Revised Proposal

Attachment 5.13.M.11

Pole Top Substations program CBA summary

January 2019

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Pole Top Substations program CBA summary

Introduction

Ausgrid has reviewed the risks associated with Pole Top (PT) Substations by undertaking a quantitative risk assessment. The majority of the replacement quantities that Ausgrid has recorded over the last 5 years have been Pole Top Substations where the pole has reached end of life and is therefore informed by the pole CBA model[1]. This document covers the outcomes of cost benefit analysis, and should be reviewed in conjunction with the cost benefit analysis (CBA) modelling methodology report[2].

Scope

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

- Poles - > 1 KV & < = 11 KV; Wood - Replacement of Unstaked Pole
- Transformers - Pole mounted; < = 22KV ; < = 60 KVA ; Single Phase
- Transformers - Pole mounted; < = 22KV ; > 60 KVA AND < = 600 KVA ; Single Phase
- Transformers - Pole mounted; < = 22KV ; < = 60 KVA ; Multiple Phase
- Transformers - Pole mounted; < = 22KV ; > 60 KVA AND < = 600 KVA ; Multiple Phase

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.

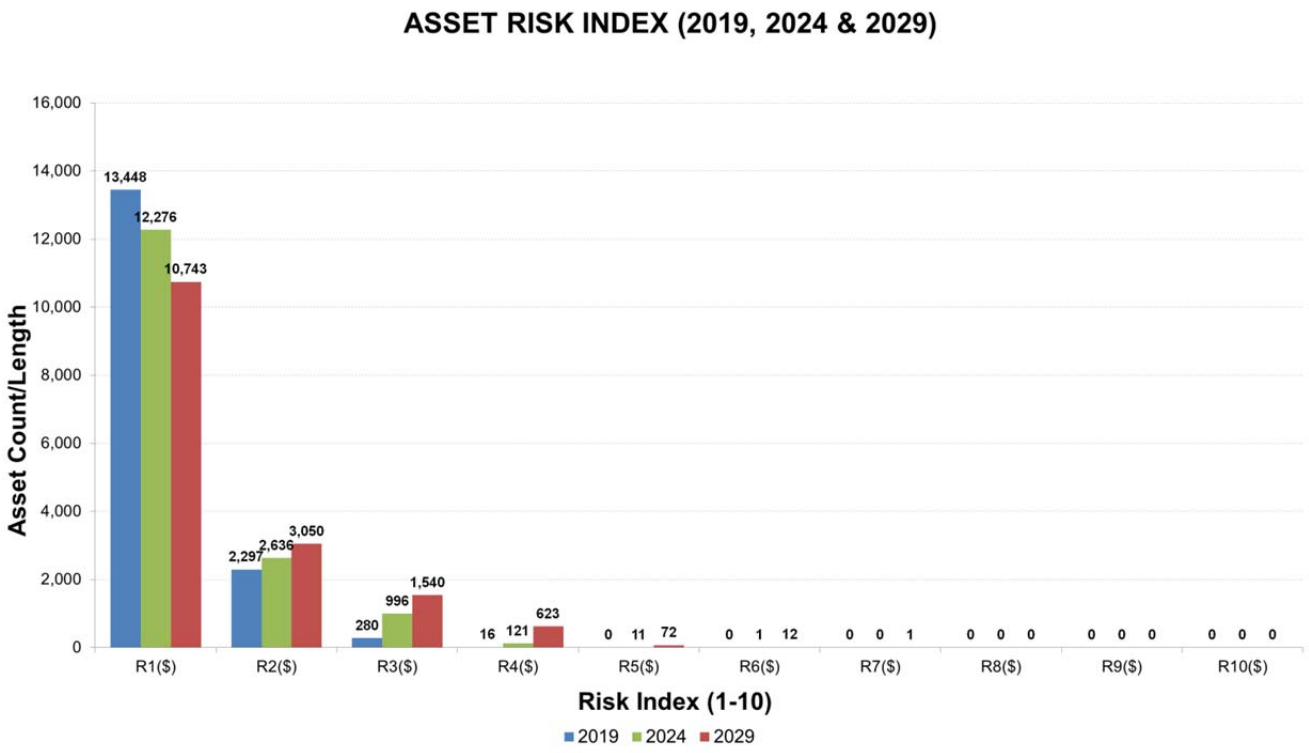
Ausgrid has committed to 72 Pole Top Substations being replaced in FY19. Based on the analysis completed, the model output is supporting the reactive replacement of a further 398 Pole Top Substations by the end of FY24.

In forming this decision Ausgrid considered three options and performed sensitivity analysis as described in this document. Ausgrid is recommending Option 1 – reactive replacement of failures until the end of FY24 for this asset category.

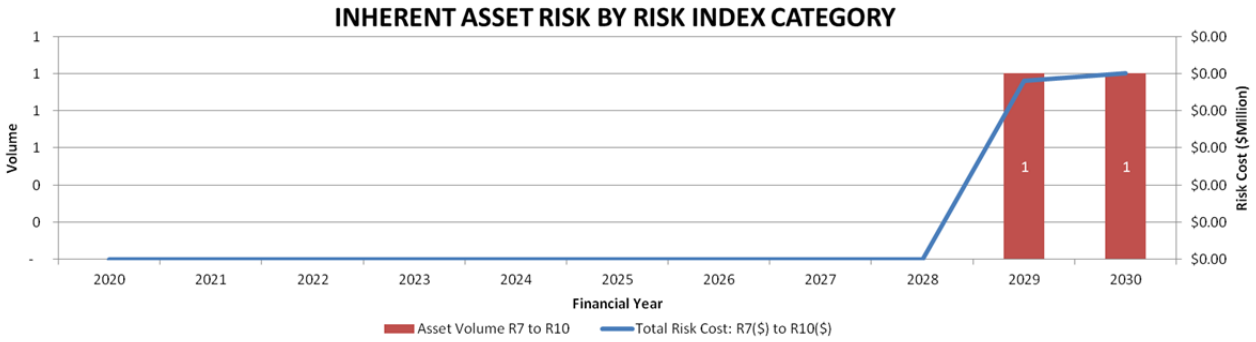
Risk Index

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

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



The inherent risk of PT substations that are cost benefit positive is shown in the figure below.



While it is inherently understood that pole failures can lead to a significant safety risk exposure, particularly to the public, the low risk shown in the Risk Index is reflective of Ausgrid's strong history in managing this asset class. The low Incident Conversion Rates (ICR) capture Ausgrid's strong recent history in managing this asset class utilising condition based replacement.

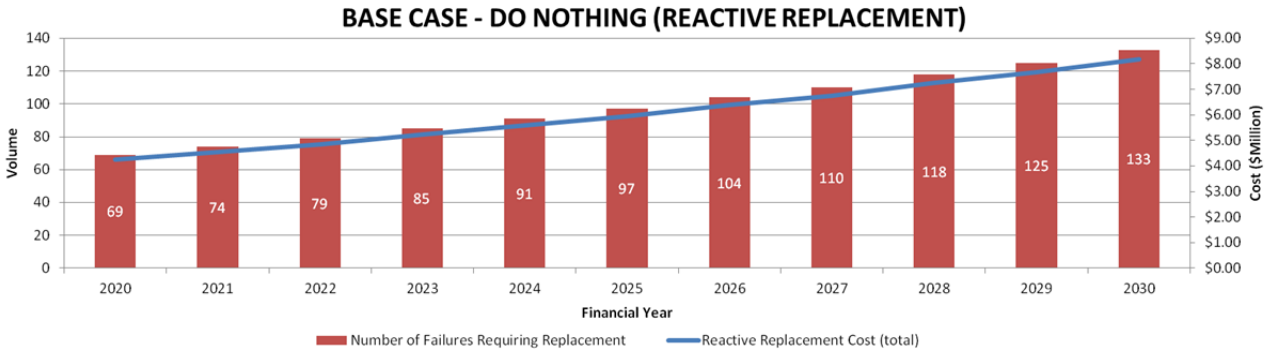
The historical failures included in the probability of failure modelling include both condition based and functional failures. An effective condition based replacement approach is captured within the failure forecast and therefore within the base case (reactive replacement) option.

Option One – Base Case (Reactive Replacement)

Under a base case scenario, if Ausgrid were to adopt a reactive replacement strategy, the minimum replacement quantity during FY20 to FY24 is 398 PT substations. 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	69	74	79	85	91

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



Option Two – Replace where cost benefit positive

Given the model shows no PT substations as cost benefit positive before the end of FY24, this option is not considered as supported.

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

Given the model shows no PT substations as cost benefit positive before the end of FY24, this option is not considered as supported.

Data input

		Data Source
Population	16,041	SAP – Asset Register
Object Types	SUB_POLE – Pole Substation	SAP – Asset Register
Conditional & Functional Failures / Time Period	38,178 failures 6 years	Failures for the pole population SAP – Defect Records
Asset standard life	52.07 years	RAB life – Pole Asset
WACC	3.90%	Regulated Rate

Planned Replacement Cost

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

Cost	Data Source
$61,434	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. These parameters relate to the pole asset as the replacement of a PT substation is driven by the failure of the pole in most circumstances.

β_{good}	4.1634	$\beta_{average}$	4.1686	β_{poor}	4.1737
η_{good}	70.4252	$\eta_{average}$	70.0573	η_{poor}	69.6923

b (intercept)	-17.7135

Adjustments factors

The adjustment factors relate to the pole asset, however the presence of a transformer on the pole exacerbates these factors.

Probability of Failure (PoF)	• Actual Failure Data • Age • Previous reinstatement • Previous termites • Diameter Score • Strength Score
Probability of Consequence (PoC)	• Proximity to a School • Voltage • Spatial Risk

Model calculated failures

Pole failure rate applied to the population of PT substations.

	2020	2021	2022	2023	2024
Failures	138	148	158	170	181

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. As this model is purely reactive this has no effect on the recommended replacement quantities or strategy.

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 – 0.05% (Industry Average ICR)
Physical Impact ICR – 0.06% (Industry Average ICR)
Shock ICR – 0.06% (Industry Average ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 4,469,292	0.00005	10	0.032	152
Major	$ 446,929	0.00008	8	0.050	98
Moderate	$ 44,693	0.00016	6	0.100	49
Minor	$ 4,469	0.00040	4	0.250	20
Insignificant	$ 447	0.00091	2	0.568	8.6

Average **safety** consequence per asset: $2,625 per event.

Ausgrid have proposed that inherently a fatality would occur due to a failure of a PT substation every 152 years based on the potential for a fatality which has not yet been experienced within Ausgrid or Industry. The model overall is insensitive to changes in the probability of severity for safety risk.

Fire

ICR – 3.39% (Industry Average ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 66,000,000	0.0000170	10	0.0005	460
Major	$ 6,600,000	0.0000339	8	0.0010	230
Moderate	$ 660,000	0.0001695	6	0.0050	46
Minor	$ 66,000	0.0016950	4	0.0500	4.6
Insignificant	$ 6,600	0.0319847	2	0.9435	0.2

Average **fire** consequence per asset: $14,518 per event.

Due to the location of these assets in the public space and often in remote areas, the risk of a severe fire incident was deemed probable but has not occurred on the Ausgrid network to date. The model overall is insensitive to changes in the probability of severity for fire risk.

Environment

ICR – 11.23% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 10,193,119	0	1	n/a	n/a
Major	$ 4,558,501	0.0000225	1	0.0002	347
Moderate	$ 1,019,312	0.0001123	1	0.0010	69
Minor	$ 101,931	0.0011230	1	0.0100	6.9
Insignificant	$ 10,193	0.1110422	1	0.9888	0.1

Average **environment** consequence per asset: $1,463 per event

Due to the volume of oil contained within these assets, the risk of a severe environmental incident was low enough that the probability of consequence was set to zero. The model overall is insensitive to changes in the probability of severity for environment risk.

Loss of supply

Ausgrid's failure data has been reviewed to determine the proportion of failures resulting in unserved energy, with consideration of the number of outages recorded using data from Ausgrid's outage management system (OMS).

Outage Type	LV	Data Source
Proportion of failures resulting in unserved energy	0%	Conditional program for poles detects failure before unserved energy is experienced
VCR	$40.73/kWh	AEMO / AER
Actual outage time experienced	8.4 hrs	OMS - 3 year average
Time without supply	0 hrs	Calculated

Average **loss of supply** consequence per asset: $0 per event.

The model predicts replacements due to pole failures however when Ausgrid's OMS data was interrogated a number of failures of the other elements of a PT substation resulted in unserved energy. Sensitivity analysis was completed using this actual outage data from OMS, shown below, and it was observed that the outcome of the model as a reactive approach for replacement was unchanged.

Outage Type	LV	Data Source
Proportion of failures resulting in unserved energy	75%	OMS - 3 year average relating to PT substations failures excluding the pole
VCR	$40.73/kWh	AEMO / AER
Average interruption duration	8.4 hrs	OMS - 3 year average
Time without supply	6.3 hrs	Calculated

Finance

		Data Source
Annual deferral benefit of replacement	$2,306	Planned replacement cost applied at the WACC
Repair cost	$2,145	FY13-FY18 actuals (Direct '19)
Proportion replaced	50%	Based on pole calculations
Weighted replacement/repair cost	**$2,225**	Calculated
Maintenance original asset per annum	$33	Based on historical maintenance
Maintenance replacement asset per annum	$33	Based on historical maintenance
Maintenance benefit per asset per annum	**$0**	Calculated

Average **financial** consequence/benefit per asset: $2,225 per event.

AVERAGE TOTAL CONSEQUENCE per asset: $20,831 (including POC x C($))