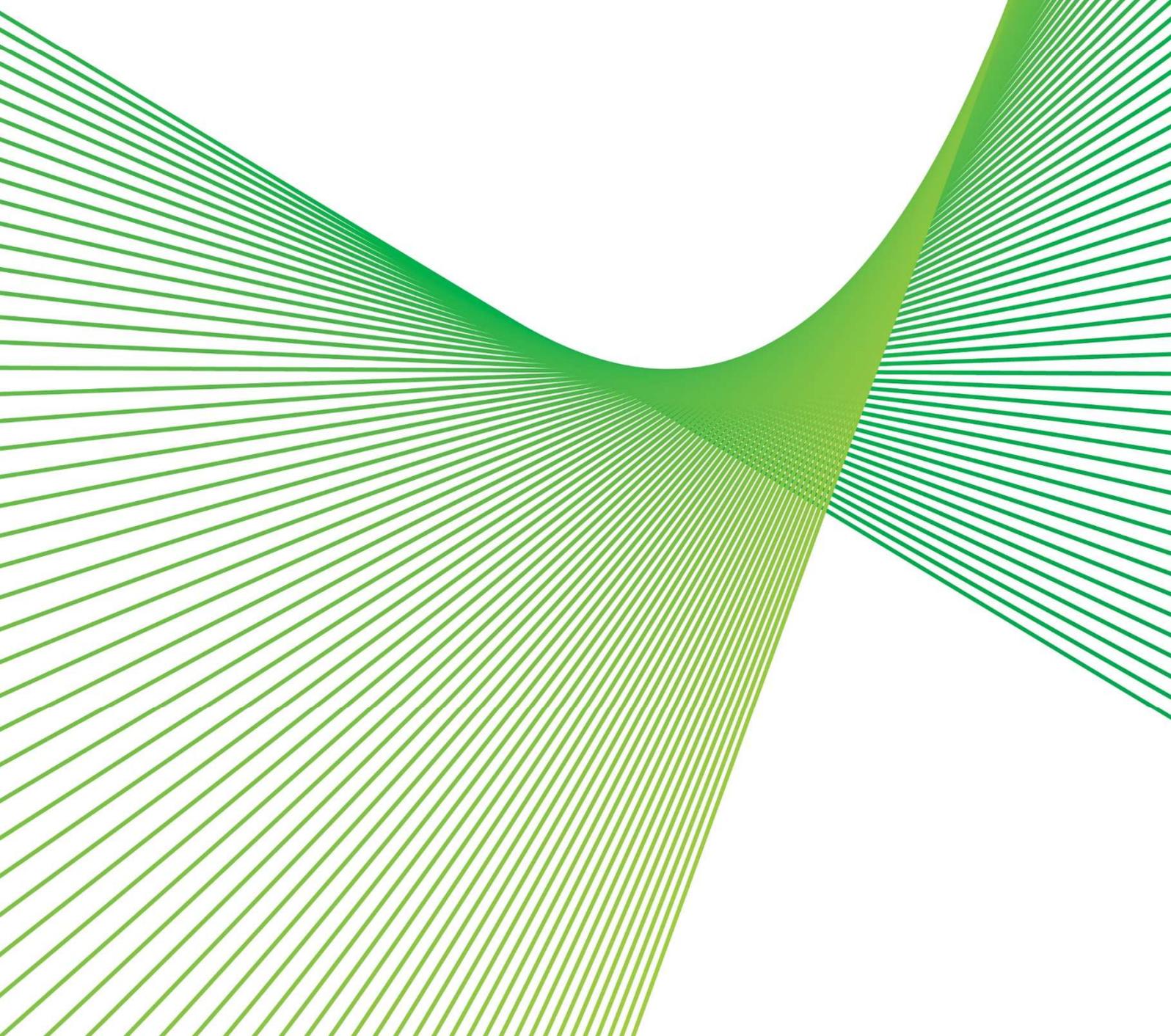


Summary: Managing the risk of circuit breaker failure

RIT-T Project Assessment Conclusions Report

Issue date: 19 December 2023



Disclaimer

This suite of documents comprises Transgrid's application of the Regulatory Investment Test for Transmission (RIT-T) which has been prepared and made available solely for information purposes. It is made available on the understanding that Transgrid and/or its employees, agents and consultants are not engaged in rendering professional advice. Nothing in these documents is a recommendation in respect of any possible investment.

The information in these documents reflect the forecasts, proposals and opinions adopted by Transgrid at the time of publication, other than where otherwise specifically stated. Those forecasts, proposals and opinions may change at any time without warning. Anyone considering information provided in these documents, at any date, should independently seek the latest forecasts, proposals and opinions.

These documents include information obtained from the Australian Energy Market Operator (AEMO) and other sources. That information has been adopted in good faith without further enquiry or verification. The information in these documents should be read in the context of the Electricity Statement of Opportunities, the Integrated System Plan published by AEMO and other relevant regulatory consultation documents. It does not purport to contain all of the information that AEMO, a prospective investor, Registered Participant or potential participant in the National Electricity Market (NEM), or any other person may require for making decisions. In preparing these documents it is not possible, nor is it intended, for Transgrid to have regard to the investment objectives, financial situation and particular needs of each person or organisation which reads or uses this document. In all cases, anyone proposing to rely on or use the information in this document should:

1. Independently verify and check the currency, accuracy, completeness, reliability and suitability of that information
2. Independently verify and check the currency, accuracy, completeness, reliability and suitability of reports relied on by Transgrid in preparing these documents
3. Obtain independent and specific advice from appropriate experts or other sources.

Accordingly, Transgrid makes no representations or warranty as to the currency, accuracy, reliability, completeness or suitability for particular purposes of the information in this suite of documents.

Persons reading or utilising this suite of RIT-T-related documents acknowledge and accept that Transgrid and/or its employees, agents and consultants have no liability for any direct, indirect, special, incidental or consequential damage (including liability to any person by reason of negligence or negligent misstatement) for any damage resulting from, arising out of or in connection with, reliance upon statements, opinions, information or matter (expressed or implied) arising out of, contained in or derived from, or for any omissions from the information in this document, except insofar as liability under any New South Wales and Commonwealth statute cannot be excluded.

Privacy notice

Transgrid is bound by the *Privacy Act 1988 (Cth)*. In making submissions in response to this consultation process, Transgrid will collect and hold your personal information such as your name, email address, employer and phone number for the purpose of receiving and following up on your submissions.

Under the National Electricity Law, there are circumstances where Transgrid may be compelled to provide information to the Australian Energy Regulator (AER). Transgrid will advise you should this occur.

Transgrid's Privacy Policy sets out the approach to managing your personal information. In particular, it explains how you may seek to access or correct the personal information held about you, how to make a complaint about a breach of our obligations under the Privacy Act, and how Transgrid will deal with complaints. You can access the Privacy Policy here (<https://www.transgrid.com.au/Pages/Privacy.aspx>).

Summary

We are applying the Regulatory Investment Test for Transmission (RIT-T) to options for managing the risk of circuit breaker failure on the New South Wales (NSW) transmission network. Publication of this Project Assessment Conclusions Report (PACR) represents the final step in the RIT-T process.

Circuit breakers are essential for the control and protection of the high voltage network. We have identified 122 circuit breakers on our network that will have reached or be approaching the end of their technical life by 2027/28. The probability of failure for these assets is high and is expected to increase as the assets age. If left unaddressed, this will result in greater unserved energy for consumers, greater safety and environment risk, and greater financial costs associated with emergency repair and replacements.

We consider it prudent and cost effective to manage this risk of circuit breaker failure through an asset replacement program during the 2023/24 and 2027/28 regulatory period.

Identified need: ensure the safe and reliable operation of our transmission network by managing the risk of circuit breaker 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 circuit breakers that are approaching the end of their technical life.

The end-of-life assets have been identified through the application of our [Network Asset Health Framework](#) to the circuit breaker population to determine each assets effective age and identify assets with increased risk of failure. The evaluated health index inputs for circuit breakers considers aging factors including natural age, operation count and high wear switching applications; as well as performance factors including defects rate and cost, condition monitoring results and sub population type issues.

The failure of a circuit breaker to operate during a network fault will result in an uncleared fault that must be cleared with a larger outage (via a circuit breaker failure back up protection operation), leading to greater unserved energy. The impact of each circuit breaker failure on lost load varies according to where it is located in the network. Asset failure may also increase the risk of safety and environment issues associated with catastrophic asset failure, and the potential costs of emergency repair and replacements.

We have identified 122 circuit breakers that will have reached or be approaching the end of their technical life by 2027/28. These are all live head circuit breakers (LHCBs) and therefore have separate current transformers installed within the switch bay.

The associated current transformers for 55 of the 122 identified circuit breakers are also approaching the end of their technical life. It is therefore feasible to replace the two units with a single dead tank circuit breaker (DTCB) which incorporates both the circuit breaker and current transformers.

Installing a DTCB removes the need for a separate current transformer and therefore provides additional benefits through avoiding the risk of in-service current transformer failure which can result in interruptions to customer load, safety and environmental consequences and emergency repair and replacement costs.

We have classified this RIT-T as a 'market benefits' driven RIT-T as the economic assessment is not being progressed specifically to meet a mandated reliability standard but by the net benefits that are expected to be generated for end-customers. Given the quantity of circuit breakers that have been identified for

replacement, we consider it prudent and cost effective to manage this risk through a single asset replacement program. This replacement will help limit the amount of in-service failures that occur (along with the associated interruptions to customer load, and safety and environmental consequences).

No submissions received in response to the Project Specification Consultation Report

We published a Project Specification Consultation Report (PSCR) on 18 May 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. The following changes have occurred since the PSCR which have not made an impact on the preferred option:

- Updated the discount rate used
- Updated the VCR

Option 2 remains the preferred option at this stage of the RIT-T process.

We note that, since the PSCR was released, there has been a law change to introduce an emissions reduction objective into the national energy objectives¹ and that the National Electricity Rules are currently being updated to add a new category of market benefit to the RIT-T reflecting changes in Australia's greenhouse gas emissions.² As part of the transitional arrangement of the rule we are not required to consider emissions reduction as part of this PACR. However, we have been proactive in considering these impacts are already implementing a trial of new low greenhouse gas (GHG) insulation technologies and will evaluate wider adoption after its completion.

Credible options considered

We identified two credible network options that would meet the identified need from a technical, commercial, and project delivery perspective³. These options are summarised in Table E-1.

Table E-1 Summary of credible options, \$2021/22

Category	Number of existing CBs in this category	Option 1	Option 2
LHCBs that are reaching the end of their technical life, and for which (i) the associated current transformers are also reaching end of life, and (ii) replacement with a DTCB is technically feasible	55	Replace the existing LHCB with a new LHCB	Replace the existing LHCB and CT with a DTCB

¹ On 12 August 2022, Energy Ministers agreed to fast track the introduction of an emissions reduction objective into the national energy objectives, consisting of the National Electricity Objective (NEO), National Gas Objective and National Energy Retail Objective. On 21 September 2023, the *Statutes Amendment (National Energy Laws) (Emissions Reductions Objectives) Act 2023* (the Act) received Royal Assent.

² AEMC, *Harmonising the electricity network planning and investment rules and AER guidelines with the updated energy objectives (electricity)*, draft determination, 26 October 2023, p. i.

³ As per clause 5.15.2(a) of the NER.

Category	Number of existing CBs in this category	Option 1	Option 2
LHCBs that are reaching the end of their technical life, and for which, (i) a DTCTB is not technically feasible, (ii) there are no associated current transformers, or (iii) the current transformers have a substantial remaining life	67	Replace the existing LHCB with a new LHCB	Replace the existing LHCB with a new LHCB
Estimated capex (\$2021-22)		32.27	41.50
Expected commission date		2028	2028

Appendix B presents a list of circuit breakers identified by this need and the proposed replacement approach under the preferred option, Option 2.

Non-network options are not expected to assist in this RIT-T

We do not consider non-network options to be commercially and technically feasible to assist with meeting the identified need for this RIT-T. The objective of this identified need is to avoid the increasing risks of asset failure due to the deteriorated condition of the circuit breakers. For non-network options to assist, they would need to provide greater net economic benefits than the network options. That is, non-network options would need to reduce the reliability, safety and financial risk related costs (which in practice are not expected to be affected by non-network solutions due to the nature of circuit breakers). We did not receive any submissions from proponents of these solutions in response to the PSCR.

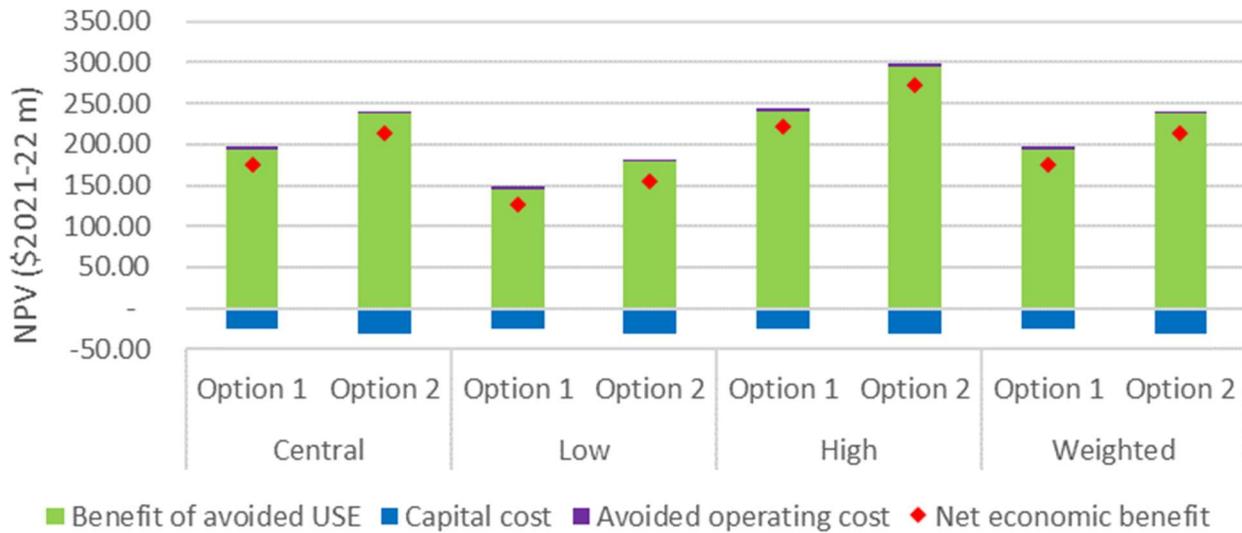
Conclusion: Replacing 55 of the identified assets with dead tank circuit breakers and the remaining 67 with live head circuit breakers is optimal

This PACR finds that implementation of Option 2 is the preferred option at this final stage of the RIT-T process. Under Option 2:

- 55 of the 122 identified circuit breakers will be replaced with a DTCTB. For these circuit breakers, the associated current transformers are approaching the end of their technical life.
- 67 of the 122 identified circuit breakers will be replaced with a LHCB. For these circuit breakers, either replacement with a DTCTB is not technically feasible, there is no associated current transformers, or the current transformers have substantial remaining life.

We have assessed that Option 2 is net beneficial under all three reasonable scenarios considered in this PACR. On a weighted basis, where each scenario is weighted equally, Option 2 is expected to deliver net benefits of approximately \$217.10m.

Figure E-1 Net economic benefits (\$m, PV)



The capital cost of this option is approximately \$41.50 million (in \$2021/22). The work will be undertaken over a five-year period with all works expected to be completed by 2027/28. Routine operating and maintenance costs are estimated at approximately \$0.16 million per annum (in \$2021/22).⁴ 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 to complete the works with minimal network impact.

Next steps

This PACR represents the final step of the consultation process in relation to the application of the Regulatory Investment Test for Transmission (RIT-T) process undertaken by Transgrid. It follows a PSCR released in May 2023. No submissions were received in response to the PSCR.

The second step of the RIT-T process, production of a Project Assessment Draft Report (PADR), was not required as Transgrid considers its investment in relation to the preferred option to be exempt from that part of the RIT-T process under NER clause 5.16.4(z1). Production of a PADR is not required due to:

- the estimated capital cost of the preferred option being less than \$46 million;
- the PSCR stating:
 - the proposed preferred option, together with the reasons for the proposed preferred option;
 - the RIT-T is exempt from producing a PADR; and
 - the proposed preferred option and any other credible options will not have a material market benefit for the classes of market benefit specified in clause 5.15A.2(b)(4), with the exception of market benefits arising from changes in voluntary and involuntary load shedding;
- no PSCR submissions identifying additional credible options that could deliver a material market benefit; and
- the PACR addressing any issues raised in relation to the proposed preferred option during the PSCR consultation.

⁴ Average operating costs over the period 2028/29 to 2049/50.

Parties wishing to raise a dispute notice with the AER may do so prior to 23 January 2024⁵ (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 'Circuit breaker renewal program PACR'.

⁵ Additional days have been added to cover public holidays