

OPTIONS EVALUATION REPORT (OER)



Line 5A1/5A2 500kV Transmission Lines Renewal

OER 000000001278 revision 3.0

Ellipse project no.: P0005747

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	15 September 2016	Revised for Updated Risk Cost
2	27 October 2016	Revised for New SFAIRP/ALARP Methodology
3	2 December 2016	Update to format

1. Need/opportunity

Line 5A1/5A2 is a double circuit steel tower 500kV transmission line between Eraring and Kemps Creek 500kV substations, with a route length of 143 km. The transmission line is a key link between generation from the Central Coast region and the Sydney metropolitan area. This transmission line was constructed in 1976 and consists of 312 structures. The majority of this line passes through isolated, heavily timbered ridgetops and State Forests. Within the Sydney basin, the line traverses small rural holdings and more populated suburban developments.

Network Asset Condition Assessment (NACA) [NACA 1278](#) performed in October/November 2015 has identified a number of condition related issues with Line 5A1/5A2 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.

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 1278](#) has identified existing issues with the line which require rectification. A summary of these can be found in Need/Opportunity Statement (NOS) [NS 1278](#).

Under a Base Case 'run-to-fail' option, the associated risk cost from the issues identified in Table 1 is \$0.91m 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	0.02
Operational/Compliance	0
People (Safety)	0.25
Environment	0.64
Reputation	0
Total	0.91

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 other substantial contributor to the overall risk cost is the 'people (safety)' category, again mostly due to the consequences of conductor drop failure.

The risk cost per kilometre of line is \$0.005m per annum.

Option A — Line Refurbishment [[OFR 1278A](#), [OFS 1278A](#)]

This option involves the refurbishment of Line 5A1/5A2 preventing corrosion to tower steelwork which could lead to asset failure and 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 5A1/5A2 Option A scope of works

Issue	Qty	Remediation
Ground line corrosion of steel at footing	9 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	16 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 strap	3 towers	> Replacement of earth straps in line with current standard
Corrosion of fasteners	16 towers	> Replacement of fasteners > Assume 2% of fasteners per tower
Corrosion of insulators	36 insulator strings	> Like for like replacement of insulators

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is \$0.74m ±25%. Details can be found in Section 6 of [OFS 1278A](#).

Following the refurbishment under this option, the risk cost associated with the remediated line is \$0.25m 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)	0.07
Environment	0.17
Reputation	0
Total	\$0.25

The total projected risk reduction as a result of implementing Option A is \$0.66m 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. Considerable reductions are also expected in the ‘people (safety)’ category.

The total projected risk reduction per kilometre of line is \$0.005m per annum.

Both the Base Case option and Option A outlined in Section 3 are considered to be technically feasible¹.

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	0.91	N/A	N/A	2
A	Line refurbishment	0.74	-	0.25	4.06	4.05	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	3.07	5.66

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
- > Uncontrolled discharge or contact with electricity (faulty earthing)

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)
- > Uncontrolled discharge or contact with electricity (faulty earthing) – 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	740	20 years	37

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	247	0	640	N/A	N/A	N/A
A	67	0	172	180	0	468

Table 8 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ²	Annualised CAPEX	Reasonably practicable ³ ?
A	3,889	37	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 \$0.74m \pm 25%. The vast majority of this expenditure is proposed to be carried out in 2018-2019.

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 5A1/5A2 as outlined under Option A is undertaken.

Attachment 1 – Commercial evaluation report

Option A NPV Calculation

Project_Option Name		Line 5A1/5A2 Refurbishment			
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$4.05m	NPV / Capital (Ratio)	5.47	
NPV @ upper bound rate	13.00%	\$3.06m	Pay Back Period (Yrs)	0.80 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$5.64m	IRR%	80.23%	
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%	\$4.06m	NPV / Capital (Ratio)	-1.35	
NPV @ upper bound rate	13.00%	\$3.07m	Pay Back Period (Yrs)	1.11 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$5.66m	IRR%	80.39%	
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	\$0.02m	\$0.01m	\$0.01m	All other risk benefits	\$0.66m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$0.66m
People (safety)	\$0.25m	\$0.07m	\$0.18m	Benefits in the financial NPV*	\$0.66m
Environment	\$0.64m	\$0.17m	\$0.47m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$0.66m
Total Risk benefits	\$0.91m	\$0.25m	\$0.66m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$0.66m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$0.74m	Major Asset Life (Yrs)	20.00 Yrs
Residual Value - initial investment			\$0.04m	Re-investment capital	\$0.00m
Capitalisation period			3.00 Yrs	Start of the re-investment period	0.00 Yrs