional regulatory consultations at the appropriate time for future investments if required.

The indicative capital cost of the RIT-T project for the preferred option is $11.29 million in 2018/19 prices.

Powerlink is the proponent of the proposed network project.

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

Contact us

Registered office	33 Harold St Virginia Queensland 4014 Australia
Postal address:	GPO Box 1193 Virginia Queensland 4014 Australia
Contact:	Roger Smith Manager Network and Alternate Solutions
Telephone	(+617) 3860 2328 (during business hours)
Email	networkassessments@powerlink.com.au
Internet	www.powerlink.com.au