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Summary: Maintaining compliance with performance standards applicable to protection relays

RIT-T Project Assessment Conclusions Report

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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 Conclusions Report (PACR) represents the final 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)[1].

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 The risk of failing to protect primary assets increases as technology becomes superseded by the manufacturer, manufacturer support ceases, and spare parts become scarce.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Technology obsolescence	Manufacturer support is limited or withdrawn, repair and replacement facilities are expected to be unavailable.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 the 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

[1] 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. [2]

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.[3] 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[4].

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 need 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.

No submissions received in response to the Project Assessment Draft Report

We published a Project Assessment Draft Report (PADR) on 22 April 2024 and invited written submissions on the material presented within the document. No submissions were received in response to the PADR.

[2] As per Schedule 5.1 of the NER.
[3] As per S5.1.2.1(d) of the NER.
[4] AEMO. "Power System Security Guidelines, 3 June 2024." Melbourne: AEMO, 2023.23. Accessed 4 June 2024. SO_OP_3715 - Power System Security Guidelines (aemo.com.au)

No material developments since publication of the PADR

Following the publication of the PADR the renewal program's scope was adjusted to include additional assets. These assets have been incorporated within the updated program because of emerging issues identified after the PADR was published. There is a minor cost decrease to the preferred option (Option 1) and related changes in the base case and option risks.

In addition, there is an increase in annual operating costs for the base case and the preferred option. The method for calculating the operating expenditure in the PADR aligned with the method we typically use to assess protection relays at individual sites. However, as we are conducting a RIT-T to assess a program of works which are part of our Asset Renewal Strategy (ARS), we have re-calculated the opex to reflect the scope and scale of the project, and with consideration of the varying asset condition across the network. Overall, this update has not materially impacted the assessment.

Option 1 remains the preferred option for meeting the service level required under the National Electricity Rules for protection schemes at this stage of the RIT-T process.

Credible options considered

In the PADR we identified one credible network option that we consider would meet the identified need from a technical, commercial, and project delivery perspective.[5] 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
Option 1	Renewal of individual assets		2024-2028
Transmission line protection relays		$35.17	
Transformer protection relays		$8.30	
Reactor protection relays		$1.89	
Capacitor protection relays		$2.88	
Busbar (and interzone) protection relays		$0.98	
Protection relays associated with UFLS schemes		$0.96	
		Total: $50.18	

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 Table 3-5.

[5] As per clause 5.15.2(a) of the NER.

No submissions received in relation to non-network options

In the PSCR and PADR, we noted that 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. No submissions were received in response to the PSCR, nor the PADR, in relation to non-network options.

Conclusion: Renewal of individual assets is optimal

This PACR 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 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 in-service until investment in future years.

We have assessed that Option 1 is net beneficial under all three reasonable scenarios considered in this PACR. On a weighted basis, where each scenario is weighted equally, Option 1 is expected to deliver net benefits of approximately $19.19 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.

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 $50.18 million (in $2023-24). In addition, routine operating and maintenance costs are estimated at approximately $61,650 per annum (in $2023-24). We expect that the protection relays will have an asset life of 15 years.

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.

Parties wishing to raise a dispute notice with the AER may do so prior to 26 July 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.[6] In the subject field, please reference 'Protection Relays PACR.'

[6] 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.