OPTIONS EVALUATION REPORT (OER)

Line 947 - Refurb

OER- N2621 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

Author	Lakshman Ganesharajah	Transmission Line and Cables Analyst
Endorsed	Charles Kurniawan	Transmission Lines and Cables Asset Manager
	Debashis Dutta	Asset Analytics and Insights Manager
Approved	Lance Wee	Head of Asset Management
Date submitted for approval	25 October 2021	

Change history

Revision	Date	Amendment
0	07/10/2021	Initial Issue
1	25/10/2021	Minor revision to Risk Model

Executive summary

Line 947 is a 132kV transmission line between Wellington 330kV and Orange North 132kV Substations. The line has a route length of 89km and consists of 345 structures, of which 335 are wood pole structures and 10 concrete poles. Constructed in 1968, the line route primarily traverses rural agricultural areas in mid-western NSW.

Detailed analysis of asset condition information records has 32 structures already identified to have condition issues, it is expected that a further five structures will experience decay and degradation by 2025 (the proposed delivery date for a related augmentation need). This estimate of additional structures is based on average decay rates over the past 10 years on this line.

The total number of wood pole structures expected to require replacement is 37.

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 and forecast wood pole condition issues on the line by replacing with a concrete or steel pole structure.	4.83	0.48	5.31	22.65	1

The preferred option is Option A, as it has the highest weighted NPV result of the technically and commercially feasible options which were considered. It is therefore recommended that Option A be scoped in detail and 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 2027/2028.

[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.

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

1. Need/opportunity

Line 947 is a 132kV transmission line between Wellington 330kV and Orange North 132kV Substations. The line has a route length of 89km and consists of 345 structures, of which 335 are wood pole structures and 10 concrete poles. Constructed in 1968, the line route primarily traverses rural agricultural areas in mid-western NSW.

Detailed analysis of asset condition information records has 32 structures already identified to have condition issues, it is expected that a further five structures will experience decay and degradation by 2025 (the proposed delivery date for a related augmentation need). This estimate of additional structures is based on average decay rates over the past 10 years on this line.

The total number of wood pole structures expected to require replacement is 37.

In addition to the wood pole condition issues, the inspection data and existing asset condition records have identified that various condition issues impact 324 of the 345 structures across multiple line components. These have been set out based on the criteria set out in the Transmission Line Refurbishment Criteria document. These issues include:

- Porcelain insulators reaching the end of their serviceable life – failure of these components can lead to a fallen conductor.
- Deterioration of earthwire bonding and structure earthing – this can lead to possible transfer potential, earth current and voltage gradient issues
- Deterioration of conductor fittings, and the pole guy and anchor arrangement – failure of these attachments can lead to a fallen conductor and/or structure

While these issues are widespread, it is not considered that it would be economically efficient to conduct a refurbishment program to remediate them. Due to the advanced age and condition of the wood pole structures on the line, it is likely that full replacement of the structures will be required within the medium term. Were these components to be replaced under any refurbishment programme, they would need to be replaced again at the time of the structure replacement, and will accordingly only be in service for a fraction of their nominal expected lives. Hence, only targeted wood pole replacement is proposed.

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 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 in sufficient time, then the asset will operate with increasing risk 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.

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.

2. Related needs/opportunities

> Need N2384: Supply to Central West – Load Growth. Under all network options proposed to meet this augmentation need, Line 947 is proposed to be re-arranged as part of works required for a new Orange 330/132kV substation. The need proposes that this be required by 2025, and it is proposed that any other condition based works on Line 947 be reviewed at that time.

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 refurbishment option has been considered.

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 and forecast wood pole condition issues on the line by replacing with a concrete or steel pole structure.

The total number of wood pole structures expected to require replacement is 37.

It is estimated that this option would cost $5.31 million ± 25% in $2020-21.

This project is expected to be completed within the 2024 – 2028 regulatory period and 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 double 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 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 cost benefits	100%	75%	125%
Scenario weighting	**50%**	**25%**	**25%**

Parameters used in this commercial evaluation:

Table 4 Model Parameters

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
Useful life of asset	Depreciation period applied to 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	4.41	18.52	4.79	48.76	22.65	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. 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 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 Table 6.

Table 6 - Reasonably practicable test ($ million)

Option	Network Safety Risk Reduction	Annualised Capex	Reasonably Practicable?[5]
A	0.29	0.28	Y

Option A meets the ALARP threshold.

4.4 Preferred option

The preferred option is Option A, as it has the highest weighted NPV result of all the technically and commercially feasible options considered as part of this need. The optimal delivery date for this option is 2027/2028 based on an optimal timing analysis (see Section 5)

---

[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.

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

Capital and Operating Expenditure

The capital cost for the project is $5.31 million

Regulatory Investment Test

As the project's capital cost falls below $6 million, a RIT-T is not required.

5. Optimal Timing

In consideration of the delivery requirements and the NPV analysis for the need, its optimal timing is 2027/2028.

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 the meet the commissioning year based on the OFS.

The results of optimal timing analysis is:

- Optimal commissioning year: 2027/2028
- Commissioning year annual benefit: $0.34 million
- Annualised cost: $0.28 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 A, as it has the highest weighted NPV result of all the technically and commercially feasible options 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 $5.31 million including an amount of $0.5 million to progress the project from DG1 to DG2.

Appendix A – Option Summaries[6]

Project Description	Line 947 Refurbishment		
Option Description	Option A - Replace wood pole structures identified as having condition issues with concrete or steel pole structures only		
Project Summary			
Option Rank	*1*	Investment Assessment Period	*25*
Asset Life	*50*	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	18.52	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 0.28
NPV @ Lower Bound Scenario (PV, $m)	4.79	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction 0.29
NPV @ Higher Bound Scenario (PV, $m)	48.76	ALARP	ALARP Compliant? Yes
NPV Weighted (PV, $m)	22.65	Optimal Timing	Optimal timing (Business Case) 2028
Cost (Central Scenario)			
Direct Capex ($m)		Network and Corporate Overheads ($m)	
Total Capex ($m)	5.31	Cost Capex (PV,$m)	4.41
Terminal Value ($m)	2.55	Terminal Value (PV,$m)	0.57
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 0.00	Reliability Risk (Post) 0.00	Pre – Post 0.00
Financial (PV,$m)	Financial Risk (Pre) 3.05	Financial Risk (Post) 0.15	Pre – Post 2.90
Operational/Compliance (PV,$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) 20.08	Environmental Risk (Post) 0.97	Pre – Post 19.11
Reputational ($m)	Reputational Risk (Pre) 0.36	Reputational Risk (Post) 0.02	Pre – Post 0.34
Total Risk (PV,$m)	Total Risk (Pre) 23.50	Total Risk (Post) 1.14	Pre – Post 22.36
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 22.36

Commissioning year annual benefit ($k): 340.02

[6] Figures may vary due to rounding