

# OPTIONS EVALUATION REPORT (OER)



Line 16 330kV Transmission Line Renewal

OER 000000001353 revision 1.0

**Ellipse project no.:** P0007973

**TRIM file:** [TRIM No]

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

**Project category:** Prescribed - Asset Renewal Strategies

## Approvals

|                                    |                    |   |
|------------------------------------|--------------------|---|
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| <b>Endorsed</b>                    | Steve Stavropoulos | Transmission Lines and Cables Asset Manager |
|                                    | Azil Khan          | Investment Analysis Manager                 |
| <b>Approved</b>                    | Lance Wee          | Manager/Asset Strategy                      |
| <b>Date submitted for approval</b> | 2 December 2016    |   |

## Change history

| Revision | Date              | Amendment                                |
|----------|-------------------|--|
| 0        | 20 June 2016      | Initial issue                            |
| 1        | 20 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

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Line 16 is a single circuit steel tower 330kV transmission line between Marulan and Avon 330kV Substations, with a route length of 71 km. The transmission line is a major link between the Goulburn and Wollongong regions. Parts of this line were originally constructed in 1956 as the Yass to Dapto No. 1 and No. 2 330kV transmission lines until the line re-arrangements occurred in 1974 with the construction of Kangaroo Valley Power Station and later Marulan Substation. The total number of structures on the line is 160. The transmission line mainly traverses through farmland, national parks and Sydney Catchment Authority lands.

Network Asset Condition Assessment (NACA) [NACA 1353](#) performed in February 2016 has identified a number of corrosion related issues with Transmission Line 16 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 16 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

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No related Needs/opportunities have been identified.

## 3. Options

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

### Base Case

Network Asset Condition Assessment (NACA) [NACA 1353](#) has identified existing issues with the line which require rectification. A summary of these can be found in Need/Opportunity Statement (NOS) [NS 1353](#).

Under a Base Case 'run-to-fail' option, the associated risk cost from the issues identified in Table 1 is \$1.36m 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)        | 0.07             |
| Environment            | 1.26             |
| Reputation             | 0                |

| Risk Category | Annual Risk Cost |
|---------------|------------------|
| <b>Total</b>  | <b>1.36</b>      |

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. Other contributors to the overall risk cost are the 'people (safety)' and 'financial' categories.

The risk cost per kilometre of line is \$0.019m per annum.

### Option A — Line Refurbishment ([OFR 1353A](#), [OFS 1353A](#))

This option involves the refurbishment of Line 16 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 16 Option A scope of works**

| Issue   | Qty                            | Remediation  |
|---|--------------------------------|--|
| Corrosion of tower steel members                | 14 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                     | 8 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 steel members                | 14 towers                      | > Abrasive blast cleaning of steelwork to remove any corrosion product and application of Zinga paint  |
| Corrosion of tower fasteners                    | 40 towers                      | > Replacement of fasteners<br>> Assume 5% of fasteners per tower   |
| Corrosion of conductor fittings                 | 30 fittings                    | > Replacement of hot end fittings  |
| Corrosion of earthwire fittings                 | 19 fittings                    | > Replacement of earthwire fittings  |
| Insulator pin corrosion – suspension insulators | 379 insulator strings          | > Replacement with composite longrod insulators  |
| Corrosion of earthwire                          | 8km<br>(4km of route length)   | > Like for like replacement of SC/GZ earthwire   |
| Damaged conductor vibration dampers             | 10% of line<br><br>191 dampers | > Replacement of Stockbridge vibration dampers<br>> 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 \$2.02m ±25%. Details can be found in Section 6 of Option Feasibility Study (OFS) [OFS 1353A](#).

Following the refurbishment under this option, the risk cost associated with the remediated line is \$0.37m 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                |
| Operational/Compliance | 0.01             |
| People (Safety)        | 0.02             |
| Environment            | 0.34             |
| Reputation             | 0                |
| <b>Total</b>           | <b>\$0.37</b>    |

The total projected risk reduction as a result of implementing Option A is \$1.00m 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. Reductions in risk costs in the ‘people (safety)’ and ‘financial’ categories are also expected.

The total projected risk reduction per kilometre of line is \$0.014m 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 |
|-----------|--------------------|-------------|-------------|-------------------------------|-------------------|--------------------|------|
| Base Case | Run-to-fail        | N/A         | N/A         | 1.36                          | N/A               | N/A                | 2    |
| A         | Line refurbishment | 2.02        | -           | 0.37                          | 4.84              | 4.82               | 1    |

The commercial evaluation is based on:

- > A 10% discount rate

<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 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 | 3.43              | 7.17                |

## 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 | 2,020 | 20 years      | 101              |

**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   | 75                   | 4                | 1,260         | N/A                 | N/A              | N/A           |
| A      | 21                   | 0                | 339           | 55                  | 3                | 921           |

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

| Option | Network Safety Risk Reduction <sup>2</sup> | Annualised CAPEX | Reasonably practicable <sup>3</sup> ? |
|--------|--|------------------|---------------------------------------|
| A      | 5,856                                      | 101              | 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.

#### Capital and operating expenditure

The estimated capital expenditure associated with the refurbishment outlined in this option is \$2.02m ±25%. 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 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 16 as outlined under Option A is undertaken.

<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

## Attachment 1 – Commercial evaluation report

### Option A NPV calculation

| Project_Option Name  |         | Line 16 Refurbishment |                       |                                   |           |
|--|---------|-----------------------|-----------------------|-----------------------------------|-----------|
| <b>1. Financial Evaluation</b> (excludes VCR benefits)   |         |                       |                       |                                   |           |
| NPV @ standard discount rate   | 10.00%  | \$4.82m               | NPV / Capital (Ratio) | 2.38                              |           |
| NPV @ upper bound rate   | 13.00%  | \$3.41m               | Pay Back Period (Yrs) | 0.47 Yrs                          |           |
| NPV @ lower bound rate (WACC)  | 6.75%   | \$7.15m               | IRR%                  | 46.52%                            |           |
| <b>2. Economic Evaluation</b> (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost) |         |                       |                       |                                   |           |
| NPV @ standard discount rate   | 10.00%  | \$4.84m               | NPV / Capital (Ratio) | -1.61                             |           |
| NPV @ upper bound rate   | 13.00%  | \$3.43m               | Pay Back Period (Yrs) | 2.03 Yrs                          |           |
| NPV @ lower bound rate (WACC)  | 6.75%   | \$7.17m               | IRR%                  | 46.65%                            |           |
| <b>Benefits</b>  |         |                       |                       |                                   |           |
| 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               | \$0.02m               | All other risk benefits           | \$0.99m   |
| Operational/compliance   | \$0.00m | \$0.00m               | \$0.00m               | Total Risk benefits               | \$1.00m   |
| People (safety)  | \$0.08m | \$0.02m               | \$0.05m               | Benefits in the financial NPV*    | \$0.99m   |
| Environment  | \$1.26m | \$0.34m               | \$0.92m               | *excludes VCR benefits            |           |
| Reputation   | \$0.00m | \$0.00m               | \$0.00m               | Benefits in the economic NPV**    | \$1.00m   |
| Total Risk benefits  | \$1.36m | \$0.37m               | \$1.00m               | **excludes ENS penalty            |           |
| Cost savings and other benefits  |         |                       | \$0.00m               |                                   |           |
| Total Benefits   |         |                       | \$1.00m               |                                   |           |
| <b>Other Financial Drivers</b>   |         |                       |                       |                                   |           |
| Incremental opex cost pa (no depreciation)   |         |                       | \$0.00m               | Write-off cost                    | \$0.00m   |
| Capital - initial \$m  |         |                       | -\$2.02m              | 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  |