OPTIONS EVALUATION REPORT (OER)

Line 81 330kV Transmission Line Renewal

OER 000000001268 revision 3.0

Ellipse project no.: P0005395
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	2 December 2016	

Change history

Revision	Date	Amendment
0	19 June 2016	Initial issue
1	16 September 2016	Revised for Updated Risk Cost
2	28 October 2016	Revised for New SFAIRP/ALARP Methodology
3	2 December 2016	Update to format

1. Need/opportunity

Line 81 is a steel tower 330kV transmission line between Newcastle and Liddell 330kV Substations, with a route length of 102 km. The transmission line links key Hunter region base load generators. This transmission line was constructed in 1966 and consists of 288 structures.

Network Asset Condition Assessment (NACA) NACA 1268 performed in December 2015 has identified a number of corrosion related issues with Line 81 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 in the longer term.

In addition to the condition issues identified, the single circuit transmission line structures used on Line 81 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

No related Needs/opportunities have been identified.

3. Options

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

Base Case

Network Asset Condition Assessment (NACA) NACA 1268 has identified existing issues with the line which require rectification. A summary of these can be found in Need/Opportunity Statement (NOS) NS 1268.

Under a Base Case 'run-to-fail' option, the associated risk cost from the issues identified in Table 1 is $1.84m 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)	1.37
Financial	0.02
Operational/Compliance	0
People (Safety)	0.01
Environment	0.44
Reputation	0
Total	**1.84**

It can be seen from Table 1 that the category with the highest risk cost is 'reliability (system)', due to the significant consequences of losing a key connection between the Hunter Valley generators, the Central Coast generators and the Newcastle metropolitan load area. Another substantial contributor to the overall risk cost is the 'environment' category, due to the high consequence of a bushfire event resulting from conductor drop.

The risk cost per kilometre of line is $0.018m per annum.

Option A — Line Refurbishment [OFR 1268A, OFS 1268A]

This option involves the refurbishment of Line 81, including replacement of components which have reached end of life and treating corrosion to tower steelwork which could lead to asset failure. The scope of this option is summarised in Table 2.

Table 2 – Transmission Line 81 Option A scope of works

Issue	Qty	Remediation
Ground line corrosion of steel at footing	15 towers	> Abrasive blast cleaning of steelwork to remove any corrosion product, application of Zinga paint and concrete encasement to prevent future corrosion
Buried concrete foundations	32 towers	> Dig out tower legs, abrasive blast cleaning of steelwork to remove any corrosion product, application of Zinga paint and establishment of drainage channel
Corrosion of tower members	32 towers	> Replacement of tower steel members > 1% of crossarm members per tower
Corroded fasteners	32 towers	> Replacement of fasteners > 5% of fasteners per tower
Corroded conductor attachment fittings	128 fittings	> Replacement of hot and cold end fittings
Corrosion of earthwire	80 fittings	> Replacement of earthwire fittings
Corroded earthwire attachment fittings	14 km of earthwire	> Like for like replacement of SC/GZ earthwire

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is $2.23m ±25%. Details can be found in Section 6 of Option Feasibility Study (OFS) OFS 1268A.

Following the refurbishment under this option, the risk cost associated with the remediated line is $0.61m 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)	0.41
Financial	0.01
Operational/Compliance	0
People (Safety)	0.01
Environment	0.19

Risk Category	Annual Risk Cost
Reputation	0
Total	**$0.61**

The total projected risk reduction as a result of implementing Option A is $1.23m per annum. It can be seen from Table 3 that considerable reductions in the risk cost under the 'reliability (system)' category, with the refurbishments reducing the likelihood of unplanned outages of the critical line. The risk cost in the 'environment' category has also decreased as a result of the reduced likelihood of a bushfire event.

The total projected risk reduction per kilometre of line is $0.012m per annum.

Both the Base Case option and Option A outlined in Section 3 are considered to be technically feasible[1].

4. Evaluation

4.1 Commercial evaluation

The commercial evaluation of the technically feasible options is set out in Table 4. Details of the Net Present Value (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	1.84	N/A	N/A	2
A	Line refurbishment	2.23	-	0.61	6.15	0.02	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	4.40	9.04

[1] 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.

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

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	2,230	20 years	112

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	11	1,368	439	N/A	N/A	N/A
A	6	410	190	5	958	249

Table 8 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[2]	Annualised CAPEX	Reasonably practicable[3]?
A	1,622	112	Yes

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

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

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

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.

Capital and operating expenditure

The estimated capital expenditure associated with the refurbishment outlined in this option is $2.23m ±25%. The vast majority of this expenditure is proposed to be carried out in 2020-2021.

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 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 81 as outlined under Option A is undertaken.

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name	Line 81 Line Refurbishment				
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	$0.02m		*NPV / Capital (Ratio)*	*0.01*
NPV @ upper bound rate	13.00%	-$0.26m		*Pay Back Period (Yrs)*	*0.10 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$0.53m		*IRR%*	*10.16%*
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%	$6.15m		*NPV / Capital (Ratio)*	*-2.05*
NPV @ upper bound rate	13.00%	$4.40m		*Pay Back Period (Yrs)*	*1.82 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$9.04m		*IRR%*	*51.68%*

Benefits					
Risk cost	As Is	To Be	Benefit	*VCR Benefit*	*$0.96m*
Systems (reliability)	*$1.37m*	*$0.41m*	*$0.96m*	*ENS Penalty*	*$0.00m*
Financial	*$0.02m*	*$0.01m*	*$0.01m*	*All other risk benefits*	*$0.27m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*	Total Risk benefits	$1.23m
People (safety)	*$0.01m*	*$0.01m*	*$0.01m*		
Environment	*$0.44m*	*$0.19m*	*$0.25m*	Benefits in the financial NPV*	$0.27m
Reputation	*$0.00m*	*$0.00m*	*$0.00m*	**excludes VCR benefits*	
Total Risk benefits	$1.84m	$0.61m	$1.23m		
Cost savings and other benefits			$0.00m	Benefits in the economic NPV**	$1.23m
Total Benefits			$1.23m	***excludes ENS penalty*	
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			$0.00m	Write-off cost	$0.00m
Capital - initial $m			-$2.23m	Major Asset Life (Yrs)	20.00 Yrs
Residual Value - initial investment			$0.00m	Re-investment capital	$0.00m
Capitalisation period			3.00 Yrs	Start of the re-investment period	0.00 Yrs

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