

NEED/OPPORTUNITY STATEMENT (NOS)



Line 3W 330kV Transmission Line Renewal

NOS- 00000001269 revision 2.0

Ellipse project description: P0005410

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	29 November 2016	

Change history

Revision	Date	Amendment
0	12 April 2016	Initial issue
1	27 July 2016	Update to 2016/17 dollars
2	29 November 2016	Update to format

1. Background

Line 3W is a single circuit steel tower 330kV transmission line between Capital Wind Farm and Kangaroo Valley 330kV substations, with a route length of 129 km. The transmission line is a key link between Canberra, Wollongong, and the Capital Wind Farm and Shoalhaven hydro generators. This transmission line was originally constructed in 1972 and consists of 296 structures. It generally traverses through isolated, timber country, with a large portion of the line running through Morton National Park.

Condition assessment NACA-12691 performed in November 2015 has identified a number of issues with Line 3W 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-1269 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 3W Condition Issues

Issue	Extent (% line)	Cause	Impact
Ground line corrosion of steel at footing	5%	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 earth strap	15%	Corrosion as buried at footing	Possible transfer potential, earth current and voltage gradient issues, can lead to serious injury or possible death
Corroded fasteners	5%	Zinc galvanising end-of-life	Structural failure
Corroded conductor attachment fittings	5%	Zinc galvanising end-of-life	Conductor drop
Corroded earthwire attachment fittings	5%	Zinc galvanising end-of-life	Conductor drop
Corroded insulator pins	89%	Zinc sleeve protection end-of-life	Conductor drop
Conductor dampers	10%	Damaged	Accelerated fatigue of conductor due to vibration

The risk cost associated with the issues identified in Table 1 is \$0.96m per annum (refer Attachment 1). The most significant element of concern is ground line corrosion of steel transmission tower legs at the footings as these are

¹ [NACA-1269](#) on PDGS Need Site

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 3W 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. 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 1973-1974 vintage make up another 80% of Line 3W. These require replacement to reduce the risk of conductor drop.

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

The benefit of addressing the condition issues on Line 3W 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 3W

Option Name: 1269 - Base Case

Option Assessment Name: 1269 - 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	Fittings	Conductor Drop (Conductor)	\$3.19	Fitting Failure	\$3,187.01	0.00%	\$0.02	\$0.00	\$0.00	\$0.00	\$0.00	\$0.02	\$0.00
Conductor	999	Fittings	Unplanned Outage - HV (Conductor)	\$0.02	Structural Failure	\$16.88	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Conductor	999	Insulators	Conductor Drop (Conductor)	\$3.19	Insulator Failure	\$3,187.01	0.02%	\$0.69	\$0.01	\$0.03	\$0.01	\$0.03	\$0.66	\$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	\$0.00	\$0.00	\$0.00
Earth Wire	666	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire)	\$0.15	Fitting Failure	\$97.37	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Earth Wire	666	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire)	\$0.02	Structural Failure	\$11.25	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Earth Wire 2	0	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire 2)	\$0.00	Break	\$0.00	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Earth Wire 2	0	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire 2)	\$0.00	Break	\$0.00	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Structure	296	Steel Structure	Unplanned Outage - HV (Structure)	\$0.12	Structural Failure	\$34.92	0.02%	\$0.01	\$0.01	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Structure	296	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	\$3.46	Structural Failure	\$1,024.22	0.02%	\$0.23	\$0.02	\$0.01	\$0.02	\$0.01	\$0.21	\$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	\$0.00	Earthing Failure	\$0.00		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
				\$10.16		\$7,575.54		\$0.96	\$0.01	\$0.03	\$0.04	\$0.89	\$0.00	\$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 (15%) multiplied by the total number of original structures (296).
- > 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 (89%) multiplied by the total number of suspension insulators on the line (3 per suspension structure).
- > 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.