OPTIONS EVALUATION REPORT (OER)

FY24-28 Microwave Renewal Program

OER- N2442 revision 0.0

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

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

Approvals

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Change history

Revision	Date	Amendment
0	14/10/2021	First Issue

Executive summary

TransGrid currently utilises the microwave radio network for data transmission between TransGrid substations, offices and depots, network control rooms and data centres where duplicated fibre optic paths do not exist. There are currently 44 microwave links under consideration for this Need which have install years ranging between 2004 and 2015.

For the purpose of this document, a microwave link is classified as a complete individual link from one radio repeater site or substation to another. It is to be noted that number of microwave systems within a microwave link will vary based on the link type.

Common services that traverse our communication network include Protection, SCADA, Operational Telephony, Corporate Data, and the Substation Security Zone that are critical in maintaining a safe, secure and reliable transmission network. The communications network and its infrastructure are a core component of TransGrid's operations and is required into the foreseeable future.

The assets identified are reaching the end of their serviceable life by 2027/28. Manufacturer support for these assets is withdrawn, meaning that repair and replacement facilities are expected to be unavailable by 2027/28. There is a need to address deteriorating asset health and increasing risks associated with the identified assets. Addressing this need will ensure TransGrid will continue to meet its regulatory obligations set out in the NER.

The assessment of options considered to address this need appears in Table 1. The microwave links evaluated for asset replacement are those utilising obsolete technology (no manufacturer support), evaluated as NPV positive, and reaching end of life by 2027/28.

Under the Base Case TransGrid continues to operate and maintain the existing assets across various sites as required. This approach will not address the obsolescence and health of these ageing assets.

Table 1 - Evaluated options

Option	Description	Direct capital cost ($m)	Network and corporate overheads ($m)	Total capital cost[1] ($m)	Weighted NPV (PV, $m)	Rank
Option A – N2442A	Renewal of Individual Assets Like-for-like replacement whereby the asset is replaced by its modern equivalent.	8.72	1.53	10.25	12.62	1

It is the recommendation that Option A – Renewal of Individual Assets, 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

TransGrid currently utilises the microwave radio network for data transmission between TransGrid substations, offices and depots, network control rooms and data centres where duplicated fibre optic paths do not exist. Microwave systems highlighted in this need encompass the radio equipment responsible for converting electrical signals to microwave signals, and providing communication path from one point to another.

There are currently 44 links (representing 67% of total population) under consideration for this Need which have install years ranging between 2004 and 2015. For the purpose of this document, a microwave link is classified as a complete individual link from one radio repeater site or substation to another. It is to be noted that number of microwave systems within a microwave link will vary based on the link type.

Common services that traverse our communication network include Protection, SCADA, Operational Telephony, Corporate Data, and the Substation Security Zone that are critical in maintaining a safe, secure and reliable transmission network. The communications network and its infrastructure are a core component of TransGrid's operations and is required into the foreseeable future.

The assets identified are reaching the end of their serviceable life by 2027/28. Manufacturer support for these assets is withdrawn, meaning that repair and replacement facilities are expected to be unavailable by 2027/28.

TransGrid's assets are classified as a Data Communication Provider, Data Communications Facility and Intervening Facility under the Power System Data Communication Standard (PSDCS) to meet clause 4.11.2(a) of the NER. This standard places an obligation on TransGrid to provide high reliability data communication services to support the power system security of the network.

Additionally, the Network Performance Requirements set out in Schedule 5.1 of the NER, place an obligation on TNSPs to meet critical clearance times for protection services to ensure the transmission system is adequately protected. Schedule 5.1.9(c) of the NER requires a TNSP to provide sufficient primary and back-up protection systems, including any communications facilities, to ensure that a fault of any type anywhere on its transmission system is automatically disconnected.

Though the replacement of failed components is a possible interim measure, the approach is not sustainable as spare components may not be available due to supplier constraints and technological obsolescence in the future. Once spares are depleted due to ceased manufacturer support, defect repairs can no longer be a viable approach to maintain compliance with performance obligations.

In accordance with TransGrid's Renewal and Maintenance Strategy for Telecommunications Systems[2], a pre-emptive approach to asset renewals is required to address several factors increasing the risk of identified assets including:

- increasing probability of failure
- end of serviceable life
- obsolete technology
- withdrawal of manufacturer support for repair and procurement
- depletion of spares

Addressing this need upholds the capital expenditure objectives in the NER Clause 6A.6.7 (a), in particular it will:

1. maintain the quality, reliability and security of supply of prescribed transmission services; and
2. maintain the reliability and security of the transmission system through the supply of prescribed transmission services

[2] Refer to Renewal and Maintenance Strategy – Telecommunications Systems

2. Related needs/opportunities

The following related needs could improve efficiency of delivery where timing is coordinated in alignment with risk profiles:

- N2550 – FY24-28 OPGW Rollout
- N2487 – FY24-28 Rack Power Supply Renewal
- N2486 – FY24-28 NiCd Battery and Charger Renewal
- N2441 – FY24-28 Multiplexer Renewal

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 identified assets. This approach does not address the deteriorating condition of the assets under evaluation or the risk cost associated with maintaining aging assets. The risk will likely increase due to:

- The probability of failure increasing as assets move further along their failure curves. Failures are the result unrepairable internal electronic subcomponents requiring the replacement of complete assets.
- TransGrid's decreasing ability to effectively recover from asset failure due to no manufacturer support and increasing unavailability of spares over time, increases the consequence of asset failure.

Key drivers for this risk cost are:

- All targeted assets will have reached their end of life and have no manufacturer support. The underlying technology is no longer produced in the market and thus replacements are reliant on depleting excess stocks held by TransGrid. This increases the likelihood of a hazardous event occurring and decreases TransGrid's ability to mitigate or repair failures.
- Assets have increasing numbers of faults, degrading components are prone to mechanical wear, increasing the likelihood of a hazardous event occurring.

Increasing maintenance on the identified equipment cannot reduce the probability of failure or reduce risk costs. This is because the conduct of maintenance of these assets at an electronic component level is neither feasible nor practicable.

3.2 Options evaluated

Option A — Renewal of Individual Assets [NOSA N2442, OFS N2442A]

This option involves individual replacements of 44 microwave links and 34 dehydrators across 42 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 period. 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 the network to incur investment in future years.

3.3 Options considered and not progressed

Table 2 - Option considered but not progressed

Option	Reason for not progressing
Refurbishment of Individual Assets	This option is considered not feasible due to the specialised skillsets required and the inability to resolve the lack of support from manufacturers.
Asset Retirement	This can only be achieved through retirement of the associated primary assets, which is not technically or economically feasible.
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

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 - Scenarios

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

Parameters used in this commercial evaluation:

Table 4 - Parameters used in commercial evaluation

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

Parameter	Parameter Description	Value used for this evaluation
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 environmental and safety related risk cost included in NPV analysis to demonstrate implementation of obligation to reduce 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 (PV, $ million)

Option	Capital Cost PV	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Option A	8.12	11.00	1.22	27.2	12.62	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 replacement of the identified assets is not driven by these risks and 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 only technically and commercially feasible solution enabling TransGrid to continue meeting its regulatory obligations set out in PSDCS and Schedule 5.1 of the NER.

Capital and Operating Expenditure

There is no change 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 those components with no manufacturer support and limited spares carry the potential for incurring aspects of the proposed capital expenditure as operational expenditure. In such a scenario these larger costs are attributed to significant design and preparation costs, and likely augmentation of linking systems required to move a system from one design solution to a differing 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) of the preferred option exceeds the annualised costs of the option. The commencement year is determined based on the required project disbursement to the meet the commissioning year based on the OFS.

The results of optimal timing analysis is:

- Optimal commissioning year: 2027/28
- Commissioning year annual benefit: $2.52 million
- Annualised cost: $0.97 million

Based on the optimal timing, the project is expected to commence in the 2023/24-2027/28 Regulatory Period.

6. Recommendation

It is the recommendation that Option A – Renewal of Individual Assets, be scoped in detail.

The total project cost associated with this option is $10.25 million including an amount of $1.35 million to progress the project from DG1 to DG2.

Appendix A – Option Summaries

Project Description	FY24-28 Microwave Renewal Program		
Option Description	Option A - Renewal of Individual Assets		
Project Summary			
Option Rank	*1*	Investment Assessment Period	*15*
Asset Life	*15*	NPV Year	2020/21
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	11.00	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 0.97
NPV @ Lower Bound Scenario (PV, $m)	1.22	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction 0.00
NPV @ Higher Bound Scenario (PV, $m)	27.27	ALARP	ALARP Compliant? NA
NPV Weighted (PV, $m)	12.62	Optimal Timing	Optimal timing (Business Case) 2023/24
Cost (Central Scenario)			
Total Capex ($m)	10.25	Cost Capex (PV,$m)	8.12
Terminal Value ($m)	0.00	Terminal Value (PV,$m)	0.00
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 0.00	Reliability Risk (Post) 0.00	Pre – Post 0.00
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) 0.00	Total Risk (Post) 0.00	Pre – Post 0.00
OPEX Benefit (PV,$m)			OPEX Benefit 0.00
Other benefit (PV,$m)			Incremental Net Benefit 19.13
Total Benefit (PV,$m)			Business Case Total Benefit 19.13

Appendix B – Asset Renewal Program

The following table provides a summary of the individual option evaluations of the communication links evaluated under Option A of this OER. An asset is included in the final program if it is NPV positive, and is optimally timed prior to 2027/28. Assets that meet the criteria are recommended to proceed under this OER and are indicated in the table below.

MW Link ID	Location A	Location B	Existing Link Type	New Link Type	Cost[3] ($)	NPV (Weighted)	Optimal Timing
MWLink-0041-A*	CRW	WG1	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0041-B	CRW	WG1	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0042-A*	CRW	SQH	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0042-B	CRW	SQH	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0043-A*	DNT	SQH	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0043-B	DNT	SQH	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0044*	SQH	YA2	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0046	DNT	WID	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0047	GRF	WID	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0048	WG1	WGN	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0053	HKH	MBH	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0057	MPP	MTP	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0059	BLM	CA1	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24

[3] The cost provided is the unitised cost only. It does not include the one off development costs and consultation cost (refer to OFS-N2442A)

MW Link ID	Location A	Location B	Existing Link Type	New Link Type	Cost[3] ($)	NPV (Weighted)	Optimal Timing
MWLink-0060	BLM	QBY	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0065-A	KCR	RAZ	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0065-B	KCR	RAZ	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0066-A	MAC	RAZ	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0066-B	MAC	RAZ	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0071	SOM	TGH	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0086	ELS	MRN	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0087	MRN	ELS	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0090	MGY	GUL	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0091	MGY	GUL	PDH	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0011	ORG	MCN	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0017-A	CA1	MSG	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0017-B	CA1	MSG	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0018-A	HHR	MSG	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0018-B	HHR	MSG	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0019-A*	MRN	BBY	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0019-B	MRN	BBY	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0088	ELS	MGY	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0089	ELS	MGY	SDH HSB	Hybrid SDH 1+1 HSB	$175,380	$228,689	2023/24
MWLink-0001	BRA	WG1	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24

MW Link ID	Location A	Location B	Existing Link Type	New Link Type	Cost[3] ($)	NPV (Weighted)	Optimal Timing
MWLink-0002	BRA	HKH	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0003	HKH	MDL	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0014	MRW	WLR	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0015	MAT	MRW	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0016	BAY	MAT	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0035*	LSM	PAN	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0054	CW2	MDL	SDH 2+1	2x Hybrid SDH 1+1 HSB	$412,440	$531,722	2023/24
MWLink-0021	SYS	SDE	SDH 3+1	Hybrid SDH 3+1	$235,380	$305,387	2023/24
MWLink-0022	SOM	SDE	SDH 3+1	Hybrid SDH 3+1	$235,380	$305,387	2023/24
MWLink-0023	SOM	SUL	SDH 3+1	Hybrid SDH 3+1	$235,380	$305,387	2023/24
MWLink-0024	SUL	NTH	SDH 3+1	Hybrid SDH 3+1	$235,380	$305,387	2023/24

* Microwave links may be decommissioned as part of the Need N2550 – FY24-28 OPGW Rollout. In the case where Need N2550 proceeds, these links will not require renewal and the scope will need to be reassessed.

The following table provides a summary of the individual option evaluations of the dehydrators evaluated under Option A of this OER. Assets that meet the aforementioned criteria are recommended to proceed under this OER and are indicated in the table below.

Asset ID	Location A	Existing Asset Type	New Asset Type	Cost[3] ($)	NPV (Weighted)	Optimal Timing
102927	BAY	MT050	MT050C	$4,540	$5,803	2023/24
92827	BBY	MT050	MT050C	$4,540	$5,803	2023/2025
108407	CRW	MT050	MT050C	$4,540	$5,803	2023/2026
217383	GUL	MT050	MT050C	$4,540	$5,803	2023/2027
101518	HHR	MT050	MT050C	$4,540	$5,803	2023/2028

Asset ID	Location A	Existing Asset Type	New Asset Type	Cost[3] ($)	NPV (Weighted)	Optimal Timing
154264*	LSM	MT050	MT050C	$4,540	$5,803	2023/2029
150217	MBH	MT050	MT050C	$4,540	$5,803	2023/2030
93168	MCN	MT050	MT050C	$4,540	$5,803	2023/2031
108492	MDL	MT050	MT050C	$4,540	$5,803	2023/2032
101134	MRW	MT050	MT050C	$4,540	$5,803	2023/2033
92962	MTP	MT050	MT050C	$4,540	$5,803	2023/2033
108364	BRA	MT050	MT050C	$4,540	$5,803	2023/2033
101044	CA1	MT050	MT050C	$4,540	$5,803	2023/2033
108426	DNT	MT050	MT050C	$4,540	$5,803	2023/2033
102860	MAT	MT050	MT050C	$4,540	$5,803	2023/2033
92740	MRN	MT050	MT050C	$4,540	$5,803	2023/2033
105343	MSG	MT050	MT050C	$4,540	$5,803	2023/2033
93151	ORG	MT050	MT050C	$4,540	$5,803	2023/2033
151100*	PAN	MT050	MT050C	$4,540	$5,803	2023/2033
100990	QBY	MT050	MT050C	$4,540	$5,803	2023/2033
73783	RAZ	MT050	MT050C	$4,540	$5,803	2023/2033
108582	SQH	MT050	MT050C	$4,540	$5,803	2023/2033
154171*	YA2	MT050	MT050C	$4,540	$5,803	2023/2033
225050	ELS	MT050	MT050C	$4,540	$5,803	2023/2033
204003	MGY	MT050	MT050C	$4,540	$5,803	2023/2033
149837	SOM	MT050	MT050C	$4,540	$5,803	2023/2033

Asset ID	Location A	Existing Asset Type	New Asset Type	Cost[3] ($)	NPV (Weighted)	Optimal Timing
145507	SUL	MT050	MT050C	$4,540	$5,803	2023/2033
901737	GRF	MT050	MT050C	$4,540	$5,803	2023/2033
150045	SYS	MT050	MT050C	$4,540	$5,803	2023/2033
149977	TGH	MT050	MT050C	$4,540	$5,803	2023/2033
93092	WG1	MT050	MT050C	$4,540	$5,803	2023/2033
92281	WGN	MT050	MT050C	$4,540	$5,803	2023/2033
626339	WID	MT050	MT050C	$4,540	$5,803	2023/2033
101462	WLR	MT050	MT050C	$4,540	$5,803	2023/2033

* Dehydrators may be decommissioned as part of the Need N2550 – FY24-28 OPGW Rollout. In the case where Need N2550 proceeds, these links will not require renewal and the scope will need to be reassessed.