NEED/OPPORTUNITY STATEMENT (NOS)

Line 14 330kV Transmission Line Renewal

NOS- 000000001280 revision 2.0

Ellipse project no.: P0005451
TRIM file: [TRIM No]

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

Approvals

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Approved	Lance Wee	Manager/Asset Strategy
Date submitted for approval	24 November 2016	

Change history

Revision	Date	Amendment
0	11 April 2016	Initial issue
1	27 July 2016	Update to 2016/17 dollars
2	9 November 2016	Revised to contain tower strength commentary and update to format

1. Background

Line 14 is a steel tower 330kV transmission line between Kemps Creek and Sydney North 330kV substations, with a route length of 50.6km. The transmission line links generation entering Kemps Creek to Sydney metro area. The single circuit section of this line was constructed in 1963 and consists of 132 structures, a route length of 48.4km. The line passes through urban areas of Sydney.

Condition assessment NACA-1280[1] performed in November 2015 has identified a number of issues with transmission line 14 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.

This transmission line falls within a zone of low[2] steel corrosion.

2. Need/opportunity

Condition assessment NACA-1280 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 14 Condition Issues

Issue	Extent (% line)	Cause	Impact
Buried concrete foundations	10%	Erosion of soil building up around footings	Accelerated corrosion of critical member
Corrosion of earth wire attachment fittings	5%	Zinc galvanising end of life	Conductor drop
Insulator pin corrosion	53%	Pollution build up and deterioration of galvanising	Conductor drop
Corrosion of earth wire	10%	Zinc galvanising end of life	Conductor drop
Earth wire vibration damper	5%	Damaged/Weathering	Accelerated fatigue of earth wire due to vibration

The risk cost associated with the issues identified in Table 1 is $1.05m per annum (refer Attachment 1). The most significant element of concern is ground line corrosion of steel transmission tower legs at the footings. These are an item of concern as they are the critical load bearing members of the tower and cannot be easily remediated if the condition passes a stage where rectification work is not possible. Conductor drop as a result of fitting or insulator failure is also a concern, as many of these items are single point of failure (e.g. insulator attachments).

The single circuit transmission line structures used on Line 14 were designed to the standards at that time but were found to be a lower set of design criteria compared with newer structures. Following a number of structure failures in extreme wind events, investigations found that these single circuit suspension towers had design deficiencies in the governing load combinations when compared to more recent design philosophies and standards. Strengthening of structures with utilisation over 85% at road crossings and public areas has occurred. As not all

[1] NACA-1280 on PDGS Need Site

[2] Steel corrosion rate as defined in *AS 4312 – Atmospheric corrosivity zones in Australia*

structures have been strengthened, it is essential that condition issues on these towers be addressed so that they do not reduce the capacity of the towers and further reduce the security of supply.

Corrosion of fittings and earthwire is as expected given the age and location 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.

Corrosion of steel pins on ceramic insulators is a common issue. 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. A number of insulator failures leading to conductor drop have occurred due to the pins corroding through. Original (pre 1965) insulators are installed on the majority (52%) of Line 14 with insulators of the 1965-1974 vintage making up another 1%. These require replacement to reduce the risk of conductor drop as Line 14 passes through urban areas.

The corrosion issues associated with fittings, insulators and earthwire is consistent with other transmission lines of the same vintage in the region.

Ground line corrosion of steel transmission tower legs at the footings are an item of concern as these are the critical load bearing members of the tower and cannot be easily remediated if the condition passes a stage where rectification work is not possible.

The benefit of addressing the condition issues on Transmission Line 14 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.

Attachment 1 - Risk costs summary

Summary of results is attached below. Refer to supporting document in PDGS for full risk assessment.

Current Option Assessment - Risk Summary

Project Name: Line 14

Option Name: 1280 - Base Case

Option Assessment Name: 1280 - 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	474	Insulators	Conductor Drop (Conductor)	$4.87	Insulator Failure	$2,307.57	0.04%	$0.86			$0.01	$0.23	$0.63	$0.00
Conductor	474	Insulators	Unplanned Outage - HV (Conductor)	$0.00	Structural Failure	$0.59	0.04%	$0.00	$0.00		$0.00			$0.00
Conductor 2	474	Fittings	Conductor Drop (Conductor 2)	$4.87	Fitting Failure	$2,307.57	0.00%	$0.02	$0.00		$0.00	$0.01	$0.02	$0.00
Conductor 2	474	Fittings	Unplanned Outage - HV (Conductor 2)	$0.00	Structural Failure	$0.59	0.00%	$0.00	$0.00		$0.00			$0.00
Earth Wire	2	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.16	Break	$0.32	0.04%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	2	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.00	Break	$0.00	0.04%	$0.00	$0.00		$0.00			$0.00
Earth Wire 2	316	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	$1.32	Fitting Failure	$416.42	0.00%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire 2	316	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	$0.00	Structural Failure	$0.40	0.00%	$0.00	$0.00		$0.00			$0.00
Structure	17	Earthing	Uncontrolled Electrical Contact / Discharge (Structure)	$0.09	Earthing Failure	$1.58	3.72%	$0.06			$0.00	$0.06		$0.00
Structure	128	Steel Structure	Unplanned Outage - HV (Structure)	$0.01	Structural Failure	$1.08	0.02%	$0.00	$0.00		$0.00			$0.00
Structure	128	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$5.11	Structural Failure	$653.90	0.02%	$0.11			$0.01	$0.03	$0.07	$0.00
				$16.43		$5,690.04		$1.05	$0.00		$0.01	$0.32	$0.72	$0.00

Total VCR Risk: $0.00

Total ENS Risk: $0.00

Number of Components

The number of components used in the - Risk costs summary 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 (15%) multiplied by the total number of original structures (296).
- Steel Structure Earthing: The number of steel structures on the line in areas readily accessible by members of the general public (17).
- Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (53%) multiplied by the total number of suspension insulators on the line (3 per suspension structure).
- Earth Wire: Length of earth wire on the transmission line multiplied by portion with advanced corrosion condition issues identified in Table 1 (10%).
- Earth Wire Fittings: The extent of the earth wire fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (5%) multiplied by the total number of fittings (2 per suspension structure and 4 per tension structure).

Probability of Failure

As per the - Risk costs summary model.

Consequence of Failure

As per the - Risk costs summary model.