Powerlink Queensland

Project Specification Consultation Report

29 October 2018

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. The main purpose of this document is to provide details of the identified need, credible options, technical characteristics of non-network options, and categories of market benefits addressed in the assessment. In particular, it seeks information from potential proponents of feasible non-network options to address the identified need.

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Executive Summary

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

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.

Powerlink is required to apply the RIT-T to this investment

This investment is driven by an obligation under the Rules, and is classified as a 'reliability corrective action' under the RIT-T.

Four credible options have been identified to address the need

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 and 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*	4.36*	
	Replace selected panels by: December 2025† December 2028† December 2033†	 2.22† 1.96† 0.64†	
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*	6.52*	
	Replace selected panels by: December 2028†	 2.54†	

Option	Description	Indicative capital cost ($million, 2018/19)	Indicative average annual operating and maintenance costs ($million, 2018/19
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*	9.64*****	

*****Proposed RIT-T project
†Modelled projects

The Base Option reflects a conventional approach to ensuring continued compliance with the secondary systems obligations in the Rules and has been selected to serve as the basis of comparison between options. Due to space limitations in the existing buildings at Woree, the Base Option requires the addition of a new building.

This option has then been compared with two other options in which the ageing secondary systems are replaced using a variety of building options and completion dates.

Powerlink has also considered whether non-network options could address the identified need. A non-network option that avoids replacement of secondary systems would need to replicate the support that Woree Substation provides Powerlink and Ergon in meeting their reliability obligations on an enduring basis at a cost that is lower than the network options under consideration.

Powerlink welcomes submissions from potential proponents who consider that they could offer a credible non-network option that is both economically and technically feasible.

Base Option has been identified as the preferred option

Due to the nature of the investment, none of the options considered, including the preferred option, are expected to give rise to market benefits. The difference between the options relates primarily to differences in capital costs and timing. The net present value (NPV) analysis demonstrates the Base Option is the lowest cost option. (Refer to Table 2)

Table 2: NPV of credible options (NPV, $m 2018/19)

Option	Central Scenario NPV ($m)	Ranking
Base Option	-9.24	1
Option 1	-9.60	2
Option 2	-10.43	3

Powerlink has identified the Base Option as the preferred option for the following reasons:

- lowest cost in NPV terms
- maximised life of current equipment

Under the Base Option design and procurement work for the RIT-T project will commence in late 2021 for the SVC secondary systems and in mid-2022 for the 132kV and 275kV secondary systems. Commissioning of the Base Option will be completed by December 2022.

The indicative capital cost of the RIT-T project for the preferred option is $9.64 million in 2018/19 prices.

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.

Submissions

Powerlink welcomes written submissions on this *Project Specification Consultation Report*. Submissions are particularly sought on the credible options presented.

Submissions are due on or before Friday 25 January 2019.

Please address submissions to:

Roger Smith
Manager, Network and Alternate Solutions
Network Portfolio
Powerlink Queensland
PO Box 1193
VIRGINIA QLD 4014
Tel: (07) 3860 2328
networkassessments@powerlink.com.au

1. Introduction

Powerlink Queensland is a Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM) that owns, develops, operates and maintains Queensland's high-voltage electricity transmission network. This network transfers bulk power from Queensland power stations to electricity distributors Energex and Ergon Energy (part of the Energy Queensland Group), Essential Energy and to a range of large industrial customers.

Powerlink's approach to asset management includes a commitment to sustainable asset management practices that ensure Powerlink provides a valued transmission service to its customers by managing risk,[1] optimizing performance and efficiently managing assets through the whole of asset life cycle[2].

The secondary systems associated with the Woree Static Var Compensator (SVC) and most of the substation's standard 132kV and 275kV secondary systems are nearing the end of their technical service lives and are now obsolete (i.e. no longer supported by the manufacturer with few spares available), or will become obsolete in the near future. Secondary systems refer to control, protection and communications equipment that are necessary to operate the transmission network and prevent damage to primary systems[3] when adverse events occur.

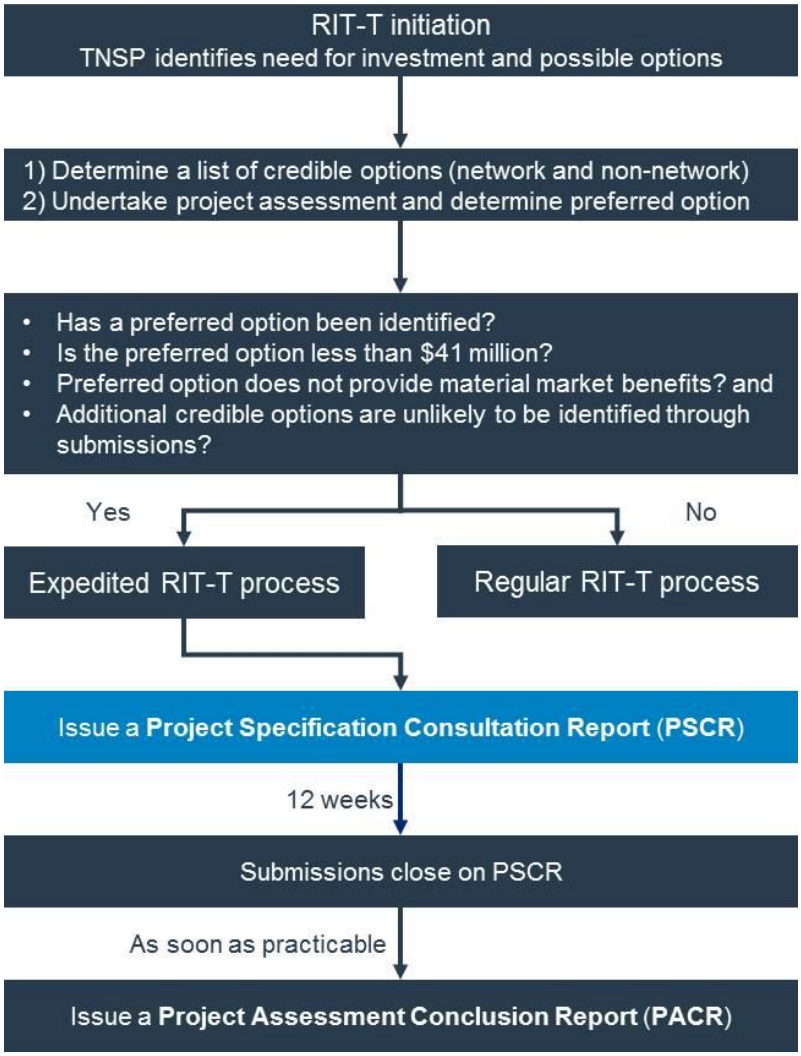
This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process[4]. It:

- describes the reasons why Powerlink has determined that investment is necessary (the 'identified need'), together with the assumptions used in identifying this need
- provides potential proponents of non-network options with information on the technical characteristics that a non-network solution would need to deliver, in order to assist proponents in considering whether they could offer an alternative solution
- describes the credible options that Powerlink currently considers may address the identified need
- discusses why Powerlink does not expect market benefits to be material for this RIT-T[5]
- presents the net present value (NPV) assessment of each of the credible options (as well as the methodologies and assumptions underlying these results)
- identifies and provides a detailed description of the credible option that satisfies the RIT-T, and is therefore the preferred option
- provides stakeholders with the opportunity to comment on this assessment so that Powerlink can refine the analysis (if required) as part of the Project Assessment Conclusions Report (PACR).

Figure 1.1 outlines the RIT-T process.

[1] Risk assessments are underpinned by Powerlink's corporate risk management framework and the application of a range of risk assessment methodologies set out in AS/NZS ISO31000:201809 *Risk Management Guidelines*.
[2] Powerlink aligns asset management processes and practices with AS ISO55000:2014 *Asset Management – Overview, principles and terminology* to ensure a consistent approach is applied throughout the life cycle of assets
[3] Primary systems include the switchgear at Woree and the transmission lines connected to Woree.
[4] 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.
[5] As required by clause 5.16.1(c)(iv) of the Rules.

Figure 1.1: RIT-T process overview



Powerlink has adopted the expedited process for this RIT-T, as allowed for under the Rules for investments of this nature.[6]

Specifically, Powerlink is proposing to publish a PACR following public consultation on this PSCR and apply the exemption from publishing a Project Assessment Draft Report (PADR) as:

- the preferred option has an estimated capital cost of less than $41 million
- none of the credible options have material market benefits
- Powerlink has identified its preferred option in this PSCR (together with the supporting quantitative cost benefit analysis)
- Powerlink does not envisage that additional credible options which could deliver material market benefits will be identified through the submission process, given the nature of this secondary system replacement project.

Powerlink will however publish a PADR if submissions to this PSCR identify other credible options that have not yet been considered and which could provide a material market benefit.

[6] In accordance with clause 5.16.4(z1) of the Rules

2. Identified need

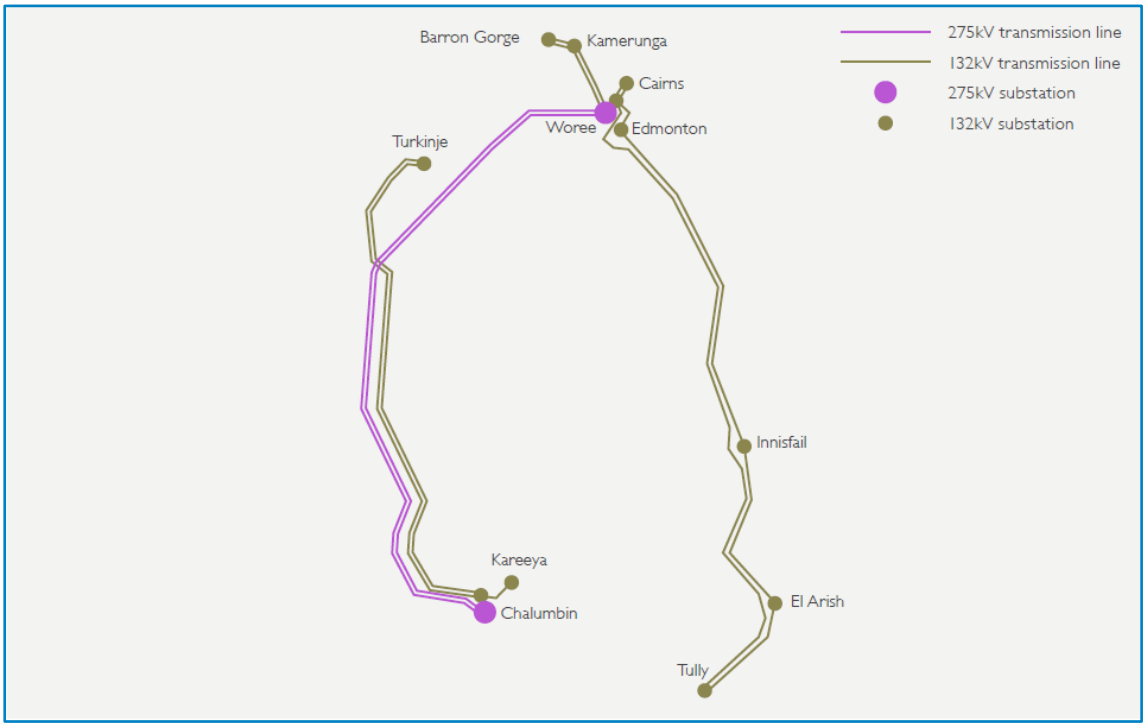
This section provides an overview of the supply arrangements at Woree Substation. It then describes the Rules' obligations relating to secondary systems and summarises the most recent assessment of asset condition and risks relating to the secondary systems at Woree Substation.

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[7]. 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[8], it is vital that electricity supply is maintained to satisfy these demands and for Powerlink to meet its reliability of supply obligations.

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.

[7] 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.
[8] *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[9]. This requirement extends to any communications facilities on which protection systems depend[10].

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[11]. 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[12].

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 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 place 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 are nearing 20 years of age and 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 terminals across its network.

Moreover, the manufacturer of Woree's SVC no longer support 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.

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.

[9] 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)
[10] Clause S5.2.5.9 (2) of the Rules
[11] Clause S5.1.2.1 (d) of the Rules
[12] 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)).

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. Required technical characteristics for non-network options

The information provided in this section is intended to enable interested parties to formulate and propose genuine and practicable non-network solutions such as, but not limited to, local generation and Demand Side Management (DSM) initiatives.

Powerlink identified in its Transmission Annual Planning Reports (TAPRs) 2016 - 2018, an expectation that action would be required at Woree Substation to maintain reliability of supply requirements in the Far North transmission zone.[13]

Powerlink has consulted with Registered Participants, Powerlink's Non-Network Engagement Stakeholder Register and interested parties on the proposed investment at Woree Substation as part of TAPR publication and through associated engagement activities. No submissions proposing credible and genuine non-network options were received from prospective solution providers in the normal course of business or in response to TAPRs. As a result Powerlink is currently not aware of any non-network options that could be adopted. However, Powerlink will investigate the feasibility of any potential non-network option proposed or otherwise identified.

This PSCR provides a further opportunity for providers of feasible non-network options to submit details of their proposals for consideration.

3.1 Criteria for proposed network support services

A non-network solution that avoids replacement of the secondary systems at Woree would need to replicate the functionality, capacity and reliability of the substation on an enduring basis at a cost that is lower than the network options currently under consideration.

Woree Substation provides injection and switching to the Cairns area of up to 285MW at peak. Voltage stability governs the maximum supportable power transfer that can be injected into the Cairns area, as such, the Woree SVC is considered vital to provide voltage support to this region.

Powerlink has identified the following common criteria that must be satisfied if any proposed non-network solutions are to meet supply requirements[14].

Size and location

Proposed solutions must be large enough, individually or collectively, to provide the size of injection or demand response set out above. However, the level of support is dependent on the location, type of network support and load forecasts.

- Due to the bulk nature of the transmission network, aggregation of sub 10MW non-network solutions will be the sole responsibility of the non-network provider.
- Notwithstanding the location of any solution, each proposal would require assessment in relation to technical constraints pertinent to the network connection, such as other intra-regional transfer limits, fault level or quality of supply impacts of operation.

Operation

- A non-network option would need to be capable of operating continuously 24 hours per day over a period of years.
- If a generation service is proposed (either standalone or in conjunction with other services), such operation will be required regardless of the pool price[15].
- Proponents of generation services are advised that network support payments are intended for output that can be demonstrated to be additional to the plant's normal operation in the NEM.

[13] 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.
[14] Powerlink's Network Support Contracting Framework has been developed as a general guide to assist potential non-network solution providers. This framework outlines the key contracting principles that are likely to appear in any non-network support agreement.
[15] The National Electricity Rules prevent a generator that is providing network support from setting the market price.

Reliability

- Proposed services must be capable of reliably meeting electricity demand under a range of conditions and, if a generator must meet all relevant National Electricity Rules requirements related to grid connection.
- Powerlink has obligations under the National Electricity Rules, its Transmission Authority and connection agreements to ensure supply reliability is maintained to its customers. Failure to meet these obligations may give rise to liability. Proponents of non-network options must also be willing to accept any liability that may arise from its contribution to a reliability of supply failure.

Timeframe and certainty

- Proposed services must be able to be implemented in sufficient time to meet the identified need using proven technology and, where not already in operation, provision of information in relation to development status such as financial funding and development timeline to support delivery within the required timeframe must be provided.

Duration

- The agreement duration for any proposed service will provide sufficient flexibility to ensure that Powerlink is pursuing the most economic long run investment to address the secondary systems condition risks at Woree Substation.

Powerlink welcomes submissions from potential proponents who consider that they could offer a credible non-network option that is both economically and technically feasible.

4. Details of credible option to address the identified need

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)

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).[16]

Indicative costs for each credible option are presented in Table 4.2, and are based on Powerlink estimates[17].

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

[16] 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.
[17] 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 and 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*	4.36*	
	Replace selected panels by: December 2025† December 2028† December 2033†	 2.22† 1.96† 0.64†	
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*	6.52*	
	Replace selected panels by: December 2028†	 2.54†	
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*	9.64*	

*Proposed RIT-T project
†Modelled projects

4.1 Selection of a Base Option

Powerlink has undertaken this RIT-T assessment using a Base Option that reflects the conventional approach that would otherwise be implemented by Powerlink to ensure ongoing compliance with the Rules' obligations to maintain operational protection systems.

Given the specific nature of the Rules' obligations relating to protection, control and data systems, the conventional option reflects the replacement of the current ageing and obsolete secondary systems when they reach the end of technical service life, rather than an option in which the current systems are run to failure with an escalating risk of unserved energy and reactive maintenance costs.

The failure of any individual secondary system at the Woree Substation would not necessarily lead to unserved energy, given the requirement in the Rules to maintain redundancy in protection systems. However, while networks are typically resilient to isolated faults, the assumption of running a fleet of secondary systems to failure leads to a higher likelihood of multiple concurrent systemic faults. This could result in substantial unserved energy and overwhelm Powerlink's capacity to undertake corrective maintenance or replacement projects.

In a worst-case scenario, running fleets of secondary systems to failure could lead to cascading blackouts across the network. Powerlink does not therefore consider that this would be a credible base case against which to conduct the RIT-T assessment, as it is far removed from accepted practice.

4.2 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.

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	**4.36**
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	**2.22**
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	**1.96**
Completion December 2033	Replace high speed and power quality monitoring systems	**0.64**

4.3 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	**6.52**
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.	**2.54**

4.4 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	**9.64**

4.5 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[18].

[18] 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 secondary systems replacement at Woree Substation would provide any market benefits due to the nature of the project. None of the secondary systems replacement options will have an impact on wholesale market outcomes. The 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, and so do not need to be estimated.[19]

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

A discussion of each market benefit under the RIT-T is presented below:

- **changes in patterns of generation dispatch**: replacement of secondary systems by itself does not affect transmission network constraints or affect transmission flows that would change patterns of generation dispatch. It follows that changes through different patterns of generation dispatch are not material to the outcome of the RIT-T assessment
- **changes in voluntary load curtailment**: a secondary systems fault by itself does not affect prices in the wholesale electricity market. It follows that changes in voluntary load curtailment will not be material for the purposes of this RIT-T
- **changes in involuntary load shedding**: as discussed above, secondary systems faults by themselves do not necessarily lead to unserved energy as redundancies are built into transmission network at a broader level. These redundancies mitigate the risk of involuntary load shedding in the event of secondary systems faults to a negligible level
- **changes in costs for other parties**: the effect of replacing secondary systems under the credible options considered are localised to the substation they are located at and do not affect the capacity of transmission network assets and therefore are unlikely to change generation investment patterns (which are captured under the RIT-T category of 'costs for other parties')
- **differences in the timing of expenditure**: credible options for secondary systems replacement do not affect the capacity of transmission network assets, the way they operate, or transmission flows. Accordingly, differences in the timing of expenditure of unrelated transmission investments are unlikely to be affected
- **changes in network losses**: credible options are not expected to provide any changes in network losses as replacing secondary systems does not affect the characteristics of primary transmission assets
- **changes in ancillary services cost**: there is no expected change to the costs of Frequency Control Ancillary Services (FCAS), Network Control Ancillary Services (NCAS), or System Restart Ancillary Services (SRAS) due to credible options under consideration. These costs are therefore not material to the outcome of the RIT-T assessment
- **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.

[19] AER, *Regulatory investment test for transmission application guidelines,* September 2017, version 2, pp13-14

5.2 Consideration of market benefits for non-network options

Powerlink notes that non-network options may impact the wholesale electricity market (for example by displacing generation output). Accordingly, it is possible that several of the above classes of market benefits may be material where there are credible non-network options, depending on the specific form of the option.

Where credible non-network options are identified as part of the consultation process on this PSCR, Powerlink intends on assessing the materiality of market benefits arising from these options. Where the market benefits are considered to be material, these will be quantified as part of the RIT-T assessment of these options.

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%[20] 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%[21] 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[22].

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.

Table 6.1: Reasonable scenario assumed

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

[20] 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.
[21] 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.
[22] AER, *Final Regulatory Investment Test for Transmission*, June 2010, version 1, paragraph 16, p. 7

7. Cost benefit analysis and identification of the preferred option

Table 7.1 outlines the net present value and the corresponding ranking of each credible option.

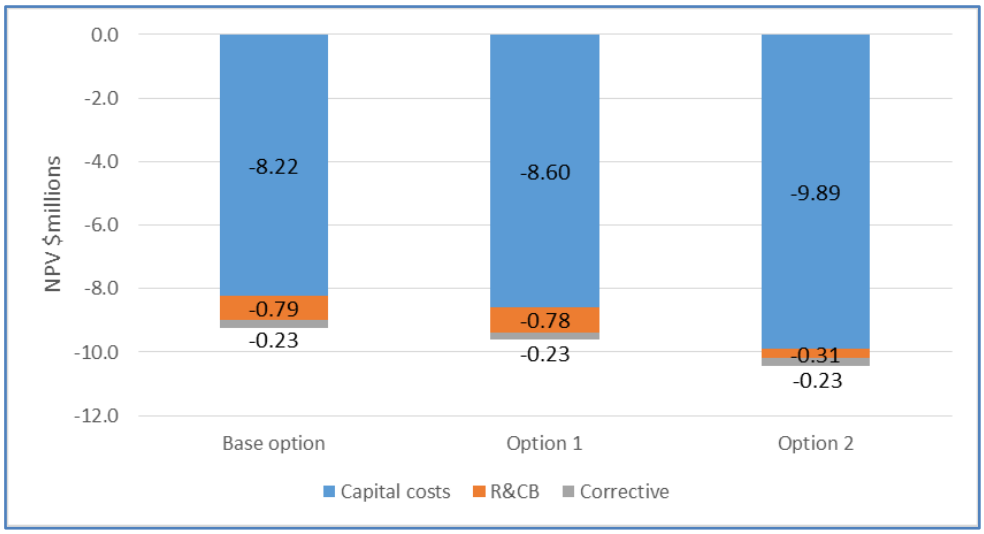
Table 7.1: NPV for each credible option (NPV, $million 2018/19)

Option	Central Scenario NPV ($m)	Ranking
Base Option	-9.24	1
Option 1	-9.60	2
Option 2	-10.43	3

When comparing Options 1 and 2 to the Base Option, Option 1 cost is $0.36m more and Option 2 cost is $1.19m 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)



7.1 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).

7.2 Conclusion

The result of the cost benefit analysis indicates that the Base Option is the highest net benefit solution (lowest cost in NPV terms) over the 15-year period of analysis. Sensitivity testing shows the analysis is robust to variations in the capital cost and the discount rate assumptions. The Base Option is therefore considered to satisfy the requirement of the RIT-T and is the proposed preferred option.

8. Draft 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 risks arising from the 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 this 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 $9.64 million in 2018/19 prices.

9. Submissions requirements

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

Submissions should be presented in a written form and should clearly identify the author of the submission, including contact details for subsequent follow-up if required. If parties prefer, they may request to meet with Powerlink ahead of providing a written response.

9.1 Submissions from non-network providers

This is not a tender process – submissions are requested so that Powerlink can fulfil its regulatory obligations to analyse non-network options. In the event that a non-network option appears to be a genuine and practicable alternative that could satisfy the RIT-T, Powerlink will engage with that proponent or proponents to clarify cost inputs and commercial terms.

Submissions from potential non-network providers should contain the following information:

- details of the party making the submission (or proposing the service)
- technical details of the project (capacity, proposed connection point if relevant, etc.) to allow an assessment of the likely impacts on future supply capability
- sufficient information to allow the costs and benefits of the proposed service to be incorporated in a comparison in accordance with AER RIT-T guidelines
- an assessment of the ability of the proposed service to meet the technical requirements of the Rules
- timing of the availability of the proposed service
- other material that would be relevant in the assessment of the proposed service.

As the submissions will be made public, any commercially sensitive material, or material that the party making the submission does not want to be made public, should be clearly identified.

It should be noted that Powerlink is required to publish the outcomes of the RIT-T analysis. If parties making submissions elect not to provide specific project cost data for commercial-in-confidence reasons, Powerlink may rely on cost estimates from independent specialist sources.

9.2 Assessment and decision process

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

Part 1	PSCR (including PADR exemption)	29 October 2018
	Submissions due on the PSCR Have your say on the credible options and potential non-network options.	25 January 2019
Part 2	Publication of the PACR Responding to any submissions received and making a final recommendation on the preferred option for implementation.	February 2019

Powerlink reserves the right to amend the timetable at any time. Amendments to the timetable will be made available on the Powerlink website (www.powerlink.com.au).

Appendix 1: Options considered but not progressed

Table A1: Options considered but not progressed

Option description	Reason for not progressing option
A two stage replacement of the Woree SVC secondary systems in 2022 and 2025 combined with the various options of replacing the substation secondary systems presented in this report.	The option of staging the replacement of the Woree SVC secondary systems was compared with the option of replacing all SVC secondary systems in one stage in 2022. Preliminary economic analysis showed the option to replace the secondary systems in a single stage in 2022 to be the most economical solution, while the single staged replacement also has operational and logistical benefits, requiring less outages and a single mobilisation of staff to work on the SVC secondary systems.

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