

# OPTIONS EVALUATION REPORT (OER)



Line 8 MRN - DPT 330kV Line Renewal

OER 000000001341 revision 4.0

**Ellipse project no.:** P0007884

**TRIM file:** [TRIM No]

**Project reason:** Reliability - To meet overall network reliability requirements

**Project category:** Prescribed - Replacement

## Approvals

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Date submitted for approval	6 December 2016	

## Change history

Revision	Date	Amendment
0	19 June 2016	Initial issue
1	24 June 2016	Revised for Updated Commercial Evaluation
2	20 September 2016	Revised for Updated Risk Cost
3	28 October 2016	Revised for New SFAIRP/ALARP Methodology
4	6 December 2016	Update to format

## 1. Need/opportunity

Line 8 is a single circuit steel tower 330kV transmission line between Marulan and Dapto 330kV Substations, with a route length of 70.4 km. The transmission line is a key link between the Goulburn and Wollongong regions. This transmission line was originally constructed in 1956 and 1962 as part of the Yass to Dapto No. 1 and No. 2 lines respectively until line re-arrangements occurred at Robertson in 1974. The total number of structures on the line is 175. The transmission line mainly traverses through farmland and national park areas – after leaving Dapto, it climbs from the coastal plain up the Illawarra Escarpment.

Network Asset Condition Assessment (NACA) [NACA 1341](#) performed in February 2016 has identified a number of condition related issues with Line 8 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 8 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 1341](#) has identified existing issues with the line which require rectification. A summary of these can be found in Need/Opportunity Statement (NOS) [NS 1341](#).

Under a Base Case 'run-to-fail' option, the associated risk cost from the issues identified in Table 1 is \$1.80m 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)	0.02
Financial	0.04
Operational/Compliance	0
People (Safety)	0.55
Environment	1.19
Reputation	0
<b>Total</b>	<b>1.80</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 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 \$0.026m per annum.

#### Option A — Line Refurbishment [[OFR 1341A](#), [OFS 1341A](#)]

This option involves the refurbishment of Line 8 by treating 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 8 Option A scope of works**

Issue	Qty	Remediation
Corrosion of tower members	12 towers	> Abrasive blast cleaning of steelwork to remove any corrosion product, application of Zinga paint – entire tower
Corrosion of tower fasteners	9 towers	> Replacement of fasteners > Assume 5% of fasteners per tower
Corrosion of conductor fittings	33 fittings	> Replacement of hot end fittings
Corrosion of earthwire fittings	21 fittings	> Replacement of earthwire fittings
Insulator pin corrosion	286 insulator strings	> Replacement with composite longrod insulators
Corrosion of earthwire	4km	> Like for like replacement of SC/GZ earthwire
Damaged conductor vibration dampers	10% of line 209 dampers	> Replacement of Stockbridge vibration dampers > Assumed 4 vibration dampers per full tension span per phase

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is \$3.73m ±25%. Details can be found in Section 6 of Option Feasibility Study (OFS) [OFS 1341A](#).

Following the refurbishment under this option, the risk cost associated with the remediated line is \$0.56m 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)	0.01
Financial	0.03
Operational/Compliance	0
People (Safety)	0.16
Environment	0.37

Risk Category	Annual Risk Cost
Reputation	0
<b>Total</b>	<b>\$0.56</b>

The total projected risk reduction as a result of implementing Option A is \$1.24m per annum. It can be seen from Table 3 that considerable reductions in risk cost reductions in the 'environment' and 'people (safety)' categories are expected, due to the reduction in the likelihood of conductor drop failure.

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<sup>1</sup>.

## 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
<b>Base Case</b>	Run-to-fail	N/A	N/A	1.80	N/A	N/A	2
<b>A</b>	Line refurbishment	3.73	-	0.56	5.63	5.63	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%
<b>A</b>	Line refurbishment	3.88	8.51

<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.

## 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	3,730	20 years	187

**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	555	15	1,187	N/A	N/A	N/A
A	155	10	366	400	5	821

**Table 8 – Reasonably practicable test (\$ thousand)**

Option	Network Safety Risk Reduction <sup>2</sup>	Annualised CAPEX	Reasonably practicable <sup>3</sup> ?
A	7,326	187	Yes

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

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

<sup>3</sup> 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 \$3.73m  $\pm$ 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

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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 8 as outlined under Option A is undertaken.

## Attachment 1 – Commercial evaluation report

### Option A NPV calculation

Project_Option Name			Line 8 Line Refurbishment		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	\$5.60m	NPV / Capital (Ratio)	1.50	
NPV @ upper bound rate	13.00%	\$3.85m	Pay Back Period (Yrs)	0.32 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$8.46m	IRR%	31.90%	
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%	\$5.64m	NPV / Capital (Ratio)	-1.88	
NPV @ upper bound rate	13.00%	\$3.88m	Pay Back Period (Yrs)	3.01 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$8.51m	IRR%	32.02%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$0.00m
Systems (reliability)	\$0.01m	\$0.01m	\$0.00m	ENS Penalty	\$0.00m
Financial	\$0.04m	\$0.03m	\$0.01m	All other risk benefits	\$1.24m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.24m
People (safety)	\$0.55m	\$0.15m	\$0.40m	Benefits in the financial NPV*	\$1.24m
Environment	\$1.19m	\$0.37m	\$0.82m	*excludes VCR benefits	
Reputation	\$0.01m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$1.24m
Total Risk benefits	\$1.80m	\$0.56m	\$1.24m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.24m		
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			\$0.00m	Write-off cost	\$0.00m
Capital - initial \$m			-\$3.73m	Major Asset Life (Yrs)	20.00 Yrs
Residual Value - initial investment			\$0.19m	Re-investment capital	\$0.00m
Capitalisation period			3.00 Yrs	Start of the re-investment period	0.00 Yrs