NEED/OPPORTUNITY STATEMENT (NOS)

39 330kV Transmission Line Renewal

NOS- 000000001276 revision 2.0

Ellipse project description: P0005459
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	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 39 a single circuit steel tower 330kV transmission line between Bannaby and Sydney West 330kV substations, consisting of 272 structures with a route length of 114.1 km. The transmission line is a key link between Canberra, the southern highlands and the Sydney metropolitan area. This transmission line was originally constructed in 1968 as the Yass to Sydney West 330kV line before it was cut in to Bannaby in 2010. It generally traverses through National Parks, ridgetops and small rural land holdings.

The route of Line 39 has been identified for potential rebuild as a 500kV circuit.

Condition assessment NACA-1276[1] performed in November 2015 has identified a number of issues with Line 39 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-1276 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 39 Condition Issues

Issue	Extent (% line)	Cause	Impact
Ground line corrosion of steel at footing	2%	Buried steelwork at footing	Steel corrosion of critical member, can lead to structural failure of tower
Buried concrete foundations	5%	Erosion of soil building up around footings	Accelerated corrosion of critical member
Corrosion of earth strap	5%	Corrosion as buried at footing	Possible transfer potential, earth current and voltage gradient issues, can lead to serious injury or possible death
Corroded fasteners	3%	Zinc galvanising end of life	Structural failure
Corroded earthwire attachment fittings	5%	Zinc galvanising end of life	Conductor drop
Corroded insulator pins	90%	Zinc sleeve protection end of life	Conductor drop
Corrosion of earthwire	2%	Zinc galvanising end of life	Conductor drop
Conductor dampers	5%	Damaged	Accelerated fatigue of conductor due to vibration
Earthwire dampers	63%	Damaged	Accelerated fatigue of conductor due to vibration

[1] NACA-1276 on PDGS Need Site

The risk cost associated with the issues identified in Table 1 is $0.76m per annum (refer Attachment 1). Ground line corrosion of steel transmission tower legs at the footings is 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 single circuit transmission line structures used on Line 39 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.

Corrosion of steel pins on ceramic insulators is also a significant issue of concern. 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 (9%). In addition, insulators of the 1965-1974 vintage make up another 81% of Line 39. These require replacement to reduce the risk of conductor drop.

Damaged conductor and earthwire dampers require replacement to ensure the long term health of the conductors/earthwires isn't impacted by vibration.

The benefit of addressing the condition issues on Line 39 is to continue providing the service at a lower risk of failure.

3 Related needs/opportunities

- Pre-requisite: There are no pre-requisite needs
- Related: The following projects involving Line 39 may require coordination
  - Need ID 1056 – Relocation of Line 39 for Badgerys Creek Airport
- Dependent: There are no dependent needs

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 39

Option Name: 1276 - Base Case

Option Assessment Name: 1276 - 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	999	Insulators	Conductor Drop (Conductor)	$3.33	Insulator Failure	$3,328.27	0.02%	$0.61			$0.01	$0.05	$0.55	$0.00
Conductor	999	Insulators	Unplanned Outage - HV (Conductor)	$0.02	Structural Failure	$16.88	0.02%	$0.00	$0.00		$0.00			$0.00
Conductor 2	999	Fittings	Conductor Drop (Conductor 2)	$3.33	Fitting Failure	$3,328.27	0.00%	$0.02	$0.00		$0.00	$0.00	$0.02	$0.00
Conductor 2	999	Fittings	Unplanned Outage - HV (Conductor 2)	$0.02	Structural Failure	$16.88	0.00%	$0.00	$0.00		$0.00			$0.00
Earth Wire	2	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.03	Break	$0.06	0.02%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	2	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.02	Break	$0.03	0.02%	$0.00	$0.00		$0.00			$0.00
Earth Wire 2	666	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	$0.29	Fitting Failure	$191.54	0.00%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire 2	666	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	$0.02	Structural Failure	$11.25	0.00%	$0.00	$0.00		$0.00			$0.00
Structure	272	Steel Structure	Unplanned Outage - HV (Structure)	$0.12	Structural Failure	$32.08	0.01%	$0.00	$0.00		$0.00			$0.00
Structure	272	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$3.60	Structural Failure	$979.64	0.01%	$0.12			$0.01	$0.01	$0.10	$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	$0.00	Earthing Failure	$0.00								
				$10.77		$7,904.91		$0.76	$0.01		$0.02	$0.06	$0.67	$0.00

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 (5%) multiplied by the total number of original structures (272).
- Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (90%) 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 (2%). 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.