NEED/OPPORTUNITY STATEMENT (NOS)

Cable 41 Tunnels Condition

NOS- 000000001088 revision 0

Ellipse project no.:
TRIM file: [TRIM No]

Project Reason: Capability - Asset Replacement for end of life condition
Project Category: Prescribed - Asset Renewal Strategies

Approvals

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Approved	Lance Wee	Manager / Asset Strategy
Date submitted for approval	10 January 2017	

Change history

Revision	Date	Amendment
0	4 April 2016	Initial issue
1	30 November 2016	Update to format
2	10 January 2017	Revised related needs/opportunities
3	10 January 2017	Revised related needs/opportunities

1 Background

There are two cable tunnels constructed for Cable 41, located near Boomerang Reserve, Revesby Heights. The western tunnel, “tunnel 1”, is 147 metres long, the Eastern tunnel, “tunnel 2” is 197 metres long. The two tunnels were built in 1978 by a locally manufactured machine which appears to have been a hybrid road-header in a shield.

The tunnels are excavated through Hawkesbury Sandstone and have dimensions of 1.5 metres wide by 1.9 metres high with Cable 41 embedded in sand along the floor.

2 Need/opportunity

These tunnels are inspected on a three-yearly basis by Tunnel Engineering consultants Pells Sullivan Meynink. Inspection reports note that whilst the tunnels are generally in “reasonably good condition” there are localised zones of instability which result in rock falls. Rock in these zones will continue to fret away before a stable configuration is reached.

Depending on location the types of tunnel support include steel sets, rock bolts, shotcrete and unsupported. Sections with steel sets have been shotcreted and feature “hit and miss” timber lagging. In many locations this lagging is rotten, providing no support.

The cable bedding is very soft and may not provide adequate protection to the cable in the event of tunnel cave in causing deformation of the outer sheath. When the outer sheath is deformed the electric field stresses within the cable insulation are no longer evenly distributed, which can then lead to insulation failure.

The repair works of cable failure within the tunnel are significant. There is insufficient room for joints within the tunnel. Essentially a whole section of cable would be required to be replaced. If more than one phase of cable was damaged in the cave there would be insufficient spares to complete the repairs. The lead time for replacement cable is at least 9 months. If only a single phase is damaged then the return time would be approximately 2-3 months and costs approximately $2.5m (excluding penalties or consequential losses).

Drainage for these tunnels flow to the Georges River, an electrical failure as a result of cable deformation would likely puncture the aluminium sheath, causing loss of insulating oil. This location is at the bottom of the oil profile and therefore at high pressure, increasing the oil loss rate. The consequences are therefore higher than most other locations on the cable route.

Cable 41 is a critical circuit, essential for maintaining the mandated “modified N-2” reliability criteria for the Sydney CBD. This criteria states that there will be no inadvertent loss of load (other than load which is interruptible or dispatchable) with the simultaneous outage of a single 330kV cable and any 132kV feeder or 330/132kV transformer. If the event of Cable 41 outages, load will be transferred to Cable 42 and the Ausgrid network. Ausgrid have several 1960’s 132kV cables that are at end of life. The additional loading may cause these cables to fail. Planned maintenance outages on other network elements would have to be deferred.

The tunnel therefore requires remediation to address the risk of collapse and possible subsequent cable damage, environmental and outage impacts.

Table 1 – Cable 41 Condition Issues

Issue	Cause	Main Impacts
Insulation failure	Damage to cable sheath from tunnel cave-in, resulting in cable failure before next inspection.	Unplanned outage Repair costs
Damage to cable sheath	Tunnel failure which damages cable sheath identified during inspection	Short notice outage Repair costs

The risk cost associated with the issues identified in Table 1 is $5.85m per annum (refer Attachment 1). Cable 41 has a high reliability cost and repair times are extensive.

3 Related needs/opportunities

Pre-requisite

There are no pre-requisite Needs.

Related

Need 1413 – Cable 41 Short Term Rating

- Service provider resources for completion and scheduling of Cables projects should be considered.

Need DCN 42 – Capability of Cable 41 Sydney South to Beaconsfield

- A component of this Need could involve a backfill replacement, which could be resource intensive. Parallel scheduling may not be possible.

Dependent

There are no dependent Needs.

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: Cable 41 Tunnels Condition

Option Name: 1088 - Base Case

Option Assessment Name: 1088 - 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)
Cable	1	High Voltage Cable Insulation	Unplanned Outage - HV (Cable)	$1,453.51	Insulation Breakdown	$1,453.51	0.40%	$5.81	$5.80		$0.01			$0.00
Cable2	1	High Voltage Cable	Unplanned Outage - HV (Cable2)	$3.50	Infrastructure Failure	$3.50	1.00%	$0.03			$0.03			
				$1,457.01		$1,457.01		$5.85	$5.80		$0.05			$0.00

Total VCR Risk: $5.80

Total ENS Risk: $0.00