OPTIONS EVALUATION REPORT (OER)

Line 23 330kV Transmission Line Renew

OER 000000001408 revision 3.0

Ellipse project no.: P0008167
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	6 December 2016	

Change history

Revision	Date	Amendment
0	20 June 2016	Initial issue
1	20 September 2016	Revised for Updated Risk Cost
2	28 October 2016	Revised for New SFAIRP/ALARP Methodology
3	6 December 2016	Update to format

1. Need/opportunity

Line 23 is a steel tower 330kV transmission line between Munmorah and Vales Point 330kV Substations, with a route length of 7.2 km. The transmission line is a key link between the Central Coast generators. This transmission line was originally constructed in 1963 and has a total of 24 structures. The transmission line mainly traverses through land close to Lake Macquarie and the power stations.

Network Asset Condition Assessment (NACA) NACA 8001[1] performed in December 2011 has identified a number of corrosion related issues with Line 23 which require rectification in the short – medium term (within the 2018-2023 Regulatory Control Period) to ensure that asset risk levels remain within an acceptable level within the longer term.

In addition to the condition issues identified, the single circuit transmission line structures used on Line 23 are known to contain particular deficiencies due to the design philosophies used at the time of its installation. Although the structures were designed to the standards at that time, following a number of structure failures in extreme wind events, investigations found that the towers were designed to a lower set of criteria with inadequacies in the governing load combinations when compared to more recent design philosophies and standards. A program to strengthen structures with utilisation over 85% at road crossings and public areas has occurred; however, not all structures have been strengthened. Due to this, it is considered essential that condition issues on these towers be addressed so that their capacity, and as a consequence, the security of supply, are not further reduced.

2. Related Needs/opportunities

> Need DCN 226 Line 23 – 330kV Transmission Line - Munmorah to Vales Point tower refurbishment – refurbishment of steel members on tension towers and selected suspension towers. This work has been completed.

3. Options

All dollar values in this document are expressed in un-escalated 2016/17 dollars.

Base Case

Network Asset Condition Assessment (NACA) NACA 8001 has identified existing issues with the line which require rectification. A summary of these can be found in Need/Opportunity Statement (NOS) NS 1408.

Under a Base Case 'run-to-fail' option, the associated risk cost from the issues identified in Table 1 is $0.37m per annum. A breakdown of the Base Case risk cost by category is shown in Table 1.

Table 1 – Base Case risk cost by category ($ million)

Risk Category	Annual Risk Cost
Reliability (System)	0
Financial	0.01
Operational/Compliance	0
People (Safety)	0.02

1 NACA 8001 on Network Asset Condition Assessment Site. Although conducted over 5 years ago, Field Services have advised it remains relevant.

Risk Category	Annual Risk Cost
Environment	0.34
Reputation	0
Total	**0.37**

It can be seen from Table 1 that the category with the highest risk cost is 'environment', mainly due to the considerable consequences of a bushfire event resulting from conductor drop.

The risk cost per kilometre of line is $0.052m per annum.

Option A — Line Refurbishment [OFR 1408A, OFS 1408A]

This option involves the refurbishment of Line 23 by replacement of components which have reached end of life due to corrosion. The scope of this option is summarised in Table 2.

Table 2 – Transmission Line 23 Option A scope of works

Issue	Qty	Remediation
Corrosion of tower fasteners	23 towers	> Replacement of fasteners > Assume 6% of fasteners per tower
Corrosion of conductor fittings	7 fittings	> Replacement of hot and cold end fittings
Corrosion of earthwire fittings	5 fittings	> Replacement of earthwire fittings
Insulator pin corrosion – tension structures	72 insulators strings	> Replacement with composite longrod insulators > Replacement of tension hot and cold end fittings

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is $1.00m ±25%. Details can be found in Section 6 of Option Feasibility Study (OFS) OFS 1408A.

Following the refurbishment under this option, the risk cost associated with the remediated line is $0.02m per annum. A breakdown of the Option A risk cost by category is shown in Table 3.

Table 3 – Option A Risk cost by category (million $)

Risk Category	Annual Risk Cost
Reliability (System)	0
Financial	0
Operational/Compliance	0
People (Safety)	0
Environment	0.01
Reputation	0
Total	**$0.02**

The total projected risk reduction as a result of implementing Option A is $0.35m per annum. It can be seen from Table 3 that the largest component of the reduction is in the 'environment' category due to the reduced likelihood of conductor drop failure.

The total projected risk reduction per kilometre of line is $0.049m per annum.

Both the Base Case option and Option A outlined in Section 3 are considered to be technically feasible[2].

4. Evaluation

4.1 Commercial evaluation

The commercial evaluation of the technically feasible options is set out in Table 4. Details of the NPV calculation for Option A are provided in Attachment 1.

Table 4 — Commercial evaluation ($ million)

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Financial NPV @10%	Rank
Base Case	Run-to-fail	N/A	N/A	0.37	N/A	N/A	2
A	Line refurbishment	1.00	-	0.02	1.47	1.47	1

The commercial evaluation is based on:

> A 10% discount rate

> A life of the investment of 20 years and a corresponding residual/terminal value

Discount rate sensitivities based on TransGrid's current AER-determined pre-tax real regulatory Weighted Average Cost of Capital (WACC) of 6.75% and 13% appear in Table 5.

Table 5 — Discount rate sensitivities ($ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Line refurbishment	0.99	2.28

4.2 SFAIRP/ALARP evaluation

In the context of the Network Asset Risk Assessment Methodology, the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) principle is applicable to the following Key Hazardous Events:

> Structure failure

> Conductor / earthwire drop

[2] An option is technically feasible if TransGrid reasonably considers that there is a high likelihood that the option, if developed, will provide the relevant service while complying with all relevant laws.

Options to reduce the network safety risk as per the risk treatment hierarchy have been considered in other lifecycle stages of the asset, and it has been determined that no reasonably practicable options exist to reduce the risk further than those capital investment options listed in Table 6.

Evaluation of the proposed options has been completed against the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011. The Key Hazardous Events and the disproportionality multipliers considered in the evaluation are as follows:

- Structure failure – 6 times the environment (bushfire) risk, 6 times the safety risk and 10% of the reliability risk (applicable to safety)
- Conductor / earthwire drop – 6 times the environment (bushfire) risk, 6 times the safety risk and 10% of the reliability risk (applicable to safety)

Table 6 – Feasible options ($ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Run-to-fail	N/A	N/A	N/A
A	Line refurbishment	1,000	20 years	50

Table 7 – Annual risk calculations ($ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	17	1	343	N/A	N/A	N/A
A	6	0	12	11	0	330

Table 8 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[3]	Annualised CAPEX	Reasonably practicable[4]?
A	2,048	50	Yes

From the above evaluation, it is considered that Option A is reasonably practicable.

4.3 Preferred option

From the SFAIRP/ALARP evaluation, Option A is considered to be reasonably practicable and is required to be undertaken in order to satisfy the organisation's SFAIRP/ALARP obligations.

Option A is also considered to be commercially viable (as per the commercial evaluation). For the aforementioned reasons, it is proposed that Option A be scoped in further detail.

[3] The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

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

Capital and operating expenditure

The estimated capital expenditure associated with the refurbishment outlined in this option is $1.00m ±25%. The vast majority of this expenditure is proposed to be carried out in 2022-2023.

Should the Option A (Line Refurbishment) works not occur by the Need date, an increase in corrective maintenance and subsequent operating expenditure is expected.

Regulatory Investment Test

No Regulatory Investment Test for Transmission (RIT-T) analysis is required as the works are condition based.

5. Recommendation

From the above SFAIRP/ALARP evaluation in accordance with the regulatory requirements, and the commercial and technical evaluation of the available options, it is recommended that detailed scoping for the refurbishment of Line 23 as outlined under Option A is undertaken.

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name	Line 23 (SC Only) Refurbishment			
1. Financial Evaluation (excludes VCR benefits)				
NPV @ standard discount rate	10.00%	$1.47m	*NPV / Capital (Ratio)*	*1.47*
NPV @ upper bound rate	13.00%	$0.99m	*Pay Back Period (Yrs)*	*0.32 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$2.28m	*IRR%*	*31.69%*
2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)				
NPV @ standard discount rate	10.00%	$1.47m	*NPV / Capital (Ratio)*	*-0.49*
NPV @ upper bound rate	13.00%	$0.99m	*Pay Back Period (Yrs)*	*2.86 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$2.28m	*IRR%*	*31.72%*

Benefits					
Risk cost	As Is	To Be	Benefit	*VCR Benefit*	*$0.00m*
Systems (reliability)	*$0.00m*	*$0.00m*	*$0.00m*	*ENS Penalty*	*$0.00m*
Financial	*$0.01m*	*$0.00m*	*$0.01m*	*All other risk benefits*	*$0.35m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*	Total Risk benefits	$0.35m
People (safety)	*$0.02m*	*$0.01m*	*$0.01m*		
Environment	*$0.34m*	*$0.01m*	*$0.33m*	Benefits in the financial NPV* **excludes VCR benefits*	$0.35m
Reputation	*$0.00m*	*$0.00m*	*$0.00m*		
Total Risk benefits	$0.37m	$0.02m	$0.35m		
Cost savings and other benefits			$0.00m	Benefits in the economic NPV** ***excludes ENS penalty*	$0.35m
Total Benefits			$0.35m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			$0.00m	Write-off cost	$0.00m
Capital - initial $m			-$1.00m	Major Asset Life (Yrs)	20.00 Yrs
Residual Value - initial investment			$0.05m	Re-investment capital	$0.00m
Capitalisation period			3.00 Yrs	Start of the re-investment period	0.00 Yrs

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