Attachment PWCR03.3P

Wishart Non-network and DM Investment Analysis

Memo

22 November 2018

Confidential version

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Rev	Date	Description	By	Review	Approve
1	30/10/2018	Draft	GJ	RD	RD
2	16/11/2018	Final	GJ	RD	RD
3	22/11/2018	Minor editorials	GJ	RD	RD

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Introduction

Background

A temporary NOMAD mobile substation was installed at Wishart in 2015 to improve the voltage profile in the 11kV network at East Arm. PWC determined a temporary solution was preferable to a permanent substation given the load uncertainty at the time. The Wishart substation reduced the transformer loadings at the Berrimah substation.

In their regulatory proposal, PWC forecast capital expenditure for a permanent substation at Wishart.

The AER raised concerns in its draft determination regarding the need for a new zone substation at Wishart in the 2019-24 regulatory period. The basis for the AER's concern included:

- Uncertainty in respect to the load growth forecast for the Berrimah/Wishart area, particularly regarding the timing of spot loads
- Insufficient consideration of non-network and/or demand management (DM) options to defer or avoid the proposed augmentation at Wishart
- The scope and timing of the Wishart zone substation being driven by a proposed reduction of the capacity at Berrimah substation

The AER proposed a substitute investment estimate to maintain the existing capacity at Berrimah and therefore reduce or defer the potential need for augmentation at Wishart.

CulterMerz has been engaged to analyse several growth scenarios (including loads and embedded generation) to determine the likelihood that additional non-network and/or DM investment could defer the construction of Wishart ZS indefinitely or otherwise.

What we did

1. Review – We reviewed the project business case and previous non-network and DM analysis for the Wishart zone substation in conjunction with PWC's planners to confirm the non-network and DM options to be analysed.
2. Demand Forecast – We developed a bottom up demand forecast and scenarios including for base load, committed and uncommitted spot loads, and embedded generation growth to determine the load at risk.
3. Analysis – We undertook an options study considering non-network and DM options and produced an NPC estimate to enable decision making with respect to the proposed investment.
4. Reflect – We compiled this report to document the outcomes of our findings

This stage of the analysis developed a concise overview of the key investment driver, to ensure that the proposed non-network and/or DM investment is consistent with, and supports, the business objectives of prudent and cost efficient investment.

Demand forecast

We reviewed the spatial load forecast prepared by AEMO in September 2017 that was used in PWC's regulatory proposal. The forecast comprised existing loads, committed loads, and committed embedded generation data available at the time. AEMO provided a revised forecast in November 2018 addressing mainly connection growth based on more recent connection data.

The load at Wishart has been increasing over the last 3 years and is forecast to continue to grow under all demand forecast scenarios (refer Figure 1). Two main scenarios were considered. The **base forecast** scenario include:

- Underlying demand growth based on the latest connection growth forecast for the Darwin-Katherine area as determined by AEMO in its Forecasting Advice for the revised Regulatory Submission, November 2018.
- Committed and uncommitted spot loads based on expected likelihood of occurrence as assessed by PWC planners
- Committed embedded generation (Solar PV) growth based on AEMO growth forecast and likelihood adjusted uncommitted embedded generation, offsetting the forecast maximum demand

The analysis reflected in this report has been based on a **reduced growth** forecast scenario to align with the AEMO forecast for the initial regulatory proposal. The difference between the AEMO forecast and the proposed forecast appears to be the timing of the committed load and generator connections as reflected in the latest available data from the PWC planners.

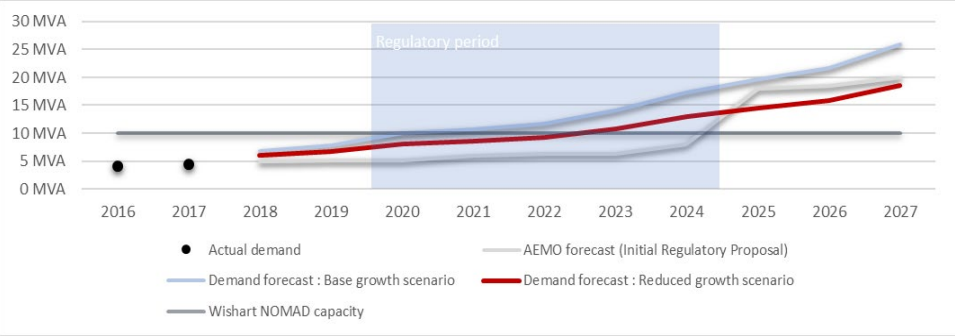

Figure 1 – Wishart load growth

Key investment driver

There is no supply redundancy for the load supplied from Wishart substation. Accordingly, the distribution network is currently in breach of the requirements of the network planning criteria relating to the restoration of power following a single contingency. The planning criteria requires that urban loads:

- Over 5 MVA and up to 50 MVA be restored within 60 minutes
- Over 1 MVA and up to 5 MVA be restored within 3 hours, and
- The remaining loads up to 1MVA to be restored within 8 hours

The planning criteria is not achievable following a transformer failure at the Wishart substation. Whilst some load can be supplied from Berrimah substation following a transformer failure at Wishart, the remaining load would need to be restored within 3 hours. There are no current options available to restore supply within this timeframe.

The load at risk is shown in Figure 2 and includes:

- Increasing load at risk as result of 11kV voltage constraints, exacerbated by demand growth at the extremities of the 11kV network in the East Arm area, and
- Increasing load at risk due to diminishing capacity to transfer load to Berrimah substation as result of demand growth in the Berrimah substation supply area and based on the existing capacity at Berrimah.

The load at risk increases from around 1.7MW to around 2.4MW over the regulatory period and is expected to increase markedly from 2025 as result of demand growth and associated transfer capacity constraints at Berrimah substation. Therefore, it is advisable that action be taken to comply with the planning criteria requirements.

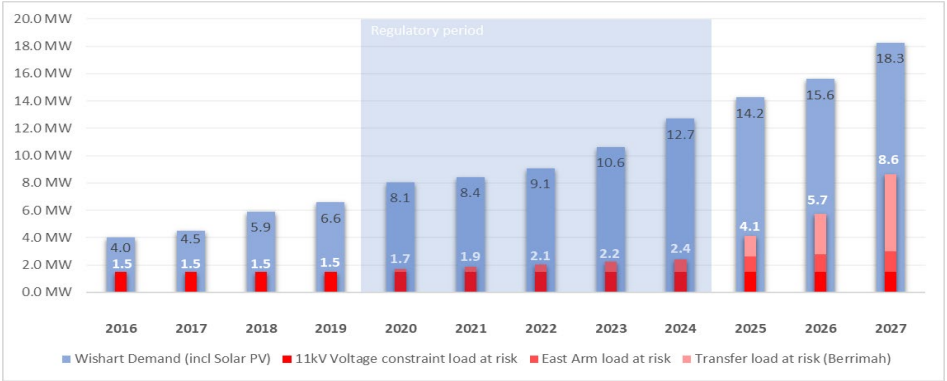

Figure 2 – Wishart-Berrimah load at risk

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The selection stage of our analysis describes the main non-network and DM options considered and the reasons for selecting the preferred investment option. It provides a concise description of the preferred option and the outcomes of the economic analysis.

Options

The available non-network and DM options identified and considered as potential alternatives to defer the need for network augmentation are summarised as follows:

- Load curtailment/demand side response

  Load curtailment/demand side response involves an agreement between PWC and its customers whereby the customers concedes to drop portions of their load off the grid at the request and with advanced notice from PWC, leaving the customers to meet their own power needs.

  This option provides a controlled way of reducing load during peak demand periods and is highly dependent on the number and type of customers willing to participate.

  Load curtailment/demand side response provide a potential means of reducing the amount of load at risk. Based on the scale of the reduction required and PWC's experience with demand side response in the past, it is unlikely that this option will be feasible within the timeframe required; however, the option will be tested through the RIT-D process prior to finalising the investment decision.

- Distributed Solar PV

  One alternative to load curtailment is to incentivise customer investment in solar PV and battery systems. This option relies on distributed rooftop solar PV to provide security of supply during a single transformer contingency scenario. For the option to be an effective and reliable source of power supply, a significant step increase in customer uptake of solar PV in the Wishart supply area is required, as well as sustained ideal weather conditions during an extended contingency restoration period.

  The load growth forecast and load at risk for the Wishart supply area includes consideration of the expected solar PV uptake, taking into consideration the daily demand profile for the area and the maximum demand that can effectively be offset. The expected uptake is not sufficient to provide security of supply for the load at risk. Extended periods of overcast and rainy conditions are not uncommon in Darwin and impedes the ability of Solar PV to provide effective security of supply when needed.

  Distributed solar PV is not considered a viable solution providing reliable security of supply in the Wishart supply area.

- Micro-grid

  The Wishart 11kV network is an integral part of a meshed network transferring power within the Wishart-Berrimah supply area. A micro-grid will require this part of the integrated network to operate in an islanded mode resulting in operational safety risks and inefficiencies.

  It will require network augmentation to establish a supply substation, generator connection, special protection schemes, and the establishment of non-standard operational practices to operate within a meshed environment.

  Best industry practice is to restrict islanded mode operation to networks that are isolated. The Wishart network does not lend itself to a micro-grid solution.

- Back up generation

  Backup generation was identified as a potential viable and cost effective option to support the load at risk at Wishart whilst deferring the need for investment in the construction of the Wishart substation until after the regulatory period.

  The option considers a staged investment approach installing modular generator units as required over the regulatory period. The investment profile has been based on a reduced load forecast and load at risk under a single transformer contingency at either Wishart or Berrimah substations.

  The investment approach proposes an initial investment in 2 x 1.2MVA generator units by 2020 and a potential 3rd generator by 2024.

  The net present cost (NPC) calculations have been calculated over a 40 year period and include for the construction of Wishart substation to commence in 2025 with commissioning in 2027. The generators are expected to be redeployed within the network following the commissioning of Wishart.

  The proposed investment profile results in a NPC of [redacted] or a c[redacted] operational investme[redacted] egulatory period of [redacted], and [redacted] respectively, and the [redacted] Wishart zone subst[redacted] uction until 2025.

  This compares with a NPC of [redacted] for the netwo[redacted] tion so[redacted] ng the construction of W[redacted] substation at [redacted] and a[redacted] [redacted] operational expenditure over the same period.

  The back up generation option defers the network augmentation investment until after the 2019-24 regulatory period at a slightly lower NPC.

  The investment profile is shown in Figure 3.

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Figure 3 – Proposed Wishart investment profile

Expenditure forecast	2020	2021	2022	2023	2024	Total
Number of Generators	2	-	-	-	1	3
Capital investment						
Operational expenditure						
Total expenditure						

Table 1 – Regulatory period forecast

Addressing the AER findings

The outcomes of the Wishart non-network and DM options analysis in context of the AER's key concerns:

1. AER's concern:

   - *Uncertainty in respect to the load growth forecast for the Wishart/Berrimah area, particularly regarding the timing of spot loads*

   Key Finding: The demand forecast for Wishart has been based AEMO's revised assessment of connections growth, and PWC's assessment of the likelihood of committed and known but uncommitted loads realising over the next regulatory period. It includes an offset in peak demand growth based on AEMO's forecast of solar PV penetration, and PWC's assessment of the likelihood of committed and uncommitted embedded generation connections realising.

   The demand forecast applied in the assessment of the load at risk at Wishart has been reduced to align with the AEMO forecast included in the initial regulatory proposal and is considered to be a conservative approximation of the demand that can be expected to realise over the next regulatory period.

2. AER's concern:

   - *Insufficient consideration of non-network and/or demand management options to defer or avoid the proposed augmentation at Wishart*

   Key finding: Available non-network and DM options were considered in the analysis. The majority of these available options do not provide a viable alternative security of supply solution. The proposed investment option provides a marginally lower net present cost in comparison with the network augmentation investment, however provides a more conservative investment approach that allows for the close monitoring of demand growth and assessment of investment need over the regulatory period.

   The proposed investment option defers the network augmentation investment until after the regulatory period.

3. AER concern:

   - *The scope and timing of the Wishart zone substation being driven by a proposed reduction of the capacity at Berrimah substation.*

   Key finding: The main investment driver for Wishart substation is compliance with the Network Planning Criteria for security of supply to the existing and future loads in the Wishart supply area. Under a single transformer contingency an initial 1.7MW and up to 2.4MW of load at Wishart will not be able to be restored within the required timeframes. This risk assumes that the existing capacity at Berrimah substation is maintained.

   The proposed non-network investment profile provides an interim security of supply solution deferring the need for establishing Wishart zone substation until after the regulatory period.

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