NEED/OPPORTUNITY STATEMENT (NOS)

Line 93 330kV Transmission Line Renewal

NOS- 000000001407 revision 2.0

Ellipse project description: P0008162
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	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 93 is a steel tower 330kV transmission line between Eraring and Newcastle 330kV Substations, with a route length of 19.5 km. The transmission line is a key link between the Central Coast generators and the Newcastle region. This transmission line was originally constructed in 1964 as part of the Sydney North to Newcastle 330kV line. The transmission line mainly traverses through bushland areas and is in close proximity to Lake Macquarie and Eraring Power Station. This NOS covers the single circuit section of the line between Eraring and Structure 98 only, a length of 5.6 km totalling 16 structures.

Condition assessment NACA-1407[1] performed in March 2016 has identified a number of issues with Transmission Line 93 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-1407 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 93 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
Corroded fasteners	3%	Zinc galvanising end-of-life	Structural failure
Corroded suspension insulators	46%	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

The risk cost associated with the issues identified in Table 1 is $0.20m 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.

The single circuit transmission line structures used on Line 93 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.

[1] NACA-1407 on PDGS Need Site

Corrosion of steel pins on ceramic insulators is also 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.

Due to the environment that Line 93 traverses through, with nearby Lake Macquarie the main contributing factor, 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 corrosion issues associated with the tower structures are consistent with other transmission lines of the same vintage in the region.

The benefit of addressing the condition issues on Line 93 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 93

Option Name: 1407 - Base Case

Option Assessment Name: 1407 - 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	57	Insulators	Conductor Drop (Conductor)	$4.12	Insulator Failure	$234.98	0.03%	$0.07			$0.00	$0.00	$0.07	$0.00
Conductor	57	Insulators	Unplanned Outage - HV (Conductor)	$0.00	Structural Failure	$0.18	0.03%	$0.00	$0.00		$0.00			$0.00
Conductor 2	57	Fittings	Conductor Drop (Conductor 2)	$4.12	Fitting Failure	$234.98	0.00%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Conductor 2	57	Fittings	Unplanned Outage - HV (Conductor 2)	$0.00	Structural Failure	$0.18	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								
Earth Wire	0	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.00	Break	$0.00								
Earth Wire	38	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire)	$0.07	Fitting Failure	$2.68	0.24%	$0.01	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	38	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire)	$0.00	Structural Failure	$0.12	0.24%	$0.00	$0.00		$0.00			$0.00
Structure	15	Steel Structure	Unplanned Outage - HV (Structure)	$0.02	Structural Failure	$0.33	0.19%	$0.00	$0.00		$0.00			$0.00
Structure	15	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$4.39	Structural Failure	$65.85	0.19%	$0.12			$0.01	$0.00	$0.11	$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	$0.00	Earthing Failure	$0.00								
				$12.81		$539.29		$0.20	$0.00		$0.01	$0.01	$0.18	$0.00

Total VCR Risk: $0.00

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 (20%) multiplied by the total number of original structures (15).
- Suspension Insulators: The extent of insulators on the transmission line with corrosion condition issues identified in Table 1 (46%) 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).

Probability of Failure

As per the Risk costs summary model.

Consequence of Failure

As per the Risk costs summary model.