NEED/OPPORTUNITY STATEMENT (NOS)

Line 27 330kV Transmission Line Renewal

NOS- 000000001273 revision 3.0

Ellipse project no.: P0005453
TRIM file: [TRIM No]

Project reason: Capability - Asset Replacement for end of life condition
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	24 November 2016	

Change history

Revision	Date	Amendment
0	12 April 2016	Initial issue
1	27 July 2016	Update to 2016/17 dollars
2	9 November 2016	Update to format
3	24 November 2016	Revised to contain tower strength commentary

1. Background

Line 27 is a steel tower 330kV transmission line between Sydney North and Sydney East 330kV substations, with a route length of 21.6 km. The transmission line links generation to the North-Eastern Sydney metro area. This transmission line was constructed in 1976 and consists of 58 structures. The majority of this line passes through National Park with sections in urban areas of Sydney.

Condition assessment NACA 1273[1] performed in January 2016 has identified a number of issues with Transmission Line 27 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 medium[2] corrosion.

2. Need/opportunity

Condition assessment NACA 1273 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 27 condition issues

Issue	Extent (% line)	Cause	Impact
Ground line corrosion of steel at footing	16%	Buried steelwork at footing	Steel corrosion of critical member, can lead to structural failure of tower
Earth strap	16%	Corrosion as buried at footing	Earthing safety hazard
Insulator pin corrosion	25%	Pollution build up and deterioration of galvanising	Conductor drop

The risk cost associated with the issues identified in Table 1 is $0.79m per annum (refer Attachment 1). The most significant element of concern is ground line corrosion of steel transmission tower legs at the footings.

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 27 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.

[1] NACA 1273 on PDGS Need Site

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

Corrosion of steel pins on ceramic insulators is also a significant 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. Inspections have also identified rusting of insulator caps and associated rust stains on insulator sheds (15%). In addition, insulators of the original 1965-1974 vintage make up another 10% of Line 27. These require replacement to reduce the risk of conductor drop.

The corrosion issues associated with insulators is consistent with other transmission lines of the same vintage in the region. A significant number of Line 27 fittings and insulators have been replaced when compared to Line 28.

The benefit of addressing the condition issues on Transmission Line 27 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 27

Option Name: 1273 - Base Case

Option Assessment Name: 1273 - 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	288	Insulators	Conductor Drop (Conductor)	$5.27	Insulator Failure	$1,518.85	0.01%	$0.10			$0.00	$0.02	$0.07	$0.00
Conductor	288	Insulators	Unplanned Outage - HV (Conductor)	$0.96	Structural Failure	$277.02	0.01%	$0.02	$0.02		$0.00			$0.00
Conductor 2	288	Fittings	Conductor Drop (Conductor 2)	$5.27	Fitting Failure	$1,518.85	0.00%	$0.01	$0.00		$0.00	$0.00	$0.01	$0.00
Conductor 2	288	Fittings	Unplanned Outage - HV (Conductor 2)	$0.96	Structural Failure	$277.02	0.00%	$0.00	$0.00		$0.00			$0.00
Earth Wire	0	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$1.22	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)	$0.96	Break	$0.00	0.00%	$0.00	$0.00		$0.00			$0.00
Earth Wire	192	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire)	$1.22	Fitting Failure	$233.63	0.00%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	192	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire)	$0.96	Structural Failure	$184.68	0.00%	$0.00	$0.00		$0.00			$0.00
Structure	10	Earthing	Uncontrolled Electrical Contact / Discharge (Structure)	$0.11	Earthing Failure	$1.14	1.66%	$0.02			$0.00	$0.02		$0.00
Structure	57	Steel Structure	Unplanned Outage - HV (Structure)	$6.73	Structural Failure	$383.77	0.09%	$0.36	$0.36		$0.00			$0.00
Structure	57	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$5.52	Structural Failure	$314.82	0.09%	$0.29			$0.02	$0.06	$0.21	$0.00
				$29.20		$4,709.78		$0.79	$0.38		$0.02	$0.10	$0.29	$0.00

Total VCR Risk: $0.38

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 (16%) based on assumption that structures with earthing issues also have corrosion issues) multiplied by the total number of original structures (58).
- Steel Structure Earthing: The number of steel structures on the line in areas readily accessible by members of the general public (10).
- Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (25%) multiplied by the total number of suspension insulators on the line (3 per suspension structure).

Probability of Failure

As per – Risk costs summary model.

Consequence of Failure

As per – Risk costs summary model.