Revised Proposal

Attachment 5.13.M.6

Low Voltage Dedicated Mains program CBA summary

January 2019

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Introduction

Ausgrid has reviewed the risks associated with dedicated LV mains 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 expenditure within the following RIN category:

- Overhead Conductors - Other

Ausgrid has considered the impact of the replacement of existing street lights connected to dedicated LV mains with those utilising LED technology and connected to Ausgrid's general low voltage distribution mains. Ausgrid, in consultation with street lighting customers, is aiming to transition most street lights to LED technology during FY20 to FY24. The changeover of these lights to newer technology and subsequently new connection arrangements reduces the likelihood of customer reporting of mains fallen to the ground as the likelihood of a visible outage reduces. As customer reporting is a critical element in identifying network issues, reduced reporting will increase the public exposure to these risks. The CBA model has incorporated an increase in public safety exposure over time in-line with the transition of street light technology away from the use of the dedicated low voltage distribution mains.

Analysis Outcome

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

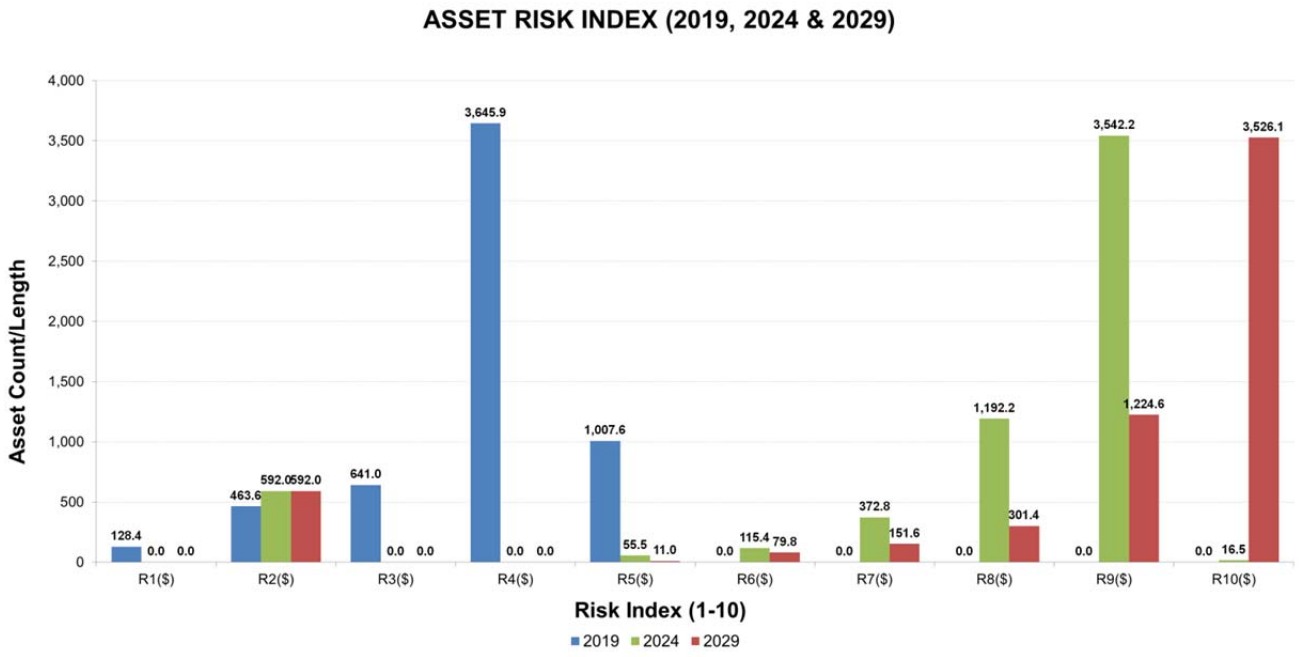
Based on the analysis completed, the model output is supporting the reconfiguration of a total of 5,124 km of dedicated LV mains by the end of FY24. This includes a total of 580 km of dedicated LV mains which have been committed in FY19 and a total of 4,544 km of dedicated LV mains which are cost benefit positive during FY20 to FY24.

In forming this forecast, 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.

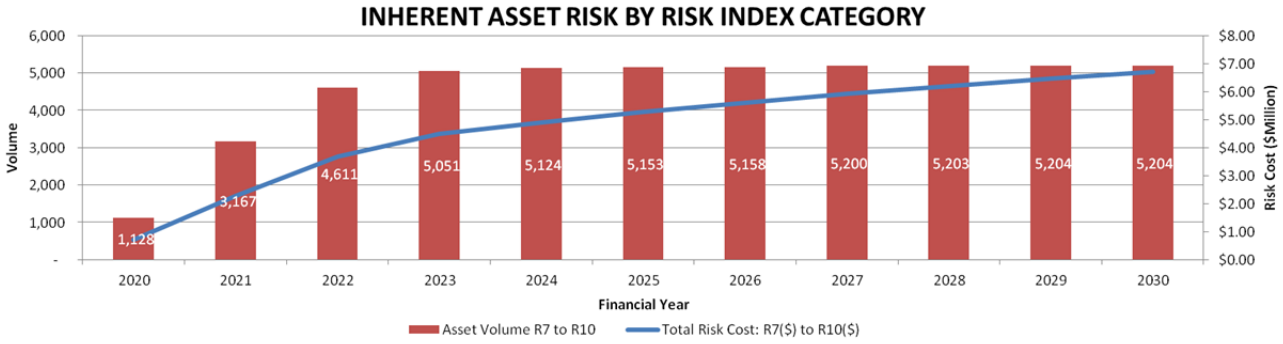
Risk Index

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

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



The inherent risk of dedicated LV mains that are cost benefit positive is shown in the figure below.



Option One – Base case (reactive reconfiguration)

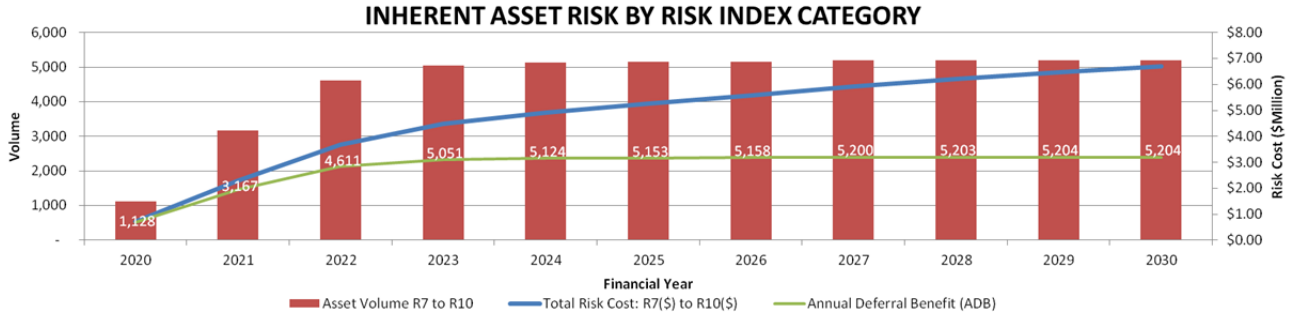
The base case (reactive reconfiguration) for dedicated LV mains is not a practical option. Following a failure, repairs are undertaken to restore dedicated LV mains to their pre-failure condition in an appropriate timeframe to address the immediate public safety risks associated with fallen mains and loss of public lighting services. These immediate public safety risks do not allow sufficient time to complete reconfiguration to the dedicated mains on a given circuit, and therefore reconfiguration is only considered viable when it is planned.

Option Two – Reconfigure where cost benefit positive

Given Ausgrid plans to reconfigure 580 km of dedicated LV mains in FY19, the recommended volume from the model is 4,544 km of dedicated LV mains. The table below shows the year in which these assets should be addressed based on when the benefit to customers exceeds the annualised deferral benefit:

Direct Costs (real $FY19)	FY20	FY21	FY22	FY23	FY24
Volumes for reconfiguration (km)	548	2039	1444	441	72

Based on this volume, 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.



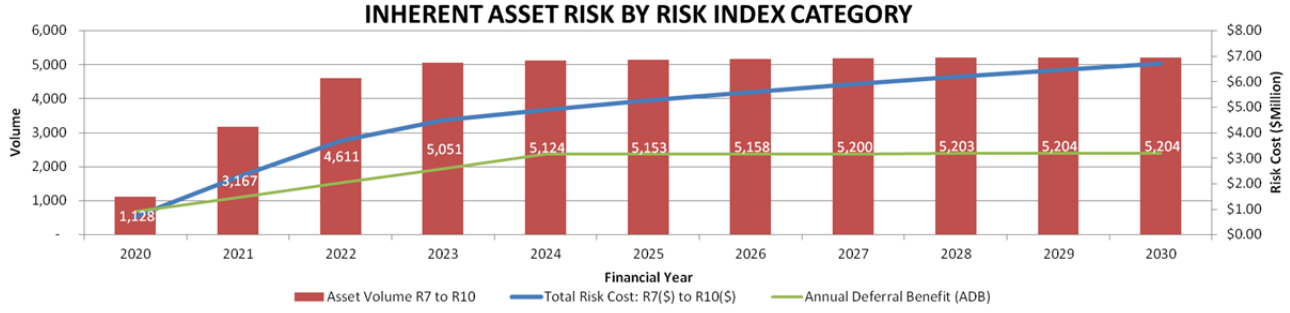
This option provides the maximum benefit to customers as it leads to the avoidance of risk at the point at which the benefits exceed the costs. However, the large delivery requirement in FY21 and FY22 will not be reasonably achievable due to the constraints on network access, physical access and efficient delivery resourcing.

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

Given the delivery constraints, under this option Ausgrid has considered the levelled reconfiguration of all dedicated LV mains that are cost benefit positive by the end of FY24. This results in approximately 909 km (rounded) of dedicated LV mains being addressed per year.

Direct Costs (real $FY19)	FY20	FY21	FY22	FY23	FY24
Volumes for reconfiguration (km)	909	909	908	909	909

Based on this volume, 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 with consideration of the constraints associated with efficient delivery and is therefore the recommended option.

Data input

		Data Source
Population	5,885.60 km	GIS – Asset Register
Object Types	LV Line with usage 'Street lighting'	GIS – Asset Register
Conditional & Functional Failures / Time Period	2,819 failures 6 years	SAP – Defect Records
Asset standard life	52.07 years	RAB life
WACC	3.90%	Regulated Rate

Planned Costs

	Cost	Data Source
Reconfigure	$16,406	2020-24 Revised Regulatory Proposal (FY19 real direct costs +25% of indirect costs)
Repair	$1,099	SAP – Defect Records

Crow-AMSAA parameters

Traditional Crow-AMSAA has been utilised for this model by applying the failure correlation to time. The failures are normalised per unit length of the asset this is completed using Ausgrid historical failure and asset data.

β_{good}	0.9244	$\beta_{average}$	1.2217	β_{poor}	1.5190	$\lambda_{average}$	0.05693

Adjustments factors

Probability of Failure (PoF)	• Actual failure data • Age • Conductor construction
Probability of Consequence (PoC)	• Proximity to a school • Public exposure • Conductor construction • Bushfire area • Streetlight replacement

Model calculated failures

	2020	2021	2022	2023	2024
Failures	616	724	812	888	959

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 24% reduction to 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

Worker Safety ICR – 0.19% (Ausgrid recorded ICR)

Shock ICR – 0.39% (Ausgrid recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity (2019)	Years until event (2019)	Probability of Severity (2024)	Years until event (2024)
Severe	$ 4,469,292	0.00004	10	0.00720	51	0.00796	23
Major	$ 446,929	0.00005	8	0.00791	47	0.00874	21
Moderate	$ 44,693	0.00087	6	0.14950	2.5	0.16522	1.1
Minor	$ 4,469	0.00174	4	0.30000	1.2	0.33155	0.5
Insignificant	$ 447	0.00310	2	0.53540	0.7	0.48653	0.4

Average **safety** consequence per asset: $2,293 per event.

Based on a known recent Australian industry fatality associated with dedicated LV mains, it is reasonable to propose that a fatality could occur on Ausgrid's network approximately every 51 years (based on the annual forecast failures in 2019). Changing the probability of severity to 0.014 (or 1 fatality every 26 years) increases the average safety consequence by 77% and increases the recommended reconfigurations by 171 km during FY20 to FY24. Changing this to 0.0036 (or 1 fatality every 103 years) reduces the average safety consequence by 41% and reduces the recommended forecast volume by 1,444 km over the same period.

Ausgrid has also taken account of the replacement of existing street lights connected to dedicated LV mains with those utilising LED technology, the changeover of these lights to newer technology and required reconfiguration of the connection arrangements reduces the likelihood of customer reporting of "mains down" as the likelihood of a visible outage reduces. This reduced likelihood of reporting increases the exposure to customers and therefore the probability of consequence. Ausgrid has modelled an increased probability of consequence for public safety in-line with the timeline for street light upgrades. This is reflected in the 'Years until event (2024)' column in the table above.

This modelling variation is unique to the LV dedicated mains model.

Fire

ICR – 0.21% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 66,000,000	0.000000281	10	0.00013	7,634
Major	$ 6,600,000	0.000000558	8	0.00026	3,846
Moderate	$ 660,000	0.000008407	6	0.00392	255
Minor	$ 66,000	0.000042035	4	0.01960	51
Insignificant	$ 6,600	0.002093354	2	0.97609	1.0

Average **fire** consequence per asset: $285 per event.

Ausgrid has experienced a number of fires as a result of failures of dedicated LV mains during the observation period. Changing the probability of severity to 0.00026 for a severe outcome (or 1 every 3,846 years), increases the average fire consequence by 63% and increases the recommended reconfigurations by 29.5 km during FY20 to FY24. Changing this to 0.00007 for a severe fire (or 1 every 14,285 years), reduces the average fire consequence by 30% and reduces the recommended replacements by 71.6 km during FY20 to FY24. The long periods applied in the model are reflective of the actual ICR seen on Ausgrid's network at lower severities and the relatively smaller amount of LV dedicated mains in higher risk bushfire areas.

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 no plausible environmental consequences relating to dedicated LV mains. There have been no recorded environmental impacts (excluding fire) as a result of these assets.

Loss of supply

Ausgrid have considered the loss of supply consequences relating to dedicated LV mains to be negligible.

Finance

		Data Source
Annual deferral benefit of reactive	$616	20% increase on planned replacement cost
Repair cost	$1,099	FY13-FY18 actuals (FY19 real direct costs +25% of indirect costs)
Proportion replaced	0%	Not replaced reactively (reactive repair only)
Weighted replacement/repair cost	**$1,099**	Calculated
Planned maintenance original asset per annum	$0	Based on historical maintenance expenditure
Planned maintenance replacement asset p.a.	$0	Based on historical maintenance expenditure
Planned maintenance benefit per asset p.a.	**$0**	Calculated

Average **financial** consequence/benefit per asset: $1,099 per event.

AVERAGE TOTAL CONSEQUENCE per asset: $3,677 (including POC x C($))