OPTIONS EVALUATION REPORT (OER)

Line 9W-96 - Refurb

OER- N2499 revision 1.0

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

Project reason: Reliability - To meet overall network reliability requirements
Project category: Prescribed - Replacement

Approvals

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Change history

Revision	Date	Amendment
0	23/09/2021	Initial Issue

Executive summary

Line 9W/96 is a double circuit, steel tower 330kV transmission line with a route length of 17km. The transmission line is a key link in the Newcastle region, connecting the Tomago Aluminium smelter. Line 9W connects Waratah West and Tomago, whilst Line 96 connects Newcastle and Waratah West Substations. There are 7 structures on the transmission line, which traverses through urban areas in the west of Newcastle.

Detailed analysis of asset condition information has identified 5 of the 7 structures on Line 9W/96 have several condition issues on the line which require refurbishment to address asset health and maintain appropriate risk levels across the network.

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 an economic benefit to consumers through reductions in reliability, 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.

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 for line components which have experienced greater deterioration and/or reached the end of their functional lives	0.91	0.15	1.06	35.01	2
Option B	Refurbish all asset components that have been identified as having condition issues	1.16	0.20	1.36	45.18	1

The preferred option is Option B, as it has the highest weighted NPV result of the technically and commercially feasible options which were considered. It is therefore recommended that the option be scoped in detail and progressed from DG1 to DG2. In consideration of the delivery requirements and the economic benefit NPV analysis for the need, its optimal timing is 2024/2025.

[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

Line 9W/96 is a double circuit, steel tower 330kV transmission line with a route length of 17km. The transmission line is a key link in the Newcastle region, connecting the Tomago Aluminium smelter. Line 9W connects Waratah West and Tomago, whilst Line 96 connects Newcastle and Waratah West Substations. There are 7 structures on the transmission line, which traverses through urban areas in the west of Newcastle.

The transmission line has several condition issues on various line components, all of which increase the probability of asset failure. These issues present a reliability and safety risk which TransGrid is obligated to manage.

Detailed analysis of asset condition information has identified 5 of the 7 structures on Line 9W/96 have several condition issues on the line which require refurbishment to address asset health and maintain appropriate risk levels across the network.

The most significant element of concern is the corrosion on conductor and earthwire fittings. These typically have a lower level of galvanising on the component at the time of installation, and the deteriorating fittings are reaching the end of their serviceable lives. Failure of the fitting can result in a fallen conductor. It is noted that the Newcastle region is a zone with amongst the highest levels of atmospheric corrosion in Australia.

Another identified issue is that the insulators have reached the end of their expected lives, and some deterioration of insulation resistance has occurred. There are signs of corrosion on the corrosion of steel pins of the ceramic insulators, which has been identified through line inspections. The pins on the underside of suspension insulator discs build up pollution and are not adequately washed by rain, which leads to an increased rate of corrosion. Failure of an insulator may result in a fallen conductor which can present safety and bushfire risk.

Other issues on the line include, but are not limited to:

- Corrosion related deterioration on the towers and foundations. Failure of critical members, particularly tower legs which cannot be readily replaced, can compromise structural integrity
- Deterioration on asset components relating to public safety such as 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’; and
- Provide an economic benefit to consumers through reductions in reliability, 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. This will lead to consumers bearing an increasing amount of reliability, safety and bushfire risk.

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 each (Option A and Option B) are based on the Transmission Line Refurbishment Criteria document.

2. Related needs/opportunities

> Need N2500: Line 94/9W Refurbishment
> Need N2501: Line 94/96 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, two remediation options have been considered. The first, Option A involves a targeted program to address components which have experienced the greatest deterioration. The second, Option B, involves addressing all identified condition issues on the line.

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 inspections will not rectify 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 cost replacing failed assets has been included as part of risk cost on the asset under this option.

3.2 Options evaluated

Option A — Remediate all identified condition issues for line components which have experienced greater deterioration and/or reached the end of their functional lives [NOSA N2499, OFS N2499A]

Detail of scope can be found in Appendix B.

It is estimated that this option would cost $1.06 million ± 25% ($2020-21).

This option is expected to be completed within the 2024 – 2028 regulatory period, and within 21 months following DG1.

Option B — Refurbish all asset components that have been identified as having condition issues [NOSA N2499, OFS N2499B].

Detail of scope can be found in Appendix B.

It is estimated that this option would cost $1.36 million ± 25% ($2020-21). This option is expected to be completed within the 2024 – 2028 regulatory period, and within 21 months following DG1.

Option B will provide efficiency in delivery by addressing all identified condition issues for line components in a single mobilisation whilst reducing reliability risks on the line that may arise from conductor drop due to asset failure.

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.

Option	Reason for not progressing
Elimination of all associated risk	This can only be achieved through retirement and decommissioning of the associated assets which may lead to reliability issue. Therefore, it is considered not technically feasible.
New transmission line	Due to significant costs of this option, a new double circuit 330 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 Scenario Inputs

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

Parameters used in this commercial evaluation:

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	2020/2021
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	35 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	0.88	31.78	16.01	60.48	35.01	2
Option B	1.13	40.77	20.18	79.01	45.18	1

Based on the commercial analysis, Option B 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 reliability 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.[2]

In its Network Risk Assessment Methodology, under the ALARP test with the application of a gross disproportionate factor3, the weighted benefits are expected to exceed the cost. TransGrid's analysis concludes 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 + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction.

Results of the ALARP evaluation are set out in **Error! Reference source not found.**6.

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

[3] 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.

Table 6 - Reasonably practicable test ($ million)

Option	Network Safety Risk Reduction	Annualised Capex	Reasonably Practicable?[4]
A	0.22	0.06	Yes
B	0.25	0.08	Yes

The result of the ALARP evaluation is that both options meet the ALARP threshold.

4.4 Preferred option

The preferred option is Option B, as it has the highest weighted NPV result of all the technically and commercially feasible options considered as part of this need. Option B 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 $1.36 million.

Regulatory Investment Test

A regulatory investment test for transmission (RIT-T) is not required as the estimated capital cost for the preferred option is below 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 21 months 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: $2.50 million
- Annualised cost: $0.08 million

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

6. Recommendation

The preferred option is Option B, as it has the highest weighted NPV result of all the technically and commercially feasible options considered as part of this need.

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

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 $1.36 million including an amount of $0.2 million to progress the project from DG1 to DG2.

Appendix A – Option Summaries[6]

Project Description	Line 9W/96 Refurbishment		
Option Description	Option A - Refurbish asset components that meet the primary condition criteria only		
Project Summary			
Option Rank	2	Investment Assessment Period	25
Asset Life	35	NPV Year	2020/2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	31.78	Annualised CAPEX ($m)	0.06
NPV @ Lower Bound Scenario (PV, $m)	16.01	Network Safety Risk Reduction ($m)	0.22
NPV @ Higher Bound Scenario (PV, $m)	60.48	ALARP	Yes
NPV Weighted (PV, $m)	35.01	Optimal Timing	2024/2025
Cost			
Total Capex ($m)	1.06	Cost Capex (PV,$m)	0.88
Terminal Value ($m)	0.27	Terminal Value (PV,$m)	0.07
Risk (central scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	92.21	59.71	32.50
Financial (PV,$m)	0.15	0.10	0.05
Operational/Compliance (PV,$m)	0.00	0.00	0.00
Safety (PV,$m)	0.04	0.02	0.02
Environmental (PV,$m)	0.04	0.03	0.01
Reputational ($m)	0.06	0.04	0.02
Total Risk Benefit (PV,$m)	92.50	59.90	32.59
OPEX Benefit (PV,$m)			0.00
Other benefit (PV,$m)			0.00
Total Benefit (PV,$m)			32.59

Commissioning year annual benefit ($k): **2221.43**

[6] Figures may not add due to rounding

Project Description	Line 9W/96 Refurbishment		
Option Description	Option B - Refurbish all asset components that have been identified as having condition issues		
Project Summary			
Option Rank	1	Investment Assessment Period	25
Asset Life	35	NPV Year	2020/2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	40.77	Annualised CAPEX ($m)	0.08
NPV @ Lower Bound Scenario (PV, $m)	20.18	Network Safety Risk Reduction ($m)	0.25
NPV @ Higher Bound Scenario (PV, $m)	79.01	ALARP	Yes
NPV Weighted (PV, $m)	45.18	Optimal Timing	2024/2025
Cost			
Total Capex ($m)	1.36	Cost Capex (PV,$m)	1.13
Terminal Value ($m)	0.35	Terminal Value (PV,$m)	0.09
Risk (central scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	92.21	50.59	41.62
Financial (PV,$m)	0.15	0.05	0.10
Operational/Compliance (PV,$m)	0.00	0.00	0.00
Safety (PV,$m)	0.04	0.02	0.02
Environmental (PV,$m)	0.04	0.01	0.03
Reputational ($m)	0.06	0.02	0.04
Total Risk Benefit (PV,$m)	92.50	50.68	41.81
OPEX Benefit (PV,$m)			0
Other benefit (PV,$m)			0
Total Benefit (PV,$m)			41.81

Commissioning year annual benefit ($k): **2502.95**

Appendix B – Structure with Condition Issues by Asset Category

Asset Component Category	Cause	Effect	Consequence	No. of Structures	
				Option A	Option B
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	2	2
Corona Rings	Corrosion of corona rings.	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	2	2
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	2	2
Foundations	Structure legs covered with soil. Corrosion of tower leg members can compromise the structural integrity of the tower.	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	1	1
Insulator	Porcelain insulators have reached end of serviceable life. Corrosion of insulator pins.	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	0	5
Public Safety – Danger Signs	Deteriorated.	Unauthorised access	Safety incident resulting in potential injury or death Line outage with potential network reliability impacts	2	2

Asset Component	Cause	Effect	Consequence	No. of Structures	
Tower Fasteners	Loose and deteriorated tower bolts.	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	3