# NEED/OPPORTUNITY STATEMENT (NOS)

Line 31/32 330kV Transmission Lines Renewal

NOS- 000000001275 revision 2.0

**Ellipse project no:** P0005457
**TRIM file: [TRIM No]**

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

**Approvals**

| | | |
|---|---|---|
| **Author** | Edward Luk | Transmission Lines and Cables Analyst |
| **Endorsed** | Steve Stavropoulos | Transmission Lines and Cables Asset Manager |
| **Approved** | Lance Wee | Manager/Asset Strategy |
| **Date submitted for approval** | 25 November 2016 | |

**Change history**

| Revision | Date | Amendment |
|---|---|---|
| 0 | 12 April 2016 | Initial issue |
| 1 | 27 July 2016 | Update to 2016/17 dollars |
| 2 | 25 November 2016 | Update to format |

# 1. Background

Line 31/32 is a double circuit steel tower 330kV transmission line between Bayswater and Regentville 330kV substations, with a route length of 171 km. The transmission line is a key link between the Sydney metropolitan area and the Hunter Valley generators. This transmission line was originally constructed in 1969 and consists of 456 structures. It mostly traverses through Wollemi National Park and timbered ridgetops. Within the Sydney basin, the line runs through rural properties and backs onto residential areas.

Condition assessment NACA-1275[1] performed in October/November 2015 has identified a number of issues with Transmission Line 31/32 which require rectification in the short – medium term to ensure that the asset remains operational in the long term. Corrosion of steel is the main contributing factor leading to a decline in the health of the asset.

# 2. Need/opportunity

Condition assessment NACA-1275 has identified issues which require rectification, these are summarised in Table 1.

**Table 1 – Transmission Line 31/32 Condition Issues**

| Issue | Extent (% line) | Cause | Impact |
|---|---|---|---|
| Ground line corrosion of steel at footing | 2% | Buried steelwork at footing | Steel corrosion of critical member, can lead to structural failure of tower |
| Buried concrete foundations | 10% | Erosion of soil building up around footings | Accelerated corrosion of critical member |
| Corrosion of earth strap | 10% | Corrosion as buried at footing | Possible transfer potential, earth current and voltage gradient issues, can lead to serious injury or possible death |
| Rusting of tower steel members | 2% | Zinc galvanising end of life | Structural failure |
| Corroded fasteners | 5% | Zinc galvanising end of life | Structural failure |
| Corroded insulators | 92% | Corrosion of steel caps<br>Zinc sleeve protection end of life | Conductor drop |
| Conductor dampers | 5% | Damaged | Accelerated fatigue of conductor due to vibration |
| Earthwire dampers | 5% | Damaged | Accelerated fatigue of conductor due to vibration |

[1] NACA-1275 on PDGS Need Site

The risk cost associated with the issues identified in Table 1 is $7.33m per annum (refer Attachment 1). One of the most significant elements of concern is the excess soil at the tower footings as it accelerates ground line corrosion of steel transmission tower legs. As these are the critical load bearing members of the tower, they cannot be easily remediated if the condition passes a stage where rectification work is not possible.

Corrosion of fasteners and fittings is as expected given the age of the asset. These items are original and the sacrificial zinc galvanising layer has reached end of life. These items generally had a significantly thinner layer of galvanising at the time of manufacturing compared with the steel tower members due to fabrication processes. Fasteners also have no galvanising on the nut thread which explains their poor condition relative to the main tower steelwork.

Corrosion of steel pins on ceramic insulators is also a significant issue. Two insulator strings have failed in the past 15 years, both in the vicinity of Bayswater. The pins on the underside of suspension insulator discs build up pollution and are not adequately washed by rain which leads to an increased rate of corrosion. Inspections have identified rusting of both insulator caps and pins (4%). In addition, insulators of the 1965-1974 vintage make up another 88% of Line 31/32. These require replacement to reduce the risk of conductor drop.

Damaged conductor/earthwire dampers require replacement to ensure the long term health of the conductors/earthwires is not impacted by vibration.

The benefit of addressing the condition issues on Line 31/32 is to continue providing the service at a lower risk of failure.

## 3. Related needs/opportunities

No related needs/opportunities have been identified.

## 4. Recommendation

It is recommended that options be considered to address the identified need/opportunity by 2023.

# Current Option Assessment - Risk Summary

Project Name: Line 31/32

Option Name: 1275 - Base Case

Option Assessment Name: 1275 - Base Case - Assessment 1

Rev Reset Period: Next (2018-23)

| Major Component | No. | Minor Component | Sel. Hazardous Event | LoC x CoF ($M) | Failure Mechanism | NoxLoC xCoF ($M) | PoF (Yr 1) | Total Risk ($M) | Risk ($M) (Rel) | Risk ($M) (Op) | Risk ($M) (Fin) | Risk ($M) (Peo) | Risk ($M) (Env) | Risk ($M) (Rep) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conductor | 3402 | Insulators | Conductor Drop (Conductor) | $5.50 | Insulator Failure | $18,697.39 | 0.02% | $3.25 | | | $0.02 | $0.83 | $2.39 | $0.01 |
| Conductor | 3402 | Insulators | Unplanned Outage - HV (Conductor) | $3.12 | Structural Failure | $10,615.70 | 0.02% | $1.85 | $1.85 | | $0.00 | | | $0.00 |
| Conductor 2 | 3402 | Fittings | Conductor Drop (Conductor 2) | $5.50 | Fitting Failure | $18,697.39 | 0.00% | $0.09 | $0.00 | | $0.00 | $0.02 | $0.07 | $0.00 |
| Conductor 2 | 3402 | Fittings | Unplanned Outage - HV (Conductor 2) | $3.12 | Structural Failure | $10,615.70 | 0.00% | $0.05 | $0.05 | | $0.00 | | | $0.00 |
| Earth Wire | 0 | Earth Wire (inc Joints) | Earth Wire Drop (Earth Wire) | $1.44 | Break | $0.00 | 0.00% | $0.00 | $0.00 | | $0.00 | $0.00 | $0.00 | $0.00 |
| Earth Wire | 0 | Earth Wire (inc Joints) | Unplanned Outage - HV (Earth Wire) | $3.12 | Break | $0.00 | 0.00% | $0.00 | $0.00 | | $0.00 | | | $0.00 |
| Earth Wire | 1134 | Fittings (inc Attachment) | Earth Wire Drop (Earth Wire) | $1.44 | Fitting Failure | $1,631.83 | 0.00% | $0.01 | $0.00 | | $0.00 | $0.01 | $0.00 | $0.00 |
| Earth Wire | 1134 | Fittings (inc Attachment) | Unplanned Outage - HV (Earth Wire) | $3.12 | Structural Failure | $3,538.57 | 0.00% | $0.01 | $0.01 | | $0.00 | | | $0.00 |
| Structure | 13 | Earthing | Uncontrolled Electrical Contact / Discharge (Structure) | $0.02 | Earthing Failure | $0.29 | 13.17% | $0.04 | | | $0.00 | $0.04 | | $0.00 |
| Structure | 456 | Steel Structure | Unplanned Outage - HV (Structure) | $21.84 | Structural Failure | $9,959.66 | 0.02% | $1.60 | $1.60 | | $0.00 | | | $0.00 |
| Structure | 456 | Steel Structure (inc Footings) | Conductor / Earth Wire / OPGW Drop (Structure) | $5.77 | Structural Failure | $2,629.30 | 0.02% | $0.42 | | | $0.02 | $0.10 | $0.30 | $0.00 |
| | | | | $53.98 | | $76,385.82 | | $7.33 | $3.52 | | $0.04 | $1.00 | $2.76 | $0.01 |

Total VCR Risk: $3.52

Total ENS Risk: $0.00

**Number of Components**

The number of components used in the risk model has been derived as follows:

- Steel Structures: The extent of the steel structures on the transmission line with advanced corrosion condition issues identified in Table 1 (10%) multiplied by the total number of original structures (456).
- Steel Structure Earthing: The number of steel structures on the line in areas readily accessible by members of the general public (13).
- Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (92%) multiplied by the total number of suspension insulators on the line (6 per suspension structure).

**Probability of Failure**

As per the Risk Costs Summary model.

**Consequence of Failure**

As per the Risk Costs Summary model.