

Managing the risk of capacitor bank failure

Notification of MCC Assessment

Region: Northern NSW

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2. Executive Summary

The 'Managing the risk of capacitor bank failure' Regulatory Investment Test for Transmission (RIT-T) was completed on 2 May 2024. This RIT-T considered one credible network option, which was identified as the preferred option to meet the identified need. This option is summarised in Table E-1.

Table E-1 Summary of the credible options

	Option	Description
1	Kempsey No.1 Capacitor	Renew the capacitor bank bay
	Narrabri No.2 Capacitor	Renew the capacitor bank bay ¹
	Narrabri No.3 Capacitor	Renew the capacitor bank bay
	Coffs Harbour No.1 Capacitor	Renew the capacitor bank bay

Since completion of the RIT-T, the following changes have occurred:

- Capital cost estimate for Option 1 has increased;
- Delivery time for Coffs Harbour No.1 Capacitor and Kempsey No.1 Capacitor has been delayed.

In the PACR, we considered four capacitor banks for replacement: Kempsey No.1 Capacitor, Narrabri No.2 Capacitor, Narrabri No.3 Capacitor and Coffs Harbour No.1 Capacitor. Option 1 has been revised since the PACR; the current project scope covers the replacement of Narrabri No.2 Capacitor Bank and Narrabri No. 3 Capacitor Bank only. Due to changes in risk methodology, assumptions and capital constraints, Kempsey No.1 Capacitor and Coffs Harbour No.1 Capacitor will not be replaced by 2027 as originally planned. These capacitors will be considered for replacement later and if required, a further MCC Assessment will be conducted once costs and timing have been confirmed.

We have performed this Material Change in Circumstance (MCC) Assessment to determine whether the increase in capital costs and revised delivery timing for Narrabri No.2 Capacitor and Narrabri No.3 Capacitor constitute a material change in circumstance under the National Electricity Rules (NER). The revised cost estimate is outside the 25 per cent capital cost sensitivity tested in the PACR, and delivery is now expected to occur later than originally planned. Accordingly, we considered it prudent to assess whether these changes affect the preferred option. In this MCC Assessment, we refer to this as assessing whether an 'MCC event' has occurred.

Section 3.2 of this MCC Assessment outlines the underlying factors affecting the cost estimate. The scope assessed in this MCC Assessment has been limited to Narrabri No.2 Capacitor and Narrabri No.3 Capacitor, with Kempsey No.1 Capacitor and Coffs Harbour No.2 Capacitor removed from the current assessment and deferred for later consideration.

For the two capacitors assessed, the revised Class 2 estimate, with an accuracy of +/- 10 per cent, was developed using our MTWO cost estimating system and is based on detailed design with a higher level of accuracy than the estimate available at the time the PACR was published. Despite the reduced scope, the

¹ The PACR proposed replacing Narrabri No. 2 capacitor bank cans only; however, this MCC Assessment includes a scope change to replace the whole capacitor bank bay rather than the individual unit. This is outlined in section 3.2.

capital cost estimate has increased by at least 25 per cent compared to the PACR estimate. This increase is driven by higher labour, plant and contractual costs, with the primary contributors including procurement costs, construction contract costs and internal Transgrid resource costs. The key drivers behind these increases are detailed in section 3.2.

We are on track to reach Financial Investment Decision (FID) within the next three months and do not anticipate any further increase in costs in relation to the two capacitor replacements subject to this MCC Assessment.

Section 3.3 outlines the reason for delay in the estimated delivery time, related to time required to procure the capacitors for Option 1.

This MCC assessment demonstrates that, for the two capacitors assessed, Narrabri No.2 and Narrabri No.3, there is no material change to the net benefits of Option 1. Option 1 remains the preferred option for these capacitors.

The Net Present Value (NPV) results which determine which option is preferred are presented below for Narrabri No.2 Capacitor and Narrabri No.3 Capacitor. Option 1 remains the preferred option with positive NPV of net economic benefit

Table 2-1 Revised NPV of net economic benefits – weighted scenario (\$2025/26)

Assessment	Option	Net Economic Benefit
Narrabri No.2 & Narrabri No.3	Option 1	\$ 78.17m

This MCC Assessment confirms that Option 1 (revised), comprising the replacement of Narrabri No.2 Capacitor and Narrabri No.3 Capacitors only remains the preferred option for managing the risk of capacitor bank failure.

We therefore have concluded that an MCC event has not occurred. This MCC Assessment includes a statement that the preferred option remains the preferred option and sets out supporting information necessary to demonstrate that the preferred option identified remains the preferred option in section 5 (MCC Assessment results).²

² As per clause 5.16.4(z4B)(1) of the NER

3. Context and purpose of this report

On 2 May 2024, Transgrid completed the Regulatory Investment Test for Transmission (RIT-T) for Managing the risk of capacitor bank failure. This RIT-T considered one credible option which is outlined in the table below.

Table 3-2 Summary of credible options

	Option	Description
1	Kempsey No.1 Capacitor	Renew the capacitor bank bay
	Narrabri No.2 Capacitor	Renew the capacitor bank bay ³
	Narrabri No.3 Capacitor	Renew the capacitor bank bay
	Coffs Harbour No.1 Capacitor	Renew the capacitor bank bay

3.1. Background to the RIT-T

Capacitor banks are essential for ensuring that system voltage levels are maintained within +/-10% of nominal volts, as required under the NER.⁴

The likelihood of capacitor can and reactor failure is expected to increase as the units continue to deteriorate. Addressing this risk on a proactive basis increases upfront replacement costs compared with continuing to operate the assets until failure, particularly where works must be planned, procured and delivered before assets fail in service. However, if left unaddressed, deteriorating capacitor banks are expected to result in unserved energy for consumers, higher replacement costs due to long lead times and reactive delivery, and increased safety and environmental risks.

The RIT-T considered options to address the deterioration in the condition 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, as set out in the PACR, would apply to the following capacitor banks: Kempsey No.1, Narrabri No.3, Coffs Harbour No.1 and Narrabri No.2.

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.

³ The PACR proposed replacing Narrabri No.2 capacitor bank cans only; however, this MCC Assessment includes a scope change to replace the whole capacitor bank bay rather than the individual unit. This is outlined in section 3.2.

⁴ Clause S5.1a.4

As part of assessing the ongoing viability of the capacitor banks identified in the PACR, we considered the following factors for each capacitor bank:

- Existing holdings of spares and the ability to source more spares;
- General condition of the equipment; and
- Age of the asset.

Based on this assessment, we determined that Narrabri No.2 Capacitor and Narrabri No.3 Capacitor continue to meet the relevant factors for proactive replacement under this MCC Assessment. These capacitor banks continue to present an ongoing risk having regard to the condition and age of the assets, together with the availability and suitability of existing spares and the ability to source additional spares in a reasonable timeframe.

Kempsey No.1 Capacitor and Coffs Harbour No.1 Capacitor have been removed from this MCC Assessment not because they failed to meet the factors or criteria for ongoing viability of capacitor bank replacement. Rather, they have been deferred due to current capital constraints and are therefore outside the scope of this MCC Assessment. These capacitor banks will be considered separately once updated cost estimates and delivery timing are confirmed.

The identified capacitor banks have been in service longer than their expected technical lives, which is 35 years and we 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.

The capital cost estimate for Option 1 (revised), comprising of Narrabri No.2 Capacitor and Narrabri No.3 Capacitor is 63 per cent higher than the comparable estimate in the PACR.

Accordingly, this MCC Assessment is limited to assessing whether the updated cost estimate and delivery timing for Narrabri No.2 Capacitor and Narrabri No.3 Capacitor constitute a material change in circumstance.

The key economic benefits associated with addressing this need are summarised as:

- Reduction of risk as valued as a direct impact to Transgrid and consumers including:
 - Changes in involuntary load shedding;
 - Safety and environmental hazards associated with a catastrophic failure;
- Avoided operating expenditure related to corrective maintenance.

If left unreplaced, the likelihood that the identified capacitor banks will fail is expected to increase significantly as the capacitor banks continue to deteriorate. If the capacitor banks are not available during times of high load, load shedding will be required for customers in NSW to ensure that system voltage levels remain +/- 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. Based on 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 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).

3.2. Capital cost changes since completion of the RIT-T

The table below compares the capital costs for Option 1 (revised), covering Narrabri No.2 and Narrabri No.3 Capacitor only, against the corresponding capital costs presented in the PACR.

Table 3-2 Original and revised capital cost (\$m, 2025/26)

Cost	Option 1
Original (as presented in the PACR)	5.51
MCC Assessment (July 2026)	8.95

For comparison purposes, the costs are presented in \$2025/26. The cost for Option 1 in PACR was converted from real \$2021-22 to real \$2025/26 with CPI data.

Labour, plant, and other contractual costs were significantly higher than those forecast in the PACR. The primary contributors to these increases were, procurement costs, construction contract costs, and internal Transgrid resource costs. The key drivers behind these increases are outlined below:

- Equipment costs have increased significantly. This is driven by market forces due to international supply chain demands;
- The scope for Narrabri No.2 changed from replacing an individual capacitor unit to replacing the whole capacitor bank, requiring additional design work and an extension of the fence to comply with clearance requirements;
- New location for No.3 Capacitor Bank replacement due to space constraints at the original location. This resulted in additional design works, civil works, footing and cable installation and internal resources;
- Additional enabling scope such as upgrading substation control systems to align with current standard and support future upgrades;
- Removal of asbestos concrete pipe and conduits at the No.3 Capacitor Bank;
- The construction timeline has been extended which led to higher overheads, labour expenses and remote area allowances.

3.3. Delay to timing since RIT-T completion

The PACR indicated that commissioning was possible in 2027/28. This update was reflected in our 2024 Transmission Annual Planning Report (TAPR), published on 20 August 2024, with the proposed in-service date listed as December 2026. This was extended by 10 months to October 2027, as per our 2025 TAPR. The work is scheduled to be undertaken in 2026/27 with commissioning possible by 2026/27 for Narrabri No.2 and Narrabri No.3 Capacitor Banks. The delay is a result of the additional construction works outlined in section 3.2 above.

3.4. Material change in circumstance provisions in the NER

The NER covers the situation where there has been a material change in circumstance following the publication of a PACR. It is important to note that the increase in the capital cost estimate for the project, whilst substantial, does not in itself mean that an MCC event has occurred for the purposes of the NER. The NER defines a *material change in circumstance* as including, but not being limited to, a change to:

- key inputs and assumptions;
- the identified need described in the PACR; or
- the credible options assessed in the PACR.

Pursuant to these NER provisions, we have undertaken this MCC Assessment to evaluate whether the changes to the capital cost and delivery timing represent an MCC event.

In the PACR assessment, Option 1 was found to be the only feasible option to meet the identified need, and a refined version of it remains as such. Transgrid has undertaken this MCC Assessment to confirm that there has not been an MCC event.

4. Approach to the MCC Assessment

This section outlines the inputs and assumptions used to complete the MCC assessment with updated capital costs for Narrabri No.2 capacitor and Narrabri No.3 capacitor bank bays of Option 1.

4.1. Assessment against the base case

The costs and benefits of each option are compared against a 'do nothing' base case. Under the base case, no investment is undertaken to replace existing capacitor banks which will be expected to run until they fail.

The degraded condition of the capacitor banks which have been identified for replacement under this project will lead to an increase in unplanned outages due to an increase in the failure rate of capacitor banks and therefore insufficient capacity during high load conditions. This would result in system voltage falling below the minimum standard required to remain compliant with the NER. It would also lead to higher safety, environmental and financial related risk costs that are caused by the failure of the capacitor banks to operate when required.

Routine operating and maintenance costs are equal under both the base case and Option 1. We note that this course of action is not expected in practice; however, this approach has been adopted since it is consistent with AER guidance on the base case for RIT-T applications.⁵

4.2. Assessment period and discount rate

The RIT-T analysis uses a 20-year assessment period from 2022/23 to 2041/42. Where asset lives extend beyond this period, the NPV modelling includes a terminal value based on the undepreciated value of capital costs at the end of the assessment period. A real, pre-tax discount rate of 7.0 per cent has been adopted as the central assumption for the NPV analysis, consistent with the latest IASR.⁶

4.3. Approach to estimating option costs

We have estimated the capital and operating costs of the options based on the scope of works necessary together with costing experience from previous projects of a similar nature.

As the works are being conducted within existing substations, we have assumed normal soil for any civil works and have no allowance for any additional access work required. The cost estimates are developed using our 'MTWO' cost estimating system. This system utilises historical average costs, updated by the costs of the most recently implemented project with similar scope. All estimates in MTWO are developed to deliver a 'P50' portfolio value for a total program of works (i.e., there is an equal likelihood of over- or under-spending the estimate total).⁷

⁵ The AER RIT-T Guidelines state that the base case is where the RIT-T proponent does not implement a credible option to meet the identified need but rather continues its 'BAU activities'. The AER define 'BAU activities' as ongoing, economically prudent activities that occur in the absence of a credible option being implemented. (See: [AER, Application guidelines Regulatory Investment Test for Transmission, November 2024](#))

⁶ AEMO, 2025 IASR, August 2025, page 158.

⁷ For further detail on our cost estimating approach refer to section 7 of our [Augmentation Expenditure Overview Paper](#) submitted with our 2023-28 Revenue Proposal.

For this MCC Assessment, the cost estimate with an accuracy of +/- 10 per cent was developed using our MTWO cost estimating system, based on a detailed design with a higher level of accuracy. An accuracy of +/- 10 per cent for cost estimates is consistent with industry best practice and aligns with the accuracy range of a 'Class 2 estimate', as defined in the Association for the Cost Engineering classification system. All cost estimates are prepared in nominal dollars.

Routine operating and maintenance costs are based on works of similar nature. The project does not incur any incremental operating and maintenance costs. The options have been assessed against three reasonable scenarios

The RIT-T is focused on identifying the top ranked credible option in terms of expected net benefits. However, uncertainty exists in terms of estimating future inputs and variables (termed future states of the world).

To deal with this uncertainty, the NER requires that costs and market benefits for each credible option are estimated under reasonable scenarios and then weighted based on the likelihood of each scenario to determine a weighted ('expected') net benefit. It is this 'expected' net benefit that is used to rank credible options and identify the preferred option.

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 economic benefits (ie, the estimated risk costs avoided).

Given that wholesale market benefits are not relevant for this RIT-T, the three scenarios implicitly assume the most likely scenario from the 2025 ISP (ie, the 'Step Change' scenario). The scenarios differ by the assumed level of risk costs and unserved energy, 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, as discussed in section 2.

We developed the Central Scenario around a static model of demand scenarios, described further in Section A.3 of our Network Asset Criticality Framework. We consider that this approach is appropriate since it materially reduces the computational effort required, and since differences in demand forecasts will not materially affect the ranking of the credible options.

How the NPV results are affected by changes to other variables (including the discount rate and capital costs) has been investigated in the sensitivity analysis. We consider this is consistent with the latest AER guidance for RIT-Ts of this type (ie, where wholesale market benefits are not expected to be material).

The table below summarises the specific key variables that influence the net benefits of the options under each of the scenarios considered, as stated in the PACR.

Table 4-1 Summary of scenarios

Variable/Scenario	Central scenario	Low risk costs scenario	High risk costs scenario
Scenario weighting	1/3	1/3	1/3
Discount rate	7.0%	7.0%	7.0%
VCR (2025/26) ⁸	\$ 32,108/MWh	\$32,108/MWh	\$32,108/MWh
Network capital costs	Base estimate	Base estimate	Base estimate
Operating and maintenance costs	Base estimate	Base estimate	Base estimate
Avoided unserved energy	Base estimate	Low demand	High demand
Safety, environmental, and financial risk benefit	Base estimate	Base estimate – 25%	Base estimate + 25%

No further updates were applied to these scenarios for this MCC Assessment.

4.4. Sensitivity analysis

We have not conducted sensitivity analysis in this MCC Assessment as we expect to reach the point of Financial Investment Decision (FID) within the next three months. Should that period extend beyond six months, we will re-assess if required.

⁸ AEMO [2025 Inputs, Assumptions and Scenarios Report](#), August 2025, pp.158

5. MCC assessment results

This MCC Assessment evaluates the Narrabri No.2 and Narrabri No.3 capacitor bank bays only. The Coffs Harbour No.1 capacitor and Kempsey No.1 capacitor, which were included in the PACR, are outside the scope of this assessment and have therefore not been assessed.

NPV results from this MCC Assessment are shown in the table below.

Table 5-2 NPV of net economic benefits relative to the base case (\$m, 2025/26), as presented in this MCC Assessment

Option	Weighted Scenario
Option 1	78.17

The strong positive net economic benefit is overwhelmingly driven by avoided unserved energy (EUE), which accounts for more than 99 per cent of total benefits. Updated EUE forecasts indicate much higher expected volumes of unserved energy in future years. While the VCR adopted in this assessment is lower than that used in the PACR, the increase in projected EUE volumes has more than offset the combined impact of the lower VCR and higher project costs.

6. Conclusion and recommendation

This MCC Assessment has found that Option 1 (renew the capacitor bank bays at Narrabri No.2 and Narrabri No.3) remains the preferred option with a positive NPV of \$78.17 (real FY2025/26) million in this MCC Assessment.

As a result, no MCC event has occurred and Transgrid will continue to deliver Option 1 as outlined in this MCC Assessment.