NEED/OPPORTUNITY STATEMENT (NOS)

Line 90 330kV Transmission Line Renewal

NOS- 000000001347 revision 3.0

Ellipse project no: P0007961
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	30 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	Update to format
3	30 November 2016	Revised to contain tower strength commentary

1. Background

Line 90 is a steel tower 330kV transmission line between Eraring and Newcastle 330kV substations, with a route length of 21 km. The transmission line is a key link between the Central Coast generators and the Newcastle region. The single circuit section of the transmission line between Structure 98 and Newcastle Substation, a route length of 11 km, was constructed in 1959 and 1964, and consists of 28 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-1347[1] performed in March 2016 has identified a number of issues with Transmission Line 90 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-1347 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 90 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	17%	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 $0.71m per annum (refer Attachment 1). The most significant element of concern is corrosion of steel pins on insulators.

Corrosion of steel pins on ceramic insulators is an issue as it 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.

[1] NACA-1347 on PDGS Need Site

Ground line corrosion of steel transmission tower legs at the footings is also a significant issue. 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 90 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 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 90 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 line also traverses through coal mining areas and there have also been mine subsidence issues in the past.

The benefit of addressing the condition issues on Line 90 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 90

Option Name: 1347 - Base Case

Option Assessment Name: 1347 - 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	132	Insulators	Conductor Drop (Conductor)	$5.18	Insulator Failure	$683.31	0.06%	$0.44			$0.00	$0.01	$0.43	$0.00
Conductor	132	Insulators	Unplanned Outage - HV (Conductor)	$0.00	Structural Failure	$0.43	0.06%	$0.00	$0.00		$0.00			$0.00
Conductor 2	132	Fittings	Conductor Drop (Conductor 2)	$5.18	Fitting Failure	$683.21	0.00%	$0.01	$0.00		$0.00	$0.00	$0.01	$0.00
Conductor 2	132	Fittings	Unplanned Outage - HV (Conductor 2)	$0.00	Structural Failure	$0.43	0.00%	$0.00	$0.00		$0.00			$0.00
Earth Wire	0	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.11	Break	$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
Earth Wire	88	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire)	$0.11	Fitting Failure	$9.31	0.24%	$0.02	$0.00		$0.01	$0.02	$0.00	$0.00
Earth Wire	88	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire)	$0.00	Structural Failure	$0.29	0.24%	$0.00	$0.00		$0.00			$0.00
Structure	26	Steel Structure	Unplanned Outage - HV (Structure)	$0.02	Structural Failure	$0.59	0.17%	$0.00	$0.00		$0.00			$0.00
Structure	26	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$5.44	Structural Failure	$141.46	0.17%	$0.23			$0.01	$0.00	$0.22	$0.00
Structure 2	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure 2)	$0.00	Earthing Failure	$0.00								
				$16.04		$1,519.03		$0.71	$0.00		$0.02	$0.03	$0.66	$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 (26).
- Suspension Insulators: The extent of insulators on the transmission line with corrosion condition issues identified in Table 1 (17%) 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.