NEED/OPPORTUNITY STATEMENT (NOS)

Line 16 330kV Transmission Line Renewal

NOS- 000000001353 revision 2.0

Ellipse project no.: P0007973
TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements
Project category: Prescribed - Asset Renewal Strategies

Approvals

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Date submitted for approval	24 November 2016	

Change history

Revision	Date	Amendment
0	12 April 2016	Initial issue
1	2 August 2016	Update to 2016/17 dollars
2	24 November 2016	Revised to contain tower strength commentary and update to format

1. Background

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.

Condition assessment NACA-1353[1] performed in February 2016 has identified a number of issues with Transmission Line 16 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-1353 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 16 Condition Issues

Issue	Extent (% line)	Cause	Impact
Corrosion of tower steel members	9%	Zinc galvanising end of life	Steel corrosion, particularly of critical members, can lead to structural failure of tower
Buried concrete foundations	5%	Erosion of soil building up around footings	Accelerated corrosion of critical member
Corroded fasteners	5%	Zinc galvanising end of life	Structural failure
Corroded conductor attachment fittings	5%	Zinc galvanising end of life	Conductor drop
Corrosion of earthwire attachment fittings	5%	Zinc galvanising end of life	Conductor drop
Corroded insulators	97%	Corrosion of steel caps Zinc sleeve protection end of life	Conductor drop
Corroded earthwire	5%	Zinc galvanising end of life	Conductor drop
Conductor dampers	10%	Damaged/Weathered	Accelerated conductor fatigue due to vibration

The risk cost associated with the issues identified in Table 1 is $1.36m per annum (refer Attachment 1). The most significant element of concern is the corrosion of steel pins on ceramic insulators and is a common issue. The pins on the underside of suspension insulator discs build up pollution and are not adequately washed by rain which

[1] NACA-1353 on PDGS Need Site

leads to an increased rate of corrosion. The vast majority of the line is fitted with original insulators, with less than 5% of structures containing non-original insulators. Corrosion of insulator pins and caps is widespread and severe in some areas. The condition of insulators is fairly similar along the line with the older (1955 vintage) inland insulators being in a similar condition to the newer (1973) semi-coastal insulators.

Another key issue is the corrosion of steel members on the structures, particularly in the section of the line closer to the coast. This includes possible ground line corrosion of steel tower legs at the footings. As some members are critical load bearing members of the tower, they cannot be easily remediated if the condition passes a stage where rectification work is not possible. The corrosion issues associated with the tower structures are consistent with other transmission lines of the same vintage in the region.

The single circuit transmission line structures used on Line 16 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 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 fasteners and fittings is as expected given the age of the asset as the sacrificial zinc galvanising layer on these items 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. Nuts/bolts and pins are rusting with some nuts/bolts starting to explode losing their shape.

The earthwires are showing severe signs of corrosion as they have lost galvanising and appear red/brown in colour. The earthwires require addressing to extend life.

Conductor dampers show various signs of drooping, and require replacement to prevent accelerated conductor fatigue.

The benefit of addressing the condition issues on Line 16 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 16

Option Name: 1353 - Base Case

Option Assessment Name: 1353 - 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	570	Fittings	Conductor Drop (Conductor)	$3.25	Fitting Failure	$1,852.96	0.00%	$0.01			$0.00	$0.00	$0.01	$0.00
Conductor	570	Fittings	Unplanned Outage - HV (Conductor)	$0.01	Structural Failure	$4.12	0.00%	$0.00	$0.00		$0.00			$0.00
Conductor	570	Insulators	Conductor Drop (Conductor)	$3.25	Insulator Failure	$1,852.96	0.07%	$1.24			$0.01	$0.07	$1.16	$0.00
Conductor	570	Insulators	Unplanned Outage - HV (Conductor)	$0.01	Structural Failure	$4.12	0.07%	$0.00	$0.00		$0.00			$0.00
Earth Wire	2	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.04	Break	$0.07	0.06%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	2	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.01	Break	$0.01	0.06%	$0.00	$0.00		$0.00			$0.00
Earth Wire 2	380	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	$0.21	Fitting Failure	$78.58	0.00%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire 2	380	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	$0.01	Structural Failure	$2.75	0.00%	$0.00	$0.00		$0.00			$0.00
Structure	160	Steel Structure	Unplanned Outage - HV (Structure)	$0.05	Structural Failure	$8.05	0.02%	$0.00	$0.00		$0.00			$0.00
Structure	160	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$3.52	Structural Failure	$563.33	0.02%	$0.10			$0.01	$0.01	$0.09	$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	$0.00	Earthing Failure	$0.00								
				$10.34		$4,366.95		$1.36	$0.00		$0.02	$0.08	$1.26	$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 and footing issues identified in Table 1 (9%) multiplied by the total number of original structures (160).
- Conductor Fittings: The extent of the conductor fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (5%) multiplied by the total number of fittings (3 per suspension structure and 6 per tension structure).
- Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (97%) 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 the portion with advanced corrosion condition issues identified in Table 1 (5%).
- 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.