

NEED/OPPORTUNITY STATEMENT (NOS)



Line 24 330kV Transmission Line Renewal

NOS- 000000001348 revision 2.0

Ellipse project description: P0007965

TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements

Project category: Prescribed - Asset Renewal Strategies

Approvals

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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 24 is a steel tower 330kV transmission line between Vales Point and Eraring 330kV substations, with a route length of 31 km. The transmission line is a key link between two of the Central Coast generators. The single circuit section of the transmission line, a route length of 28 km, was constructed in 1959 and 1964, and consists of 79 structures. The transmission line mainly traverses through semi-urban and forested areas. Note this NOS refers to the single circuit section of the line only.

Condition assessment NACA-1348¹ performed in March 2016 and Tower Inspection Report conducted by Dennis Richards (DMR 316) have identified a number of issues with Transmission Line 24 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-1348 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 24 Condition Issues

Issue	Extent (% line)	Cause	Impact
Ground line corrosion of steel at footing	20%	Buried steelwork at footing	Steel corrosion of critical member, can lead to structural failure of tower
Buried concrete foundations	8%	Erosion of soil building up around footings	Accelerated corrosion of critical member
Corrosion of tower steel members	22%	Zinc galvanising end-of-life	Steel corrosion, particularly of critical members, can lead to structural failure of tower
Corroded fasteners	3%	Zinc galvanising end-of-life	Structural failure
Corroded suspension insulators	34%	Corrosion of steel caps Zinc sleeve protection end-of-life	Conductor drop
Corroded tension insulators	100%	Corrosion of steel caps and pins Zinc sleeve protection end-of-life	Conductor drop
Corroded earthwire	20%	Zinc galvanising end-of-life	Conductor drop

The risk cost associated with the issues identified in Table 1 is \$1.04m 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 the critical load bearing members of the tower, they cannot be easily remediated if the condition passes a stage where rectification work is not possible.

¹ [NACA-1348](#) on PDGS Need Site

The single circuit transmission line structures used on Line 24 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 tower steel members is an issue, particularly on the waist diaphragm and arm support chord of the towers as identified in the steelwork condition report from Dennis Richards. Painting has been recommended on all tension towers (17 in total). Due to the proximity of three of these towers to Vales Point Power Station and the coast, they are considered to have the higher level of corrosion than the remainder of the line, and accordingly, painting of the entire tower is recommended.

Corrosion of steel pins on ceramic insulators is a significant issue and may result in conductor drop due to insulator failure. The remaining 1990s vintage porcelain suspension insulators on the line are fog profile with the insulator pins becoming rusty. Tension insulators, whilst more easily washed than suspensions, are of the original vintage with expected corrosion related issues. The corrosion issues associated with the insulators are consistent with other transmission lines of the same vintage in the region.

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. Nuts and bolts of the entire structures are generally in poor condition ranging from signs of rusting to severe corrosion and metal loss in some circumstances.

Significant corrosion of the right SC/GZ earthwire from the coastal atmospheric conditions is as expected. The earthwires have lost galvanising and appear red/brown in colour, and require addressing to extend life.

Due to the environment that Line 24 traverses through, there has been a long history of corrosion related defects on the line, affecting tower members, nuts and bolts, insulators and conductor and earthwire fittings.

The benefit of addressing the condition issues on Line 24 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 24 may have outage clashes and require coordination
 - Need ID 0528 – Relocation of Line 24 for Centennial Coal (Mandalong Mine)
 - As part of the mine extension, the line will be deviated between existing Structures 33 and 44, a section of approximately 2km
 - As part of the mine extension works, 6 cruciform foundations have been proposed on existing Structures 27, 28, 29, 30, 31 and 32 of Line 24 to mitigate the effects of subsidence
 - As part of the mine extension works, 6 cruciform foundations have been proposed on Structures 34X, 35X, 36X, 37X, 38X and 39X of the proposed Line 24 deviation to mitigate the effects of subsidence
- > 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 24

Option Name: 1348 - Base Case

Option Assessment Name: 1348 - 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)	\$5.18	Insulator Failure	\$1,490.63	0.03%	\$0.48	\$0.00	\$0.00	\$0.00	\$0.01	\$0.47	\$0.00
Conductor	288	Insulators	Unplanned Outage - HV (Conductor)	\$0.00	Structural Failure	\$0.36	0.03%	\$0.00	\$0.00	\$0.00	\$0.00			\$0.00
Conductor 2	288	Fittings	Conductor Drop (Conductor 2)	\$5.18	Fitting Failure	\$1,490.63	0.00%	\$0.01	\$0.00	\$0.00	\$0.00	\$0.00	\$0.01	\$0.00
Conductor 2	288	Fittings	Unplanned Outage - HV (Conductor 2)	\$0.00	Structural Failure	\$0.36	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	0.05%	\$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)	\$0.00	Break	\$0.01	0.05%	\$0.00	\$0.00	\$0.00	\$0.00			\$0.00
Earth Wire 2	192	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	\$0.11	Fitting Failure	\$20.31	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Earth Wire 2	192	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	\$0.00	Structural Failure	\$0.24	0.00%	\$0.00	\$0.00	\$0.00	\$0.00			\$0.00
Structure	78	Steel Structure	Unplanned Outage - HV (Structure)	\$0.01	Structural Failure	\$0.66	0.13%	\$0.00	\$0.00	\$0.00	\$0.00			\$0.00
Structure	78	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	\$5.44	Structural Failure	\$424.69	0.13%	\$0.54		\$0.03	\$0.01	\$0.50		\$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	\$0.00	Earthing Failure	\$0.00								
				\$15.96		\$3,428.06		\$1.04	\$0.00	\$0.03	\$0.02	\$0.98		\$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 (20%) multiplied by the total number of original structures (78).
- > Suspension Insulators: The extent of insulators on the transmission line with corrosion condition issues identified in Table 1 (34%) multiplied by the total number of suspension insulators on the line (3 per suspension structure).
- > Tension Insulators: The extent of insulators on the transmission line with corrosion condition issues identified in Table 1 (100%) multiplied by the total number of tension insulators on the line (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 (20%).

Probability of Failure

As per the Risk costs summary model.

Consequence of Failure

As per the Risk costs summary model.