NEED/OPPORTUNITY STATEMENT (NOS)

Line 8 MRN - DPT 330kV Line Renewal

NOS- 000000001341 revision 2.0

Ellipse project description: P0007884
TRIM file: [TRIM No]

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

Approvals

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Approved	Lance Wee	Manager/Asset Strategy
Date submitted for approval	28 November 2016	

Change history

Revision	Date	Amendment
0	12 April 2016	Initial issue
1	27 July 2016	Update to 2016/17 dollars
2	28 November 2016	Revised to contain tower strength commentary and update to format

1. Background

Line 8 is a single circuit steel tower 330kV transmission line between Marulan and Dapto 330kV substations, with a route length of 70.4 km. The transmission line is a key link between the Goulburn and Wollongong regions. This transmission line was originally constructed in 1956 and 1962 as part of the Yass to Dapto No. 1 and No. 2 lines respectively until line re-arrangements occurred at Robertson in 1974. The total number of structures on the line is 175. The transmission line mainly traverses through farmland and national park areas – after leaving Dapto, it climbs from the coastal plain up the Illawarra Escarpment.

Condition assessment NACA-1341[1] performed in February 2016 has identified a number of issues with Line 8 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-1341 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 8 Condition Issues

Issue	Extent (% line)	Cause	Impact
Corrosion of tower steel members	7%	Zinc galvanising end of life	Steel corrosion, particularly of critical members, can lead to structural failure of tower
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	66%	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 $1.80m per annum (refer Attachment 1). The most significant element of concern is the corrosion of steel pins on ceramic insulators. 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. There are a number of recorded insulator failures on this line. Past condition issues associated with Line 8 have been handled through maintenance and a number of fittings and insulators have been replaced

[1] NACA-1341 on PDGS Need Site

during the 1990s and 2000s. However, there are still large numbers of very old insulators (1955 Dulmison plain profile) on the line, right through to the coastal strip with expected advanced pin corrosion due to their age and locality.

Due to the Illawarra location of a section of Line 8, it is considered to have the higher level of corrosion than the remainder of the line. A 2015 steelwork condition report by Dennis Richards noted that none of the 19 towers inspected would require major maintenance in the next 10 years. However, NPV cost analysis has indicated that from a cost perspective, it is more beneficial to paint all tension towers (12 in total) in the section between Dapto and the Illawarra escarpment within the next six years as a remediation measure for corrosion, with the whole tower to be painted.

The single circuit transmission line structures used on Line 8 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. 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. Nuts/Buts and pins are rusting with some nuts/bolts starting to explode losing their shape.

Corrosion of the original remaining earthwire is evident having lost galvanising and appearing red/brown in colour. It requires 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 8 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 8

Option Name: 1341 - Base Case

Option Assessment Name: 1341 - 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	618	Fittings	Conductor Drop (Conductor)	$4.34	Fitting Failure	$2,683.11	0.00%	$0.02			$0.00	$0.01	$0.01	$0.00
Conductor	618	Fittings	Unplanned Outage - HV (Conductor)	$0.01	Structural Failure	$8.96	0.00%	$0.00	$0.00		$0.00			$0.00
Conductor	618	Insulators	Conductor Drop (Conductor)	$4.34	Insulator Failure	$2,683.11	0.05%	$1.25			$0.01	$0.36	$0.87	$0.00
Conductor	618	Insulators	Unplanned Outage - HV (Conductor)	$0.01	Structural Failure	$8.96	0.05%	$0.00	$0.00		$0.00			$0.00
Earth Wire	4	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.10	Break	$0.39	0.03%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	4	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.01	Break	$0.06	0.03%	$0.00	$0.00		$0.00			$0.00
Earth Wire 2	412	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	$1.30	Fitting Failure	$534.61	0.01%	$0.06	$0.00		$0.00	$0.06	$0.00	$0.00
Earth Wire 2	412	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	$0.01	Structural Failure	$5.98	0.01%	$0.00	$0.00		$0.00			$0.00
Structure	1	Earthing	Uncontrolled Electrical Contact / Discharge (Structure)	$0.00	Earthing Failure	$0.00	5.41%	$0.00			$0.00	$0.00		$0.00
Structure	175	Steel Structure	Unplanned Outage - HV (Structure)	$0.10	Structural Failure	$17.71	0.06%	$0.01	$0.01		$0.00			$0.00
Structure	175	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$4.61	Structural Failure	$807.03	0.06%	$0.46			$0.03	$0.12	$0.30	$0.00
				$14.85		$6,749.93		$1.80	$0.01		$0.04	$0.55	$1.19	$0.01

Total VCR Risk: $0.01

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 (7%) multiplied by the total number of original structures (175).
- 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 (66%) 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 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 Risk costs summary model.

Consequence of Failure

As per Risk costs summary model.