NEED/OPPORTUNITY STATEMENT (NOS)

959/92Z 330kV Transmission Line Renewal

NOS- 000000001346 revision 2.0

Ellipse project description: P0007959
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	30 November 2016	Revised to contain tower strength commentary and update to format

1. Background

Line 959/92Z is a double circuit 132kV transmission line constructed on modified single circuit 330kV steel towers between Sydney North and Sydney East 330kV substations, with a route length of 23.7 km. Line 92Z has a tee to Ausgrid's Mt Colah Switching Station. The transmission line links generation to the Northern Sydney metropolitan area. This transmission line was constructed in 1965 and consists of 62 structures. The majority of this line passes through National Park with sections in urban areas of Sydney.

Condition assessment NACA-1346[1] performed in January 2016 has identified a number of issues with Transmission Line 959/92Z 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.

This transmission line falls within a zone of medium[2] corrosion.

2. Need/opportunity

Condition assessment NACA-1346 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 959/92Z Condition Issues

Issue	Extent (% line)	Cause	Impact
Corrosion of tower steel members	5%	Zinc galvanising end-of-life	Steel corrosion, particularly of critical members, can lead to structural failure of tower
Buried concrete foundations	5%	Erosion of soil building up around footings	Accelerated corrosion of critical member
Earth strap	5%	Corrosion as buried at footing	Earthing safety hazard
Corroded fasteners	10%	Zinc galvanising end-of-life	Structural failure
Corroded conductor attachment fittings	15%	Zinc galvanising end-of-life	Conductor drop
Corrosion of earthwire attachment fittings	20%	Zinc galvanising end-of-life	Conductor drop
Corroded earthwire	50%	Zinc galvanising end-of-life	Conductor drop
Conductor dampers	10%	Damaged/Weathered	Accelerated conductor fatigue due to vibration

[1] NACA-1346 on PDGS Need Site

[2] Steel corrosion rate as defined in *AS 4312 – Atmospheric corrosivity zones in Australia*

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 corrosion of steel members on the structures, including possible ground line corrosion of steel tower legs.

Corrosion of steel members on the structures, including possible ground line corrosion of steel tower legs at the footings is a significant issue. 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 modified single circuit 330kV transmission line structures used on Line 959/92Z 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/Bolts and pins are rusting with some nuts/bolts starting to explode losing their shape.

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

There has been ongoing issues with earth strap corrosion due to the predominantly sandstone rock in which towers are situated. The earth straps are typically laid in shallow counterpoise trenches, which have eroded away leaving the straps exposed above ground.

Conductor dampers show various signs of drooping, and require replacement to prevent accelerated conductor fatigue.

The benefit of addressing the condition issues on Line 959/92Z is to continue providing the service at a lower risk of failure and risk to public safety.

Given the significant proportion of earthwire identified with corrosion related issues, replacement of an earthwire with OPGW will improve the communications system by bringing fibre to Sydney East, allowing for duplicated paths between Sydney East and Sydney North (one fibre and one Ausgrid fibre). The benefits of this opportunity come as a result of reduced OPEX through maintenance and licensing saving, with an expected quantified benefit of $0.030m per annum. It is noted that organisational benefits such as efficiency savings have not been taken into account.

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 959

Option Name: 1346 - Base Case

Option Assessment Name: 1346 - 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	480	Fittings	Conductor Drop (Conductor)	$4.36	Fitting Failure	$2,093.66	0.00%	$0.02			$0.00	$0.01	$0.01	$0.00
Conductor	480	Fittings	Unplanned Outage - HV (Conductor)	$0.00	Structural Failure	$0.60	0.00%	$0.00	$0.00		$0.00			$0.00
Conductor	480	Insulators	Conductor Drop (Conductor)	$4.36	Insulator Failure	$2,093.66	0.00%	$0.02			$0.00	$0.01	$0.01	$0.00
Conductor	480	Insulators	Unplanned Outage - HV (Conductor)	$0.00	Structural Failure	$0.60	0.00%	$0.00	$0.00		$0.00			$0.00
Earth Wire	12	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.68	Break	$8.15	0.19%	$0.02	$0.00		$0.00	$0.01	$0.00	$0.00
Earth Wire	12	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.00	Break	$0.02	0.19%	$0.00	$0.00		$0.00			$0.00
Earth Wire2	160	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire2)	$1.32	Fitting Failure	$210.85	0.05%	$0.10	$0.00		$0.00	$0.09	$0.00	$0.00
Earth Wire2	160	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire2)	$0.00	Structural Failure	$0.20	0.05%	$0.00	$0.00		$0.00			$0.00
Structure	4	Earthing	Uncontrolled Electrical Contact / Discharge (Structure)	$0.05	Earthing Failure	$0.19	1.82%	$0.00			$0.00	$0.00		$0.00
Structure	61	Steel Structure	Unplanned Outage - HV (Structure)	$0.01	Structural Failure	$0.51	0.08%	$0.00	$0.00		$0.00			$0.00
Structure	61	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$4.63	Structural Failure	$282.54	0.08%	$0.22			$0.01	$0.06	$0.14	$0.00
				$15.41		$4,690.99		$0.37	$0.00		$0.02	$0.18	$0.17	$0.00

Total VCR Risk: $0.00

Total ENS Risk: $0.00

Number of Components

The number of components used in the risk model has been derived as follows:

- Steel Structures: The extent of the steel structures on the transmission line with advanced corrosion condition and footing issues identified in Table 1 (5%) multiplied by the total number of original structures (51).
- Steel Structure Earthing: The number of steel structures on the line in areas readily accessible by members of the general public (4).
- Conductor Fittings: The extent of the conductor fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (15%) 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 (50%).
- Earth Wire Fittings: The extent of the earth wire fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (20%) 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.