# OPTIONS EVALUATION REPORT (OER)

FY24-28 Prot - Temporary Recall Renewal

OER- N2449 revision 0.0

**Ellipse project no(s):**
**TRIM file: [TRIM No]**

**Project reason:** Capability - Asset Replacement for end of life condition
**Project category:** Prescribed - Replacement

**Approvals**

| | | |
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| **Date submitted for approval** | 9 November 2021 | |

**Change history**

| Revision | Date | Amendment |
|---|---|---|
| 0 | 09/11/2021 | First Issue |
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# Executive summary

Temporary Recall protection assets are protection systems with limited functionality that are deployed on a non-permanent basis to ensure that primary services can remain operational during protection failures or short recalls to meet reliability requirements.

These systems are based on obsolete relays that are no longer supported by the manufacturer. These temporary protections are held by our maintenance delivery teams to ensure rapid return to service of primary assets when required.

We currently have 9 units available in the network that provide basic Overcurrent and harmonic restraint protection functionality. The identified assets have reached the end of their serviceable life with manufacturer support withdrawn.

There is a need for temporary protection systems to be available to address short recalls and unrepairable protection failures. These systems mitigate the risk of outage unavailability and the withdrawal of primary plant from service during protection failures.

The assessment of the options considered to address the need appears in Table 1, which includes communications alarm systems evaluated as NPV positive, and reaching end of life by 2027/28. A summary of all options considered are detailed below.

Under the Base Case TransGrid continues to operate and maintain (O&M) the existing systems as required. This approach will not address the obsolescence and health of the obsolete and unsupported assets.

Option A involves individual replacements of 9 identified assets within the regulatory period. The option is based on a direct replacement approach whereby the asset is replaced by a modern standard equivalent. Minor additional system capability improvements would be deployed under this option.

**Table 1 - Evaluated options**

| Option | Description | Direct capital cost ($m) | Overheads ($m) | Total capital cost[1] ($m) | Weighted NPV (PV, $m) | Rank |
|---|---|---|---|---|---|---|
| Option A – N2449A | Replace with new standards | 0.64 | 0.11 | 0.75 | 2.30 | 1 |

It is the recommendation that Option A – Replace with new standards, be scoped in detail.

[1] Total capital cost is the sum of the direct capital cost and network and corporate overheads. Total capital cost is used in this OER for all analysis.

# 1. Need/opportunity

Temporary Recall protection assets are protection systems with limited functionality that are deployed on a non-permanent basis to ensure that primary services can remain operational during protection failures or short recalls to meet reliability requirements.

These systems are based on obsolete relays that are no longer supported by the manufacturer. These temporary protections are held by our maintenance delivery teams to ensure rapid return to service of primary assets when required.

We currently have 9 units available in the network that provide basic Overcurrent and harmonic restraint protection functionality. The identified assets have reached the end of their serviceable life with manufacturer support withdrawn.

There is a need for temporary protection systems to be available to address short recalls and unrepairable protection failures. These systems mitigate the risk of outage unavailability and the withdrawal of primary plant from service during protection failures.

The transmission network is becoming more complex and with the continued deployment of renewables, is likely to present new challenges in achieving outages for maintenance or allowing operation on a single protection scheme.

We are additionally facing an increasing number of protection schemes that have seen the withdrawal of manufacturer support. Resulting in the need for temporary quick deployment protection schemes to allow us to meet the requirements of the NER:

- Clause 4.6.5(a) – "*Where there is an outage of one protection system of a transmission line, AEMO must determine, in consultation with the relevant Network Service Provider, the most appropriate action. Depending on the circumstances the determination may be:*

  *(1) to leave the transmission element in service for a limited duration;*

  *(2) to take the transmission element out of service immediately;*

  *(3) to install temporary protection system;*

  *(4) to accept a degraded performance from the protection system, with or without additional operational measures or temporary protection measures to minimise power system impact; or*

  (5) *to operate the transmission element at a lower capacity*"

- Schedule S5.1.2.1(d) – "*The Network Service Provider must ensure that all protection systems for lines at a voltage above 66kV, including associated intertripping, are well maintained so as to be available at all times other than for short periods (not greater than eight hours) while the maintenance of a protection system is being carried out.*"
- Schedule S5.2.5.9(a)(2) – "*each primary protection system must have sufficient redundancy to ensure that a faulted element within its protection zone is disconnected from the power system within the applicable fault clearance time with any single protection element (including any communications facility upon which that protection system depends) out of service*"

We are currently operating 2165 primary protection systems for prescribed transmission elements throughout the network with 1065 systems either currently unsupported by the manufacturer or are expected to be unsupported by the end of FY2027/28. This poses issues with depleting spares holdings and the lack of ability to replenish spares.

The quantity of assets that may fail and cannot be returned to service requires an uplift of temporary protection systems to assist in defect responses that keep major transmission elements in service.

# 2. Related needs/opportunities

There are no identified needs that would deliver efficiencies through the coordination of works.

# 3. Options

## 3.1 Base case

The Base Case for this Need is to continue with TransGrid's business as usual operations and maintenance (O&M) for the assets. This approach does not address the deteriorating condition of the temporary protections or the risk cost associated with maintaining aging assets. It is of note that these assets are held in storage until an unresolvable protection issue requires their deployment. The risk will likely increase due to:

- The probability of failure increasing as assets move further along their failure curves[2].
- TransGrid's inability to recover from asset failure in the future due to withdrawn manufacturer support, and depletion of spares availability that would otherwise limit the overall consequence of asset failure.

Key drivers for this risk cost are:

- The majority of assets identified have reached their end of technical life and no manufacturer support as highlighted in previous sections. This therefore increases the likelihood of a hazardous event occurring and decreases TransGrid's ability to mitigate or repair failures.
- Assets have increasing numbers of failure as they progress along their failure curves, increasing the likelihood of a hazardous event occurring.

Increasing maintenance on protection equipment cannot reduce the probability of failure or reduce risk costs. This is because maintenance of computer assets is focused on device inspection and functional performance checks only, the conduct of maintenance at an electronic component level is neither feasible nor practicable.

## 3.2 Options evaluated

**Option A** — Replace with new standards [NOSA N2449, OFS N2449A]

This option involves targeted replacements of the 9 identified assets up to 2027/28. The option is based on a targeted approach whereby the asset is replaced by its modern equivalent utilising the latest standards.

This option would deliver the greatest benefits to consumers and the network by targeting the probability of failure of targeted assets. This option will provide additional operational benefits such as improved capabilities for temporary protection schemes.

This option is planned for deployment across the 2023/24-2027/28 regulatory control period. Targeted assets will be in service for approximately 15 years.

## 3.3 Options considered and not progressed

**Table 2 – Options not progressed**

| Option | Reason for not progressing |
|---|---|
| Refurbish existing assets | The assets are a proprietary product utilising surface mount technology, these are not technically or economically feasible for refurbishment. |
| Non-network solutions | It is not technically feasible for non-network solutions to provide the functionality of secondary systems assets for protection, control, communications and metering |

[2] Refer Network Asset Health Framework

# 4. Evaluation

## 4.1 Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set assumptions based on current information that is most likely to eventuate (central scenario), a set of assumptions that give rise to a lower bound for net benefits (lower bound scenario), and a set of assumptions that give rise to an upper bound on benefits (higher bound scenario).

Assumptions for each scenario are set out in the table below.

**Table 3 – Scenario assumptions**

| Parameter | Central scenario | Lower bound scenario | Higher bound scenario |
|---|---|---|---|
| Discount rate | 4.8% | 7.37% | 2.23% |
| Capital cost | 100% | 125% | 75% |
| Operating expenditure benefit | 100% | 75% | 125% |
| Risk costs benefit | 100% | 75% | 125% |
| Other benefit | 100% | 75% | 125% |
| **Scenario weighting** | **50%** | **25%** | **25%** |

Parameters used in this commercial evaluation:

**Table 4 - Commercial evaluation parameters**

| Parameter | Parameter Description | Value used for this evaluation |
|---|---|---|
| Discount year | Year that dollar values are discounted to | 2020/21 |
| Base year | The year that dollar value outputs are expressed in real terms | 2020/21 dollars |
| Period of analysis | Number of years included in economic analysis with remaining capital value included as terminal value at the end of the analysis period. | 15 years |
| Safety disproportionality | Multiplier of the safety risk cost included in NPV analysis to demonstrate implementation of obligation to reduce safety to ALARP. | Refer to section 4.3 for details. |

The capex figures in this OER do not include any real cost escalation.

## 4.2 Commercial evaluation results

The commercial evaluation of the technically feasible options is set out in Table 5. Details appear in Appendix A.

**Table 5 - Commercial evaluation ($ million)**

| Option | Capital Cost PV | Central scenario NPV | Lower bound scenario NPV | Higher bound scenario NPV | Weighted NPV | Ranking |
|---|---|---|---|---|---|---|
| Option A | 0.59 | 2.16 | 1.02 | 3.86 | 2.30 | 1 |

## 4.3 ALARP evaluation

TransGrid manages and mitigates bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with the regulation obligations and TransGrid's business risk appetite. The need for these assets is not driven by these risks. There is no quantifiable safety risk reduction by addressing the condition of these assets.

## 4.4 Preferred option

The preferred option to meet the identified need by 2027/28 is Option A. Option A is the most prudent and economically efficient solution to enable TransGrid to continue meeting its regulatory obligations set out in clause 4.11.1, 4.6.1(b)[3] of the NER. This option maximises net economic benefits to all those who produce, consume and transport electricity in the market, and will ensure performance standards applicable to the networks communications systems continue to remain met.

Option A involves the renewal (replacement) of the individually assessed components in an old for new replacement.

**Capital and Operating Expenditure**

There is negligible difference in predicted ongoing planned routine operational expenditure between the option and the Base Case.

Resultant corrective maintenance under the base case strategy is anticipated to result in higher expenditure over the upcoming regulatory period. Delivery of proposed works under Option A will reduce the risk of increasing direct defect response costs.

It has been modelled that under corrective maintenance, those components with no manufacturer support and limited spares could incur significant costs associated with design and preparation, and likely augmentation of linking systems required to move to a different design solution. Such costs would not be present in cases where a like-for-like replacement is feasible.

These operating expenditure benefits have been captured in the economic evaluation.

**Regulatory Investment Test**

The program and estimate allows for the appropriate Regulatory approvals as required.

# 5. Optimal Timing

The test for optimal timing of the preferred option has been undertaken. The approach taken is to identify the optimal commissioning year for the preferred option where net benefits (including avoided costs and safety disproportionality tests) of the preferred option exceeds the annualised costs of the option. The commencement year is determined based on the required project disbursement to meet the commissioning year based on the OFS.

[3] As per clause 4.6.1(b) of the NER, AEMO must ensure that there are processes in place, which will allow the determination of fault levels for normal operation of the power system and in anticipation of all credible contingency events and protected events that AEMO considers may affect the configuration of the power system, so that AEMO can identify any busbar which could potentially be exposed to a fault level which exceeds the fault current ratings of the circuit breakers associated with that busbar.

The results of optimal timing analysis are:

- Optimal commissioning year: 2027/28
- Commissioning year annual benefit: $0.14 million
- Annualised cost: $0.07 million

The project is expected to commence in the 2023/24-2027/28 Regulatory Period based on the optimal timing

# 6. Recommendation

It is the recommendation that Option A – Replace with new standards be scoped in detail.

The total project cost is $0.75 million including $0.12 million to progress the project from DG1 to DG2

# Appendix A – Option Summaries

| Project Description | FY24-28 Temporary Recall Renewal | | |
|---|---|---|---|
| Option Description | Option A – Replace with new standards | | |
| **Project Summary** | | | |
| Option Rank | *1* | Investment Assessment Period | *15* |
| Asset Life | *15* | NPV Year | 2021 |
| **Economic Evaluation** | | | |
| NPV @ Central Benefit Scenario (PV, $m) | 2.16 | Annualised CAPEX @ Central Benefit Scenario ($m) | Annualised Capex - Standard (Business Case) 0.07 |
| NPV @ Lower Bound Scenario (PV, $m) | 1.02 | Network Safety Risk Reduction ($m) | Network Safety Risk Reduction 0.02 |
| NPV @ Higher Bound Scenario (PV, $m) | 3.86 | ALARP | ALARP Compliant? No |
| NPV Weighted (PV, $m) | 2.30 | Optimal Timing | Optimal timing (Business Case) 2020 |
| **Cost (Central Scenario)** | | | |
| Total Capex ($m) | 0.75 | Cost Capex (PV,$m) | 0.59 |
| Terminal Value ($m) | 0.00 | Terminal Value (PV,$m) | 0.00 |
| **Risk (Central Scenario)** | **Pre** | **Post** | **Benefit** |
| Reliability (PV,$m) | Reliability Risk (Pre) 2.42 | Reliability Risk (Post) 0.00 | Pre – Post 2.42 |
| Financial (PV,$m) | Financial Risk (Pre) 0.00 | Financial Risk (Post) 0.00 | Pre – Post 0.00 |
| Operational/Compliance (PV,$m) | Operational Risk (Pre) 0.00 | Operational Risk (Post) 0.00 | Pre – Post 0.00 |
| Safety (PV,$m) | Safety Risk (Pre) 0.00 | Safety Risk (Post) 0.00 | Pre – Post 0.00 |
| Environmental (PV,$m) | Environmental Risk (Pre) 0.00 | Environmental Risk (Post) 0.00 | Pre – Post 0.00 |
| Reputational ($m) | Reputational Risk (Pre) 0.00 | Reputational Risk (Post) 0.00 | Pre – Post 0.00 |
| **Total Risk (PV,$m)** | Total Risk (Pre) 2.42 | Total Risk (Post) 0.00 | Pre – Post 2.42 |
| OPEX Benefit (PV,$m) | | | OPEX Benefit 0.00 |
| Other benefit (PV,$m) | | | Incremental Net Benefit 0.33 |
| **Total Benefit (PV,$m)** | | | Business Case Total Benefit 2.75 |