Revised Proposal

Attachment 5.13.M.4

Low Voltage Overhead Service Lines program CBA summary

January 2019

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Introduction

Ausgrid has reviewed the risks associated with low voltage overhead service lines by undertaking a quantitative risk assessment. This document covers the outcomes of cost benefit analysis and should be reviewed in conjunction with the cost benefit analysis (CBA) modelling methodology report[1].

Scope

This model covers a portion of the forecast mapped to the following RIN categories:

- SERVICE LINES - < = 11 KV ; RESIDENTIAL ; SIMPLE TYPE
- SERVICE LINES - < = 11 KV ; COMMERCIAL & INDUSTRIAL ; SIMPLE TYPE

There is currently no quantitative risk assessment model built to address underground services. Following failure of underground services, Ausgrid will undertake replacement through allocation of reactive funding.

Analysis Outcome

The analysis was completed using historical data up to and including FY18. The CBA models forecast risk from FY19 onwards. The quantities included in FY19 are reflective of Ausgrid's committed program in this year.

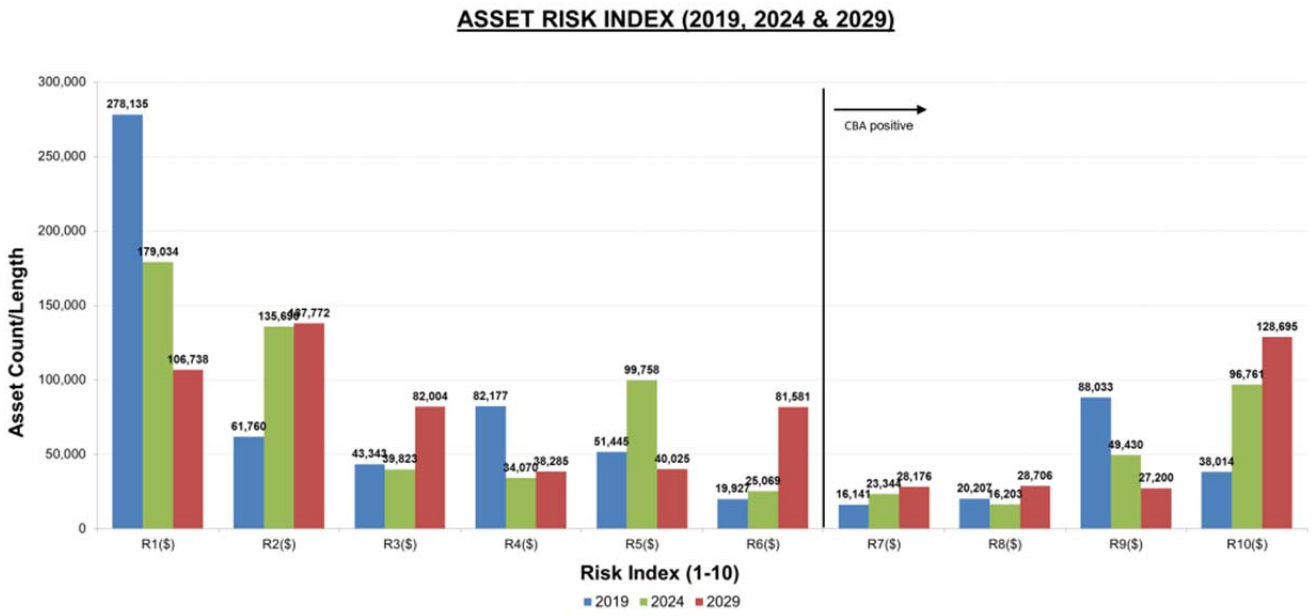
Based on the analysis completed, the model output is supporting the replacement of approximately 185,738 overhead service lines by the end of FY24. This includes 23,000 committed for replacement during FY19 and a total of 162,738 overhead service lines which are cost benefit positive (those with a Risk Index of 7 or above) during FY20 to FY24.

In forming this decision Ausgrid considered three options and performed sensitivity analysis as described in this document. Ausgrid is recommending Option 3 for the levelled replacement of all assets which are cost benefit positive by the end of FY24.

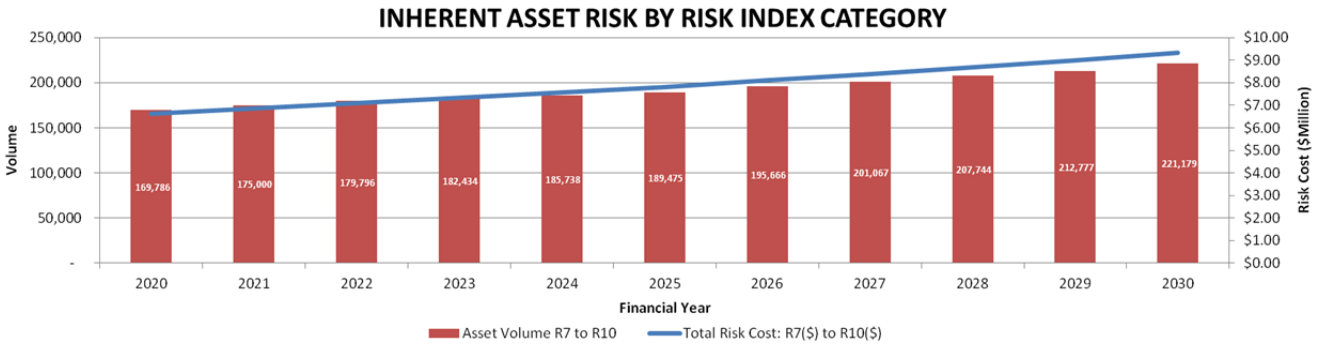
Risk Index

The normalised risk index below considers the probability of failure, consequence of failure and the annualised replacement cost.

[1] Attachment 5.13.M.0 – Repex program CBA modelling methodology



The inherent risk of overhead service lines that are cost benefit positive is shown in the figure below.

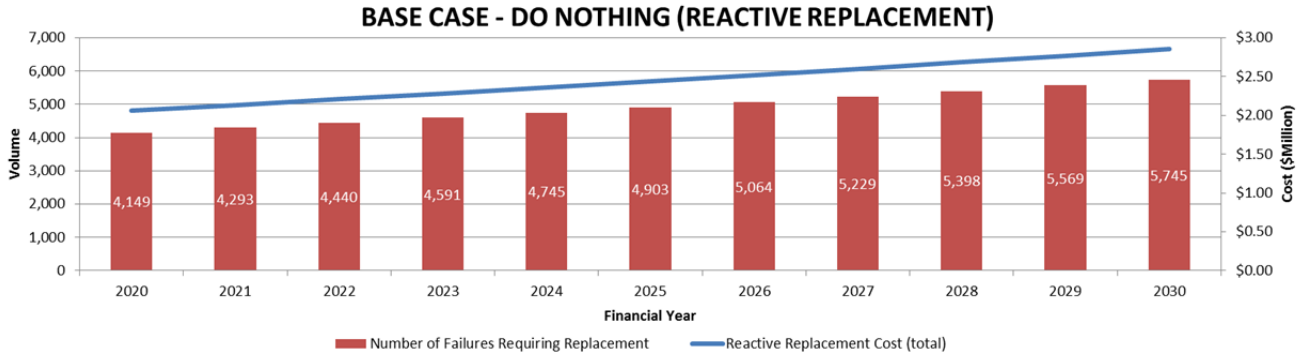


Option One – Base Case (Reactive Replacement)

Under a base case scenario, if Ausgrid were to adopt a reactively replacement strategy, the minimum replacement quantity during FY20 to FY24 is 22,218 overhead service lines. The table below shows the quantity of assets which will require reactive replacement in the year that they are forecast to fail.

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	4,149	4,293	4,440	4,591	4,745

This quantity represents the minimum required replacement volume if no proactive strategy is adopted.



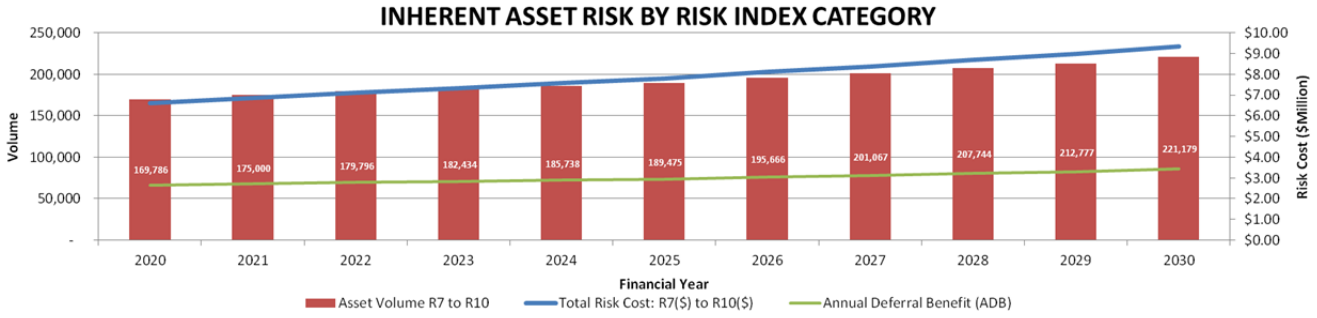
Option Two – Replace where cost benefit positive

Given Ausgrid plans to replace 23,000 overhead service lines during FY19, the recommended replacement quantity during FY20 to FY24 is 162,738 overhead service lines. The table below shows the year in which these assets should be replaced based on when the benefit to customers exceeds the annualised deferral benefit:

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	146,786	5,214	4,796	2,638	3,304

The large quantity in FY20 is due to a backlog of overhead service lines which are cost benefit positive.

Based on this replacement quantity, the annual deferral benefit against the inherent risk for all assets with a Risk Index of 7 to 10 is shown in the figure below. The annual deferral benefit remains lower than the total risk as Ausgrid is not targeting any assets that are not cost benefit positive.



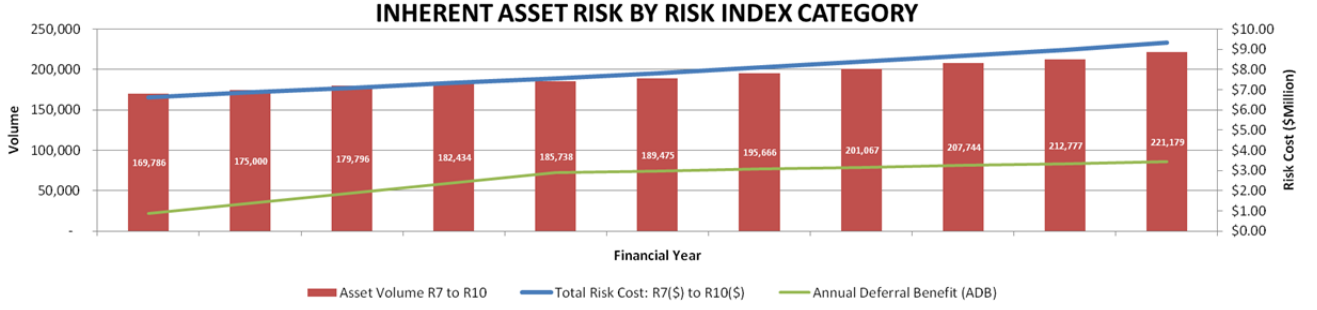
This option provides the maximum benefit to customers as it leads to the avoidance of risk at the point at which the benefits exceed the costs. However, the large delivery requirement in FY20 will not be reasonably achievable due to the constraints on network access, physical access and delivery resourcing.

Option Three – Replace all cost benefit positive by the end of the period

Given the delivery constraints, under this option Ausgrid have considered the levelled replacement of all overhead service lines that are cost benefit positive during FY20 to FY24. This results in 32,548 (rounded) overhead service lines being replaced each year of the regulatory period.

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	32,548	32,548	32,548	32,548	32,548

Based on this replacement quantity, the annual deferral benefit against the inherent risk for all assets with a Risk Index of 7 to 10 is shown in the figure below.



This option balances achieving value for customers by the end of the regulatory period with consideration of the delivery constraints.

Data input

		Data Source
Population	674,291	GIS
Object Types	Service	GIS
Conditional & Functional Failures / Time Period	24,064 6 years	SAP – Defect Records
Asset standard life	52.07 years	RAB life
WACC	3.90%	Regulated Rate

Planned Replacement Cost

Given the variation in annual cost, a weighted average for the period per asset was used in this model.

Cost	Data Source
$414	2020-24 Revised Regulatory Proposal (FY19 real direct costs +25% of indirect costs)

Weibull parameters

Developed by applying asset age to failure correlation using Ausgrid historical failure and asset data.

β_{good}	2.8270	$\beta_{average}$	2.8330	β_{poor}	2.8390
η_{good}	102.6281	$\eta_{average}$	101.6244	η_{poor}	100.6347

b (intercept)	-13.1036

Adjustments factors

Probability of Failure (PoF)	• Actual Failure Data • Age • Construction type
Probability of Consequence (PoC)	• Spatial risk score (based on factors including bushfire risk, people / traffic exposure and proximity to schools)

Model calculated failures

	2020	2021	2022	2023	2024
Failures	4149	4293	4440	4591	4745

Sensitivity

Ausgrid tested the sensitivity of the applied grossly disproportionate factor by applying a factor of 6 for all safety and fire severities. The impact of these changes is a 22% reduction to the overall recommended replacement quantities. The model is therefore sensitive to the grossly disproportionate factor.

Modelled inherent incident consequences

In determining the probability of severity, Ausgrid has utilised available information to determine the rate of occurrence of an event by each severity. These values were then tested for sensitivity.

Safety

Worker Safety ICR – 0.01% (Ausgrid's recorded ICR)

Shock ICR – 1.36% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 4,469,292	0.00000500	10	0.0004	50
Major	$ 446,929	0.00000999	8	0.0007	25
Moderate	$ 44,693	0.00002498	6	0.0018	10
Minor	$ 4,469	0.00013690	4	0.0100	1.8
Insignificant	$ 447	0.01351313	2	0.9871	0.02

Average **safety** consequence per asset: $280 per event.

Ausgrid have proposed a probability of severity for overhead service lines that results in a severe consequence every 50 years based on the population. Changing the probability of severity to 0.0007 (or 1 fatality every 25 years), increases the average safety consequence by 80% and increases the recommended replacements by 6,118 planned during FY20 to FY24. Changing this to 0.00018 (or 1 fatality every 100 years), reduces the average safety consequence by 40% and reduces the recommended replacements by 5,942 planned during FY20 to FY24.

Fire

ICR – 0.06% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 66,000,000	0.0000025	10	0.0042	100
Major	$ 6,600,000	0.0000050	8	0.0083	50
Moderate	$ 660,000	0.0000495	6	0.0825	5
Minor	$ 66,000	0.0001800	4	0.3000	1.4
Insignificant	$ 6,600	0.0003630	2	0.6050	0.69

Average **fire** consequence per asset: $2,159 per event.

Ausgrid have proposed a probability of severity for overhead service lines that results in a severe fire every 100 years based on the population. Changing the probability of severity to 0.0084 (a severe fire every 50 years), increases the average fire consequence by 76% and increases the recommended replacements to 294,378 during FY20 to FY24. Changing the probability of severity to 0.0021 (a severe fire every 200 years), reduces the average fire consequence by 38% and reduces the recommended replacements to 123,254 during FY20 to FY24.

Environment

ICR – 0%

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 10,193,119	n/a	1	n/a	n/a
Major	$ 4,558,501	n/a	1	n/a	n/a
Moderate	$ 1,019,312	n/a	1	n/a	n/a
Minor	$ 101,931	n/a	1	n/a	n/a
Insignificant	$ 10,193	n/a	1	n/a	n/a

Average **environment** consequence per asset: $ n/a.

Ausgrid have considered that there are negligible environmental consequences relating to overhead service lines. There have been no recorded environmental impacts (excluding fire) as a result of these assets.

Loss of supply

Ausgrid's failure data has been reviewed to estimate the proportion of failures resulting in unserved energy and repair times.

Outage Type	LV	Data Source
Proportion of failures resulting in unserved energy	10%	Estimated
VCR	$40.73/kWh	AEMO / AER
Average kWh/failure	1.29 kWh	Calculated
Restoration/Repair Time	4 hrs	Estimated
Restoration/Repair Load % Lost Prior to	100%	Estimated
Time without supply	0.40 hrs	Calculated

Average **loss of supply** consequence per asset: $52 per event.

Finance

		Data Source
Annual deferral benefit of reactive	$18.65	20% increase on planned replacement cost applied at the WACC
Repair cost	$350	Estimated
Proportion replaced	100%	Estimated
Weighted replacement/repair cost	**$19**	Calculated
Maintenance original asset per annum	$0	Based on historical maintenance
Maintenance replacement asset per annum	$0	Based on historical maintenance
Maintenance benefit per asset per annum	**$0**	Calculated

Average **financial** consequence/benefit per asset: $19 per event.

AVERAGE TOTAL CONSEQUENCE per asset: $2,510 (including POC x C($))