NEED/OPPORTUNITY STATEMENT (NOS)

Line 81 330kV Transmission Line Renewal

NOS- 000000001268 revision 2.0

Ellipse project no.: P0005395
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	24 November 2016	Revised to contain tower strength commentary and update to format

1 Background

Line 81 is a steel tower 330kV transmission line between Newcastle and Liddell 330kV substations, with a route length of 102 km. The transmission line links key Hunter region base load generators. This transmission line was constructed in 1966 and consists of 288 structures.

Condition assessment NACA-1268[1] performed in December 2015 has identified a number of issues with transmission line 81 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.

The first 50 structures from Newcastle substation are considered 'coastal' due to their proximity to the coast and Lake Macquarie. Accordingly, this section of transmission line falls within a zone of medium[2] steel corrosion whereas the remainder of the transmission line to Liddell substation falls within a zone of low[1] steel corrosion.

2 Need/opportunity

Condition assessment NACA-1268 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 81 Condition Issues

Issue	Extent (% line)	Cause	Impact
Ground line corrosion of steel at footing	7%	Buried steelwork at footing	Steel corrosion of critical member, can lead to structural failure of tower
Buried concrete foundations	15%	Erosion of soil building up around footings	Accelerated corrosion of critical member
Corrosion of tower members	1%	Zinc galvanising end of life	Failure of member
Corroded fasteners	5%	Zinc galvanising end of life	Structural failure
Corroded conductor attachment fittings	15%	Zinc galvanising end of life	Conductor drop
Corrosion of earth wire	6%	Zinc galvanising end of life	Conductor drop
Corroded earthwire attachment fittings	15%	Zinc galvanising end of life	Conductor drop

The risk cost associated with the issues identified in Table 1 is $1.84m per annum (refer Attachment 1). The most significant element of concern is steel structure failure. The items listed in Table 1 generally exist on the 'coastal' portion of the transmission line due to the higher expected rate of steel corrosion.

[1] NACA-1268 on PDGS Need Site

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

Ground line corrosion of steel transmission tower legs at the footings is a significant area 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 single circuit transmission line structures used on Line 81 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, fittings and earthwire is as expected (in the medium corrosion zone) 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.

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

The benefit of addressing the condition issues on Line 81 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 2021.

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

Current Option Assessment - Risk Summary

Project Name: Line 81

Option Name: 1268 - Base Case

Option Assessment Name: 1268 - 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	1101	Fittings	Conductor Drop (Conductor)	$5.76	Fitting Failure	$6,345.17	0.00%	$0.05			$0.00	$0.00	$0.05	$0.00
Conductor	1101	Fittings	Unplanned Outage - HV (Conductor)	$3.11	Structural Failure	$3,420.39	0.00%	$0.03	$0.03		$0.00			$0.00
Conductor 2	1101	Insulators	Conductor Drop (Conductor 2)	$5.76	Insulator Failure	$6,345.17	0.00%	$0.06			$0.00	$0.00	$0.06	$0.00
Conductor 2	1101	Insulators	Unplanned Outage - HV (Conductor 2)	$3.11	Structural Failure	$3,420.39	0.00%	$0.03	$0.03		$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)	$3.11	Break	$6.21	0.06%	$0.00	$0.00		$0.00			$0.00
Earth Wire 2	734	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	$0.19	Fitting Failure	$136.96	0.00%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire 2	734	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	$3.11	Structural Failure	$2,280.26	0.00%	$0.02	$0.02		$0.00			$0.00
Structure	211	Steel Structure	Unplanned Outage - HV (Structure)	$21.74	Structural Failure	$4,588.14	0.03%	$1.28	$1.28		$0.00			$0.00
Structure	211	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$5.99	Structural Failure	$1,263.86	0.03%	$0.35			$0.02	$0.01	$0.33	$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	$0.00	Earthing Failure	$0.00	7.91%	$0.00	$0.00		$0.00	$0.00		$0.00
				$51.91		$27,806.64		$1.84	$1.37		$0.02	$0.01	$0.44	$0.00

Total VCR Risk: $1.37

Total ENS Risk: $0.00

Number of Components

The number of components used in the Risk cost 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 (211).
- Conductor Fittings: The extent of the conductor fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (15%) multiplied by the total number of fittings (3 per suspension structure and 6 per tension structure).
- Earth Wire: Length of earth wire on the transmission line multiplied portion with advanced corrosion condition issues identified in Table 1 (6%).
- Earth Wire Fittings: The extent of the earth wire fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (15%) multiplied by the total number of fittings (2 per suspension structure and 4 per tension structure).

Probability of Failure

As per the Risk cost summary model.

Consequence of Failure

As per the Risk cost summary model.