

NEED/OPPORTUNITY STATEMENT (NOS)



Line 18 330kV Transmission Line Renewal

NOS- 000000001351 revision 2.0

Ellipse project no.: P0007969

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	26 July 2016	

Change history

Revision	Date	Amendment
0	12 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 18 is a single circuit steel tower 330kV transmission line between Kangaroo Valley and Dapto 330kV substations, with a route length of 43 km. The transmission line is a key link between the Shoalhaven hydro generation and the Wollongong region. Part of this line was originally constructed in 1962 as the Yass to Dapto No. 2 330kV transmission line until the line re-arrangements occurred in 1974 with the construction of Kangaroo Valley Power Station. The total number of structures on the line is 107. The transmission line mainly traverses through farmland and Morton National Park – after leaving Dapto, it climbs from the coastal plain up the Illawarra Escarpment.

Condition assessment NACA-1351¹ performed in March 2016 and the ICS report² has identified a number of issues with Line 18 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-1351 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 18 Condition Issues

Issue	Extent (% line)	Cause	Impact
Buried concrete foundations	5%	Erosion of soil building up around footings	Accelerated corrosion of critical member at ground line
Earth strap	15%	Corrosion as buried at footing	Earthing safety hazard
Corrosion of tower steel members	12% from ICS report)	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 insulators	75%	Corrosion of steel caps Zinc sleeve protection end of life	Conductor drop
Corroded conductor attachment fittings	30%	Zinc galvanising end of life	Conductor drop
Corrosion of earthwire attachment fittings	5%	Zinc galvanising end of life	Conductor drop
Corroded earthwire	10%	Zinc galvanising end of life	Conductor drop

¹ [NACA-1351](#) on PDGS Need Site

² The ICS report was limited to the older section of line from Structure 69 to Dapto.

Issue	Extent (% line)	Cause	Impact
Conductor dampers	10%	Damaged/Weathered	Accelerated conductor fatigue due to vibration

The risk cost associated with the issues identified in Table 1 is \$0.99m per annum (refer Attachment 1). The most significant element of concern is conductor drop due to 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 still large numbers of original 1955 Dulmison plain profile insulators (54%) on the line and insulators of the 1965-1974 vintage (21%) right through to the coastal strip. Due to their age and locality, it is expected that the discs have advanced pin corrosion of varying degrees.

The single circuit transmission line structures used on Line 18 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 also an area of significant concern as a number of fittings failures leading to conductor drop have been recorded due to the corrosion. Corrosion of fasteners and fittings is as expected given the age of the asset as the sacrificial zinc galvanising layer on these items 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 structure steel members is an issue, particularly ground line corrosion of steel tower legs at the footings. As some members could be critical load bearing members of the tower, they cannot be easily remediated if the condition passes a stage where rectification work is not possible. This is of particular concern in the section of line closer to the coast. The corrosion issues associated with the tower structures are consistent with other transmission lines of the same vintage in the region.

Corrosion of tower steel members is also an issue as identified in the steelwork condition report from ICS. Painting has been recommended on 13 tension towers on the line.

Significant corrosion of the earthwires, particularly between Dapto Substation and Structure 69, due to atmospheric conditions is as expected. The earthwires have lost galvanising and appear red/brown in colour, and require 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 18 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 18

Option Name: 1351 - Base Case

Option Assessment Name: 1351 - 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) (Pco)	Risk (\$M) (Env)	Risk (\$M) (Rep)		
Conductor	414	Insulators	Conductor Drop (Conductor)	\$2.70	Insulator Failure	\$1,119.41	0.04%	\$0.47	\$0.01	\$0.02	\$0.01	\$0.02	\$0.44	\$0.00		
Conductor	414	Insulators	Unplanned Outage - HV (Conductor)	\$0.01	Structural Failure	\$4.21	0.04%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00		
Conductor 2	0	Conductor (inc Joints)	Conductor Drop (Conductor 2)	\$2.70	Break	\$0.00										
Conductor 2	0	Conductor (inc Joints)	Unplanned Outage - HV (Conductor 2)	\$0.01	Break	\$0.00										
Conductor 2	414	Fittings	Conductor Drop (Conductor 2)	\$2.70	Fitting Failure	\$1,119.41	0.03%	\$0.28	\$0.00	\$0.00	\$0.00	\$0.01	\$0.26	\$0.00		
Conductor 2	414	Fittings	Unplanned Outage - HV (Conductor 2)	\$0.01	Structural Failure	\$4.21	0.03%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00		
Earth Wire	4	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	\$0.04	Break	\$0.17	0.08%	\$0.00	\$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	\$0.04	0.08%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00		
Earth Wire 2	276	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	\$0.17	Fitting Failure	\$45.93	0.01%	\$0.01	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00		
Earth Wire 2	276	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	\$0.01	Structural Failure	\$2.81	0.01%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00		
Structure	107	Steel Structure	Unplanned Outage - HV (Structure)	\$0.07	Structural Failure	\$7.24	0.07%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00		
Structure	107	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	\$2.97	Structural Failure	\$318.21	0.07%	\$0.22	\$0.02	\$0.01	\$0.02	\$0.01	\$0.19	\$0.00		
Structure 2	16	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	\$0.01	Earthing Failure	\$0.19	3.30%	\$0.01	\$0.00	\$0.00	\$0.00	\$0.01	\$0.01	\$0.00		
								\$11.42	\$0.99	\$0.01	\$0.03	\$0.06	\$0.88	\$0.00		
								\$2,621.84	Total VCR Risk: \$0.01		Total ENS Risk: \$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 tension towers identified by the ICS report with corrosion condition issues identified in Table 1 (13 structures (12%) as identified by ICS report). End of life replacements are not suitable.
- > Tower footings: The number of structures noted as having “Buried concrete foundations” (5% of line, 6 structures).
- > Steel Structure Earthing: The number of steel structures on the line in areas readily accessible by members of the general public (16).
- > Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (75%) multiplied by the total number of suspension insulators on the line (3 per suspension structure).
- > Conductor Fittings: The extent of the conductor fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (30%) 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 by the portion with advanced corrosion condition issues identified in Table 1 (10%).
- > 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.