

NEED/OPPORTUNITY STATEMENT (NOS)



Line 23 330kV Transmission Line Renewal

NOS- 000000001408 revision 3.0

Ellipse project description: P0008167

TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements

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	28 November 2016	

Change history

Revision	Date	Amendment
0	4 April 2016	Initial issue
1	12 April 2016	Minor change
2	2 August 2016	Update to 2016/17 dollars
3	28 November 2016	Revised to contain tower strength commentary and update to format

1. Background

Line 23 is a steel tower 330kV transmission line between Munmorah and Vales Point 330kV Substations, with a route length of 7.2 km. The transmission line is a key link between the Central Coast generators. This transmission line was originally constructed in 1963 and has a total of 24 structures. The transmission line mainly traverses through land close to Lake Macquarie and the power stations.

Condition assessment NACA-8001¹ performed in December 2011 (Field Services has advised that they believe the data remains relevant) have identified a number of issues with Line 23 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-8001 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 23 Condition Issues

Issue	Extent (% line)	Cause	Impact
Corroded fasteners	6%	Zinc galvanising end of life	Structural failure
Corroded conductor attachment fittings	6%	Zinc galvanising end of life	Conductor drop
Corrosion of earthwire attachment fittings	6%	Zinc galvanising end of life	Conductor drop
Corroded tension insulators	100%	Corrosion of steel caps and pins Zinc sleeve protection end of life	Conductor drop

The risk cost associated with the issues identified in Table 1 is \$0.37m per annum (refer Attachment 1). The most significant element of concern is the corrosion of insulator steel caps and pins as these can be a single point of failure.

The condition of the suspension insulator discs are generally expected to be in good condition, as over the past 20 years, all suspension and pilot insulators have been replaced, primarily due to pin corrosion, with longrods. However, 10 out of 11 existing tension structures have insulators which are still original with the only replacement on Structure 25 in 1975. The tension insulator pins are showing signs of rust.

The single circuit transmission line structures used on Line 23 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

¹ [NACA-8001](#) on Network Asset Condition Assessment Site

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.

The corrosion of fasteners and fittings on the towers is also an area of concern. 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/Bolts and pins are rusting with some nuts/bolts starting to explode losing their shape. Over the past 20 years, a maintenance program replacing corroded nuts and bolts on various towers has been carried out.

Corrosion of steel members on the structures is another concern due to the proximity of the line to the coast and power stations, 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. The corrosion issues associated with the tower structures are consistent with other transmission lines of the same vintage in the region. Over the past 20 years, a maintenance program involving corrosion removal and painting, and member replacement on various towers on the line has been carried out.

The benefit of addressing the condition issues is so that Line 23 continues providing the service at a lower risk of failure.

3. Related needs/opportunities

- > Need DCN226 – Line 23 tower refurbishment – Refurbishment of steel members on tension towers and selected suspension towers. This is due to be completed before June 2018.

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 23

Option Name: 1408 - Base Case

Option Assessment Name: 1408 - Base Case - Assessment 1

Rev Reset Period: Next (2018-23)

Major Component	No.	Minor Component	Sel. Hazardous Event	LoC x CoF (\$M)	Failure Mechanism	NoxtLoC 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	108	Insulators	Conductor Drop (Conductor)	\$3.62	Insulator Failure	\$390.52	0.06%	\$0.23	\$0.00	\$0.00	\$0.00	\$0.00	\$0.23	\$0.00
Conductor	108	Insulators	Unplanned Outage - HV (Conductor)	\$0.00	Structural Failure	\$0.14	0.06%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Conductor 2	0	Conductor (inc Joints)	Conductor Drop (Conductor 2)	\$3.62	Break	\$0.00								
Conductor 2	0	Conductor (inc Joints)	Unplanned Outage - HV (Conductor 2)	\$0.00	Break	\$0.00								
Conductor 2	108	Fittings	Conductor Drop (Conductor 2)	\$3.62	Fitting Failure	\$390.52	0.03%	\$0.11	\$0.00	\$0.00	\$0.00	\$0.00	\$0.11	\$0.00
Conductor 2	108	Fittings	Unplanned Outage - HV (Conductor 2)	\$0.00	Structural Failure	\$0.14	0.03%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Earth Wire	0	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	\$0.07	Break	\$0.00	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)	\$0.00	Break	\$0.00	0.00%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Earth Wire	72	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire)	\$0.07	Fitting Failure	\$4.71	0.45%	\$0.02	\$0.00	\$0.00	\$0.01	\$0.01	\$0.00	\$0.00
Earth Wire	72	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire)	\$0.00	Structural Failure	\$0.09	0.45%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Structure	23	Steel Structure	Unplanned Outage - HV (Structure)	\$0.01	Structural Failure	\$0.19	0.01%	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Structure	23	Steel Structure (inc Footings)	Conductor / Earth Wire / OP/GW Drop (Structure)	\$3.88	Structural Failure	\$89.34	0.01%	\$0.01	\$0.00	\$0.00	\$0.00	\$0.00	\$0.01	\$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	\$0.00	Earthing Failure	\$0.00								
Total VCR Risk: \$0.00														
Total ENS Risk: \$0.00														
Total Risk: \$14.88														
Total Risk: \$875.64														
Total Risk: \$0.37														
Total Risk: \$0.34														
Total 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 (6%) multiplied by the total number of original structures (23).
- > Conductor Fittings: The extent of the conductor fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (6%) multiplied by the total number of fittings (3 per suspension structure and 6 per tension structure)
- > Tension Insulators: The extent of tension insulators on the transmission line with advanced 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 Fittings: The extent of the earth wire fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (6%) 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.