

OPTIONS EVALUATION REPORT (OER)



TL Low Spans Stage 2

OER 000000001556 revision 1.0

Ellipse project no.: P0009031

TRIM file: [TRIM No]

Project reason: Capability - Improved Asset Management

Project category: Prescribed - Augmentation

Approvals

| | | |
|-----------------------------|--------------------|---|
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| Date submitted for approval | 8 December 2016 | |

Change history

| Revision | Date | Amendment |
|----------|-----------------|------------------|
| 0 | 20 October 2016 | Initial issue |
| 1 | 8 December 2016 | Update to format |

1. Need/opportunity

Transmission lines are designed and constructed to achieve standard electrical clearances of the conductor at specific operating conditions. At present, the accepted Australian industry standard is AS7000 for the Design of Overhead Lines. This standard takes into account a range of safety and environmental factors including the expansion of the conductor due to heating (known as sag) and movement of the conductor due to strong winds (known as blowout). The minimum electrical clearances that should be achieved when the conductor reaches its maximum operating temperature is commonly referred to as the line design temperature.

Revised planning studies¹ performed in April 2016 determined the maximum foreseeable operating temperature of a number of transmission lines with known spans violating AS7000 minimum clearances (low spans). The transmission lines analysed in this study are not included in any other low span projects to date.

These revised operating temperatures have been used to calculate the low spans which exist on the transmission lines studied. A risk assessment² has been applied to determine which of these spans are expected to require remediation to mitigate the public safety risk they present to an acceptable level. In order to fulfil the requirements of the AS 5577 – Electricity Network Safety Management Systems, the public safety risk presented by the low spans must be reduced As Low As Reasonably Practical (ALARP).

2. Related Needs/opportunities

- > Need ID 1427: 20 330kV Transmission Line Renewal – Consideration should be given to combining the works in this Need.
- > Need ID 1408: 23 330kV Transmission Line Renewal – Consideration should be given to combining the works in this Need.

3. Options

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

Base Case

The planning study, [Low Span Tower Transmission Lines – Northern/Central/Southern Regions – April 2016](#), has identified the revised operating temperatures used to determine the low span issues which exist on the transmission lines studied. A risk assessment has been performed to identify the spans which present a higher risk to public safety (due to magnitude of violation and location of the violation) and the spans which present a lower risk to public safety. A summary of these can be found in Need/Opportunity Statement (NOS) [NS 1556](#).

Under a Base Case 'do nothing' option, the associated risk cost from the issues identified is \$0.79m 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 | Lower Risk Spans Risk Cost per annum | Lower Risk Spans Risk Cost per annum | Total Risk Cost per annum |
|----------------------|---|---|------------------------------|
| Reliability (System) | 0.01 | 0.19 | 0.20 |

¹ Low Span Tower Transmission Lines – Northern/Central/Southern Regions – April 2016 planning study – on TransGrid's [Project Document Governance System \(PDGS\)](#)

² TransGrid Low Span Risk Management Approach

| Risk Category | Lower Risk Spans Risk Cost per annum | Lower Risk Spans Risk Cost per annum | Total Risk Cost per annum |
|------------------------|---|---|------------------------------|
| Financial | 0 | 0.01 | 0.01 |
| Operational/Compliance | 0 | 0 | 0 |
| People (Safety) | 0.01 | 0.56 | 0.57 |
| Environment | 0 | 0 | 0 |
| Reputation | 0 | 0 | 0 |
| Total | 0.02 | 0.77 | 0.79 |

It can be seen from Table 1 that the highest risk cost is associated with the 'people (safety)' category due to the significant consequences of uncontrolled electrical discharge with the low spans. The other main contributor to the overall risk cost is the 'reliability (system)' category as a result of associated outages.

Option A — Remediation of 'High Risk' Low Spans [[OFR 1556A](#), [OFS 1556A](#)]

This option covers the remediation of low spans which are deemed to be 'high risk' to public safety. Spans deemed 'lower risk' shall have implemented engineering controls to restrict access to the area (where trafficable) or administrative controls to reduce the public safety risk So Far As Is Reasonably Practical (SFAIRP). The list of all 'high' and 'lower risk' low spans under this option is summarised in Table 2.

Table 2 – Low Spans Stage 2 scope of works

| Line | From | To | Lower Risk Spans | High Risk Spans |
|------|-------------------|-------------------|------------------|-----------------|
| 61 | Bannaby | Gullen Range | 0 | 2 |
| 31 | Regentville | Bayswater | 0 | 0 |
| L1 | Tumut 3 PS | Lower Tumut | 0 | 0 |
| L3 | Tumut 3 PS | Lower Tumut | 0 | 0 |
| L5 | Tumut 3 PS | Lower Tumut | 0 | 0 |
| M9 | Murray | Murray 1 | 1 | 1 |
| 62 | Wagga 330 | Jindera | 1 | 2 |
| 3W | Kangaroo Valley | Capital Wind Farm | 2 | 2 |
| 6 | Capital Wind Farm | Canberra | 0 | 1 |
| 33 | Liddell | Bayswater | 0 | 0 |
| 72 | Wellington | Mt Piper | 0 | 1 |
| 0X1 | Red Cliffs | Buronga | 0 | 2 |
| X5/1 | Balranald | Darlington Point | 3 | 0 |
| X5/3 | Buronga | Balranald | 3 | 0 |
| 66 | Lower Tumut | Murray | 14 | 6 |

| Line | From | To | Lower Risk Spans | High Risk Spans |
|--------------|--------------|---------------|------------------|-----------------|
| 65 | Upper Tumut | Murray | 6 | 10 |
| 64 | Upper Tumut | Lower Tumut | 1 | 1 |
| 20 | Sydney North | Sydney West | 2 | 1 |
| 29 | Sydney West | Vineyard | 0 | 0 |
| 27 | Sydney East | Sydney North | 1 | 0 |
| 30 | Sydney West | Liverpool | 0 | 4 |
| X2 | Buronga | Broken Hill | 4 | 4 |
| 92 | Vales Point | Newcastle | 0 | 0 |
| 78 | Sydney South | Ingleburn | 0 | 0 |
| 94 | Tomago | Newcastle | 0 | 0 |
| 87 | Armidale | Coffs Harbour | 1 | 0 |
| 23 | Munmorah | Vales Point | 1 | 0 |
| 38 | Sydney West | Regentville | 0 | 0 |
| 37 | Kemps Creek | Macarthur | 0 | 2 |
| 9W | Tomago | Waratah West | 0 | 0 |
| Total | | | 40 | 39 |

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is \$2.82m \pm 25%. Details can be found in Section 6 of Option Feasibility Study (OFS) [OFS 1556A](#).

Following the refurbishment under this option, the risk cost associated with the remaining 'lower risk' spans not remediated is \$0.02m 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 |
| Operational/Compliance | 0 |
| People (Safety) | 0.01 |
| Environment | 0 |
| Reputation | 0 |
| Total | 0.02 |

The total projected risk reduction as a result of implementing Option A is \$0.77m per annum. It can be seen from Table 3 that the majority of the risk reduction is expected to come from the 'people (safety)' category from the elimination of the electrical hazard. Some reduction is expected in the 'reliability (system)' category due to the decrease in likelihood of outages from low spans.

Option B — Remediation of All Low Spans [[OFR 1556B](#), [OFS 1556B](#)]

This option covers remediation of all low spans ('high' and 'lower risk') as summarised in the above Table 2.

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is \$5.00m ±25%. Details can be found in Section 6 of [OFS 1556B](#).

Following the remediation of all low spans under this option, the remaining risk cost associated with all the new compliant spans is zero.

All options detailed in Section 3 above are considered to be technically feasible³.

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) calculations for Options A and B 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 | Do nothing | N/A | N/A | 0.79 | N/A | N/A | 3 |
| A | Remediation of 'High Risk' Low Spans | 2.82 | - | 0.02 | 2.73 | 1.50 | 1 |
| B | Remediation of All Low Spans | 5.00 | - | 0 | 1.04 | (0.22) | 2 |

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.

³ 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.

Table 5 — Discount rate sensitivities (\$ million)

| Option | Description | Economic NPV @13% | Economic NPV @6.75% |
|----------|--------------------------------------|-------------------|---------------------|
| A | Remediation of 'High Risk' Low Spans | 1.70 | 4.46 |
| B | Remediation of All Low Spans | 0.08 | 2.69 |

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:

- > Uncontrolled discharge or contact with electricity (low span)

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:

- > Uncontrolled discharge or contact with electricity (low span) – 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 | Do nothing | N/A | N/A | N/A |
| A | Remediation of 'High Risk' Low Spans | 2.82 | 20 years | 141 |
| B | Remediation of All Low Spans | 5.00 | 20 years | 250 |

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 | 571 | 196 | 0 | N/A | N/A | N/A |
| A | 11 | 4 | 0 | 561 | 192 | 0 |
| B | 0 | 0 | 0 | 571 | 196 | 0 |

Table 8 – Reasonably practicable test (\$ thousand)

| Option | Network Safety Risk Reduction ⁴ | Annualised CAPEX | Reasonably practicable ⁵ ? |
|--------|--|------------------|---------------------------------------|
| A | 3,382 | 141 | Yes |
| B | 3,448 | 250 | Yes |

From the above evaluation, it is considered that both Options A and B are reasonably practicable.

4.3 Preferred option

From the SFAIRP/ALARP evaluation, it is considered that both Options A and B are reasonably practicable and both options provide a similar level of network safety risk reduction. In order to satisfy the organisation's SFAIRP/ALARP obligations, one of these options is required to be undertaken. Option A is the more commercially viable of the two options as it achieves only \$0.02m per annum less risk reduction compared to Option B at a considerably lower capital cost. As a result, it is the preferred option and it is proposed that it be scoped in further detail.

Capital and operating expenditure

The estimated capital expenditure associated with the preferred Option A is \$2.82m \pm 25%. The vast majority of this expenditure is proposed to be carried out in 2022-2023.

In comparison, the estimated capital expenditure associated with Option B for the remediation of all identified low spans is \$5.00m \pm 25%, with the vast majority proposed to be carried out in 2021-2022.

No material change in operating expenditure to any of the lines listed above is expected as a result of the works under both Options A and B.

Regulatory Investment Test

No Regulatory Investment Test for Transmission (RIT-T) analysis is required as the works are condition based. The works are to address safety issues associated with existing assets.

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 remediation of 'high risk' low spans as outlined under Option A is undertaken.

⁴ The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

⁵ 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 | | | Low Spans Stage 2 Option A - Remediation of High Risk Spans | | |
|---|---------|---------|---|-----------------------------------|-----------|
| 1. Financial Evaluation (excludes VCR benefits) | | | | | |
| NPV @ standard discount rate | 10.00% | \$1.50m | NPV / Capital (Ratio) | 0.53 | |
| NPV @ upper bound rate | 13.00% | \$0.77m | Pay Back Period (Yrs) | 0.19 Yrs | |
| NPV @ lower bound rate (WACC) | 6.75% | \$2.76m | IRR% | 18.59% | |
| 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% | \$2.73m | NPV / Capital (Ratio) | -0.91 | |
| NPV @ upper bound rate | 13.00% | \$1.70m | Pay Back Period (Yrs) | 3.67 Yrs | |
| NPV @ lower bound rate (WACC) | 6.75% | \$4.46m | IRR% | 24.76% | |
| Benefits | | | | | |
| Risk cost | As Is | To Be | Benefit | VCR Benefit | \$0.19m |
| Systems (reliability) | \$0.20m | \$0.00m | \$0.19m | ENS Penalty | \$0.00m |
| Financial | \$0.01m | \$0.00m | \$0.01m | All other risk benefits | \$0.58m |
| Operational/compliance | \$0.00m | \$0.00m | \$0.00m | Total Risk benefits | \$0.77m |
| People (safety) | \$0.57m | \$0.01m | \$0.56m | Benefits in the financial NPV* | \$0.58m |
| Environment | \$0.00m | \$0.00m | \$0.00m | *excludes VCR benefits | |
| Reputation | \$0.00m | \$0.00m | \$0.00m | Benefits in the economic NPV** | \$0.77m |
| Total Risk benefits | \$0.78m | \$0.02m | \$0.77m | **excludes ENS penalty | |
| Cost savings and other benefits | | | \$0.00m | | |
| Total Benefits | | | \$0.77m | | |
| Other Financial Drivers | | | | | |
| Incremental opex cost pa (no depreciation) | | | \$0.00m | Write-off cost | \$0.00m |
| Capital - initial \$m | | | -\$2.82m | 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 |

Option B NPV calculation

Project_Option Name

Low Spans Stage 2 Option B - Remediation of All Low Spans

1. Financial Evaluation (excludes VCR benefits)

| | | | | |
|-------------------------------|--------|----------|-----------------------|----------|
| NPV @ standard discount rate | 10.00% | -\$0.22m | NPV / Capital (Ratio) | -0.04 |
| NPV @ upper bound rate | 13.00% | -\$0.87m | Pay Back Period (Yrs) | 0.09 Yrs |
| NPV @ lower bound rate (WACC) | 6.75% | \$0.95m | IRR% | 9.25% |

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% | \$1.04m | NPV / Capital (Ratio) | -0.35 |
| NPV @ upper bound rate | 13.00% | \$0.08m | Pay Back Period (Yrs) | 6.37 Yrs |
| NPV @ lower bound rate (WACC) | 6.75% | \$2.69m | IRR% | 13.33% |

Benefits

| Risk cost | As Is | To Be | Benefit | VCR Benefit | \$0.20m |
|---------------------------------|---------|---------|---------|--------------------------------|---------|
| Systems (reliability) | \$0.20m | \$0.00m | \$0.20m | ENS Penalty | \$0.00m |
| Financial | \$0.01m | \$0.00m | \$0.01m | All other risk benefits | \$0.59m |
| Operational/compliance | \$0.00m | \$0.00m | \$0.00m | Total Risk benefits | \$0.78m |
| People (safety) | \$0.57m | \$0.00m | \$0.57m | Benefits in the financial NPV* | \$0.59m |
| Environment | \$0.00m | \$0.00m | \$0.00m | *excludes VCR benefits | |
| Reputation | \$0.00m | \$0.00m | \$0.00m | Benefits in the economic NPV** | \$0.78m |
| Total Risk benefits | \$0.78m | \$0.00m | \$0.78m | **excludes ENS penalty | |
| Cost savings and other benefits | | | \$0.00m | | |
| Total Benefits | | | \$0.78m | | |

Other Financial Drivers

| | | | |
|--|----------|-----------------------------------|-----------|
| Incremental opex cost pa (no depreciation) | \$0.00m | Write-off cost | \$0.00m |
| Capital - initial \$m | -\$5.00m | 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 |