OPTIONS EVALUATION REPORT (OER)

Line 14 330kV Transmission Line Renewal

OER 000000001280 revision 5.0

Ellipse project no.: P0005451
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	19 June 2016	No Revision. Republished due to Technical Error
2	22 June 2016	Revised for Updated Commercial Evaluation
3	20 September 2016	Revised for Updated Risk Cost
4	27 October 2016	Revised for New SFAIRP/ALARP Methodology
5	2 December 2016	Update to format

1. Need/opportunity

Line 14 is a steel tower 330kV transmission line between Kemps Creek and Sydney North 330kV Substations, with a route length of 50.6km. The transmission line links generation entering Kemps Creek to Sydney metro area. The single circuit section of this line covered in this document was constructed in 1963 and consists of 132 structures, a route length of 48.4km. The line passes through urban areas of Sydney.

Network Asset Condition Assessment (NACA) NACA 1280 performed in November 2015 has identified a number of corrosion related issues with Line 14 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 14 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 1280 has identified existing issues with the line which require rectification. A summary of these can be found in Need/Opportunity Statement (NOS) NS 1280.

Under a base case ‘run-to-fail’ option, the associated risk cost from the issues identified in Table 1 is $1.05m 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)	0.32
Environment	0.72
Reputation	0
Total	**1.05**

It can be seen from Table 1 that the category with the highest risk cost is 'environment', mainly due to the significant consequences of a bushfire event resulting from conductor drop. The other substantial contributor to the overall risk cost is the 'people (safety)' category, again mostly due to the consequences of a conductor drop event.

The risk cost per kilometre of line is $0.022 million per annum.

Option A — Line Refurbishment [OFR 1280A, OFS 1280A]

This option involves the refurbishment of Line 14 including treatment of corrosion and replacement of components which have reached end of life and could lead to asset failure due to corrosion. The scope of this option is summarised in Table 2.

Table 2 – Transmission Line 14 Option A scope of works

Issue	Qty	Remediation
Buried concrete foundations	13 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 earth wire attachment fittings	16 fittings	> Replacement of earthwire fittings
Insulator pin corrosion	167 insulator strings	> Replacement with composite longrod insulators
Corrosion of earth wire	10 km of earthwire	> Like for like replacement of SC/GZ earthwire
Damaged earthwire vibration damper	5% of line 27 dampers	> Replacement of spiral vibration dampers > Assumed 2 vibration dampers per full tension span per earthwire/OPGW

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is $1.08m ±25%. Details can be found in Section 6 of Option Feasibility Study (OFS) OFS 1280A.

Following the refurbishment under this option, the risk cost associated with the remediated line is $0.17m 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	0.01
Operational/Compliance	0
People (Safety)	0.04
Environment	0.12
Reputation	0
Total	**$0.17**

The total projected risk reduction as a result of implementing Option A is $0.881m per annum. It can be seen from Table 3 that largest component of the reduction is in the 'environment' category, due to the reduced likelihood of the conductor drop event. Risk costs in the 'people (safety)' category have also substantially decreased.

The total projected risk reduction per kilometre of line is $0.018m 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	1.05	N/A	N/A	2
A	Line refurbishment	1.08	-	0.17	4.82	4.82	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	3.53	6.94

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

[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.

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	1,080	20 years	54

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	318	0	716	N/A	N/A	N/A
A	44	0	119	274	0	597

Table 8 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[2]	Annualised CAPEX	Reasonably practicable[3]?
A	5,228	54	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.

[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

Capital and operating expenditure

The estimated capital expenditure associated with the refurbishment outlined in this option is $1.08m ±25%. The vast majority of this expenditure is proposed to be carried out in 2019-2020.

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 14 as outlined under Option A is undertaken.

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name	Line 14 Refurbishment

1. Financial Evaluation (excludes VCR benefits)				
NPV @ standard discount rate	10.00%	$4.82m	*NPV / Capital (Ratio)*	*4.46*
NPV @ upper bound rate	13.00%	$3.53m	*Pay Back Period (Yrs)*	*0.74 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$6.94m	*IRR%*	*74.06%*

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%	$4.82m	*NPV / Capital (Ratio)*	*-1.61*
NPV @ upper bound rate	13.00%	$3.53m	*Pay Back Period (Yrs)*	*1.23 Yrs*
NPV @ lower bound rate (WACC)	6.75%	$6.94m	*IRR%*	*74.08%*

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*	*$0.01m*	*$0.01m*	*All other risk benefits*	*$0.88m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*	Total Risk benefits	$0.88m
People (safety)	*$0.32m*	*$0.04m*	*$0.27m*		
Environment	*$0.72m*	*$0.12m*	*$0.60m*	Benefits in the financial NPV*	$0.88m
Reputation	*$0.00m*	*$0.00m*	*$0.00m*	**excludes VCR benefits*	
Total Risk benefits	$1.05m	$0.17m	$0.88m		
Cost savings and other benefits			$0.00m	Benefits in the economic NPV**	$0.88m
Total Benefits			$0.88m	***excludes ENS penalty*	

Other Financial Drivers			
Incremental opex cost pa (no depreciation)	$0.00m	Write-off cost	$0.00m
Capital - initial $m	-$1.08m	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