Powerlink Queensland

# Project Specification Consultation Report

29 October 2018

# Maintaining power transfer capability and reliability of supply at Ross 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.

## Contents

# Executive Summary

## Ageing and obsolete primary plant at Ross Substation require Powerlink to take action

Ross Substation was first established in the 1983 and is an essential switching station for 275kV power transfer from central to north and far north Queensland, as well as the major injection point for the Townsville area distribution network. Three 275/132kV transformers provide the bulk supply of electricity to Townsville and the surrounding area via Powerlink substations at Townsville South, Millchester, Alan Sherriff, Dan Gleeson, Kidston and Yabulu South.

At over 35 years of age, much of the substation's primary plant is reaching the end of its technical service life and is no longer supported by the manufacturer, with few spares available.

The increasing likelihood of faults arising from Ross Substation's ageing and obsolete primary plant remaining in service, places the network at risk of being unable to meet current and forecast energy demands.

Powerlink's obligations as a Transmission Network Service Provider (TNSP) require it to maintain (including repair and replace if necessary) its transmission grid to ensure the adequate, economic, reliable and safe transmission of electricity, including the ability to meet peak demand if a major element of the network was to fail.

The increased likelihood of faults combined with its TNSP obligations present Powerlink with a number of operational and safety risks, as well as 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.

## Three credible options have been formulated to address the identified need

The Base Option reflects a conventional replacement strategy that seeks to maximise the life of the existing plant while ensuring continued compliance with the Rules and serves as the basis of comparison between options. This approach involves the refurbishment of the existing earth switches and disconnectors by October 2024, along with the replacement of selected ageing and obsolete 132kV and 275kV circuit breakers, surge arrestors and current and voltage transformers in two stages by October 2024 and October 2038.

This has then been compared with two other credible network options.

Option 1 involves the same two stage replacement of the ageing and obsolete 132kV and 275kV plant as the Base Option, but with the addition of new circuit breakers for transformer 4 and feeder 8858, as well as the replacement of the existing live tank circuit breaker on the Static Var Compensator (SVC) with a dead tank circuit breaker (DTB) in 2024. As in the Base Option, the existing earth switches and disconnectors are refurbished by October 2024.

Option 2 involves the upfront replacement of all of the ageing and obsolete 275kV primary plant, including the existing earth switches and disconnectors, by October 2024 and the same two stage replacement of the ageing and obsolete 132kV plant by October 2038.

All options are designed to provide the Townsville area with a reliable, cost effective supply and ensure that the switching capabilities of the substation are maintained on an ongoing basis.

A summary of the credible options is given in Table 1.

Table 1: Summary of credible primary plant options

| Option | Description | Indicative project costs ($million, 2018/19) | Indicative annual average O&M costs ($million, 2018/19) |
|---|---|---|---|
| Base Option<br>Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 16 dead tank circuit breakers | Refurbishment of selected earth switches and disconnectors by October 2024[#] | 3.43[#] | 0.16 |
| | Replacement of selected primary plant by October 2024***** | 22.63***** | |
| | Replacement of remaining ageing and obsolete 132kV and 275kV plant by October 2038**†** | 10.82**†** | |
| Option 1<br>Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 20 dead tank circuit breakers | Refurbishment of selected earth switches and disconnectors by October 2024[#] | 3.43[#] | 0.16 |
| | Replacement of selected equipment including 4 new DTBs for the SVC, transformer 4 and feeder 8858 by October 2024***** | 22.66***** | |
| | Replacement of remaining ageing and obsolete 132kV and 275kV plant by October 2038**†** | 11.45**†** | |
| Option 2<br>Upfront replacement of all ageing and obsolete 275kV primary plant by October 2024. Two stage replacement of selected 132kV primary plant by October 2038 | Upfront replacement of all ageing and obsolete 275kV plant by October 2024* | 13.16* | 0.14 |
| | Replacement of selected 132kV equipment by October 2024***** | 11.21* | |
| | Replacement of remaining ageing and obsolete 132kV plant by October 2038**†** | 2.29**†** | |

[#]Modelled operational project
*****Proposed RIT-T project
**†**Modelled capital project

Powerlink has also considered whether non-network options could address the identified need. A non-network option that avoids replacement of the ageing primary plant would need to replicate the support that Ross Substation provides Powerlink and Ergon Energy in meeting their reliability of supply 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.

Option 2 has been identified as the preferred option.

Due to the nature of the investment, none of the credible options considered are expected to give rise to material market benefits. The major differences between the options relate to their capital costs, the technology employed and timing.

The net present value (NPV) analysis demonstrates that Option 2 provides the lowest cost solution.

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

| Option | NPV ($m) | Ranking |
|---|---|---|
| Base option | -24.69 | 2 |
| Option 1 | -24.84 | 3 |
| Option 2 | -21.17 | 1 |

Powerlink recommends the Option 2 for the following reasons:

- lowest cost in NPV terms
- optimised life of existing plant.

The staged approach of this option also allows for a review of the condition of the plant prior to each stage to reassess the need for remedial action at that point in time.

Ross substation is a large and critical substation for the supply of electricity to the Townsville area and more broadly into north Queensland. The long lead time for this project allows for the staging of the complex outage plans associated with this project and the efficient co-ordination of these outages with other projects in the Townsville area. Under Option 2, design work will commence in mid-2019. Installation of the new circuit breakers and selected primary plant will be completed by October 2024.

The indicative capital cost of this option, including modelled future works, is $26.66 million in 2018/19 prices. The indicative capital cost of the RIT-T project for the preferred option is $24.37 million.

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:

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# 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), 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]

Under the Electricity Act 1994, Powerlink is required to operate, maintain (including repair and replace if necessary) and protect its transmission grid to ensure the adequate, economic, reliable and safe transmission of electricity. The ageing primary plant at Ross Substation is nearing the end of its technical service life and is increasingly at risk of failure, with many items of equipment no longer supported by the manufacturers and few spares available. Under the Rules, Powerlink must take action to address this risk within the RIT-T framework.

This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process[3]. 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 certain market benefits to be material for this RIT-T[4]
- presents the 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 Conclusion Report (PACR).

Figure 1.1 outlines the RIT-T process.

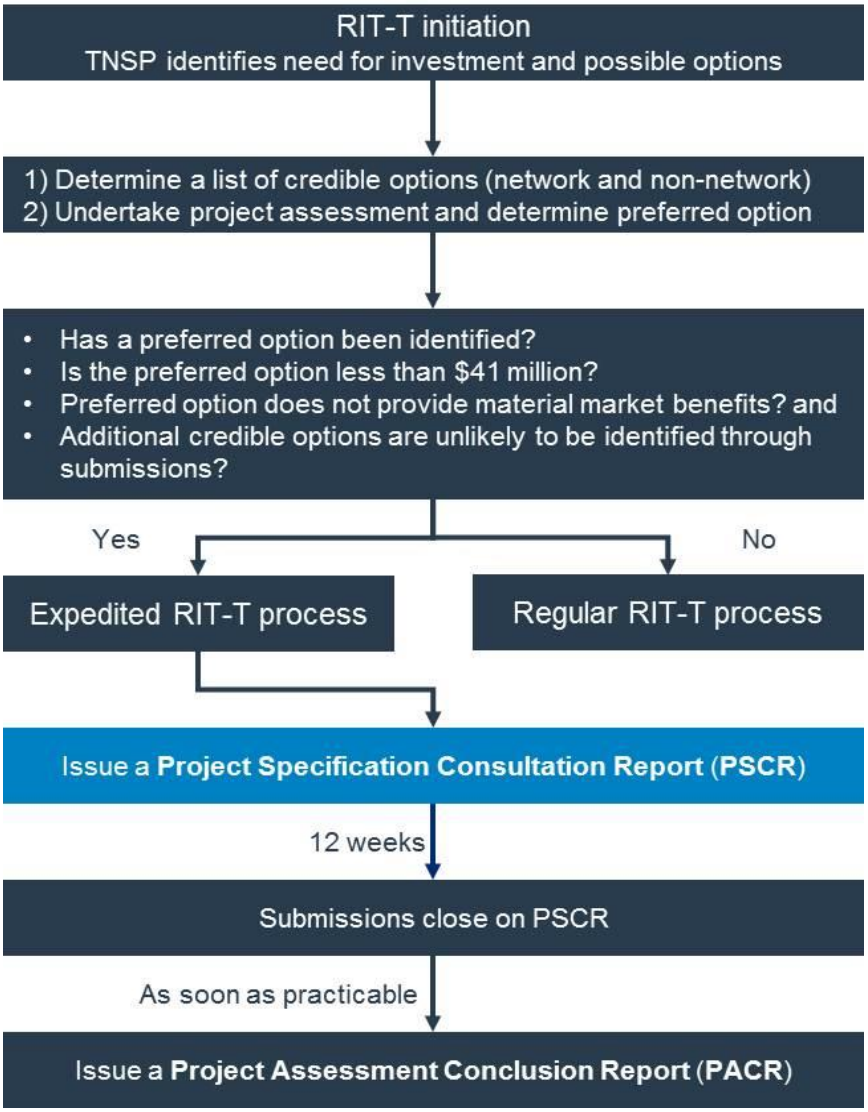
[1] Risk assessments are underpinned by Powerlink's corporate risk management framework and the application of a range of risk assessment methodologies set out in AS/NZS ISO31000:2018 *Risk Management Guidelines*.

[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] 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.

[4] 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.[5]

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 primary plant 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.

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

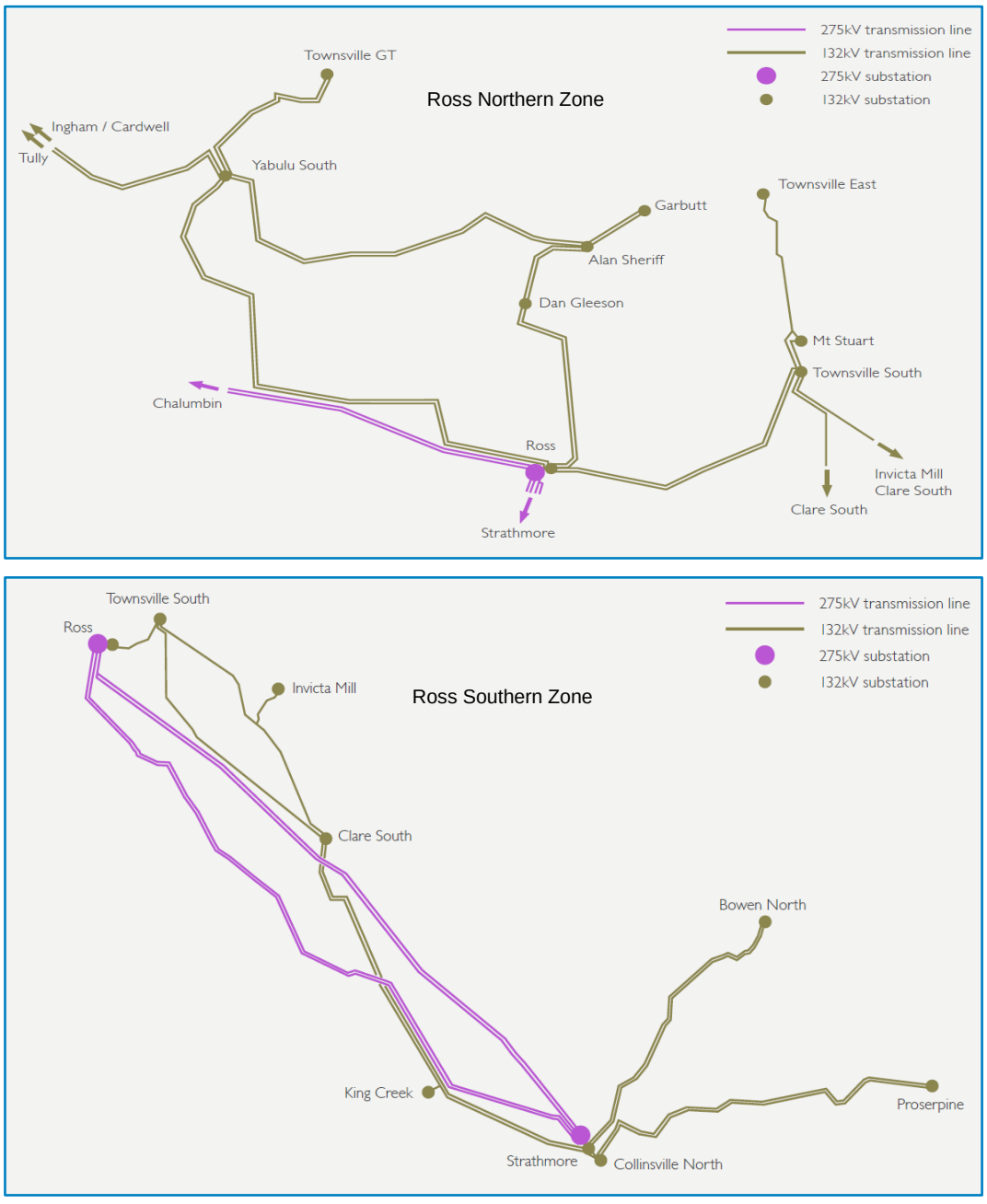
# 2 Identified need

This section provides an overview of the existing arrangements at Ross Substation and describes the increasing risk to reliability of supply in the Townsville area and more broadly into north Queensland, due to the assessed deteriorated condition of selected primary plant assets at the substation.

## 2.1 Geographical and network need

Ross Substation is located approximately 14 kilometres south west of Townsville in north Queensland and is part of the Ross transmission zone. Established in the mid-1980s it is a 275/132kV substation with multiple functions. It provides the major injection point to the Ergon Energy distribution network in the Townsville area via six 132kV Powerlink substations, acts as the marshalling point for the transfer of electricity between Strathmore in central Queensland and Chalumbin in far north Queensland and connects a direct customer to the transmission network. The Ross transmission zone is shown in Figure 2.1.

Figure 2.1: Ross transmission zone



## 2.2 Description of identified need

With peak demand in the Townsville area forecast to remain at or slightly above current levels[6], it is vital that electricity supply be maintained to satisfy these demands and for Powerlink to meet its reliability of supply obligations.

Powerlink's condition assessment of the ageing primary plant assets at Ross Substation has highlighted that many are nearing the end of their technical service lives. The majority of the Substation's original primary plant, including circuit breakers, is no longer supported by their respective manufacturers, with few or no spares available.

A number of age-related issues are also impacting the performance and safety of several current transformers on site.

### 2.2.1 Assumptions underpinning the identified need

The need to invest is driven by Powerlink's obligations to address the increasing risks to supply arising from ageing and obsolete primary plant assets at Ross Substation.

If not addressed, these risks can lead to plant failures and extend the time taken to recover (or even prevent recovery) from faults, due to a lack of support from manufacturers and a lack of spare parts.

Powerlink's obligations as a TNSP[7] require it to maintain (including repair and replace if necessary) its transmission grid to ensure the adequate, economic, reliable and safe transmission of electricity, including the ability to meet peak demand if a major element of the network was to fail.

It follows that the increasing likelihood of faults arising from ageing assets remaining in service at Ross Substation compels Powerlink to undertake reliability corrective actions if it is to continue to meet its jurisdictional obligations and the standards for reliability of supply set out in the Rules.

### 2.2.2 Description of asset condition and risks

Ross Substation was established in the 1984 to service the growing demand in Townsville and to facilitate the transfer of electricity between central and far-north Queensland. While a number of primary plant additions and replacements were undertaken between the late-1990s and 2015, the majority of the original equipment is still in service and being maintained with an increasingly limited stock of spare parts and without manufacturer support for repairs.

Powerlink has undertaken a comprehensive condition assessment of the primary plant at Ross Substation. This has identified that due to age related deterioration there is a significant amount of equipment reaching the end of its technical service life with an increasing risk of failure. The primary plant at Ross Substation that has been identified as requiring remedial action consists primarily of circuit breakers, surge arrestors, current and voltage transformers, earth switches and disconnectors, located throughout the substation.

The original 132kV circuit breakers are no longer supported by the manufacturer and have begun to experience a number of age related failures due to deterioration of their air compressor systems and pneumatic operating mechanisms, motor lock outs and pole discrepancies. Similar deterioration and obsolescence issues exist with the original 275kV circuit breakers, with the air compressor systems failing and over half suffering gas leaks. The deteriorated state of these original 132kV and 275kV circuit breakers has resulted in an increasing frequency of unplanned outages and prolonged repair times due to the lack of spares and no manufacturer support. These breakers also have asbestos impregnated washers of friable nature requiring extra safety precautions when working on the units.

With few or no spares available from the respective manufacturers, it is becoming increasingly difficult for Powerlink to service this ageing population of circuit breakers more broadly across the Powerlink transmission network.

[6] *Powerlink's Transmission Annual Planning Report* 2018
[7] Schedule 5.1a System Standards and 5.1.2 Network Reliability of the Rules, Electricity Act 1994 and Queensland Transmission Authority T01/98

The majority of the substation's oil filled current transformers have been in service for over 33 years, with routine oil analysis indicating an increasing degradation of their electrical insulation performance, along with high levels of acetylene. They are also experiencing oil leaks and integrity issues with their seals. Given the current condition and age of the current transformers the potential for failure of their porcelain housings poses an increasingly unacceptable safety risk. There are similar safety risks around the potential failure of the original capacitor voltage transformers and surge arrestors with porcelain housings.

The onset of advanced corrosion is impacting the structures and hardware of those disconnectors and earth switches installed in the mid to late 1980's, with associated deterioration of their contacts. A number of these units are also beginning to experience gearbox issues with few spare parts available for repairs.

Poor asset condition increases the risk of faults, while obsolescence increases the time needed for Powerlink to undertake any necessary repairs. The potential in-service failure of ageing and obsolete primary plant at Ross presents Powerlink with a range of unacceptable safety risks and unserved energy levels beyond those specified in its jurisdictional obligations.[8]

The commissioning date of all credible network options identified in this RIT-T has been delayed by 22 months to October 2024 from the proposed commissioning date advised in the 2018 TAPR of December 2022. This is due to the necessary staging of the complex outage plans associated with this project and the efficient co-ordination of these outages with other projects in the Townsville area. In order to manage any safety or network risks that may emerge as a result of the extended delivery timeframe of this project, additional inspections will be undertaken to closely monitor the condition of the ageing and obsolete 132kV and 275kV primary plant. Corrective actions will be identified and implemented as required.

[8] S 34(1), Electricity Act 1994; Division 2 Duties of care, Electrical Safety Act 2002; Queensland Transmission Authority T01/98

# 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 Report (TAPR) 2018 an expectation that action would be required at Ross Substation to maintain reliability of supply requirements in the Ross zone.[9]

Powerlink has consulted with Registered Participants, Powerlink's Non-Network Engagement Stakeholder Register and interested parties on the proposed investment at this substation as part of the TAPR publication and 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 the TAPRs. As a result, Powerlink is currently not aware of any non-network options that could be adopted, but 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 option that avoids replacement of the ageing primary plant would need to replicate the functionality, capacity and reliability of the Ross Substation on an enduring basis at a cost that is lower than the network options currently under consideration.

Consequently, any non-network option would need to provide injection or demand response at Ross of over 400MW at peak (comprised of the summer medium growth forecast for Energy Queensland and Powerlink customers connected to Ross Substation).

Powerlink has identified the following common criteria that must be satisfied if proposed network support services are to meet supply requirements.[10]

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.[11]
- 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.

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

[10] 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.

[11] 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 condition risks at Ross 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 Potential credible network options to address the identified need

Powerlink has developed three credible network options to address the identified need for maintaining power transfer capabilities and reliability of supply at Ross Substation.

- Base Option: Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 16 dead tank circuit breakers
- Option 1: Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 20 dead tank circuit breakers
- Option 2: Upfront replacement of all ageing and obsolete 275kV primary plant by October 2024. Two stage replacement of selected 132kV primary plant by October 2038.

Table 4.1: Summary of credible options

| Option | Description | Indicative project costs ($million, 2018/19) | Indicative annual average O&M costs ($million, 2018/19) |
|---|---|---|---|
| Base Option<br>Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 16 dead tank circuit breakers | Refurbishment of selected earth switches and disconnectors by October 2024[#] | 3.43[#] | 0.16 |
| | Replacement of selected primary plant by October 2024***** | 22.63***** | |
| | Replacement of remaining ageing and obsolete 132kV and 275kV plant by October 2038**†** | 10.82**†** | |
| Option 1<br>Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 20 dead tank circuit breakers | Refurbishment of selected earth switches and disconnectors by October 2024[#] | 3.43[#] | 0.16 |
| | Replacement of selected primary plant, including four new DTBs for the SVC, transformer 4 and feeder 8858 by October 2024 | 22.66***** | |
| | Replacement of remaining ageing and obsolete 132kV and 275kV plant by October 2038**†** | 11.45**†** | |
| Option 2<br>Upfront replacement of all ageing and obsolete 275kV primary plant by October 2024. Two stage replacement of selected 132kV primary plant by October 2038 | Upfront replacement of all ageing and obsolete 275kV plant by October 2024* | 13.16* | 0.14 |
| | Replacement of selected 132kV equipment by October 2024***** | 11.21* | |
| | Replacement of remaining ageing and obsolete 132kV plant by October 2038**†** | 2.29**†** | |

[#]Modelled operational project
*****Proposed RIT-T project
**†**Modelled capital project

It should be noted that in all options, the 132kV work is identical, with the ageing and obsolete equipment being replaced in two stages in 2024 and 2038.

All credible options address the ageing primary plant at Ross Substation. The Base Option and Option 1 seek to optimise the technical service life of existing primary plant, while Option 2 seeks to minimise mobilisation costs and outages. None of these options has been discussed by the Australian Energy Market Operator (AEMO) in its most recent National Transmission Network Development Plan (NTNDP).[12]

Additional options that have been considered but not progressed, for technical or economic reasons, are listed in Appendix 1.

The primary plant to be installed under all options is summarised in Table 4.2

Table 4.2: Primary Plant to be installed under all credible network options by October 2038

| HV Primary Plant | Number |
|---|---|
| Current Transformers | 65 |
| Surge Arrestors | 33 |
| Voltage Transformers | 16 |
| Live Tank Circuit Breakers | 1[+] |
| Dead Tank Circuit Breakers | 20[++] |
| Earth Switches | 39 |
| Disconnectors | 44 |

[+] A single live tank circuit breaker will be used for the SVC in the Base Option only
[++] Base Option will have 16 dead tank circuit breakers replaced.

## 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. It maximises the technical service life of the disconnectors and earth switches and addresses the immediate risks arising from the remaining primary plant. This base option provides a benchmark against which to assess other credible options.

## 4.2 Base Option: Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 16 dead tank circuit breakers

Powerlink is the proponent of this option.

This option involves the refurbishment of the existing 275kV earth switches and disconnectors by October 2024. Selected 132kV and 275kV circuit breakers, current and voltage transformers and surge arrestors would be replaced by October 2024. The remaining ageing and obsolete primary plant would be replaced by October 2038, including the refurbished disconnectors and earth switches.

This option seeks to optimise the life of the existing plant and minimise installation costs by using like for like plant.

[12] 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.

Table 4.3: Main project components for the Base Option

| Base Option | Description | Indicative cost ($million, 2018/19) |
|---|---|---|
| Modelled Operational Project | | |
| Refurbishment of selected earth switches and disconnectors by October 2024 | Refurbishment of the 275kV disconnectors and earth switches on their existing structures and foundations | 3.43 |
| RIT - Project | | |
| Replacement of selected primary plant by October 2024 | Replacement of selected 132kV and 275kV primary plant, including 16 dead tank circuit breakers | 22.63 |
| Modelled Capital Project | | |
| Replacement of remaining primary plant by October 2038 | Replacement of remaining ageing and obsolete 132kV and 275kV primary plant including earth switches and disconnectors. | 10.82 |
| **TOTAL** | | **36.88** |

## 4.3 Option 1: Two stage replacement of selected 132kV and 275kV primary plant by October 2038, including 20 dead tank circuit breakers.

Powerlink is the proponent of this option.

This option involves the refurbishment of the existing 275kV earth switches and disconnectors by October 2024. Selected 132kV and 275kV circuit breakers, current and voltage transformers and surge arrestors would be replaced by October 2024, along with four new DTBs for the SVC, transformer 4 and feeder 8858. The remaining ageing and obsolete primary plant would then be replaced by October 2038, including the refurbished disconnectors and earth switches.

This option seeks to optimise the life of the existing plant and standardise the fleet of circuit breakers by replacing the current live tank circuit breaker on the SVC with a dead tank unit as well as installing new dead tank circuit breakers to transformer 4 and feeder 8858.

Table 4.4: Main project components for Option 1

| Option 1 | Description | Indicative cost ($million, 2018/19) |
|---|---|---|
| Modelled Operational Project | | |
| Refurbishment of selected earth switches and disconnectors by October 2024 | Refurbishment of the 275kV disconnectors and earth switches on their existing structures and foundations | 3.43 |
| RIT - Project | | |
| Replacement of selected primary plant by October 2024 | Replacement of selected 132kV and 275kV primary plant, including 20 dead tank circuit breakers | 22.66 |
| Modelled Capital Project | | |
| Replacement of remaining primary plant by October 2038 | Replacement of remaining ageing and obsolete 132kV and 275kV primary plant including earth switches and disconnectors | 11.45 |
| **TOTAL** | | **37.53** |

## 4.4 Option 2: Upfront replacement of all ageing and obsolete 275kV primary plant by October 2024. Two stage replacement of selected 132kV primary plant by October 2038

Powerlink is the proponent of this option.

Under this option selected 132kV primary plant would be replaced in by October 2024, along with all ageing and obsolete 275kV plant, including the existing disconnectors and earth switches. A total of 20 dead tank circuit breakers would be installed.

The remaining ageing and obsolete 132kV plant would be replaced by October 2038.

This option seeks to optimise the life of the 132kV plant, standardise the fleet of circuit breakers and minimise the number of outages and mobilisation costs associated with the 275kV plant replacement.

Table 4.5: Main project components for Option 2

| Option 2 | Description | Indicative cost ($million, 2018/19) |
|---|---|---|
| RIT-T Project | | |
| Upfront replacement of all ageing and obsolete 275kV primary plant by October 2024 | Replacement of all ageing and obsolete 275kV primary plant including earth switches and disconnectors and a total of 20 dead tank circuit breakers. | 13.16 |
| Replacement of selected 132kV equipment by October 2024 | Replacement of selected 132kV primary plant | 11.21 |
| Modelled Capital Project | | |
| Replacement of remaining 132kV primary plant by October 2038 | Replacement of remaining ageing and obsolete 132kV primary plant | 2.29 |
| **TOTAL** | | **26.66** |

## 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.[13]

[13] 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 proposed works at Ross Substation will provide any market benefits, due to the nature of the project. None of the 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[14].

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

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

- **changes patterns of generation dispatch**: replacement under the credible options does not by itself affect transmission network constraints or affect transmission flows that would change patterns of generation dispatch. It follows that changes in patterns of generation dispatch are not material to the outcome of the RIT-T assessment
- **changes in voluntary load curtailment**: replacement under the credible options does not by itself 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**: replacement under the credible options considered are unlikely to result in changes to involuntary load shedding
- **changes in costs for other parties**: the effect of replacing the ageing assets under the credible options considered are localised to the substation they are located at and do not affect the capacity of transmission network assets and therefore is unlikely to change generation investment patterns (which are captured under the RIT-T category of 'costs for other parties')
- **differences in the timing of expenditure**: credible options for asset replacement do not affect the capacity of transmission network assets, the way they operate, or transmission flows. Accordingly, differences in the timing of expenditure of unrelated transmission investments are unlikely to be affected
- **changes in network losses**: credible options are not expected to provide any changes in network losses as replacing the ageing assets has no material effect on the characteristics of the asset
- **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.

[14] 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 associated with 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 35-year period, from 2020 to 2054. A 35-year period takes into account the size and complexity of the primary plant.

Due to the staged nature of the options, there will remaining asset life by 2054, 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%[15] 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%[16] 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[17] are likely to affect the ranking of the credible options, where the identified need is reliability corrective action

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.

Table 6.1: Reasonable scenario assumed

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

[15] 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.
[16] 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.
[17] 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

## 7.1 NPV Analysis

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

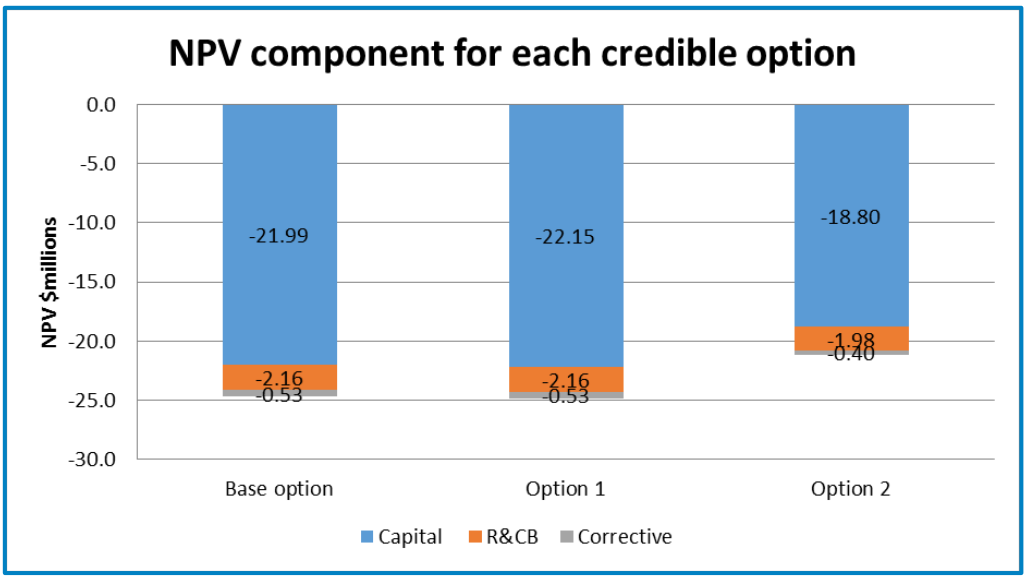
Table 7.1: NPV for each credible option ($m, 2018/19)

| Option | Description | NPV ($m) | Relative NPV to Base Option ($m) | Ranking |
|---|---|---|---|---|
| Base Option | Staged like for like replacement of selected 132kV and 275kV primary plant by October 2038 | -24.69 | - | 2 |
| Option 1 | Staged replacement of selected 132kV and 275kV primary plant including a dead tank breaker for the SVC by October 2038 | -24.84 | -0.15 | 3 |
| Option 2 | Upfront replacement of 275kV primary plant by October 2024. Staged replacement of selected 132kV primary plant by October 2038 | -21.17 | +3.51 | 1 |

Relative to the Base Option, Option 1 is $0.15m more expensive and Option 2 is $3.51m less expensive in NPV terms.

Figure 7.1 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. Option 2 has relatively lower maintenance costs due to larger proportions of plant being replaced at early stage.

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% and a higher discount rate of 10.61%

These sensitivity tests show that the Option 2 is the preferred option under all sensitivities (both considered together and in combination).

## 7.3 Conclusion

The result of the cost benefit analysis indicates that Option 2 is the highest net benefit solution (lowest cost in NPV terms) over the 35-year period of analysis. Sensitivity testing shows the analysis is robust to variations in the capital cost and the discount rate assumptions.

Option 2 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 Option 2 be implemented to address the risks associated with ageing infrastructure at Ross Substation.

Option 2 involves replacing all ageing and obsolete 275kV primary plant and selected 132kV primary plant by October 2024. This option minimises the number of outages and mobilisation costs associated with the 275kV plant replacement. Remaining ageing and obsolete 132kV primary plant will be replaced in 2038, which optimises the life of the 132kV plant. The maintenance costs for Option 2 are also reduced, as larger proportions of plant will be replaced at an early stage with dead tank circuit breakers.

The indicative capital cost of this option, including modelled future works, is $26.66 million in 2018/19 prices, with $24.37 million committed under this RIT-T

Design and procurement activities will commence in mid-2019, with the RIT-T project works to be completed by October 2024.

# 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 Publication | 29 October 2018 |
| Part 2 | Submissions due on the PSCR<br>Have your say on the credible options and propose potential non-network options. | 25 January 2019 |
| Part 3 | Publication of the PACR<br>Powerlink's response to any further submissions received and 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

Powerlink considered one further network option that has not been progressed. This option is described in A1.

Table A1: Options considered but not progressed

| Option description | Reason for not progressing option |
|---|---|
| Re-establishment of substation on new site | Replacement of the substation by rebuilding it at a nearby site was considered as an option to help reduce the number of outages required. This option was however technically unfeasible within the time frame required for replacement and economically prohibitive given the need to acquire additional land. |
| A single stage replacement of the Ross 132kV primary plant by October 2024 combined with the various options of replacing the 275kV plant presented in this report. | The option of a single stage replacement of the Ross 132kV primary plant was compared with the option of a two stage replacement of the plant. Preliminary economic analysis showed the option to replace the plant in two stages to be the most economical solution and provided greater flexibility in the use of scarce specialised resources. |

# Contact us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