

# **Summary: Maintaining compliance with performance standards applicable to protection relays**

RIT-T Project Assessment Draft Report

Issue date: 22 April 2024



## 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 maintaining compliance with performance standards applicable to protection relays. This RIT-T includes 419 protection relays at various locations on the ACT and NSW transmission network, based on their assessed condition. Publication of this Project Assessment Draft Report (PADR) represents the second step in the RIT-T process.

Protection relays are used throughout the transmission network to isolate network faults and reduce their impact on system security, system reliability and network infrastructure. In this RIT-T we are examining options to address the risk of failure of individual protection relays that isolate faults on transmission lines, transformers, reactors, capacitors, and busbars (interzone). Additionally, this RIT-T includes options for addressing risks to under frequency load shedding (UFLS) schemes. These UFLS schemes at various substations on the network are designed to arrest a fall in frequency by progressively disconnecting load in a coordinated and automatic manner. These schemes are implemented to satisfy requirements set out in the National Electricity Rules (NER)<sup>1</sup>.

The identified protection relays will reach the end of their technical life by 2027/28, with manufacturer support, access to spares and defects rates being the largest drivers for remediation. The risk of failing to protect primary assets increases as technology becomes superseded by the manufacturer, manufacturer support ceases, and spare parts become scarce.

If the deteriorating condition of these identified assets is not addressed by 2027/28, the risk of asset failure will increase. Table E-1 outlines the condition issues associated with the protection relays, the impact of each condition issue if not remediated, as well the consequences of each issue if no action is taken.

Table E-1 Condition issues on protection relays on the ACT and NSW network, their potential impact, and consequences

Issue	Potential impact	Consequence
Technology obsolescence	Manufacturer support is limited or withdrawn, repair and replacement facilities are expected to be unavailable.	Assets continue to deteriorate and risk of failure increases.
Decreased function	Assets have increasing numbers of faults as they progress along their failure curves, deteriorating components or are prone to mechanical wear.	Likelihood of a hazardous event occurring increases.

Given the high population of protection relays that have been identified for replacement, we consider it prudent and cost effective to manage this risk through a single asset replacement program.

### Identified need: meet the service level required under National Electricity Rules for protection schemes

Protection relays play a central role in supplying electricity across the ACT and NSW transmission network. Used to control, monitor, protect and secure communication to facilitate safe and reliable network

<sup>1</sup> As per Schedule 5.1 of the NER.

operation, protection relays are necessary to operate the transmission network and prevent damage to primary assets when adverse events occur.<sup>2</sup>

Redundant protection schemes are required to ensure the transmission system is adequately protected as outlined in the Network Performance Requirement under Schedule 5.1 of the National Electricity Rules (NER), therefore the condition issues affecting the identified protection relays on the ACT and NSW transmission network must be addressed. The Network Performance Requirements, set out in Schedule 5.1 of the NER, place an obligation on Transmission Network Service Providers (TNSPs) to provide redundant protection schemes to ensure the transmission system is adequately protected. Clause 5.1.9(c) of the NER requires a TNSP to provide sufficient primary 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.

Additionally, TNSPs are required to disconnect the unprotected primary assets where the secondary system fault lasts for more than eight hours (for planned maintenance) or 24 hours (for unplanned outages). TNSPs must also ensure that all protection systems for voltages above 66 kV are always well-maintained and available other than for short periods (less than eight hours), while the maintenance of protection systems is being carried out.<sup>3</sup> In the event of an unplanned outage, AEMO's Power System Security Guidelines require that the primary network assets must be taken out of service within 24 hours<sup>4</sup>.

A failure of the secondary systems would involve replacement of the failed component or taking the affected primary assets, such as lines and transformers, out of service. Though replacement of a failed secondary systems component is a possible interim measure, the approach is not sustainable as the stock of spare components will deplete due to the technology no longer being manufactured or supported. Once all spares are used, interim replacements will cease to be a viable option to meet performance standards stipulated in clause 4.6.1 of the NER.

If the failure to provide functional protection schemes due to technology obsolescence is not addressed by a technically and commercially feasible credible option in sufficient time (by 2027/28), the likelihood of not recovering from secondary systems faults and not maintaining compliance with NER performance requirements will increase.

The proposed investment will enable us to continue to meet the standards for secondary systems availability set out in the NER, and to avoid the impacts of taking primary assets out of service. Consequently, it is considered a reliability corrective action under the RIT-T.

A reliability corrective action differs from a 'market benefits'-driven RIT-T in that the preferred option is permitted to have negative net economic benefits on account of it being required to meet an externally imposed obligation on the network business.

---

<sup>2</sup> As per Schedule 5.1 of the NER.

<sup>3</sup> As per S5.1.2.1(d) of the NER.

<sup>4</sup> AEMO. "Power System Security Guidelines, 6 November 2023." Melbourne: AEMO, 2023.23. Accessed 15 March 2024. [https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security\\_and\\_Reliability/Power\\_System\\_Ops/Procedures/SO\\_OP\\_3715%20Power-System-Security-Guidelines.pdf](https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715%20Power-System-Security-Guidelines.pdf)

## No submissions received in response to the Project Specification Consultation Report

We published a Project Specification Consultation Report (PSCR) on 18 October 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

Following the publication of the PSCR, AEMO updated the central discount rate to be used within cost benefit analysis from 5.5 to 7 percent.<sup>5</sup> At the same time, The lower and upper bound for this cost benefit analysis was updated from 2 to 3 percent and 7.5 percent to 10.5 percent. Economic results presented within this PADR make use of these updated discount rates. At the same time, 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.<sup>6</sup> 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.<sup>7</sup>

Transgrid supports greater consideration of emissions impacts within network planning and investment frameworks. These changes enable network planning and investment frameworks to support achievement of the Commonwealth Government's net zero targets. Transgrid has set our own 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.<sup>8</sup>

We have applied the updated NEO to this RIT-T assessment and do not consider there to be any material changes to greenhouse gas emissions under the proposed options, as the proposed options are unlikely to significantly alter the generation mix across the NEM. 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.

Nonetheless, Transgrid is working to understand how to assess the quantum and value of expected changes in greenhouse gas emissions. Insights will be considered and presented within the PACR. Where possible and practical, we will refine this approach and any results following updated guidance being provided by the AER on RIT-T related emissions reduction assessments.

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

---

<sup>5</sup> AEMO July 2023 [2023 Inputs, Assumptions and Scenarios Report](#)

<sup>6</sup> Statutes Amendment (National Energy Laws) (Emissions Reduction Objectives) Act 2023 (SA)

<sup>7</sup> AEMC, [Harmonising the national energy rules with the updated national energy objectives – final determination](#), 1 February 2024

<sup>8</sup> 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>

## One credible network option was identified in the PSCR

In the PSCR we identified one credible network option that we consider would meet the identified need from a technical, commercial, and project delivery perspective.<sup>9</sup> The only option that meets these criteria is summarised in Table E-2.

Table E-2 Summary of the credible option

Option	Description	Estimated capex (\$2023-24 m)	Expected commission date
<b>Option 1</b>	<b>Renewal of individual assets</b>	<b>\$50.92</b>	<b>2024-2028</b>
Transmission line protection relays		\$35.69	
Transformer protection relays		\$8.42	
Reactor protection relays		\$1.92	
Capacitor protection relays		\$2.92	
Busbar (and interzone) protection relays		\$0.99	
Protection relays associated with UFLS schemes		\$0.97	

Four other options were considered (secondary systems renewal, refurbishment of individual assets, asset retirement, and non-network solutions) but not progressed. The reasons for not progressing these options are outlined in **Error! Reference source not found.**

## Non-network options are not expected to be able 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. Non-network options are not able to meet NER obligations to provide redundant protection schemes and ensure that the transmission system is adequately protected. Additionally, we did not receive any submissions in relation to non-network options in response to the PSCR.

## Option 1 has been assessed against three reasonable scenarios

The credible option has been assessed under three scenarios as part of the Project Assessment Draft Report (PADR) assessment. The scenarios differ in terms of the key drivers of the estimated net market benefits (i.e., the estimated risk costs avoided).

<sup>9</sup> As per clause 5.15.2(a) of the NER.

Given that wholesale market benefits are not relevant for this RIT-T, the three scenarios assume the most likely scenario from AEMO's Integrated System Plan (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-3 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 (\$2023-24) <sup>10</sup>	\$50,099/MWh	\$50,099/MWh	\$50,099/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 will investigate how the NPV results are affected by changes to other variables, including the discount rate and capital costs.

## Option 1 is the preferred option

We have assessed that Option 1 is net beneficial under all three reasonable scenarios considered in this PADR. On a weighted basis, where each scenario is weighted equally, Option 1 is expected to deliver net benefits of approximately \$18.12 million. Option 1 will also enable us to meet a range of obligations under the NER and jurisdictional instruments (which is not expected to be the case under the base case), including obligations set out in Schedule 5.1 of the NER to provide redundant secondary systems and ensure that the transmission system is adequately protected.

## Draft assessment

This PADR finds that Option 1 is the preferred option to address the identified need. Option 1 involves individual replacements of 419 identified assets (listed in Appendix C) across 48 sites within the regulatory period. The option is based on a like-for-like approach whereby the asset is replaced by its modern equivalent. Additional system modifications or additional functionalities would not be deployed under this option.

This option would deliver risk mitigation and reduced corrective maintenance benefits to consumers and the networks by only targeting the probability of failure of identified assets. This option will not deliver any additional operational benefits such as improved capabilities for remote interrogation and predictive

<sup>10</sup> This VCR is equal to the \$49,216 within AEMO's July 2023 [2023 Inputs, Assumptions and Scenarios Report](#) inflated to December 2023.



activities. This option will phase asset renewals across the regulatory control periods. Deployments are prioritised based on investment benefit with consideration also given to efficient delivery strategies. Targeted assets will be in service for approximately 15 years, with some assets remaining at each site to incur investment in future years.

The work will be undertaken over a five-year period with all works expected to be completed by the end of 2027/28. The capital cost of this option is approximately \$50.92 million (in \$2023-24). In addition, routine operating and maintenance costs are estimated at approximately \$13,703 per annum (in \$2023-24). We expect that the protection relays will have an asset life of 15 years.

## Submissions and next steps

We welcome written submissions on materials contained in this PADR. Submissions are due on 7 June 2024.

Submissions should be emailed to our Regulation team via [regulatory.consultation@transgrid.com.au](mailto:regulatory.consultation@transgrid.com.au).<sup>11</sup> In the subject field, please reference 'Protection Relays PADR.'

At the conclusion of the consultation process, all submissions received will be published on our website. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement. Subject to any additional credible options being identified, we anticipate publication of a PACR by August 2024.

---

<sup>11</sup> 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. If you do not wish for your submission to be made public, please clearly specify this at the time of lodgement. See Privacy Notice within the Disclaimer for more details.