OPTIONS EVALUATION REPORT (OER)

132kV TL Wood Pole Replacement

OER 000000001558 revision 2.0

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Project reason: Capability - Asset Replacement for end of life condition
Project category: Prescribed - Asset Renewal Strategies

Approvals

Author	Edward Luk	Transmission Lines and Cables Analyst
Endorsed	Steve Stavropoulos	Transmission Lines and Cables Asset Manager
	Azil Khan	Investment Analysis Manager
Approved	Lance Wee	Manager/Asset Strategy
Date submitted for approval	14 December 2016	

Change history

Revision	Date	Amendment
0	28 October 2016	Initial issue
1	14 December 2016	Update to format
2	06 January 2017	Update to options

1. Need/opportunity

Several wood pole 132kV transmission lines have or will soon exceed their nominal service life. There are also wood pole transmission lines which have not reached end of life but are exhibiting high defect rates. Analysis into defects associated with wood pole decay has been performed on these transmission lines to identify the expected wood pole replacement works required to extend the life of the assets and provide safe operation for the next 10 years.

2. Related Needs/opportunities

No related Needs/opportunities have been identified.

3. Options

All dollar values in this document are expressed in un-escalated 2016/17 dollars.

Base Case

Defects logged between June 2011 and June 2016 against wood poles across the 132kV network indicate a number of issues which would require rectification. Details of these can be found in Need/Opportunity Statement (NOS) NS 1558.

Under a Base Case 'run-to-fail' option, the associated risk cost from the issues identified in Table 1 is $3.025m per annum. A breakdown of the Base Case risk cost by category is shown in Table 1.

Table 1 – Base Case risk cost by category ($ million)

Risk Category	Annual Risk Cost
Reliability (System)	0.16
Financial	0.09
Operational/Compliance	0
People (Safety)	0.63
Environment	2.14
Reputation	0.01
Total	**3.03**

It can be seen from Table 1 that the highest risk cost is associated with the 'environment' category due to the significant consequences of a bushfire event resulting from conductor drop failure. The other significant contributor to the overall risk cost is the 'people (safety)' category, due to other consequences associated with structure and conductor drop failure.

The risk cost per pole is $0.003m per annum.

Option A — Wood Pole Replacement with Concrete Poles [OFR 1558A, OFS 1558A]

This option involves the replacement of 132kV defective wood pole structures with concrete pole structures. The quantity of individual wood poles under this Option is listed in Table 2.

Table 2 – Expected wood pole quantities for replacement

Transmission Line	Year Commissioned	Yearly Pole Defect Rate	Poles for Replacement
94X	1963	0.90%	42
99J	1960	1.63%	62
948	1963	0.74%	24
966	1963	0.16%	20
993	1963	2.18%	108
995	1957	0.53%	4
9U3	1964	1.10%	72
976/2	1963	0.45%	16
97B	1969	2.67%	16
97A	1976	0.67%	2
99P	1963	0.58%	4
97L	1957	2.30%	20
97G/3	1960	0.33%	8
96L	1972	0.76%	74
96F	1974	2.57%	86
94K	1986	1.33%	140
99A	1971	0.94%	158
99D	1983	2.33%	110
Total			**966**

It is estimated that the capital expenditure associated with the refurbishment outlined in this option is $69.96m ±25%. Details can be found in Section 6 of Option Feasibility Study (OFS) OFS 1558A.

With the replacement of poles with concrete pole structures, a reduction in maintenance costs is expected from savings on underground inspections (UGIs), totalling $0.083m per annum for the total of 966 structures. In addition, savings from the replacement of the 966 structures as defect maintenance at a cost of $0.047m per structure over the ten years (totalling $46.23m) is also anticipated.

Following the pole replacements under this option, the remaining risk cost associated with the condition of the new structures is zero.

Maintenance Option

Pole staking (also known as pole nailing) technology exists as a maintenance solution to reinforce degrading wood poles at the ground line.

The available pole staking systems were evaluated, and two shortlisted technologies which best met the technical criteria were trialled on the TransGrid wood pole network in 2015/2016. These systems were the "UAM" coach bolt system used by Ausgrid and Endeavour Energy and the “Logsys” tension band system used by Western Power. The trial has found that wood pole reinforcement can generally be used when there is at least 60mm of ‘good wood’ thickness above a height of 0.8m above the ground line of the pole.

Wood pole ground line reinforcement is installed on the premise that wood poles deteriorate through rot or termite attack at a greater rate below ground level than above ground level. In TransGrid’s experience, this is not the case on the TransGrid wood pole network. An analysis of underground inspection records from approximately 4,000 wood poles have identified 41 ‘suspect’ or ‘condemned’ wood poles, of which 10 (approximately 25%) may be suitable for reinforcement through staking. The low levels of ground line defects are attributed to the high durability native hardwood poles used on the transmission network, compared with lower quality timber used on distribution networks.

Wood poles were initially designed with a Safety Factor of 4 due to the inherent variability in wood poles. The Energy Networks Association guidelines for wood pole reinforcement require that wood poles are reinforced to a Safety Factor of 2 as a minimum, which is the factor at which a pole would generally be condemned. Wood poles on the transmission network are generally taller and subject to higher loading than wood poles on the distribution networks, thus requiring two pole stakes per wood pole to achieve a reinforced Safety Factor of 2. It is not practical to reinforce a transmission wood pole to a Safety Factor of 4.

The reinforcement of wood poles with two stakes also introduces a number of issues:

- Reduced safety factor increases the probability that the pole will fail, reducing the security of the transmission line.
- Reinforced poles require regular condition inspection/maintenance below the bolts/stake which is not possible when two stakes are installed.
- Above ground climbing inspections is not possible on staked poles, reducing the likelihood that common above ground pole deterioration and defects are detected.

As TransGrid does not experience high volumes of wood pole defects due to underground decay, and due to the issues discovered above through the pole staking trial, the use of ground line wood pole reinforcement is not considered suitable for use as a widespread maintenance solution across the network in accordance with the Transmission Lines Renewal and Maintenance Strategy.

TransGrid’s wood pole population is continuing to age and deteriorate, with 1,163 wood pole structures exceeding their nominal 65 year life by 2023. An additional 2,110 wood pole structures will exceed their nominal life in the following five years to 2028. Over the next 20 years, it is estimated that an average of 360 wood pole structures per year will require replacement, far exceeding the approximately 100 wood pole replacements currently undertaken each year on average. To avoid a future large backlog of pole replacements and increasing probability of pole failure, which can adversely impact safety and the environment as experienced recently by Western Power, it is necessary to commence pole replacements through a structured replacement programme targeting those which are deteriorating.

Both the Base Case option and Option A detailed above are considered to be technically feasible[1]. Pole staking has not been considered further as a medium to long term option due to the limitations noted above, namely prevalence of deterioration and defects above the ground line for which staking is not effective and associated maintenance implications. Pole staking will continue to be considered as a temporary and short term option for reinforcement of wood poles.

[1] An option is technically feasible if TransGrid reasonably considers that there is a high likelihood that the option, if developed, will provide the relevant service while complying with all relevant laws.

4. Evaluation

4.1 Commercial evaluation

The commercial evaluation of the technically feasible options is set out in Table 3. Details of the Net Present Value (NPV) calculation for Option A are provided in Attachment 1.

Table 3 — Commercial evaluation ($ million)

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Financial NPV @10%	Rank
Base Case	Run-to-fail	N/A	N/A	3.03	N/A	N/A	2
A	Wood Pole Replacement with Concrete Pole	69.96	(4.62)	0	(23.86)	(24.45)	1

The commercial evaluation is based on:

- A 10% discount rate
- A life of the investment of 10 years and a corresponding residual/terminal value
- An allowance for a reduction in OPEX costs for future defect pole replacements for all 966 structures at $0.047m per structure, evenly distributed over 10 years
- An allowance for a reduction in OPEX costs from savings on UGIs, totalling $0.083m per annum for the 966 structures

Discount rate sensitivities based on TransGrid's current AER-determined pre-tax real regulatory Weighted Average Cost of Capital (WACC) of 6.75% and 13% appear in Table 4.

Table 4 — Discount rate sensitivities ($ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Wood Pole Replacement with Concrete Pole	(26.69)	(18.55)

4.2 SFAIRP/ALARP evaluation

In the context of the Network Asset Risk Assessment Methodology, the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) principle is applicable to the following Key Hazardous Events:

- Structure failure

Options to reduce the network safety risk as per the risk treatment hierarchy have been considered in other lifecycle stages of the asset, and it has been determined that no reasonably practicable options exist to reduce the risk further than those capital investment options listed in Table 5.

Evaluation of the proposed options has been completed against the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011. The Key Hazardous Events and the disproportionality multipliers considered in the evaluation are as follows:

- Structure failure – 6 times the environment (bushfire) risk, 6 times the safety risk and 10% of the reliability risk (applicable to safety)

Table 5 – Feasible options ($ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Run-to-fail	N/A	N/A	N/A
A	Wood Pole Replacement with Concrete Pole	69,960	10 years	6,996

Table 6 – Annual risk calculations ($ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	632	155	2,143	N/A	N/A	N/A
A	0	0	0	632	155	2,143

Table 7 – Reasonably practicable test ($ thousand)

Option	Network Safety Risk Reduction[2]	Annualised CAPEX	Reasonably practicable[3]?
A	16,664	6,996	Yes

From the above evaluation, it is considered that the replacement of poles under Option A is reasonably practicable.

4.3 Preferred option

From the SFAIRP/ALARP evaluation, it is considered that Option A is reasonably practicable and in order to satisfy the organisation's SFAIRP/ALARP obligations, is required to be undertaken. From the commercial evaluation, Option A is not considered to be commercially viable.

Based on the SFAIRP/ALARP evaluation, it is proposed that Option A be scoped in further detail. Further, Option A meets the renewal initiative of managing the replacement of ageing wood poles with concrete or steel poles over time in accordance with the Transmission Lines Renewal and Maintenance Strategy.

Capital and operating expenditure

The estimated capital expenditure associated with replacement of wood poles outlined in Option A is $69.96m ±25%. This expenditure is proposed to be spread evenly across the 5 year regulatory period.

With the replacement of poles with concrete pole structures, a reduction in maintenance costs is expected from savings on underground inspections (UGIs), totalling $0.083m per annum for the 966 total structures. In addition, savings from the replacement of the 966 structures as defect maintenance at a cost of $0.047m per structure over the ten years (totalling $46.23m) is also anticipated.

[2] The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

[3] Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

Should the works under Option A not occur by the Need date, it is possible that there may be an increase in corrective maintenance and subsequent operating expenditure as a result of further deterioration of wood pole condition leading to an increase in defect rates.

Regulatory Investment Test

No Regulatory Investment Test for Transmission (RIT-T) analysis is required as the works are condition based.

5. Recommendation

Whilst Option A is not considered to be commercially viable (the result of the commercial evaluation is not NPV positive), from the SFAIRP/ALARP evaluation, it is recommended that detailed scoping for the replacement of wood poles with concrete structures as outlined under Option A is undertaken. Further, Option A fulfils the renewal initiative of managing the replacement of ageing wood poles with concrete or steel poles over time in accordance with the Transmission Lines Renewal and Maintenance Strategy.

Attachment 1 – Commercial evaluation report

Option A NPV calculation

Project_Option Name	Wood Pole Replacements Option A - Replace with Concrete Pol

1. Financial Evaluation (excludes VCR benefits)				
NPV @ standard discount rate	10.00%	-$24.45m	*NPV / Capital (Ratio)*	*-0.35*
NPV @ upper bound rate	13.00%	-$27.14m	*Pay Back Period (Yrs)*	*0.01 Yrs*
NPV @ lower bound rate (WACC)	6.75%	-$19.34m	*IRR%*	*0.92%*

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)				
NPV @ standard discount rate	10.00%	-$23.86m	*NPV / Capital (Ratio)*	*4.77*
NPV @ upper bound rate	13.00%	-$26.69m	*Pay Back Period (Yrs)*	*9.15 Yrs*
NPV @ lower bound rate (WACC)	6.75%	-$18.55m	*IRR%*	*1.20%*

Benefits					
Risk cost	As Is	To Be	Benefit	*VCR Benefit*	*$0.15m*
Systems (reliability)	*$0.15m*	*$0.00m*	*$0.15m*	*ENS Penalty*	*$0.00m*
Financial	*$0.09m*	*$0.00m*	*$0.09m*	*All other risk benefits*	*$2.87m*
Operational/compliance	*$0.00m*	*$0.00m*	*$0.00m*	Total Risk benefits	$3.03m
People (safety)	*$0.63m*	*$0.00m*	*$0.63m*		
Environment	*$2.14m*	*$0.00m*	*$2.14m*	Benefits in the financial NPV*	$7.49m
Reputation	*$0.01m*	*$0.00m*	*$0.01m*	**excludes VCR benefits*	
Total Risk benefits	$3.03m	$0.00m	$3.03m		
Cost savings and other benefits			$4.62m	Benefits in the economic NPV**	$7.65m
Total Benefits			$7.65m	***excludes ENS penalty*	
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			$0.00m	Write-off cost	$0.00m
Capital - initial $m			-$69.96m	Major Asset Life (Yrs)	10.00 Yrs
Residual Value - initial investment			$0.00m	Re-investment capital	$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs