

# OPTIONS EVALUATION REPORT (OER)



Line 18 330kV Transmission Line Renewal

OER 000000001351 revision 2.0

**Ellipse project description: P0007969**

**TRIM file: [TRIM No]**

**Project reason:** Capability - Asset Replacement for end of life condition

**Project category:** Prescribed - Replacement

## Approvals

Author	Edward Luk	Transmission Lines and Cables Analyst
Endorsed	Steve Stavropoulos	Transmission Lines and Cables Asset Manager
	Azil Khan	Investment Analysis Manager
Approved	Lance Wee	Manager/Asset Strategy
Date submitted for approval	26 October 2016	

## Change History

Revision	Date	Amendment
0	15 June 2016	Initial Issue
1	9 September 2016	Revised for Updated Risk Cost
2	26 October 2016	Revised for New SFAIRP/ALARP Methodology

## 1. Need/opportunity

Line 18 is a single circuit steel tower 330kV transmission line between Kangaroo Valley and Dapto 330kV substations, with a route length of 43 km. The transmission line is a key link between the Shoalhaven hydro generation and the Wollongong region. Part of this line was originally constructed in 1962 as the Yass to Dapto No. 2 330kV transmission line until the line re-arrangements occurred in 1974 with the construction of Kangaroo Valley Power Station. The total number of structures on the line is 107. The transmission line mainly traverses through farmland and Morton National Park – after leaving Dapto, it climbs from the coastal plain up the Illawarra Escarpment.

Condition assessment [NACA-000000001351](#) performed in March 2016 and the ICS report (limited to the older section of line from Structure 69 to Dapto only) have identified a number of corrosion related issues with Line 18 which require rectification in the short – medium term (within the 2018-2023 Regulatory 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

### Base Case — Run-To-Fail

Condition assessment [NACA-000000001351](#) has identified existing issues with the line which require rectification. A summary of these can be found in Needs Statement [NS-000000001351](#).

Under a base case ‘run-to-fail’ option, the associated risk cost from the issues identified in Table 1 is \$0.986 million 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**

Risk Category	Annual Risk Cost (\$m)
Reliability (System)	\$0.008
Financial	\$0.032
Operational/Compliance	\$0.000
People (Safety)	\$0.060
Environment	\$0.884
Reputation	\$0.002
<b>Total</b>	<b>\$0.986</b>

It can be seen from Table 1 that the category with the highest risk cost is ‘environmental’, mainly due to the significant consequences of a bushfire event resulting from conductor drop. The next highest 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 \$0.023 million per annum.

### Option A — Line Refurbishment ([OFR-000000001351A](#), [OFS-000000001351A](#))

This option involves the refurbishment of Line 18 including the treatment of corrosion of 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 18 Option A Scope of Works**

Issue	Qty	Remediation
Buried concrete foundations	6 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 straps	16 towers	Replacement of earth straps in line with current standard
Corrosion of tower steel members	13 tension towers	Abrasive blast cleaning of steelwork to remove any corrosion product and application of Zinga paint per ICS report.
Corrosion of tower fasteners	13 towers	Replacement of fasteners  Assume 5% of fasteners per tower
Insulator pin corrosion – suspension insulators	172 insulator strings	Replacement with composite longrod insulators
Corrosion of conductor fittings	134 fittings	Replacement of hot and cold end fittings
Corrosion of earthwire fittings	14 fittings	Replacement of earthwire fittings
Corrosion of earthwire	10km  (5km of route length)	Like for like replacement of SC/GZ earthwire
Damaged conductor vibration dampers	10% of line  254 dampers	Replacement of Stockbridge vibration dampers  Assumed 8 vibration dampers per full tension span per phase

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is \$1.65 million ±25% in 2016-2017 Australian dollars. Details can be found in Section 6 of [OFS-000000001351A](#).

Following the refurbishment under this option, the risk cost associated with the remediated line is \$0.232 million 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**

Risk Category	Annual Risk Cost (\$m)
Reliability (System)	\$0.003
Financial	\$0.011
Operational/Compliance	\$0.000
People (Safety)	\$0.012
Environment	\$0.206
Reputation	\$0.000
<b>Total</b>	<b>\$0.232</b>

The total projected risk reduction as a result of implementing Option A is \$0.754 million per annum. It can be seen from Table 3 that 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 decreased.

The total projected risk reduction per kilometre of line is \$0.018 million per annum.

## 4. Evaluation

### 4.1 Technical evaluation

Both the base case option and Option A outlined in Section 3 are considered to be technically feasible<sup>1</sup>.

### 4.2 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
<b>Base Case</b>	Run-To-Fail	-	-	\$0.986	-	-	-
<b>A</b>	Line Refurbishment	\$1.65	-	\$0.232	\$3.58	\$3.54	1

The commercial evaluation is based on:

<sup>1</sup> 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.

- > 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 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%
<b>A</b>	Line Refurbishment	\$2.51	\$5.34

### 4.3 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)

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 (\$ million)**

Option	Description	CAPEX	Expected Life	Annualised CAPEX
<b>Base Case</b>	Run-To-Fail	N/A	N/A	N/A
<b>A</b>	Line Refurbishment	\$1.65	20 years	\$0.083

**Table 7: Annual Risk Calculations (\$ million)**

Options	Annual Residual Risk			Annual Risk Reductions		
	Safety Risk	Reliability Risk	Environment Risk	Safety Risk	Reliability Risk	Environment Risk
<b>Base Case</b>	\$0.060	\$0.008	\$0.885	-	-	-
<b>A</b>	\$0.012	\$0.003	\$0.206	\$0.048	\$0.005	\$0.679

**Table 8: ALARP Evaluation (\$ million)**

Option	Network Safety Risk Reduction <sup>2</sup>	Annualised CAPEX	Reasonably Practicable (Y/N)
A	\$4.360	\$0.083	Yes

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

#### 4.4 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 \$1.65 million  $\pm$ 25% in 2016-2017 Australian dollars. The vast majority of this expenditure is proposed to be carried out in 2021-2022.

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 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 18 as outlined under Option A is undertaken.

---

<sup>2</sup> The Network Safety Risk Reduction is calculated as 6 x Environment (Bushfire) Risk Reduction + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction.

## Attachment 1 – Commercial evaluation report

### Option A NPV Calculation

Project_Option Name			Line 18 Refurbishment	
1. Financial Evaluation (excludes VCR benefits)				
NPV @ standard discount rate	10.00%	\$3.54m	NPV / Capital (Ratio)	2.15
NPV @ upper bound rate	13.00%	\$2.49m	Pay Back Period (Yrs)	0.43 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$5.30m	IRR%	43.03%
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%	\$3.58m	NPV / Capital (Ratio)	-1.19
NPV @ upper bound rate	13.00%	\$2.51m	Pay Back Period (Yrs)	2.19 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$5.34m	IRR%	43.32%
Benefits				
Risk cost	As Is	To Be	Benefit	VCR Benefit
Systems (reliability)	\$0.01m	\$0.00m	\$0.01m	ENS Penalty
Financial	\$0.03m	\$0.01m	\$0.02m	All other risk benefits
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits
People (safety)	\$0.06m	\$0.01m	\$0.05m	
Environment	\$0.88m	\$0.21m	\$0.68m	
Reputation	\$0.00m	\$0.00m	\$0.00m	
Total Risk benefits	\$0.99m	\$0.23m	\$0.75m	Benefits in the financial NPV*
Cost savings and other benefits			\$0.00m	*excludes VCR benefits
Total Benefits			\$0.75m	Benefits in the economic NPV**
				**excludes ENS penalty
Other Financial Drivers				
Incremental opex cost pa (no depreciation)		\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m		-\$1.65m	Major Asset Life (Yrs)	20.00 Yrs
Residual Value - initial investment		\$0.08m	Re-investment capital	\$0.00m
Capitalisation period		3.00 Yrs	Start of the re-investment period	0.00 Yrs