OPTIONS EVALUATION REPORT (OER)

Line 964 - Refurb

OER- N2607 revision 1.0

Ellipse project no(s):
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Project reason: Reliability - To meet overall network reliability requirements
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Approvals

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Change history

Revision	Date	Amendment
0	04/10/2021	Initial Issue
1	15/11/2021	Minor Formatting

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Executive summary

Line 964 is a 132kV transmission line between Taree and Port Macquarie Substations. Commissioned in 1979, it has a route length of 66km and a total of 260 single circuit structures, 221 of which are wood pole structures. The route of the line traverses mainly bushland and agricultural land in the mid-north coast of NSW, and crosses both the Pacific and Oxley Highways.

Detailed analysis of asset condition information records indicate that the line has several condition issues which require refurbishment to address its health and maintain appropriate risk levels across the network. Total number of wood poles to be replaced is 7.

In addition to the wood pole condition issues and bushfire impact, detailed analysis of asset condition information has identified that various condition issues impact 102 of the 334 structures across multiple line components. These have been set out based on the criteria set out in the Transmission Line Refurbishment Criteria document.

The main drivers of the need to remediate these issues are:

- Manage network safety risk levels "As-Low-As Reasonably-Practicable" in accordance with the regulation obligations and TransGrid's business risk appetite. Under the Electricity Supply (Safety and Network Management) Regulation 2014 Section 5 'A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe'; and
- Provide economic benefit to consumers through reduction in safety and bushfire risks.

The assessment of the options considered to address the need/opportunity appears in Table 1.

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	Remediate all identified condition issues on the line as per the Transmission Line Refurbishment Criteria. In addressing these condition issues, the identified wood pole structures are also to be replaced. It is noted that some of condition issues may be addressed as part of the structure replacement.	2.40	0.29	2.69	23.08	1

The preferred option is Option A, as it has a positive weighted NPV result and is technically and commercially feasible option which was considered. It is therefore recommended that Option A be scoped in detail and

[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.

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progressed from DG1 to DG2.[2] In consideration of the delivery requirements and the economic benefit NPV analysis for the need, its optimal timing is 2024/2025.

1. Need/opportunity

Line 966, between Taree and Port Macquarie Substations, traverses mainly bushland and agricultural land in the mid-north coast of NSW, and crosses both the Pacific and Oxley Highways. The line has widespread condition issues on various line components, all of which increase the probability of asset failure. These issues present a bushfire and safety risk which TransGrid is obligated to manage.

Wood Pole Structures

Detailed analysis of asset condition information has identified that 3 structures currently have condition issues which require altered maintenance practices, with one other structure on the line identified to be exhibiting deterioration. These other known condition issues affect 4 structures, or 2% of the line. Total number of structures to be replaced is 4.

Inspection records indicate a relatively good condition outlook on the remaining structures on Line 964, in line with that expected for the asset given its age. As the wood poles may have an extended life remaining before they are deemed unserviceable, only targeted replacement is propose as part of the refurbishment option.

Bushfire Damage

Line 964 was impacted by the Lindfield Park Road Fire. The fire impacted the following structure ranges:

- Structures 238 to 240B – 4 structures with a route length of 0.5km
- Structures 244 to 247 – 4 structures (2 of which are wood pole structures) with a route length of 0.6km

Subsequent inspections of the sections impacted by the fire identified three structures as burnt (Structures 238, 239 and 247). The fire damage affects the outer annulus of the pole at the region in the vicinity of the ground line and above. This is the main load bearing area of the structure, and damage to this section of the pole can impact its structural integrity.

Total number of structures to be replaced is 3.

Other Line Condition Issues

In addition to the wood pole condition issues, the inspection data and existing asset condition records have identified that various condition issues impact 61 of the 260 structures across multiple line components. These have been set out based on the criteria set out in the Transmission Line Refurbishment Criteria document.

The most significant element of concern is the condition of the insulators, some of which are fog type porcelain insulators that are more prone to corrosion of the insulator pin. Failure of an insulator may result in a fallen conductor which was recently experienced on another 132 kV transmission line. The replacement of insulators has been included as part of a wider line refurbishment programme.

Other issues on the line include:

- Deterioration of conductor dampers, and conductor and earthwire fittings due to corrosion – failure of these components can lead to a conductor drop.
- Deterioration of structure earthing and earthwire bonding due to corrosion – failure of these components result in transfer potential, earth current and voltage gradient issues.

[2] DG stands for ‘decision gate’ that forms a part of TransGrids investment decision process.

- Deterioration of guys and anchors – failure of these components can potentially compromise structural integrity.
- Deterioration on asset components relating to public safety such as climbing deterrents and warning signage

There is a need to remediate these issues to:

- Manage network safety risk levels “As-Low-As Reasonably-Practicable” in accordance with the regulation obligations and TransGrid’s business risk appetite. Under the Electricity Supply (Safety and Network Management) Regulation 2014 Section 5 ‘A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe.’
- Provide an economic benefit to consumers through reductions in safety and bushfire risks. The direct impact of asset failure can result in a conductor drop event with potential fire ignition and/or safety hazard consequences to the general public, as evaluated in the associated modelling.

If the condition issues on the line are not addressed through the timely implementation of the preferred technically and commercially feasible remediation option, then the asset will operate with increasing probability of failure as it continues to deteriorate. The level of reactive corrective maintenance needed to keep the line operating within required standards may also increase, particularly when asset failures ultimately occur.

Consequently, the proposed project has an economic benefits need, and addressed this need will provide avoided cost savings from reduced in bushfire and safety risk, and maintenance costs that would otherwise occur without refurbishment.

Appendix B provides a summary of the number of structures with condition issues within each asset component category. The figures for Option A are based on the Transmission Line Refurbishment Criteria document.

2. Related needs/opportunities

- Need N2606: Line 963 Refurbishment
- Need N2608: Line 965 Refurbishment

3. Options

The base case for this assessment is a ‘do nothing’ scenario, where the assets are left in service until they fail and require replacement. In addition to the base case, one remediation option has been considered. The Option A involves a targeted program to replace wood poles structures and address other components which have experienced the greatest deterioration.

3.1 Base case

It is noted that a ‘run to fail’ scenario, where the issues are addressed through increased asset monitoring and preventative maintenance tasks, is not a valid base case for this Need. The condition issues on the asset have already been identified through maintenance inspections, and increasing the frequency of inspections to monitor the condition issues will not necessarily address them.

The base case will instead be defined as a ‘do nothing’ scenario, where the assets are left in service until they fail and require replacement. The replacement cost has been captured in the NPV assessment under financial risk cost.

3.2 Options evaluated

Option A — Remediate all identified condition issues on the line as per the Transmission Line Refurbishment Criteria. In addressing these condition issues, the identified wood pole structures are also to be replaced. It is noted

that some of condition issues may be addressed as part of the structure replacement. [NOSA N2607, OFS N2607A]

Number of structures to be replaced for the option are 7. In addition to the wood pole condition issues, the inspection data and existing asset condition records have identified that various condition issues impact 61 of the 260 structures across multiple line components. These have been set out based on the criteria set out in the Transmission Line Refurbishment Criteria document.

It is estimated that this option would cost $2.69 million ± 25% ($2020-21).This option is expected to be completed within 23 months following DG1.

3.3 Options considered and not progressed

The following options were considered but not progressed:

Table 2 Options considered but not progressed

Option	Reason for not progressing
Increased inspections	The condition issues have already been identified and cannot be rectified through increased inspections, and therefore is not technically feasible.
Elimination of all associated risk	This can only be achieved through retirement and decommissioning of the associated assets which is not technically feasible.
New transmission line	Due to significant costs of this option, a new single circuit 132 kV transmission line is not considered commercially feasible.
Non-network solutions	TransGrid does not consider non-network options to be commercially and technically feasible to assist with meeting the identified need, as non-network options will not mitigate the environment (bushfire) and safety posed as a result of corrosion-related asset deterioration.

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%
Risk cost benefits	100%	75%	125%
Scenario weighting	**50%**	**25%**	**25%**

Parameters used in this commercial evaluation are set out in the table below

Table 4 Parameters used in the NPV evaluation

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2020/2221
Base year	The year that dollar value outputs are expressed in real terms	2020/2021 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.	25 years
Expected asset life	Period of depreciation of the asset	50 years
ALARP 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	2.23	19.60	7.32	45.79	23.08	1

Based on the commercial analysis, Option A is the preferred option as it yields the highest weighted NPV and is technically and commercially feasible. The main driver of the benefit in the NPV is bushfire risk benefit.

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. Under the Electricity Supply (Safety and Network Management) Regulation 2014 Section 5 'A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe.' TransGrid maintains an Electricity Network Safety Management System (ENSMS) to meet this obligation.[3]

In its Network Risk Assessment Methodology, under the ALARP test with the application of a gross disproportionate factor[4], the weighted benefits are expected to exceed the cost. TransGrid's analysis concludes

[3] TransGrid's ENSMS follows the International Organization for Standardization's ISO31000 risk management framework which requires following hierarchy of hazard mitigation approach

[4] The values of the disproportionality factors were determined through a review of practises and legal interpretations across multiple industries, with particular reference to the works of the UK Health and Safety Executive. The methodology used to determine the disproportionality factors in this document is in line with the principles and examples presented in the AER Replacement Planning Guidelines and is consistent with TransGrid's Revised Revenue Proposal 2023/24-2027/28.

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that the costs are less than the weighted benefits from mitigating bushfire and safety risks. The proposed investment will enable TransGrid to continue to manage and operate this part of the network to a safety and risk mitigation level of ALARP.

Evaluation of the above options has been completed in accordance with As Low As Reasonably Practicable (ALARP) obligations. The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 3 or 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction.

Results of the ALARP evaluation are set out in Table 6.

Table 6 - Reasonably practicable test ($ million)

Option	Network Safety Risk Reduction	Annualised Capex	Reasonably Practicable?[5]
A	0.41	0.14	Y

The result of the ALARP evaluation is that Option A meets the ALARP threshold.

4.4 Preferred option

The preferred option is Option A, as it has a positive NPV result and is technically and commercially feasible option considered as part of this need. Option A also meets the ALARP threshold. The optimal delivery date for this option is 2024/2025 based on an optimal timing analysis (see Section 5).

Capital and Operating Expenditure

The required capex expenditure is $2.69 million.

Regulatory Investment Test

A regulatory investment test for transmission (RIT-T) is not required at this stage, as the estimated capital cost for the preferred option is beneath the threshold of $6 million.

5. Optimal Timing

In consideration of the delivery requirements and the economic benefit NPV analysis for the need, its optimal timing is 2024/2025.

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 risk costs and safety disproportionality tests) of the preferred option exceeds the annualised costs of the option. The optimal timing assessment considers the delivery requirements of the project and the estimated delivery timeline of two years in the OFS.

The commencement year is determined based on the required project disbursement to meet the commissioning year based on the OFS.

The results of optimal timing analysis is:

- Optimal commissioning year: 2024/2025
- Commissioning year annual benefit: $0.41 million
- Annualised cost: $0.14 million

Based on the optimal timing, the project is expected to be completed in the 2024-2028 Regulatory Period.

[5] Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction.

6. Recommendation

The preferred option is Option A, as it has a positive weighted NPV result and is technically and commercially feasible option considered as part of this need. It is therefore recommended that this option be scoped in detail, so that it can be progressed from DG1 to DG2. Total project cost is $2.69 million including an amount of $0.2 million to progress the project from DG1 to DG2.

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Appendix A – Option Summaries[6]

Project Description	Line 964 Refurbishment		
Option Description	Option A - Remediate all identified condition issues on the line as per the Transmission Line Refurbishment Criteria. In addressing these condition issues, the identified wood pole structures are also to be replaced. It is noted that some of condition issues may be addressed as part of the structure replacement.		
Project Summary			
Option Rank	*1*	Investment Assessment Period	*25*
Asset Life	*50*	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	19.60	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 0.14
NPV @ Lower Bound Scenario (PV, $m)	7.32	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction 0.41
NPV @ Higher Bound Scenario (PV, $m)	45.79	ALARP	ALARP Compliant? Yes
NPV Weighted (PV, $m)	23.08	Optimal Timing	Optimal timing (Business Case) 2025
Cost (Central Scenario)			
Total Capex ($m)	2.69	Cost Capex (PV,$m)	2.23
Terminal Value ($m)	1.29	Terminal Value (PV,$m)	0.29
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 0.85	Reliability Risk (Post) 0.06	Pre – Post 0.79
Financial (PV,$m)	Financial Risk (Pre) 1.34	Financial Risk (Post) 0.17	Pre – Post 1.17
Operational/Compliance (PV,$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,$m)	Safety Risk (Pre) 0.07	Safety Risk (Post) 0.01	Pre – Post 0.06
Environmental (PV,$m)	Environmental Risk (Pre) 21.37	Environmental Risk (Post) 1.99	Pre – Post 19.38
Reputational ($m)	Reputational Risk (Pre) 0.16	Reputational Risk (Post) 0.02	Pre – Post 0.14
Total Risk (PV,$m)	Total Risk (Pre) 23.79	Total Risk (Post) 2.25	Pre – Post 21.55
OPEX Benefit (PV,$m)			OPEX Benefit 0.00
Other benefit (PV,$m)			Incremental Net Benefit 0.00
Total Benefit (PV,$m)			Business Case Total Benefit 21.55

Commissioning year annual benefit ($k): 460.91

[6] Figures may not add due to rounding

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Appendix B – Structure with Condition Issues by Asset Category

Asset Component Category	Cause	Effect	Consequence	No. of Structures
Conductor Dampers	Corrosion of dampers	Fallen conductor	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	6
Conductor Fittings	Corrosion of fittings	Fallen conductor	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	13
Earthwire Bonding	Poor connection.	Possible transfer potential, earth current and voltage gradient issues	Safety incident resulting in potential injury or death	1
Earthwire Fittings	Corrosion of fittings	Fallen conductor	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	17
Guy and Anchor	Deteriorated	Fallen structure	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	8
Insulator	Porcelain insulators have reached end of serviceable life. Some insulators are also damaged.	Fallen conductor	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	15

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Asset Component Category	Cause	Effect	Consequence	No. of Structures
Public Safety – Structure ID Signs	Deteriorated.	Unauthorised access	Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	10
Structure Earthing	Poor connection.	Possible transfer potential, earth current and voltage gradient issues	Safety incident resulting in potential injury or death	1
Wood Pole	Deterioration of ground line wood condition. This can compromise structural integrity.	Fallen structure and conductor	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	4
	Bushfire damage to the base of the tower which can compromise structural integrity.	Fallen structure and conductor	Bushfire resulting in potential loss of property and/or life Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	3 as per Section 2.2