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Summary: Managing the risk of capacitor bank failure

RIT-T Project Assessment Conclusions Report

Issue date: 21 March 2024

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Summary

We are applying the Regulatory Investment Test for Transmission (RIT-T) to options for managing the risk of capacitor bank failure. Publication of this Project Assessment Conclusions Report (PACR) represents the final step in the RIT-T process.

Capacitor banks are essential for ensuring that system voltage levels are maintained within +/-10% of nominal volts, as required under the NER.[1]

The likelihood of capacitor can and reactor failure is expected to increase as the units continue to deteriorate. If left unaddressed, this will result in unserved energy for consumers, costs associated with replacements (with long lead times) as well as higher risks relating to safety and environmental issues.

The purpose of this RIT-T is to examine and consult on options to address the deterioration in the conditions of the identified capacitor banks to ensure the safe and secure operation of our network. Given the high population of capacitor banks that fall within this category, the selected capacitor banks for replacement were chosen on the basis that they include sibling units (capacitor cans, reactors or both), are the oldest units in the network and cover a range of voltages and capabilities. The capacitor bank replacement program would apply to the following capacitor banks: Kempsey No 1, Narrabri No 3 and Coffs Harbour No 1 and Narrabri No 2.

Identified need: ensure the safe and reliable operation of our transmission network by managing the risk of capacitor bank failure

The identified need for this project is to ensure the safe and reliable operation of our transmission network by addressing the risk of failure of certain capacitor banks that are approaching, or have passed, the end of their technical life.

In this RIT-T, we have considered four capacitor banks for replacement across our network: Kempsey No 1 Capacitor, Narrabri No 2 Capacitor, Narrabri No 3 Capacitor and Coffs Harbour No 1 Capacitor. In assessing the ongoing viability of the capacitor banks, we have considered several factors:

- existing holdings of spares and the ability to source more spares.
- the general condition of the equipment; and
- age of the asset.

The identified capacitor banks have been in service longer than their expected technical lives, which is 30 years and have limited spare reactors and/or spare cans, which are also expected to deplete quickly. The ability to source additional spares in a reasonable time period may be challenging due to reduced manufacturer support. Ultimately, the selected capacitor banks for replacement were chosen on the basis that they include sibling units (capacitor cans, reactors or both), and cover a range of voltages and capabilities. This will enable us to strategically use these parts to assist with maintenance of other capacitor banks across the network, and to extend the serviceable lives of those assets.

If left unreplaced, the likelihood that the identified capacitor banks will fail is expected to increase significantly as the capacitor banks continue to deteriorate (refer to section 2.3.1). If the capacitor banks are not available during times of high load, load shedding will be required to take place for customers in

[1] Clause S5.1a.4: https://energy-rules.aemc.gov.au/ner/452/229026

NSW to ensure that system voltage levels remain within ±10% as required by the NER. The impact of each capacitor bank failure on lost load varies depending on where the capacitor bank is located on the network and whether viable spare parts are available. Asset failure may also increase the risk of safety and environment issues, and the potential costs of emergency repair and replacements. Given the limited availability of spares, the duration of such outages will also be expected to increase over time. On the basis of this assessment, we consider that replacing the identified capacitor banks would be expected to result in economic benefits for consumers by reducing the risk of load shedding.

We have classified this RIT-T as a 'reliability' driven RIT-T as the economic assessment is being progressed specifically to meet a mandated reliability standard and the net benefits are expected to be generated for end-customers. This replacement will help limit the number of in-service failures that occur (along with the associated interruptions to customer load, as well as safety and environmental consequences).

No submissions received in response to the Project Specification Consultation Report

We published a Project Specification Consultation Report (PSCR) on 8 August 2023 and invited written submissions on the material presented within the document. No submissions were received in response to the PSCR.

No material developments since publication of the PSCR

No additional credible options were identified during the consultation period following publication of the PSCR.

On 21 September 2023, the National Energy Laws were amended to reflect the incorporation of emissions reductions within the National Energy Objectives.[2] Following this the AEMC made harmonising changes to the National Electricity Rules, prompted by a rule change request from energy ministers, to ensure that network investment and planning frameworks are consistent with the new emissions reduction objective. The AEMC's Final Determination, published on 1 February 2024, included introducing a 'changes in Australia's greenhouse gas emissions' as a new class of market benefit to be considered within the RIT-T process.[3]

Transgrid supports greater consideration of emissions reduction within network planning and investment frameworks. These changes ensure network planning and investment frameworks support achievement of the Commonwealth Government's net zero targets. Transgrid has set science-based targets to cut emissions and decarbonise our business. These include:

- Reducing Scope 1 and 2 emissions by 60 per cent by 2030, compared with a base year of 2021 and net zero by 2040.
- Reducing Scope 3 emissions from Purchased Goods and Services, and Capital Goods by 48 per cent for every million dollars that we spend on these two categories by 2030, compared with a base year of 2021, and net zero by 2050.[4]

[2] Statutes Amendment (National Energy Laws) (Emissions Reduction Objectives) Act 2023 (SA)
[3] AEMC, Harmonising the national energy rules with the updated national energy objectives – final determination, 1 February 2024
[4] For more information on Transgrid's planned journey to net zero please see our website here: https://www.transgrid.com.au/about-us/our-approach/our-journey-to-net-zero

The updated National Energy Laws and Rules included transitional provisions that applied these changes to any RIT-T project that was required to publish a PADR where the deadline for doing so was after 21 November 2023.

As the PSCR for this RIT-T was submitted prior to 21 November 2023, and there is no requirement in this project to publish a PADR, this RIT-T is still subject to the old National Electricity Rules which did not consider changes in Australian emissions as a class of market benefit.

Additionally, the identified need for this RIT-T is driven by an externally imposed obligation, and therefore framed as reliability corrective action in which induced market benefits are not the primary objective.

Thus, to ensure timely publication of this RIT-T and delivery of the proposed solution, Transgrid has not assessed the change in Australian emissions tied to the project, as a benefit within this RIT-T.

Option 1 remains the preferred option at this stage of the RIT-T process.

Credible options considered

As indicated above, we have selected four capacitor banks for replacement on the basis that they include sibling units (capacitor cans, reactors or both), are the oldest units in the network and cover a range of voltages and capabilities. The four identified capacitor banks have already exceeded their expected technical lives and the likelihood of failure of the capacitor can and reactor components increases as the capacitor bank units continue to age. The list of capacitor banks which we have selected for replacement across the network are Kempsey No 1 Capacitor, Narrabri No 2 Capacitor, Narrabri No 3 Capacitor, and Coffs Harbour No 1 Capacitor.

On this basis, we consider that there is one credible network option that can meet the identified need. This option is summarised in Table Table E-1.

Table E-1: Summary of the credible options

Option	Description	Estimated capex ($2021-22)	Expected commission date
Option 1		**10.22**	**2028**
Kempsey No 1 Capacitor	Renew the Capacitor Bank Bay	2.80	2027
Narrabri No 2 Capacitor	Replace Capacitor Bank Cans only[5]	1.64	2028
Narrabri No 3 Capacitor	Renew the Capacitor Bank Bay	2.99	2027
Coffs Harbour No 1 Capacitor	Renew the Capacitor Bank Bay	2.79	2027

[5] There are no air core reactors in this bay, and consequently do not need to be replaced. The associated protection and control will be replaced under the secondary systems renewal programs.

No submissions received in relation to non-network options

In the PSCR we noted that we considered non-network options may be able to assist with meeting the identified need, specifically non-network technologies that are able to provide reactive support. We invited parties to make written submissions regarding the potential of non-network options to satisfy, or contribute to satisfying, the identified need for this RIT-T. No submissions were received in response to the PSCR in relation to non-network options.

The options have been assessed against three reasonable scenarios

The credible options have been assessed under three scenarios as part of this PACR assessment, which differ in terms of the key drivers of the estimated net market benefits (ie, the estimated risk costs avoided).

Given that wholesale market benefits are not relevant for this RIT-T, the three scenarios assume the most likely scenario from the Draft 2024 ISP (ie, the 'Step Change' scenario). The scenarios differ by the assumed level of risk costs, given that these are key parameters that may affect the ranking of the credible options. Risk cost assumptions do not form part of AEMO's ISP assumptions and have been based on Transgrid's analysis.

Table E-2 Summary of scenarios

Variable / Scenario	Central	Low risk cost scenario	High risk cost scenario risk
Scenario weighting	1/3	1/3	1/3
Discount rate	7%	7%	7%
VCR ($2021-22)[6]	$46,430/MWh	$46,430/MWh	$46,430/MWh
Network capital costs	Base estimate	Base estimate	Base estimate
Operating and maintenance costs	Base estimate	Base estimate	Base estimate
Environmental, safety and financial risk benefit	Base estimate	Base estimate – 25%	Base estimate +25%
Avoided unserved energy	Base estimate	Base estimate – 25%	Base estimate +25%

The sensitivity analysis has investigated how the NPV results are affected by changes to other variables, including the discount rate and capital costs.

Conclusion

This PACR finds that implementation of Option 1 is the preferred option. Under Option 1, the four capacitor banks identified will be renewed entirely or undergo a replacement of the capacitor can component. These capacitor banks currently exceed their technical life of 30 years and would be exceeding the technical life by at least 15 years in 2027/28. Under this option, Kempsey No 1 Capacitor, Narrabri No 3 Capacitor, and Coffs Harbour No 1 Capacitor would undertake a renewal of the capacitor bank bays i.e., replacement of all components within the capacitor bank, whereas Narrabri No 2 Capacitor would have only its capacitor bank cans and associated steelworks replaced.

[6] The analysis used a $2021-22 VCR value as this was the dollar basis for all costs in the assessment. This was calculated by deflating the VCR $2022-23 amount of $49,216/MWh (as per AEMO's 2023 IASR) by 6% (ABS CPI Jun 22 to Jun 23).

The capital cost of this option is approximately $10.22 million (in $2021-22). The work will be undertaken over a four-year period with all works expected to be completed by 2027/28. Routine operating and maintenance costs are estimated at approximately $4,000 per annum (in $2021-22). All works will be completed in accordance with the relevant standards and components shall be replaced to have minimal modification to the wider transmission network. Necessary outages of relevant assets in service will be planned appropriately in order to complete the works with minimal impact on the network.

Parties wishing to raise a dispute notice with the AER may do so prior to 24 April 2024 (30 days after publication of this PACR). Any dispute notices raised during this period will be addressed by the AER within 40 to 120 days, after which the formal RIT-T process will conclude.

Further details on the RIT-T can be obtained from Transgrid's Regulation team via regulatory.consultation@transgrid.com.au . In the subject field, please reference 'Managing risk of capacitor bank failure PACR'.