NEED/OPPORTUNITY STATEMENT (NOS)

Line 21 TGH - SYN 330kV Line Renewal

NOS- 000000001333 revision 2.0

Ellipse project description: P0007741
TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirement
Project category: Prescribed - Replacement

Approvals

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Approved	Lance Wee	Manager/Asset Strategy
Date submitted for approval	18 July 2016	

Change history

Revision	Date	Amendment
0	11 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 21 is a steel tower 330kV transmission line between Tuggerah (Sterland) and Sydney North 330kV substations, with a route length of 65 km. The transmission line is a key link between the Central Coast and the Sydney metropolitan area. The single circuit section of the transmission line, a route length of 51 km, was originally constructed in 1959, before the construction of Tuggerah Substation in 1986. The total number of structures in the single circuit section is 113. The transmission line mainly traverses through semi-urban and forested areas. Note this NOS refers to the single circuit section of the line between Structure 64A (Tuggerah end) and Sydney North only.

Condition assessments NACA-13331 performed in November 2015 to February 2016 has identified a number of issues with Line 21 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 assessments NACA-1333 has identified issues which require rectification, these are summarised in Table 1.

Table 1 – Transmission Line 21 Condition Issues

Issue	Extent (% line)	Cause	Impact
Corrosion of tower steel members	15%	Zinc galvanising end of life	Steel corrosion, particularly of critical members, can lead to structural failure of tower
Corroded fasteners	10%	Zinc galvanising end of life	Structural failure
Corroded conductor attachment fittings	20%	Zinc galvanising end of life	Conductor drop
Corrosion of earthwire attachment fittings	10%	Zinc galvanising end of life	Conductor drop
Corroded insulator strings	18%	Corrosion of steel caps Zinc sleeve protection end of life	Conductor drop
Corroded earthwire	25%	Zinc galvanising end of life	Conductor drop
Conductor dampers	10%	Damaged/Weathered	Accelerated conductor fatigue due to vibration
Earthwire dampers	20%	Damaged/Weathered	Accelerated earthwire fatigue due to vibration

[1] NACA-1333 on PDGS Need Site

The risk cost associated with the issues identified in Table 1 is $1.01m per annum (refer Attachment 1). The most significant element of concern is the corrosion of conductor and earthwire fittings which could lead to conductor drop. 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/Buts and pins are rusting with some nuts/bolts starting to explode losing their shape.

The single circuit transmission line structures used on Line 21 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 steel crossarm members on the structures is another key issue. These are critical load bearing members for the conductor and require remediation to prevent the risk of conductor drop. The corrosion issues associated with the tower structures are consistent with other transmission lines of the same vintage in the region.

Corrosion of steel pins on ceramic insulators is also an issue of concern, as it may result in conductor drop failure. The pins on the underside of suspension insulator discs build up pollution and are not adequately washed by rain which leads to an increased rate of corrosion. The corrosion issues associated with insulators is consistent with other transmission lines of the same vintage in the region. There has been one recorded instance in 2011 of insulator failure resulting in conductor drop. Past condition issues have been handled through maintenance and there has been a significant program to replace the suspension and pilot insulators in the Sydney metropolitan part of the line over the last 20 years.

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

Earthwire dampers show signs of deterioration and issues with steel fatigue may be exacerbated by rusted stands and rigid suspension attachment points. Conductor dampers show various signs of drooping, and require replacement to prevent accelerated conductor fatigue.

The benefit of addressing the condition issues on Line 21 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 21

Option Name: 1333 - Base Case

Option Assessment Name: 1333 - 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	450	Fittings	Conductor Drop (Conductor)	$3.80	Fitting Failure	$1,708.97	0.02%	$0.41			$0.00	$0.02	$0.39	$0.00
Conductor	450	Fittings	Unplanned Outage - HV (Conductor)	$0.07	Structural Failure	$32.33	0.02%	$0.01	$0.01		$0.00			$0.00
Conductor	450	Insulators	Conductor Drop (Conductor)	$3.80	Insulator Failure	$1,708.97	0.01%	$0.22			$0.00	$0.01	$0.20	$0.00
Conductor	450	Insulators	Unplanned Outage - HV (Conductor)	$0.07	Structural Failure	$32.33	0.01%	$0.00	$0.00		$0.00			$0.00
Earth Wire	5	Earth Wire (inc Joints)	Earth Wire Drop (Earth Wire)	$0.06	Break	$0.31	0.10%	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00
Earth Wire	5	Earth Wire (inc Joints)	Unplanned Outage - HV (Earth Wire)	$0.07	Break	$0.36	0.10%	$0.00	$0.00		$0.00			$0.00
Earth Wire 2	300	Fittings (inc Attachment)	Earth Wire Drop (Earth Wire 2)	$0.25	Fitting Failure	$74.16	0.02%	$0.02	$0.00		$0.00	$0.02	$0.00	$0.00
Earth Wire 2	300	Fittings (inc Attachment)	Unplanned Outage - HV (Earth Wire 2)	$0.07	Structural Failure	$21.55	0.02%	$0.00	$0.00		$0.00			$0.00
Structure	0	Earthing	Uncontrolled Electrical Contact / Discharge (Structure)	$0.00	Earthing Failure	$0.00	3.95%	$0.00	$0.00		$0.00	$0.00		$0.00
Structure	111	Steel Structure	Unplanned Outage - HV (Structure)	$0.50	Structural Failure	$55.79	0.07%	$0.04	$0.04		$0.00			$0.00
Structure	111	Steel Structure (inc Footings)	Conductor / Earth Wire / OPGW Drop (Structure)	$4.06	Structural Failure	$451.09	0.07%	$0.31	$0.00		$0.02	$0.02	$0.27	$0.00
				$12.76		$4,085.85		$1.01	$0.06		$0.03	$0.07	$0.86	$0.00

Total VCR Risk: $0.06

Total ENS Risk: $0.00

Number of Components

The number of components used in the Risk costs summary model has been derived as follows:

- Conductor Fittings: The extent of the conductor fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (20%) multiplied by the total number of fittings (3 per suspension structure and 6 per tension structure).
- Insulators: The extent of insulators on the transmission line with advanced corrosion condition issues identified in Table 1 (18%) multiplied by the total number of suspension insulators on the line (3 per suspension structure).
- Earth Wire: Length of earth wire on the transmission line multiplied portion with advanced corrosion condition issues identified in Table 1 (25%).
- Earth Wire Fittings: The extent of the earth wire fittings on the transmission line with advanced corrosion condition issues identified in Table 1 (10%) 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.