



Revised Proposal

Attachment 5.13.M.15

High Voltage Underground to Overhead Connection program CBA summary

January 2019

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Introduction

Ausgrid has reviewed the risks associated with high voltage underground to overhead connections (UGOH's) 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 report¹.

Scope

This model covers the following RIN categories:

- UNDERGROUND CABLES - > 1 KV & <= 11 KV
- UNDERGROUND CABLES - > 22 KV & <= 33 KV
- POLES - > 1 KV & <= 11 KV; WOOD - REPLACEMENT OF UNSTAKED POLE
- POLES - > 22 KV & <= 66 KV; WOOD - REPLACEMENT OF UNSTAKED POLE

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 535 UGOH's by the end of FY24. This includes 32 UGOH's committed for replacement during FY19 and a total of 503 UGOH's which are cost benefit positive (those with a Risk Index of 7 or above) during FY20 to FY24.

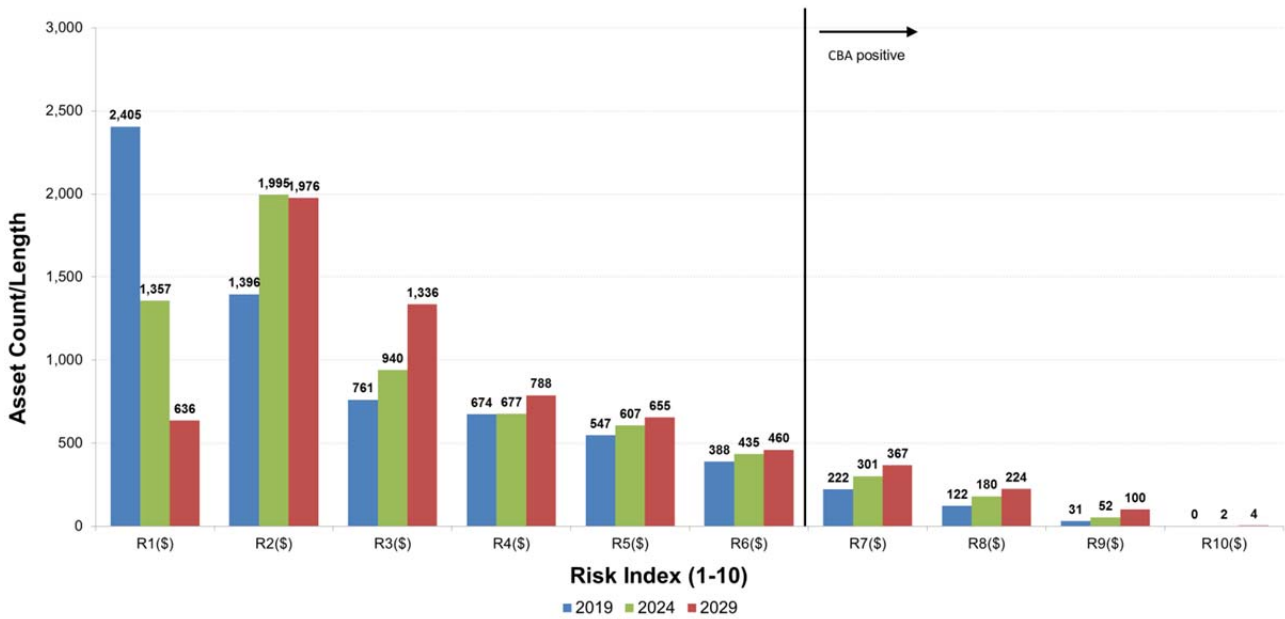
In forming this decision Ausgrid considered three options and performed sensitivity analysis as described later in this document. Ausgrid is recommending Option 3 for the levelled replacement of all assets which are cost benefit positive by the end of FY24.

Risk Index

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

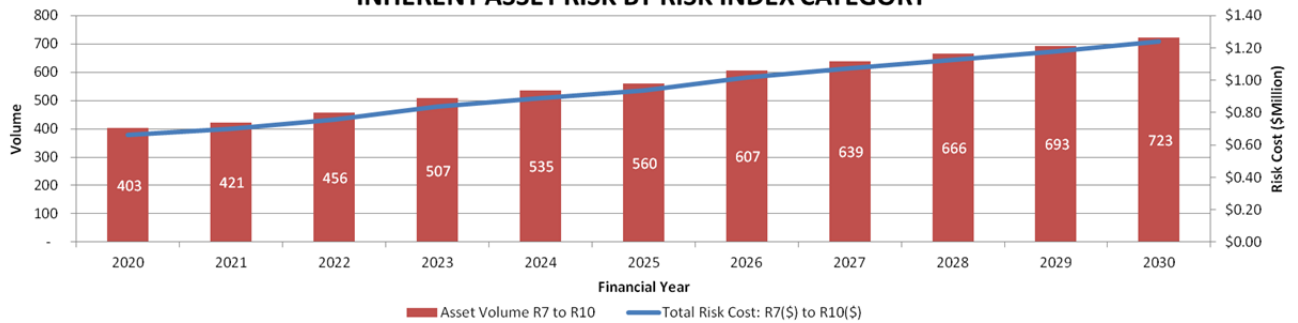
¹ Attachment 5.13.M.0 – Repex program CBA modelling methodology

ASSET RISK INDEX (2019, 2024 & 2029)



The inherent risk of UGOH's that are cost benefit positive is shown in the figure below.

INHERENT ASSET RISK BY RISK INDEX CATEGORY



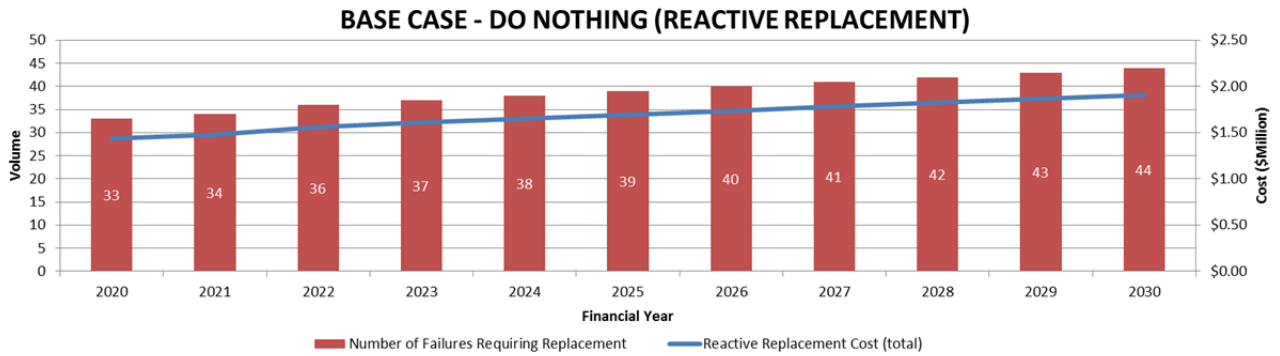
Option One – Base case (reactive replacement)

Under a base case (reactive replacement) scenario, if Ausgrid were to adopt a reactive replacement strategy, the minimum replacement quantity during FY20 to FY24 is 178 UGOH's. 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	33	34	36	37	38

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

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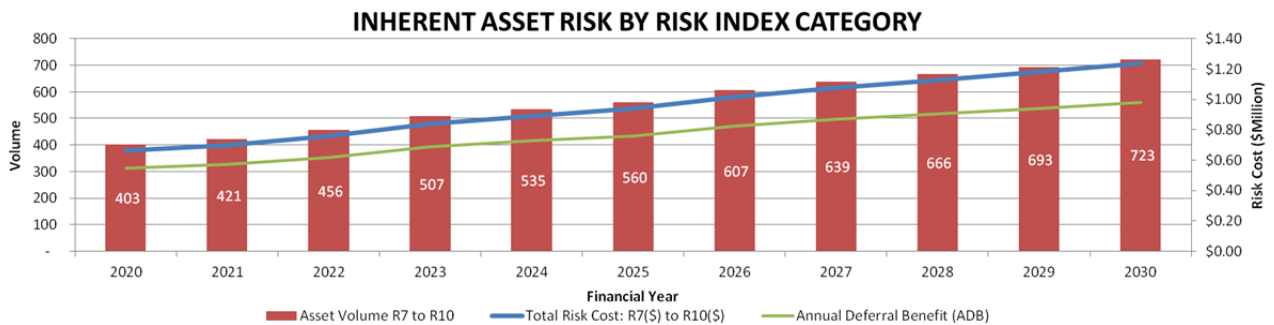


Option Two – Replace where cost benefit positive

Given Ausgrid plans to replace 32 UGOH's in FY19, the recommended planned replacement quantity during FY20 to FY24 is 503 UGOH's. 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	371	18	35	51	28

Based on this 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 constraints on network access, physical access and delivery resourcing.

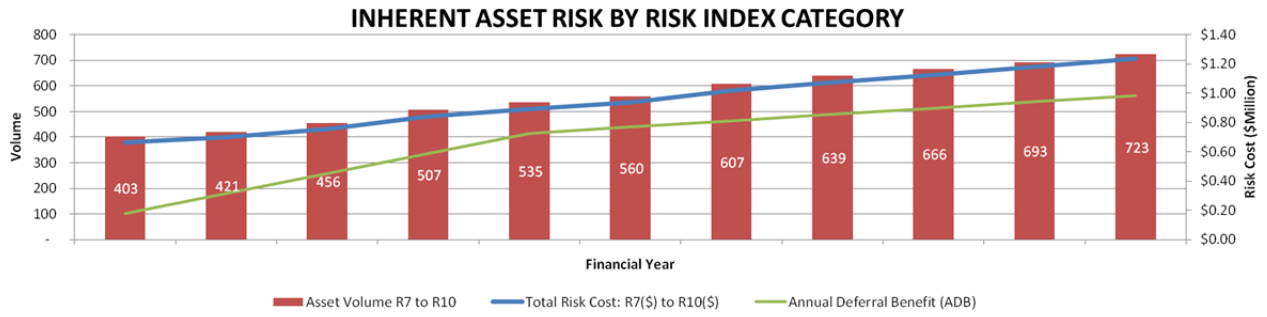
Option Three – Replace all cost benefit positive by the end of the period

Given the delivery constraint, under this option Ausgrid have considered the levelled replacement of UGOH's that are cost benefit positive during FY20 to FY24. This replacement strategy results in 101 UGOH's (rounded) replaced per year.

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	101	101	101	101	101

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.

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This option balances achieving value for customers with consideration of the delivery limitations and is therefore the recommended option.

Data input

		Data Source
Population	6,546	SAP – Asset Register
Object Types	TERM_UGOH	SAP – Asset Register
Conditional & Functional Failures / Time Period	344 failures 6 years	SAP – Defect Records
Asset standard life	58.03 years	RAB life
WACC	3.90%	Regulated Rate

Planned Replacement Cost

A weighted average for the period per asset was used in this model.

Cost	Data Source
\$41,209	2020-24 Revised Regulatory Proposal (FY19 real direct costs +25% of indirect costs)

Weibull parameters

The Weibull parameters have been developed by applying asset age to failure correlation using Ausgrid historical data relating to failures and assets.

β_{good}	1.8500	β_{average}	1.8977	β_{poor}	1.9454
n_{good}	87.9624	n_{average}	78.5963	n_{poor}	70.6164
b (intercept)	-8.2821				

Adjustments factors

Probability of Failure (PoF)	<ul style="list-style-type: none"> Actual Failure Data Age Construction type Distance to coast
Probability of Consequence (PoC)	<ul style="list-style-type: none"> Construction type Surge arrestor type 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	59	62	64	66	68

Sensitivity

Ausgrid tested the sensitivity of the applied grossly disproportionate factor by applying a factor of 6 to safety and fire consequences, based on the public safety risk. The impact of these changes is a 2% reduction in the overall recommended replacement quantities during FY20 to FY24.

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 (specifically worker safety for this asset type)

Worker Safety ICR – 0.698% (Ausgrid recorded ICR)

Public Shock ICR – 0.0% (Ausgrid recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	\$ 4,469,292	0.000017	10	0.0025	1,000
Major	\$ 446,929	0.000068	8	0.0098	255
Moderate	\$ 44,693	0.000171	6	0.0245	102
Minor	\$ 4,469	0.000698	4	0.1000	25
Insignificant	\$ 447	0.006025	2	0.8632	3

Average **safety** consequence per asset: \$1,087 per event.

Ausgrid have proposed that inherently a fatality would occur due to a failure of a UGOH every 1,000 years based on the population and industry experience. Changing the probability of severity to 0.005 (or a fatality every 500 years) increases the average safety consequence by 72% and increases the recommended replacement quantity by 22 during FY20 to FY24. Changing the probability of severity to 0.00125 (or a fatality every 2,000 years) reduces the average safety consequence by 36% and reduces the recommended replacement quantity by 11 during FY20 to FY24.

Fire

ICR – 3.14% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	\$ 66,000,000	0.000087	10	0.0006	1,000
Major	\$ 6,600,000	0.000349	8	0.0011	500
Moderate	\$ 660,000	0.001743	6	0.0022	250
Minor	\$ 66,000	0.008792	4	0.2800	2.0
Insignificant	\$ 6,600	0.020430	2	0.7161	0.9

Average **fire** consequence per asset: \$16,246 per event.

Ausgrid have proposed that inherently a severe fire would occur due to a failure of a UGOH every 1,000 years based on the population (predominantly within urban areas where fire is unlikely to spread past the pole) and industry experience. Fires which Ausgrid has experienced are typically contained on, or close to, the pole. Changing the probability of severity to 0.0011 (or a severe fire every 500 years) increases the average fire consequence by 80%. Changing the probability of severity to 0.0003 (or a severe fire every 2,000 years) reduces the average fire consequence by 36%.

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 UGOH's. There have been no recorded environmental impacts (excluding fire) as a result of these assets.

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Loss of supply

The loss of supply events have been established based on reasonable switching and restoration times as follows.

Outage Type	HV	Data Source
Proportion of failures resulting in unserved energy	100%	OMS Data
VCR	\$40.73/kWh	AEMO / AER
Automatic protection time/Proportion load	0 min / 0%	Estimated
Switching time/Proportion load	1 hrs / 98%	Estimated
Restoration/repair time/Proportion load	4 hrs / 2%	Estimated
Time without supply	1.06 hrs	Calculated

Average **loss of supply** consequence per asset: \$53,757 per event.

Finance

		Data Source
Annual deferral benefit of reactive	\$1,631	20% increase on planned replacement cost applied at the WACC
Repair cost	\$8,203	FY13-FY18 actuals (Direct '19)
Proportion replaced	56%	SAP – Defect records
Weighted replacement/repair cost	\$4,556	Calculated
Maintenance original asset per annum	\$0	N/A
Maintenance replacement asset per annum	\$0	N/A
Maintenance benefit per asset per annum	\$0	Calculated

Average **financial** consequence/benefit per asset: \$4,556 per event.

AVERAGE TOTAL CONSEQUENCE per asset: \$75,646 (including POC x C(\$))