Powerlink Queensland

Project Assessment Conclusions Report

14 December 2018

Addressing the secondary systems condition risks at Palmwoods Substation

Document Purpose

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

1. The Rules require Powerlink to carry out forward planning to identify future reliability of supply requirements and consult with interested parties on the proposed solution as part of the Regulatory Investment Test for Transmission (RIT-T). This includes replacement of network assets in addition to augmentations of the transmission network.
2. Powerlink must identify, evaluate and compare network and non-network options (including, but not limited to, generation and demand side management) to identify the '*preferred option*' which can address future network requirements at the lowest net cost to electricity consumers. This assessment compares the net present value (NPV) of all credible options to identify the option that provides the greatest economic benefits to the market.
3. This document contains the results of this evaluation, and a final recommended solution to address the secondary system condition risks at Palmwoods Substation from July 2021.

Contents

Executive Summary

Located in Sunshine Coast hinterland, Palmwoods Substation is approximately 18 kilometres west of Mooloolaba and is part of Powerlink's 275kV transmission network between generators and the main South East Queensland load centre. Palmwoods Substation also provides the major injection point into Energex's (part of the Energy Queensland Group) distribution network for the Sunshine Coast and north Caboolture areas.

Several secondary systems at the Palmwoods Substation are reaching the end of their technical service life and are facing obsolescence with no manufacturer support for repairs and few spares available.

Secondary systems include the control, protection and communications equipment that operate the transmission network and prevent damage to primary systems during adverse events. 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 adequately protected.

The deteriorated condition and obsolescence issues associated with the Palmwoods secondary systems presents Powerlink with operational and compliance issues, requiring resolution. Since consideration for this investment is driven by an obligation in the National Electricity Rules (the Rules), it is a 'reliability corrective action' under the Regulatory Investment Test for Transmission (RIT-T).

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

Credible options considered

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

Table 1: Summary of credible options

Option	Description	Indicative capital cost ($million, 2017/18)	Indicative annual O&M costs ($million, 2017/18)
Base Option: Staged replacement in existing building	Replace all obsolete secondary systems using new pre-wired panels installed in free space of the existing building in two stages between 2019 and October 2024.	8.1	0.198
Option 1: Single stage replacement in existing building	Replace all secondary systems using new pre-wired panels installed in free space of the existing building by July 2021.	7.2	0.190
Option 2: Single stage replacement in prefabricated building	Replace all secondary systems using a modular prefabricated building with new secondary systems installed by July 2021.	7.3	0.190

Evaluation and conclusion

The RIT-T requires that the proposed preferred option maximises the present value of net economic benefit, or minimises the net cost, to all those who produce, consume and transport electricity in the market.

In accordance with the expedited process for this RIT-T, the Project Specification Consultation Report (PSCR) made a draft recommendation to implement Option 2, replacement of the secondary systems in a new prefabricated building by July 2021. The estimated capital cost of the proposed preferred option is $7.3 million in 2017/18 prices. Powerlink is the proponent of the proposed network project.

There were no submissions received in response to the PSCR.

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

1. Introduction

This Project Assessment Conclusions Report (PACR) represents the final step of the RIT-T process prescribed under the Rules undertaken by Powerlink to address the condition risks arising from the ageing and obsolete secondary systems at Palmwoods Substation. It follows the publication of the Project Specification Consultation Report (PSCR) published in August 2018 that adopted the expedited process for this RIT-T, as allowed for under the Rules for investments of this nature.

The Project Specification Consultation Report (PSCR):

- described the identified need that Powerlink is seeking to address, together with the assumptions used in identifying this need
- set out the technical characteristics that a non-network option would be required to deliver in order to address the identified need
- described the credible options that Powerlink considered may address the identified need
- discussed specific categories of market benefit that in the case of this specific RIT-T assessment are unlikely to be material
- identified the preferred option and that Powerlink was claiming an exemption from producing a Project Assessment Draft Report (PADR).

Powerlink identified Option 2, single stage replacement in a prefabricated building by July 2021 at an indicative capital cost of $7.3 million, in 2017/18 prices, as the preferred option to address the identified need.

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

- the estimated capital cost of the preferred option is less than $41 million
- the preferred option has been identified in the PSCR noting exemption from publishing a PADR
- the preferred option, or other credible options, do not have a material market benefit
- submissions to the PSCR did not identify additional credible options that could deliver a material market benefit.

There were no submissions received in response to the PSCR that closed on 16 November 2018. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation.

As all of the conditions are now satisfied, Powerlink has not issued a PADR for this RIT-T and is now publishing this PACR, which:

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

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

2. Identified need

2.1 Geographical and network overview

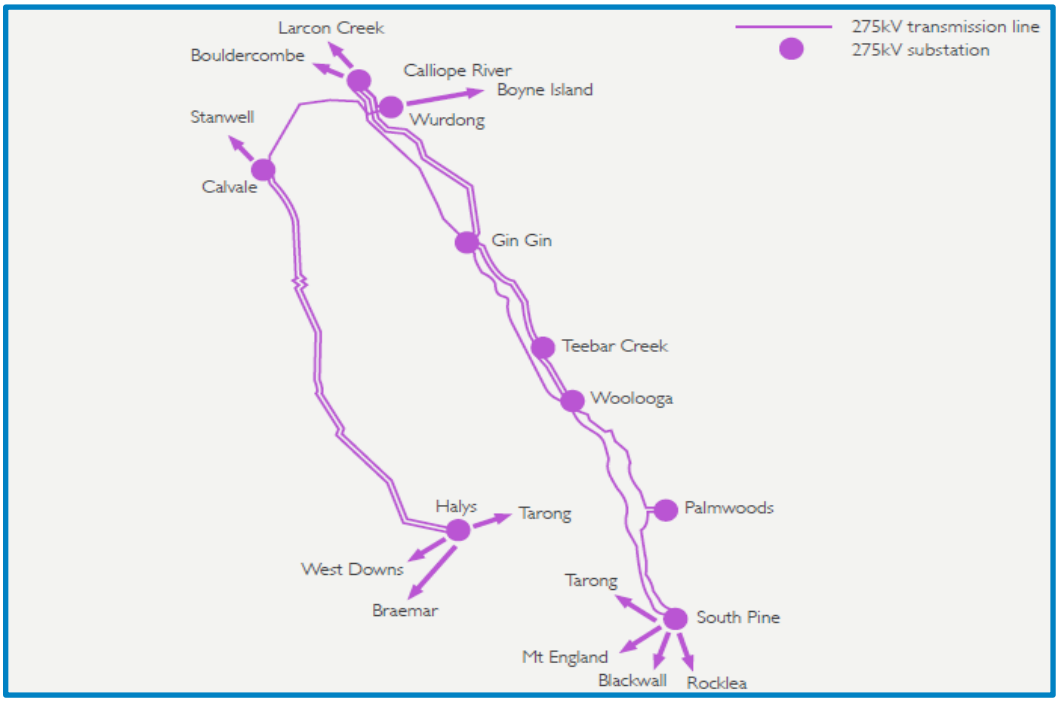
Palmwoods Substation is located approximately 18 kilometres west of Mooloolaba in the Sunshine Coast hinterland. The 132kV switchyard was first established in 1978, with a 275kV switchyard established in 1993 to meet a growing demand.

It is the major HV injection point for the Sunshine Coast and northern Caboolture areas and forms an integral part of the 275kV network in the Wide Bay Zone that connects the generators in Central Queensland to the greater Moreton area. [1]

The original two 132kV transformers and their associated bay equipment were replaced between 2009 and 2013.

The relevant transmission network is shown in Figure 2.1

Figure 2.1: Wide Bay Transmission Zone



2.2 Description of identified need

Powerlink's planning studies have identified a forecast increase for 132kV loads at Palmwoods Substation from 363MW in 2019/20 to 391 MW in 2026/27, confirming an enduring network need to retain the substation for the next 7 years[2].

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

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 risks arising from obsolete and ageing secondary system assets at Palmwoods Substation, to maintain compliance with the Rules.

[1] Palmwoods is connected to the transmission network via two 275kV feeders and supplies energy into the Sunshine Coast and Caboolture region by 132kV and 110kV connections to Energex Queensland substations at Mooloolaba, Beerwah, Nambour, Cooroy and Caboolture
[2] Powerlink Transmission Annual Planning Report 2018

2.2.1 Assumptions underpinning the identified need

The need to invest arises from the risks associated with ageing and increasingly obsolete secondary systems at Palmwoods 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. Under the Rules, Powerlink would be required to disconnect the unprotected primary systems where a secondary system fault lasts for more than eight hours (in the case of planned maintenance) or 24 hours (in the case of an unplanned outage).

Specifically, S5.1.9(c) of the Rules requires a Transmission Network Service Provider (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. This requirement extends to any communications facilities on which protection systems depend.

TNSPs must also ensure that all protection systems for lines at a voltage above 66kV are well maintained so as to be available at all times other than for short periods (less than eight hours), while the maintenance of a protection system is being carried out. The 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, the Australian Energy Market Operator's (AEMO's) Power System Security Guidelines require that the primary network assets must be taken out of service within 24 hours.

It follows that the increasing likelihood of faults arising from the condition of the ageing secondary systems and their obsolescence compels Powerlink to undertake reliability corrective actions at Palmwoods 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.

2.2.2 Description of asset condition and risks

Palmwoods Substation consists of one 275kV switchyard and one 132kV/110kV switchyard.

The 275kV switchyard was built in 1993 and expanded between 2000 and 2004, while the original 1978 132kV yard was updated between 2009 and 2013.

The majority of components in the 275kV secondary systems are approaching the end of their technical service life. Many critical protection and control items are no longer supported by their manufacturers and have been superseded by new technologies. The diminishing availability of spares and the lack of manufactures' support for repairs places an obligation on Powerlink to address the obsolescence risks arising from these ageing assets remaining in service.

Powerlink undertakes 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 the recommended action.

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

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

Bay	Construction year	Health index range (average)	Description
Transformer Bays	1993 -2003	3.8 – 10 (7.3)	40% of equipment has a health index of 10. The majority of equipment is obsolete, with insufficient spares to support ongoing operation. Recommended action: replacement.
Feeder bays	1993 - 2003	3.4 – 10 (5.9)	25% of equipment has a health index of 10. The majority of equipment is obsolete, with insufficient spares to support ongoing operation. Recommended action: replacement.
Coupler Bays		3.8-10 (7.9)	60% has a health index of 10. Majority of equipment is obsolete, with insufficient spares to support ongoing operation. Recommended action: replacement.
Bus		9.35	Transducers Health index indicates that the asset requires replacement. Recommended action: replacement.
Capacitor Bank		6.02	Relays Recommended action: replacement.
Non-bay secondary systems. *(Includes supervisory RTUs, cameras, Ethernet switches & server ports)*	2002 - 2009	3.8-10 (6.4)	Condition of equipment is fair. Equipment is not compliant with current Rules requirements and is obsolete. Recommended action: replacement; functionality provided by replacement devices.

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

3. Submissions received

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

There were no submissions received in response to the PSCR that was open for consultation until 16 November 2018. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation.

4. Credible options assessed in this RIT-T

Powerlink has considered three credible network options as follows:

- Base Option: staged replacement of all obsolete 275kV secondary system panels within the existing control building, Stage 1 (Corridor Panels) completed by late 2020, Stage 2 (Swing Frame Panels) completed by late 2024
- Option 1: single stage replacement of all 275kV secondary systems and associated panels for all secondary systems, with new secondary systems panels and equipment in free space of the existing control building, completed by July 2021 and
- Option 2: complete replacement of all 275kV secondary systems and associated panels for all identified secondary systems, using a new prefabricated building with new secondary systems equipment and wiring preinstalled, completed by July 2021.

The following systems are to be replaced or upgraded under all three options.

Table 4.1: Summary of systems to be replaced

System	Type
Protection and control systems	2x 275/132kV transformer systems 2x 275kV feeder 1x 275kV coupler system 2x 275kV bus system 1x 275kV capacitor bank system
Ancillary systems	1x network system 2x station infrastructure systems 2x battery DC voltage supply & distribution systems 1x SCADA system 1x OpsWAN system
Remote end substation protection systems	2x remote end feeder protection systems

All of the credible options address the identified need and are expected to be technically and economically feasible, and able to be implemented in sufficient time. None of these options has been discussed by the Australian Energy Market Operator (AEMO) in its most recent National Transmission Network Development Plan (NTNDP).[3]

Indicative costs for each credible option are presented in Table 4.2 and are based on Powerlink estimates.[4]

[3] 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.
[4] 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 network options

Option	Description	Indicative capital cost ($million, 2017/18)	Indicative annual O&M costs ($million, 2017/18)
Base Option: Staged replacement in existing building	Replace all obsolete secondary systems using new pre-wired panels installed in free space of the existing building in 2 stages between 2019 and 2024.	8.1	0.198
Option 1: Single stage replacement in existing building	Replace all secondary systems using new pre-wired panels installed in free space of the existing building by July 2021.	7.2	0.190
Option 2: Single stage replacement in prefabricated building	Replace all secondary systems using a modular prefabricated building with new secondary systems installed by July 2021.	7.3	0.190

Under all credible options, work would commence in early 2019, with completion either in mid-2021, or in the case of the Base Option at the end of 2024. This addresses the identified need in a timely manner and avoids a situation where corrective maintenance of obsolete and ageing assets is no longer practical.

4.1 Base Option: Replacement of all secondary system panels in two stages

Powerlink is the proponent of this option.

The Base Option involves the staged replacement of all 275kV secondary systems components within the existing control building. This represents the conventional approach under which the minimum amount of infrastructure is replaced at any one time and the technical service life of all systems is optimised.

Construction of the first stage would start early in 2019 with commissioning scheduled for late 2020. The second stage completes the full replacement of the obsolete secondary systems and would be undertaken during 2023 and 2024.

Limiting the replacement to currently obsolete secondary systems components does not resolve the health and safety issues associated with the existing corridor panel arrangement.

The integration of new secondary systems components into legacy systems is also labour intensive and technically complex, placing a significant demand on scarce specialist engineering resources. Furthermore, the staged nature of the Base Option means that multiple mobilisations of specialist resources would be required to complete the project and would impact Powerlink's capacity to deliver capital projects effectively and efficiently.

At a total cost of $8.1 million (2017/18 prices), this option costs more than Options 1 and 2.

Major cost components are shown in Table 4.3.

Table 4.3: Main project components for the Base Option

Components		Cost ($k, real 2017/18)	Construction timetable and completion date
Stage 1	Replacement of obsolete protection and control systems mounted in Corridor Panels at Palmwoods	3,717	Construction on-site: 2019 Completion: November 2020
	Modification of secondary systems at remote end substations and telecom works	551	
	Other *- this includes project management, commissioning coordination, network operations, compliance management and statutory costs (Qleave)*	852	
Subtotal		**5,120**	
Stage 2	Replacement of remaining of protection and control systems at Palmwoods	2,271	Construction on-site: 2023 Completion: October 2024
	Modification of secondary systems at remote end substations and telecom works	297	
	Other *- this includes project management, commissioning coordination, network operations, compliance management and statutory costs (Qleave)*	458	
Subtotal		**3,026**	
TOTAL		**8,146**	

Once the replacement components are in place, planned and corrective maintenance for the Base Option is estimated to be $19,800 (2017/18 prices) per annum. This is slightly higher than Options 1 and 2, and reflects the five year delay in replacing some of the secondary systems components due to the staged nature of this option.

4.2 Option 1: Full replacement with new panels in existing building by 2021

Powerlink is the proponent of this option.

Option 1 involves the replacement of all secondary systems in a single stage implementation using new pre-wired protection and control panels tested off-site and installed in the free space of the existing building.

This modular approach reduces project risk and simplifies the replacement process. While this option requires an extended level of intra-panel wiring on-site, it ensures consistent technology is maintained across the replacement systems.

Work on prefabricating the secondary systems panels would commence off-site in early 2019, with preparatory construction activities occurring on-site in 2020. Installation of the prefabricated secondary systems panels will take place in late 2020 to July 2021.

This is a single stage project that simplifies logistics by requiring only one mobilisation of specialist resources to site compared to two mobilisations under the Base Option.

Major cost components are shown in Table 4.4

Table 4.4: Main project components for Option 1

Components	Costs ($k, real 2017/18)	Construction timetable and completion date
Installation of prewired protection and control panels at Palmwoods	5,365	Construction off-site: 2019 3 Completion: July 2021
Modification of secondary systems at remote end substations	578	
Telecommunication upgrades for Palmwoods and remote end substations	249	
Other *- this includes project management, commissioning coordination, network operations, compliance management and statutory costs (Qleave)*	1,041	
TOTAL	**7,233**	

4.3 Option 2 – Full replacement in pre-fabricated building by 2021

Powerlink is the proponent of this option.

Option 2 involves a full replacement of all 275kV secondary systems at Palmwoods Substation, within a new, demountable secondary systems building.

Option 2 will utilise a prefabricated building with protection, control, communications, and other ancillary equipment wired and installed off-site within a controlled environment. This allows for more efficient utilisation of resources in the fit-out which almost entirely offsets the cost of the new building. The complete prefabricated building will then be transported to the Palmwoods site. This method adopts a modular approach to secondary systems replacement that reduces project risk and simplifies the replacement process.

Work on prefabricating the secondary systems building will commence off-site in early 2019, with preparatory construction activities occurring on-site later in 2019. Installation of the prefabricated secondary systems building on site will commence in 2020 with completion of the project in July-2021.

This is a single stage project, which simplifies logistics by requiring only one mobilisation of specialist resources to site compared to two mobilisations under the Base Option.

Major cost components are shown in Table 4.5.

Table 4.5: Main project components for Option 2

Components	Cost ($k, real 2017/18)	Construction timetable and completion date
New secondary systems (protection and control) at Palmwoods	5,415	Construction off and on site would commence late 2019. Completion of project in July 2021
Modification of secondary systems at remote end substations	578	
Telecommunication upgrades for Palmwoods and remote end substations	262	
Other *- this includes project management, commissioning coordination, network operations, compliance management and statutory costs (Qleave)*	1,045	
Total	**7,300**	

4.4 Material inter-network impact

Powerlink does not consider that any of the credible options being considered will have a material inter-network impact, based on AEMO's screening criteria.[5]

5. Materiality of Market Benefits

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

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

None of the replacement options will have an impact on wholesale market outcomes. The Australian Energy Regulator (AER) has recognised that if the proposed investment will not have an impact on the wholesale market, then a number of classes of market benefits will not be material in the RIT-T assessment[6]. Consequently, no market benefits have been estimated as part of this RIT-T.

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

6. General modelling approach adopted to assess net benefits

6.1 Analysis period

The RIT-T analysis has been undertaken over a 15 year period, from 2019 to 2033. A 15-year period takes into account the size, complexity of the secondary system.

Works on the secondary systems replacement under Options 1 and 2 is expected to begin in 2019 and to be completed by July 2021. As the new secondary system has a technical service life of 20 years, there will be some remaining asset life by 2033 under each option, at which point a terminal value is calculated to correctly account for capital costs under each credible option.

[5] 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.
[6] AER, *Final Regulatory Investment Test for Transmission Application Guidelines,* September 2017, version 2, page 13.

6.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the net present value (NPV) of costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 7.04%[7] 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%[8] 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[9]:

- are likely to affect the ranking of the credible options, where the identified need is reliability corrective action and
- are likely to affect the ranking of the credible options, or the sign of the net economic benefits of any of the credible options, for all other identified needs.

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 scenarios adopted

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

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

Table 7.1 summarises the NPV for each credible option. The table also shows that differences between the options are only minor.

Table 7.1: Net present values for each credible option (NPV, $m 2017/2018)

Option	Central scenario NPV	Ranking
Base Option: Staged replacement in existing building	-5.6	3
Option 1: Single stage replacement in the existing building	-5.5	1
Option 2: Single stage replacement with prefabricated building	-5.5	2

[7] 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.
[8] 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.
[9] AER, *Final Regulatory Investment Test for Transmission*, July 2010, version 1, paragraph 16, p. 7

Table 7.2 sets out the net present values of Options 1 and 2 relative to the Base Option under each of the scenarios considered.

Table 7.2: NPV for Options 1 and 2 relative to the Base Option (NPV, $k 2017/2018)

Option	Central scenario NPV	Ranking
Option 1:	143	1
Option 2:	93	2

The above table shows that Option 1 and Option 2 are expected to cost $143,000 and $93,000 less in relative NPV terms than the Base Option, which demonstrates only marginal variances between the options. Overall, the difference in absolute NPV terms is minor considering the magnitude of the project.

7.1 Sensitivity analysis

Powerlink has investigated the impact on the NPV assessment of assuming a 25% increase/ decrease in capital costs for each option with the results set out in Table 7.3.

Table 7.3 Sensitivities for each credible option relative to base option (NPV $k, 2017/18)

Sensitivity	Option 1 NPV	Option 2 NPV
High capital cost	174	112
Low capital cost	112	74

The magnitude of difference between the options is minor in relation to the overall capital costs and estimating accuracy, with no material impact on rankings and is consistent with the marginal variances between the options.

7.2 Preferred option

Based on the conclusions drawn from the NPV analysis, the technical characteristics of each option and the Rules' requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks arising from the ageing and obsolete secondary systems at Palmwoods Substation.

Sensitivity testing shows the economic analysis is robust to variations in the capital cost and the discount rate assumptions. Option 2 has no material difference in NPV terms to the other options, however it provides for:

- the opportunity to resolve health and safety risks by avoiding the continued use of the existing secondary systems corridor panels at Palmwoods beyond 2021 that would be required under the Base Option
- simplified planning, design and implementation as there is no need to work within the constraints of legacy designs and architecture, as required under the Base Option and Option 1
- simplified project delivery, by reducing the travel time of specialist resources to site, which would be required under the Base Option.

Option 2 will utilise a prefabricated building with protection, control, communications, and other ancillary equipment wired and installed off-site within a controlled environment. The complete prefabricated building will then be transported to the Palmwoods site.

Option 2 is therefore considered to satisfy the requirements the RIT-T and is the proposed preferred option.

8. Conclusions

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

- Powerlink has identified condition risks arising from ageing and obsolete secondary systems at Palmwoods Substation requiring action.
- S5.1.9(c) of the Rules requires a TNSP to provide sufficient primary protection systems and back-up protection systems (including breaker fail protection systems) to ensure that a fault of any type anywhere on its transmission system is automatically disconnected.
- TNSPs must also ensure that all protection systems for lines at a voltage above 66kV are well maintained so as to be available at all times other than for short periods (less than eight hours), while the maintenance of a protection system is being carried out.
- The increasing likelihood of faults associated with the ageing secondary systems and their obsolescence compels Powerlink to undertake reliability corrective actions at Palmwoods Substation if it is to continue meeting the standards for protection system availability set out in the Rules, and to avoid the impacts of taking primary systems out of service.
- Studies were undertaken to evaluate three credible options. These credible options were evaluated in accordance with the AER's RIT-T.
- Powerlink published a PSCR in August 2018 requesting submissions from Registered Participants and interested parties on the credible options presented, including alternative credible non-network options which could address the secondary systems condition risks at Palmwoods Substation.
- The PSCR also identified the preferred option and that Powerlink was adopting the expedited process for this RIT-T, claiming exemption from producing a PADR as allowed for under NER clause 5.16.4(z1) for investments of this nature.
- There were no submissions received in response to the PSCR which was open for consultation until 16 November 2018. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation. The conditions specified under the Rules for exemption have now been fulfilled.
- The result of the cost-benefit analysis under the RIT-T identified that there was no material difference between the options over the 15-year analysis period. Sensitivity testing showed the analysis is robust to variations in the capital cost assumption. As a result, Option 2 is considered to satisfy the RIT-T. This option resolves the outstanding health and safety issues in the timeliest manner, simplifies project implementation by avoiding the need to work within legacy systems and architecture and minimises the number of times specialist resources need to be deployed to site.
- The outcomes of the economic analysis contained in this PACR remain unchanged from those published in the PSCR. Consequently, the draft recommendation has been adopted without change as the final recommendation and will now be implemented.

9. Final Recommendation

Based on the conclusions drawn from the NPV analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the condition risks arising from ageing and obsolete secondary systems at Palmwoods Substation.

Option 2 involves replacing all secondary systems at Palmwoods with new secondary systems installed in a prefabricated building. The estimated capital cost is $7.3 million (2017/18).

Powerlink is the proponent of this proposed option.

Construction activities would be expected to commence off-site in late 2019, with preparatory on-site construction activities occurring in mid-2020. Installation of the prefabricated secondary systems building on site will take place in late 2020 with full commissioning by July 2021.

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

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