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## Regulatory Submission

ACTEWAGL DISTRIBUTION

### Focussed Critique of AER's REPEX - 'Calibrated Model'

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## Regulatory Submission

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## Contents

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# Executive summary

ActewAGL Distribution (AAD) has requested that Jacobs provide a focussed analysis and report which reviews the AER's 'calibrated forecast REPEX model' and in the case that any shortcomings are identified, addresses and reports on these including why it produces different results to ActewAGL Distribution's own REPEX forecast.

Jacob's has conducted a high level review of the reasons given by the AER for reducing ActewAGL Distribution's replacement capital expenditure forecast, and we have analysed the manner in which AER has developed and applied their Repex model to arrive at their proposed Repex reduction of $33.7 million (25.4%) over the period 2014-19.

Based on the information we have gathered and the analysis we have undertaken, we would make the following key findings and observations:

1)  AER has accepted ActewAGL Distribution's pole replacement strategy, and consequent replacement expenditure forecast for this class of assets.

2)  The AER was not satisfied that ActewAGL Distribution's proposed forecast Repex for the overhead conductor and pole top structures categories of expenditure was sufficiently well justified. This category of expenditure was made up of three distinct programs of work, namely:

    o  Rural pole top upgrade;

    o  Pole top hardware renewal / cross-arm replacement; and

    o  Cast iron LV pothead replacement.

3)  The AER did not accept ActewAGL Distribution's forecast Repex for the HV underground cable condition monitoring and replacement programme.

4)  In determining the amount of Repex reduction proposed, AER have divided the various Repex programs into "un-modelled" programs (reduced by $4.5 million), and "modelled" asset categories (reduced by $59.2 million).

5)  The reduction in the Repex for the "modelled" asset categories has been determined by the application of the AER's Repex  Calibrated Model which purportedly uses replacement asset quantities and replacement expenditure from the previous regulatory period to predict the appropriate amount of asset replacement (volumes and expenditure) for the next regulatory period.

6)  The AER "calibrated model" derives its own Asset Life and Standard Deviation inputs using the historical asset replacement volumes provided by ActewAGL Distribution. It is not clear how, then the "calibrated model" used by the AER in reaching its draft decision on Repex for ActewAGL Distribution bears no resemblance to the actual amount of replacement expenditure required for the 2014-19 regulatory period.

7)  Regardless of the data population problems with the AER model for ActewAGL Distribution, Jacobs fundamentally disagrees with the AER's premise that the future requirement for sustainable long term replacement expenditure for a DNSP can be predicted by looking at recent past expenditure. Such an approach runs the risk of:

    o  Being purely age based, and not recognising other justifiable reasons for replacement, such as condition, serviceability, reliability, criticality, obsolescence, etc

    o  Failing to recognise where in the investment cycle each asset class sits, relative to the expected life of the asset class / type. i.e. whether the asset class has a relatively young average age relative to its life-cycle, reflecting the period in time when it was introduced on the system, or whether it is a mature class of assets with a high average asset age, and an age profile or deteriorating asset condition / reliability, which requires increasing replacement expenditure.

    o  Failing to respond to new and critical information about the ongoing serviceability and safety of certain asset classes. An example of this would be the findings and recommendations of the 2009 Victorian Bushfire Commission that certain types of equipment and components on overhead distributions lines can contribute to an increased risk of starting a bushfire.

o Continuing to perpetuate an inadequate level of Repex investment on the basis that "if it was the level of investment that has been made in the recent past, it is therefore adequate for the immediate future". This simplistic approach fails to recognise that power systems in Australia will continue to age and deteriorate based on historical levels of Repex ( ActewAGL Distribution's system has aged approximately 1.4 – 1.5 years in the past 5 years).

o By 'locking-in' the level of expenditure to the previous regulatory period, there is no flexibility to address new and emerging replacement needs

o The methodology used to construct the calibrated forecast results in the arbitrary 'back-engineering' of average asset class lives that in some cases bear no relevance to contemporary electricity industry asset life expectancy.

**Structure of this report:**

This report addresses our understanding of what ActewAGL Distribution requires, and it is structured in the following way:

**Section 1:** describes how the AER REPEX model is structured, what assets are included in the model, and what assets are excluded from the model. The commentary also explains the differences between the components of the model eg, base case historical and forecast, the calibrated model, and the benchmarked model.

**Section 2:** summarises identified issues with the calibrated model and why Jacobs considers it to be fundamentally flawed. The key shortcomings of the calibrated model are that it is designed on the premise that future REPEX requirements can be predicted based on recent historical REPEX spend for many classes of distribution assets. This fallacy is then compounded by the calibrated model being 'back-engineered' such that it recalculates new average asset class lives which are in many cases in excess of the generally accepted lives experienced in the Australian electricity industry.

**Section 3:** makes reference to the opinion of the three NSW DNSP's, as expressed in the Networks NSW report *"REPEX Model Review"* dated November 2014, and several other key comments made by the AER in their draft decision document, which indicate they are already aware of some of the limitations of their REPEX model. They disagree however that it is fundamentally flawed.

**Section 4:** this section provides specific examples of how the AER calibrated model has distorted ActewAGL Distribution's replacement forecast. The asset categories covered are poles, underground cables, distribution transformers, and distribution switchgear. Comparisons are made between the ActewAGL Distribution forecast quantities and average asset lives, compared with the forecast quantities and average asset lives generated by the AER calibrated REPEX model.

## Important note about your report

Jacobs® has been asked to review and comment on the REPEX model that was used to arrive at the AER recommended levels of replacement capital expenditure in Attachment 6, Section 3 of the AER's draft decision document.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client.

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# 1. How is the AER's REPEX model structured?

At first glance the AER REPEX model looks quite complex and sophisticated however, on closer inspection it is actually quite simple. It is important however to differentiate between the various components of the model, and to focus on that part of the model that the AER have actually used to arrive at their draft decision numbers.

About 70% of replacement expenditure is processed through the REPEX model, but there is some replacement expenditure that is considered outside the model.

## 1.1 Un-modelled REPEX

For ActewAGL Distribution there are three categories of replacement expenditure, totalling $27.0 million in ActewAGL Distribution's submission, which for one reason or another, are not modelled within the AER REPEX model and are not subject to the adjustments made within the calibrated model These are shown in Table 1 below, along with the ActewAGL Distribution proposed, and AER draft decision values for each category.

Table 1 ActewAGL Distribution un-modelled REPEX

| ($ million) | ActewAGL Distribution  SRP | AER draft decision |
|---|---|---|
| Overhead conductor and pole top structures | $10.5 million | $6.0 million |
| SCADA, control, protection, etc | $6.9 million | $6.9 million |
| Other | $9.6 million | $9.6 million |
| Total Un-modelled | $27.0 million | $22.5 million |

It should be noted that the AER draft decision document incorrectly lists the ActewAGL Distribution proposed expenditure for "overhead conductor and pole top structures" as $17.9 million, not $10.5 million as per the SRP. It appears that the $17.9 million was sourced from RIN datasheets.[1]

The main reason for having un-modelled REPEX is that it normally applies to 'one-off' or fluctuating levels of expenditure on projects, which does not follow a consistent pattern. For example, replacement of SCADA control and protection equipment is required from time to time (usually between 10 – 15 year intervals, and is 'lumpy' when it occurs, but it does not follow a regular annual or five year cycle and is therefore difficult to model accurately by looking at recent historical expenditure.

The simplistic way in which AER have treated this un-modelled expenditure is to do a simple trend analysis by comparing what was spent in the 2009-14 regulatory period with what is requested for 2014–19. If it is higher for 2014-19 they reject it, if it is about the same or lower they accept it.

This simplistic approach is totally at odds with the underlying reason why the work is treated as 'un-modelled'. It is fluctuating expenditure driven by specific project and network needs and conditions which should not be trended. The AER's draft decision as a result omits to review the underlying condition based assessments of the ACT network.

Jacobs also notes that the main REPEX project adversely impacted in the un-modelled projects/programs is the *"Overhead conductor and pole top structures"* category. This expenditure was identified out of the 2009 Victorian Bushfire Commission and was programmed over the two regulatory periods (2009-14 and 2014-19). During 2009–14 a total of 62.2 km of 11 kV and 22 kV feeders were refurbished in high bushfire risk areas, whereas a total of 112.5 km were planned to be refurbished during 2014-19.

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[1] ActewAGL Distribution's proposal for overhead conductor and pole top structures is $10.5 million ($2013/14), as stated in its regulatory proposal for the subsequent regulatory period, but was recorded as $17.9 million ($2013/14) in ActewAGL Distribution's RIN because a portion of assets were double counted.

The expenditure for this program is higher in the 2014-19 period due to the greater network length being refurbished, but has been dismissed by the AER on the basis that ActewAGL Distribution's proposed REPEX in this category is more than three times higher for the 2014-19 period compared to what it spent in these categories for the 2009-14 period. In part, this "three times higher" factor is explained by the incorrect use of the $17.9 million sourced from the RIN data sheets, as explained above.

Jacobs considers that a 10 year period should be an adequate and appropriate timescale over which to undertake a major bushfire risk mitigation strategy such as that included within the *"Overhead conductor and pole top structures"* category. The longer that such a mitigation program takes to implement, the greater the risk that a major bushfire incident will occur, resulting in potential criticism that the work should have been implemented more rapidly.

It should be noted that this category of REPEX also includes the proposed replacement of cast iron LV pothead replacements, which are becoming an increased worker and public safety risk in close proximity situations.

Jacobs is of the view that ActewAGL Distribution has sound and justifiable reasons for proceeding with this replacement program as planned, and that it is consistent with ActewAGL Distributions' safety obligations and responsibilities under the NER.

## 1.2    The base case model

The AER's base case model uses replacement life information inputs provided by ActewAGL Distribution in its RIN (ie, the average asset replacement life and the standard deviation of the replacement life). The AER developed two dimensions to the base case model. The first is the 'historical' outcome, which essentially uses ActewAGL Distribution's observed costs over the past five years (historical unit costs). The second dimension to the base case model is the 'forecast' outcome, which uses costs derived from its (ActewAGL Distribution's) forecast expenditure (forecast unit costs).

The information for both comes from the DNSP concerned through the RIN submissions and the Regulatory submission, and as such should closely reflect what the DNSP has spent over the past five years, and what its submission requests for the next five years.

As will be seen in Table 2, this is not the case for ActewAGL Distribution, and Jacobs is at a loss to explain why the base case model outcomes for both the 'historical period' (2009–14), and the 'forecast period' (2014-19) are some $120 million and $70 million higher (respectively) than the actuals and forecast contained in ActewAGL Distribution's regulatory proposal. It should be noted that the Jacobs consultants working on this assignment have not reviewed the ActewAGL Distribution RIN submissions.

There are two types of RINs that have been used to collect this information:

8)   'Reset RINs' which were issued to all distributors requiring them to submit the information with their regulatory proposal

9)   'Category analysis RINs' which were issued to all distributors in the NEM

The table below shows the ActewAGL Distribution base case figures, as derived from the RIN submissions, compared with ActewAGL Distribution's actual REPEX for 2009-14 and its forecast REPEX for 2014-19.

Table 2 ActewAGL Distribution base case outcomes

| ($ million) | ActewAGL Distribution RIN Assessments by AER(2013/14 real$) | ActewAGL Distribution Regulatory Proposal(2013/14 real$) |
|---|---|---|
| Historical (2009-14) | $211.6 million | $92.4 million[2] |
| Forecast (2014-19) | $205.7 million | $135.3 million[3] |

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[2]ActewAGL Distribution 2014, *Regulatory Proposal 2014-19 Subsequent regulatory control period Distribution services provided by the ActewAGL Distribution electricity network in the Australian Capital Territory*, 2 June 2014 (resubmitted 10 July 2014), Table 7.2, p 157

For reasons that are unclear to Jacobs, the AER assessment of the ActewAGL Distribution's RIN submissions (which includes only the modelled group REPEX), is materially higher than the actual ActewAGL Distribution historical and forecast REPEX contained in ActewAGL Distribution's regulatory proposal (which is for both the modelled and un-modelled REPEX).

We have observed similar differences between the 'base case' outcomes and actuals for a NSW DNSP, suggesting that the problem is systemic in nature, and not just unique to ActewAGL Distribution.

This huge variance in what the AER perceives (from the RIN's) has been spent on REPEX in the past, and is being forecast into the next regulatory period, appears to have strongly influenced their thinking, leading to the comment:

> *"However, the historically high volume of asset replacement work that ActewAGL has carried out over the last five years is likely to have changed its asset age profile from five years ago."*[4]

This is a flawed assertion on the part of the AER which appears to stem from the over-inflated outcomes of their base case Repex model shown above. ActewAGL Distribution has clearly demonstrated in its asset age profile modelling that its weighted average system age increased during the 2009-14 regulatory period (from 24.88 years in 2007/08 to 26.3 years in 2012/13), continuing the trend of previous years.[5]

It would appear that either, the ActewAGL Distribution RIN submissions, the AER's interpretation of them, or a combination of both, caused the large differences shown above.

The AER drew some misguided conclusions from the 'base case' numbers, including:

- The replacement profile predicted by the REPEX model under the base case scenario features a sharp step-up in expenditure in the first year of the forecast, which then declines over the remainder of the period (see Figure A-18)

- This replacement profile indicates that a significant portion of the asset population currently in commission has survived to an older age than would be expected using the base case replacement life figures submitted by ActewAGL Distribution

- First, if ActewAGL Distribution's actual replacement lives were consistent with their base case replacement lives, we would not expect to see the observed asset replacement profile. This is because, if ActewAGL Distribution's actual asset replacement profile followed its base case replacement lives, the older assets would have:

    - Already reached the end of their economic (replacement) lives and so would have already been largely replaced

    - Would therefore not be expected to be in the asset age profile, or be in such insignificant volumes that it would not materially affect the outcome of REPEX modelling

- The 'step-up/trend down' replacement profile observed from the base case model suggests that a significant proportion of the asset population has survived longer than would be expected using ActewAGL Distribution's data. The 'survivor' assets have a material effect on the observed outcome. This outcome suggests that the base case replacement lives are shorter than those achieved in practice

- Based on these assessments, our expectation is that the prudent and efficient level of REPEX is likely to be materially below the outcomes in the base case modelling and materially lower than ActewAGL Distribution's forecast

- If the base case replacement life information is substituted with calibrated lives (as explained below) the model outputs are $71 million for historical unit costs and $76 million for forecast unit costs

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[3] ActewAGL Distribution 2014, *Regulatory Proposal 2014-19 Subsequent regulatory control period Distribution services provided by the ActewAGL Distribution electricity network in the Australian Capital Territory*, 2 June 2014 (resubmitted 10 July 2014), Table 7.6, p.169
[4] AER 2014, *Draft Decision ActewAGL Distribution Determination: ActewAGL Distribution Determination:* Attachment 6, p6-61
[5] ActewAGL Distribution 2014, *Regulatory Proposal 2014-19 Subsequent regulatory control period Distribution services provided by the ActewAGL Distribution electricity network in the Australian Capital Territory*, 2 June 2014 (resubmitted 10 July 2014), Appendix B17.1, section 1.3.

Despite the above misguided conclusions on the part of the AER, there is some indication that they may be realising that their 'base case' modelling for ActewAGL Distribution is flawed, as reflected in the comment:

> *"In this instance, for ActewAGL Distribution, the base case outcomes may be "invalid" as NSW Networks might describe our findings, but nonetheless this assists us in narrowing the range of what is reasonable by assessing the robustness of the inputs used"*[7]

## 1.3 The AER calibrated model

The AER's calibrated model assumes that the 'volume of work' (quantities), and the total replacement expenditure on each category of assets spent over the previous regulatory period (as reported in the RIN) is adequate for future regulatory periods going forward, and adequate for the next regulatory period. This approach assumes that historical practices are representative of future replacement requirements which is not necessarily the case.

The calibrated model also uses a set of 'calibrated average asset lives and standard deviations' which are calculated in such a way as to give a similar (or lower) level of expenditure for the next regulatory period. The exact nature of this calculation (which we have referred to as the back-engineering of average asset lives) is unclear.

In essence, the calibrated model transplants a similar (or lower) level of REPEX from the previous regulatory period (2009-14) into the next regulatory period (2014-19) via changing the expected useful life and standard deviation assumptions for the assets in question, for those classes of assets that are modelled.

For most asset classes in ActewAGL Distribution's network, the amount of previous expenditure would not have been sufficient to stop the whole fleet of assets from continuing to age somewhat (approximately one and a half years on average across the 2009-14 period).

In order to justify this lower level of expenditure, and continued asset ageing, the AER has been required to 'back-engineer' the average asset class lives (and standard deviations) to make the level of expenditure look adequate into the future. In doing this the AER is forced to argue that:

> *"…a significant proportion of the asset population has survived longer than would be expected using ActewAGL Distributions data. The "survivor" assets have a material effect on the observed outcome. This outcome suggests that the base case replacement lives are shorter than those achieved in practice."*

These calibrated class lives are 'notional' or 'implied' class lives. In fact, because they are derived from each individual DNSP's RIN submissions, they will be different for each DNSP. We have compared the AER calibrated asset class lives between Ausgrid and ActewAGL Distribution, and found this to be the case.

For example, the AER calibrated life of some ActewAGL Distribution wood pole assets are listed as 71 years, whereas for Ausgrid they vary from 53.1 to 60.4 years. Regardless of which set of numbers one considers, there is no known analysis or study of wood poles which assigns such high average asset lives for standard classes of wood poles.

One also has to recognise that not all wood poles are of the same quality/standard. The electricity distribution industry has recognised for some years that the quality of wood poles delivered from suppliers over recent years has declined in standard and potential service life. In years gone by, there was a species of poles called 'regal species', which were of an extremely high quality of hardwood, and which were machined into an octagonal shape. Subsequently there was a species known as 'Ironbark', which also was of a higher quality. More recent species of poles include yellow gum and spotted gum, but these do not deliver the same length of service life as the earlier species.

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[7] AER 2014, *Draft Decision ActewAGL Distribution Determination: ActewAGL Distribution Determination*, Attachment 6, p6-62

It is possible that the longer average asset lives for wood poles in the AER's calibrated model are biased towards the lives experienced by these earlier high quality timber poles, but we cannot be certain of this. In any case, 60 to 70 year average lives, is not attainable for the majority of wood pole in service today.

The asset class lives derived in the calibrated model do not reflect any reasonable Australian electricity industry assessment of actual expected technical/economic life, except by pure coincidence that the actual expenditure in the previous regulatory period was reasonably close to the long term average needed.

For example, most DNSP's pole replacement programmes are run to a defined frequency of inspection, and a reasonably constant pole failure rate, and a defined reinforcement or replacement strategy. Therefore, what was reinforced (staked) or replaced in the last regulatory period, will be roughly the same as the next. (subject to some minor differences in the quantities of poles actually installed some 35 – 45 years ago).

The AER accepted ActewAGL Distribution's pole replacement strategy and forecast, which is based on a regimented pole inspection and treatment regime, and solid cost/benefit analysis of when to stake poles (vs replacing them), and when to replace HV wooden poles with concrete (street-side applications) or fibre-glass poles (LV) in rear-of-block situations.

However, underground cable replacement, and overhead structures in bushfire prone areas, does not follow a regular cyclical inspection and replacement program. Historically, there was not as much spent on these two classes of asset replacement  in the last regulatory period, and this should not be taken, as the calibrated model implies, as evidence that it is not required going forward into the next regulatory period.

The AER rejected ActewAGL Distribution's underground cable replacement forecast (a modelled asset class), and the conductor and overhead structures replacement forecast (an un-modelled asset class), on the basis that:

- In the case of the underground cable replacement, the AER observed that *"ActewAGL Distribution's practice has been to run underground cables to failure. It now intends to change its asset management strategy for HV underground cables, from 'run to failure', to condition monitoring with prioritised replacement. ActewAGL Distribution has not provided economic justification or cost – benefit analysis for this change in asset management strategy to support a significant increase in REPEX for this category."*

- In the case of the overhead conductors and pole top structures replacement, the AER observed that *"ActewAGL Distribution has not provided justification for an increase in expenditure for the first two programs"*, these being:

  - Rural pole top upgrade
  - Pole top hardware renewal/cross-arm replacement

ActewAGL Distribution have however provided detailed business cases for the justification of the change in strategy for the replacement of underground cables, and the overhead conductor and pole top structures (based on the outcomes of the 2009 Victorian Bushfire Commission findings), however since the REPEX funding requirements of these programs do not meet the 'backward looking' philosophy of the AER's REPEX calibrated model, they have been summarily rejected.

ActewAGL Distribution should request that the business cases for these two asset replacement programmes be given more serious consideration than just whether they are justified by 'past expenditure' under the AER calibrated model.

The table below shows the AER calibrated model outcomes, compared with ActewAGL Distribution's regulatory proposal for 2014-19.

Table 3 ActewAGL Distribution calibrated model outcomes

| ($ million) | Basis of the AER model | Calibrated model outcomes assessed by AER (2013/14 real$) | ActewAGL Distribution Regulatory Proposal (2013/14 real$) |
|---|---|---|---|
| Historical (2009-14) | • Uses calibrated lives and std. deviations based on ActewAGL Distribution replacement volumes in 2009-14<br>• Uses historical ActewAGL Distribution unit costs<br>• Uses different (generally lower) replacement quantities, as predicted by the model | $71.1 million | $92.4 million[8] |
| Forecast (2014-19) | • Uses calibrated lives and std. deviations based on ActewAGL Distribution replacement volumes in 2009-14<br>• Uses ActewAGL Distribution forecast unit costs<br>• Uses different (generally lower) replacement quantities, as predicted by the model | $76.1 million | $135.3 million[9] |

Table 4 below shows how the AER has arrived at the REPEX amount for its draft decision for ActewAGL Distribution, by combining the un-modelled REPEX amount (Table 1) with the calibrated REPEX forecast amount (Table 3).

Table 4 ActewAGL Distribution total REPEX

| ($ million) | AER Draft Decision (2013/14 real$) | ActewAGL Distribution Reg. Proposal (2013/14 real$) |
|---|---|---|
| • REPEX for modelled asset classes<br>• REPEX for un-modelled asset classes | $76.1 million<br><br>$22.5 million | -<br><br>- |
| | $98.6 million | $135.3 million |

## 1.4    The benchmarked model

For the purposes of this report it is best not to confuse the 'calibrated model' with the 'benchmark model', which applies average industry benchmark costs (benchmark first quartile, benchmark average, and benchmark lowest) to the quantities derived in the calibrated model.

The benchmark model was not used to arrive at the AER's recommended level of REPEX, but the AER have indicated in their draft decision that they may consider applying benchmark unit costs in the future.

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[8] ActewAGL Distribution 2014, *Regulatory Proposal 2014-19 Subsequent regulatory control period Distribution services provided by the ActewAGL Distribution electricity network in the Australian Capital Territory*, 2 June 2014 (resubmitted 10 July 2014), Table 7.2, p 157
[9] [9] ActewAGL Distribution 2014, *Regulatory Proposal 2014-19 Subsequent regulatory control period Distribution services provided by the ActewAGL Distribution electricity network in the Australian Capital Territory*, 2 June 2014 (resubmitted 10 July 2014), Table 7.6, p.169

## 2. Why do we consider that the AER's calibrated model is fundamentally flawed?

Jacobs fundamentally disagrees with the AER's premise that the future requirement for sustainable long term replacement expenditure on network assets can be predicted by looking at recent past expenditure. Such a premise assumes that the asset age profile characteristics, and asset condition and performance can be maintained ad-infinitum into the future with the same level of expenditure.

Such a proposition would only seem to be reasonable where a network had been in service for such a period of time that the average age of all classes of assets were approaching their average asset class lives, and where the replacement expenditure in the past, and in the future, were designed to maintain the average asset age at a stable level and approximately equal to the average asset class lives. In addition, such a proposition would have to assume that the network would have grown at a constant rate over time, with no peaks or troughs in investments in the past.

Some of the specific shortcomings that are evident with the AER REPEX model are:

- It is purely age based, and does not recognise other justifiable reasons for replacement, such as condition, serviceability, reliability, criticality, obsolescence, etc

- It fails to recognise where in the investment cycle each asset class sits, relative to the expected life of the asset class/type. ie, whether the asset class has a relatively young average age relative to its life-cycle, reflecting the period in time when it was introduced on the system, or whether it is a mature class of assets with a high average asset age, and an age profile or deteriorating asset condition/reliability, which requires increasing replacement expenditure

- It fails to respond to new and critical information about the ongoing serviceability and safety of certain asset classes. An example of this would be the findings and recommendations of the 2009 Victorian Bushfire Commission that certain types of equipment and components on overhead distributions lines can contribute to an increased risk of starting a bushfire

- Continuing to perpetuate an inadequate level of REPEX investment on the basis that *"if it was the level of investment that has been made in the recent past, it is therefore adequate for the immediate future"*. This simplistic approach fails to recognise that power systems in Australia will continue to age and deteriorate based on historical levels of inadequate REPEX ( ActewAGL Distribution's system has aged by approximately1.4 years in the past five years)

- By 'locking-in' the level of expenditure to the previous regulatory period, there is no flexibility to address new and emerging replacement needs

- The methodology used to construct the calibrated forecast results in the arbitrary 'back-engineering' of average asset class lives that in some cases bear no relevance to contemporary electricity industry asset life expectancy.

# 3.　　Other supporting opinion

The AER made reference in their ActewAGL Distribution draft decision document to concerns by Networks NSW regarding, the use of calibrated lives. These concerns were expressed in the report *"Networks NSW – REPEX Model Review "*

There are three key points to note from AER's response in their draft decision document in regard to the Networks NSW report[10].

Firstly, AER's reference to OFGEM:

*"After considering the concerns raised by NSW Networks, our view is that these concerns are unfounded. The model is based on well-established principles of probability and normal distribution. It has been used by the AER previously and has similar characteristics to the model used by OFGEM"*

It appears that the AER has attempted to 'force-fit' UK asset lives onto Australian DNSP's via the REPEX model. However, the 'reverse engineering' of the AER REPEX model appears to be much more arbitrary in its design and application, than the simple adoption of a fixed set of UK asset lives.

The determination of suitable average asset class lives in different countries is totally dependent upon the prevailing environmental conditions (eg, ambient summer and winter temperatures, wind speed, etc), asset management and maintenance practices, and the system security and planning criteria adopted within that country.

For example, it is well known that the sub-transmission and transmission system security criteria in the UK, is predominantly based on the N-2 criteria, whereas the N-1 criteria is more commonly used in Australia. In addition, the distribution system in the UK is generally designed to the N-1 criteria in urban areas, with a greater use made of distribution automation to automatically restore supply where full N-1 security is not available.

The differences between the UK and Australian system security and planning criteria, when combined with the more onerous ambient temperatures (particularly Australia's hotter summers) means that most electrical equipment on Australian distribution systems will be loaded to a higher level, on average, over the life of the asset. For many classes of assets, this higher level of electrical loading over the life of the asset will result in increased 'loss of life' through insulation degradation, etc.

In the case of asset management and maintenance practices, ActewAGL Distribution has adopted an asset management philosophy based on the PAS55 system, which has its origins in the UK.

Secondly:

*"We further note, as foreshadowed in the Explanatory Statement to our Guideline that we will use the REPEX model as a first pass model, in combination with other techniques. It is not used in isolation, but one of a number of analytical tools."*

In fact, the AER has taken the specific forecast from the calibrated model, added that to un-modelled assets, and that has become its draft decision.

Thirdly:

*"In this instance, for ActewAGL Distribution, the base case outcomes may be 'invalid' as NSW Networks might describe our findings, but nonetheless this assists us in narrowing the range of what is reasonable by assessing the robustness of the inputs used."*

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[10] AER 2014, *Draft Decision ActewAGL Distribution Determination: ActewAGL Distribution Determination:  Attachment 6*, p6-62.

The AER appear to acknowledge here that their base case outcomes for ActewAGL Distribution may be 'invalid', although they give no indication of why this may be. It is certainly Jacobs view that the differences between the AER base case outcomes, and the ActewAGL Distribution actuals (2009-14) and forecast (2014-19) as shown in

Table 2 above, indicate that the basis for calculation of the AER base case outcomes is seriously in error.

This overstatement of the AER base case outcomes has led the AER to conclude that ActewAGL had grossly overspent on REPEX in the previous regulatory period, thereby reducing the average age of assets. This is definitely not the case, and ActewAGL can demonstrate that the average age of its system assets has continued to increase by approximately 1.4 to 1.5 years over the past regulatory period.

Jacobs is of the view that the distorted picture presented by the AER's overstated base case model has corrupted the AER's analysis, and given them an incorrect perspective that ActewAGL Distribution has previously overspent on Repex.

This is clearly not the case, and when combined with the distortions caused to the average asset class lives in the calibrated model, results in an inadequate level of Repex being proposed in the draft decision document.

# 4. Specific examples of how the AER calibrated model has distorted ActewAGL Distribution's replacement forecast.

## 4.1 Overview

The outcomes of the AER's "base case" forecasts (which uses ActewAGL Distributions RIN input data) as per Table 2 above bear no resemblance to the expenditure of asset replacement work actually undertaken by ActewAGL Distribution in the period 2009-14.

The AER "calibrated model" derives its own Asset Life and Standard Deviation inputs using the historical asset replacement volumes provided by ActewAGL Distribution. It is not clear how, then the "calibrated model" used by the AER in reaching its draft decision on Repex for ActewAGL Distribution bears no resemblance to the actual amount of replacement expenditure required for the 2014-19 regulatory period.

Table 5 provides an overview of the variance in quantities between the ActewAGL Distribution forecast quantities for various asset categories, sourced from ActewAGL Distribution's RIN data and Subsequent Regulatory Proposal submission, compared with the forecast average annual replacement quantities generated by the AER calibrated model. The AER's historical and forecast base model quantities are also provided for reference

As can be seen, there are large unexplainable quantity variations in the categories of underground cables (-50%), service lines (-65%), transformers (+294%) and switchgear (+68%).

Variations of these magnitudes are not supported by the condition assessment analysis of these asset classes, as contained in ActewAGL's asset management systems and databases.

Table 5 Replacement quantities comparison

| Asset Category | ActewAGL Source Data: Historical (2009-14) Average Annual Replacement Quantity | | ActewAGL Source Data: Forecast (2014-19) Average Annual Replacement Quantity | | AER Base Historical Average Annual Replacement Quantity | AER Base Forecast Average Annual Replacement Quantity | AER Calibrated Forecast Average Annual Replacement Quantity | Variance AER Calibrated Forecast to AAD RIN (2014 – 19) | Variance AER Calibrated Forecast to AAD SRP (2014 – 19) |
|---|---|---|---|---|---|---|---|---|---|
| | RIN | SRP | RIN | SRP | | | | | |
| Poles ( Exc. Pole Staking) | 839 | NA | 823 | 801 | 853 | 853 | 718 | -13% | -10% |
| Underground cables | 1.7 | NA | 9 | 6 | 88 | 88 | 3 | -67% | -50% |
| Service lines | 332 | NA | 231 | 231 | 87 | 87 | 80 | -65% | -65% |
| Transformers | 29 | NA | 17 | 17 | 50 | 50 | 67 | 294% | 294% |
| Switchgear | 47 | NA | 44 | 44 | 385 | 385 | 74 | 68% | 68% |

The three main asset categories impacted by the calibrated model approach are underground cables, transformers and switchgear. Along with poles, these asset categories generally represent the higher ranking cost categories of replacement expenditures. In ActewAGL Distribution's case they make up the majority of the replacement forecast.

With underground cables and switchgear, the replacement volumes derived for the calibrated model have been reduced significantly while higher volumes of transformer replacements are proposed. Although not evident

from a high level assessment, pole replacements have also been impacted significantly and demonstrate some of the fundamental issues with the calibrated model.

The AER's approach in deriving a calibrated replacement volume for the calibrated forecast expenditure considers the actual replacement volumes achieved over the most recent five years and then adjusts the asset replacement life for the specific asset category until the forecast replacement volume reflects the historically achieved volumes.

The main asset categories impacted by the calibrated model approach are assessed further in the sections below.

Some of the key issues identified are the following:

- The calibrated model is flawed in that historical replacement volumes do not necessarily reflect ongoing or forecast replacement requirements and strategies. For example:

  - The calibrated model proposes a significant reduction in the replacement of wood poles and an increase in wood pole staking, which does not reflect ActewAGL Distribution's strategy and cost/benefit analysis for pole staking/pole replacement. AER have separately indicated their acceptance of the ActewAGL Distribution pole staking/replacement strategies

  - The calibrated model proposes a significant reduction in replacement volumes for medium and low voltage cables. This is contrary to ActewAGL Distribution's strategy for the replacement of oil filled cable pot heads, and a condition based inspection and replacement program for 11 kV cables

- The calibrated model adopts asset replacement lives that in some cases materially exceeds industry experience, and is not aligned with the practices of a responsible network operator. For example wood poles – 71 years, underground cables – 89 years, pole mounted transformers – 60 years

- The method by which asset replacement volumes are derived is flawed in that it does not account for sound engineering interpretation. For example:

  - The model proposed an increase in asset replacement volumes for steel and concrete poles while the average asset ages for these categories are only 14 and 16 years respectively

  - The model also proposes an increase in the volume of high voltage cable replacements (66 kV and 132 kV), which ActewAGL Distribution has not identified as a critical asset management requirement

## 4.2 Poles

Table 6 provides a summary of the Base Model Replacement volumes and lives in comparison with the calibrated model.

Table 6 Pole replacement comparison

| Asset Category | AER Base Historical Replacement Quantity | AAD Historical & Forecast Replacement Life | AER Calibrated Replacement Quantity | AER Calibrated Replacement Life | Jacobs Industry Experience | Jacobs Comments |
|---|---|---|---|---|---|---|
| | Average Annual | Mean | Average Annual | Mean | Mean | |
| Poles - staking of a wooden pole | 745 | 15 | 826 | 13.9 | - | AER calibrated life appears reasonable compared to AAD replacement life |
| Poles - <=1 kV; wood | 457 | 42 | 268 | 71 | 45-50 | AER calibrated life is materially higher than AAD life and industry average life, and could distort forecast expenditure. |

| Asset Category | AER Base Historical Replacement Quantity | AAD Historical & Forecast Replacement Life | AER Calibrated Replacement Quantity | AER Calibrated Replacement Life | Jacobs Industry Experience | Jacobs Comments |
|---|---|---|---|---|---|---|
| | Average Annual | Mean | Average Annual | Mean | Mean | |
| Poles - >1 kV and <=11 kV; wood | 179 | 42 | 113 | 71 | 45-50 | AER calibrated life is materially higher than AAD life and industry average life, and could distort forecast expenditure. |
| Poles - >11 kV and <=22 kV; wood | 2 | 42 | 2 | 44.5 | 45-50 | AER calibrated life appears reasonable compared to AAD replacement life. |
| Poles - >22 kV and <=66 kV; wood | 1 | 45 | 1 | 70.8 | 45-50 | AER calibrated life is materially higher than AAD life and industry average life. |
| Poles - >66 kV and <=132 kV; wood | 6 | 45 | 11 | 37.3 | 45-50 | AER calibrated life is lower than AAD life and industry average life. . |
| Poles - <=1 kV; concrete | 14 | 60 | 71 | 46.7 | 55-60 | AAD ASP nominates the current average age of the concrete pole population is 16 years, which suggests an increase in replacement volume is questionable. AER calibrated life is lower than AAD life and industry average life. |
| Poles - >1 kV and <=11 kV; concrete | 7 | 60 | 26 | 48.9 | 55-60 | AER calibrated life is lower than AAD life and industry average life. |
| Poles - >11 kV and <=22 kV; concrete | 0.03 | 60 | 0.21 | 44.5 | 55-60 | AER calibrated life is lower than AAD life and industry average life. |
| Poles - >22 kV and <=66 kV; concrete | 0.02 | 60 | 0.05 | 43.6 | 55-60 | AER calibrated life is lower than AAD life and industry average life. |
| Poles - >66 kV and <=132 kV; concrete | 4 | 60 | 24 | 38.7 | 55-60 | AER calibrated life is lower than AAD life and industry average life and could distort forecast expenditure. |
| Poles - <=1 kV; steel | 5 | 60 | 29 | 45.6 | 60 | AER calibrated life is lower than AAD life and industry average life and could distort forecast expenditure. |
| Poles - Other - stobie and fibreglass | 18 | 60 | 18 | 60 | - | No change. |

The following observations demonstrate some of the key issues identified in the approach of the calibrated model.

- The AER calibrated model proposes an increase in the replacement volumes for steel and concrete poles, with a significant reduction in the replacement of wood poles and an increase in wood pole staking.

- The calibrated model adopts a mean replacement life of 71 years for wood poles which is excessive when considering that typical wood pole asset lives observed in the industry are 45 years. The replacement life nominated by the AER model is more likely to be a potential maximum life

- The average age of steel and concrete poles in the ActewAGL Distribution network is around 14 years and 16 years respectively and an increase in replacement volumes as proposed by the calibrated model does not appear sensible. The derived replacement volumes are the result of a reduction in asset replacement lives proposed for these asset classes and are generally between 20% and 36% lower than typical industry lives

The calibrated model is flawed in that historical replacement volumes do not necessarily reflect ongoing or forecast replacement requirements and strategies. Adopting asset replacement lives that exceeds industry experience is not the approach of a responsible network operator.

## 4.3    Underground cables

Table 7 provides a summary of the base model replacement volumes and lives in comparison with the calibrated model.

Table 7 Underground cable replacement comparison

| Asset Category | AER Base Historical Replacement Quantity | AAD Historical & Forecast Replacement Life | AER Calibrated Replacement Quantity | AER Calibrated Replacement Life | Jacobs Industry Experience | Comments |
|---|---|---|---|---|---|---|
| | Average Annual | Mean | Average Annual | Mean | Mean | |
| Underground cables - <=1 kV | 38 | 0 | 3 | 88.5 | 60 | AER calibrated life is materially higher than AAD maximum potential life (65 years) and industry average life and could distort forecast expenditure.The significant reduction in replacement volumes is contrary to ActewAGL Distribution's strategy for replacing potheads on oil filled cables. |
| Underground cables - >1 kV and <=11 kV | 16 | 40 | 2 | 89.5 | 60 | AER calibrated life is materially higher than AAD life and industry average life. |
| Underground cables - >11 kV and <=22 kV | 0.1 | 50 | 0.1 | 66.5 | 60 | AER calibrated life is materially higher than AAD life and industry average life. |
| Underground cables - >66 kV and <=132 kV | 0.0004 | 0 | 0.0022 | 45.1 | 60 | AER calibrated life is materially lower than AAD maximum potential life (65 years) and industry average life. |

The following observations demonstrate some of the key issues identified in the approach of the calibrated model.

- The AER calibrated model proposes a significant reduction in replacement volumes for medium and low voltage cables. This is contrary to ActewAGL Distribution's strategy for the replacement of oil filled cable pot heads, and a condition based inspection and replacement program for 11 kV cables

- The calibrated model adopts a mean replacement life of around 89 years for underground cables which is excessive when considering that typical underground cable asset lives observed in the industry are 60 years. The replacement life nominated by the AER is more likely to be a potential maximum life

- The model also proposes an increase in the volume of high voltage cables, which ActewAGL Distribution has not identified as a critical asset management need

The model does not appear to allow for assessment and adjustments in replacement strategy and assumes that the investment drivers will remain the same for the next regulatory period and beyond.

## 4.4    Distribution transformers

Table 8 provides a summary of the base model replacement volumes and lives in comparison with the calibrated model.

Table 8 Transformer replacement comparison

| Asset Category | AER Base Historical Replacement Quantity | AAD Historical & Forecast Replacement Life | AER Calibrated Replacement Quantity | AER Calibrated Replacement Life | Jacobs Industry Experience | Comments |
|---|---|---|---|---|---|---|
| | Average Annual | Mean | Average Annual | Mean | Mean | |
| Transformers - pole mounted; <=22 kV; <=60 kVA; single phase | 2 | 0 | 3 | 52.4 | 40-45 | AER calibrated life is materially higher than industry average life. |
| Transformers - pole mounted; <=22 kV; >60 kVA and <=600 kVA; single phase | 0.01 | 0 | 0.01 | 48.7 | 40-45 | AER calibrated life is higher than industry average life. |
| Transformers - pole mounted; <=22 kV; <=60 kVA ; multiple phase | 2 | 55 | 1 | 59.4 | 40-45 | AER calibrated life is higher than AAD life and industry average life. |
| Transformers - pole mounted; <=22 kV; >60 kVA and <=600 kVA; multiple phase | 13 | 55 | 21 | 45.4 | 40-45 | AER calibrated life is comparable to industry average life, and lower than the AAD life. |

| Asset Category | AER Base Historical Replacement Quantity | AAD Historical & Forecast Replacement Life | AER Calibrated Replacement Quantity | AER Calibrated Replacement Life | Jacobs Industry Experience | Comments |
|---|---|---|---|---|---|---|
| | Average Annual | Mean | Average Annual | Mean | Mean | |
| Transformers - kiosk mounted; <=22 kV; <=60 kVA; multiple phase | 0.1 | 50 | 0.1 | 50.0 | 40-45 | AER calibrated life is comparable to AAD life, and higher than the industry average life. |
| Transformers - kiosk mounted; <=22 kV; >60 kVA and <=600 kVA; multiple phase | 42 | 50 | 52 | 47.0 | 40-45 | AER calibrated life is reasonable in comparison to the AAD life and the industry average life. |
| Transformers - kiosk mounted; <=22 kV; >600 kVA; multiple phase | 2 | 50 | 3 | 39.1 | 40-45 | AER calibrated life is materially lower than the AAD life, and lower than the industry average life. This could ditort the forecast expenditure. |
| Transformers - ground outdoor/indoor chamber mounted; <22 kV; >60 kVA and <=600 kVA; multiple phase | 5 | 50 | 7 | 46.7 | 40-45 | AER calibrated life is reasonable in comparison to the AAD life and the industry average life. |
| Transformers - ground outdoor/indoor chamber mounted; <22 kV; >600 kVA; multiple phase | 9 | 50 | 4 | 55.9 | 40-45 | AER calibrated life is materially higher than the AAD life and industry average life, and could distort the forecast expenditure. |
| Transformers - ground outdoor/indoor chamber mounted; >=22 kV and <=33 kV; <=15 MVA | 0.03 | 50 | 0 | 62.0 | 40-45 | AER calibrated life is materially higher than the AAD life and industry average life. |

The following observations demonstrate some of the key issues identified in the approach of the Calibrated Model.

- The replacement lives adopted in the calibrated model are the same or lower than the historical lives proposed by ActewAGL Distribution, however, the replacement lives, especially for pole mounted transformers are much longer than what industry experience suggests is reasonable.

- The model does not apply industry experience to assess the asset lives and appears to accept the increased asset lives without question

- The derived replacement volumes are generally higher than proposed in the ActewAGL Distribution forecast and is a function of the lower asset replacement lives adopted in the calibrated model in comparison with the ActewAGL Distribution replacement lives

## 4.5    Distribution switchgear

Table 6Table 9 provides a summary of the base model replacement volumes and lives in comparison with the calibrated model.

Table 9 Switchgear replacement comparison

| Asset Category | AER Base Historical Replacement Quantity | AAD Historical & Forecast Replacement Life | AER Calibrated Replacement Quantity | AER Calibrated Replacement Life | Jacobs Industry Experience | Comments |
|---|---|---|---|---|---|---|
| | Average Annual | Mean | Average Annual | Mean | Mean | |
| Switchgear - >11 kV and <=22 kV; circuit breaker | 0.1 | 35.0 | 0.2 | 48.0 | 40-45 | AER calibrated life is materially higher than the AAD life and industry average life, and could distort the forecast expenditure. |
| Switchgear - >11 kV and <=22 kV; switch | 0.5 | 0.0 | 0.1 | 55.3 | 35-45 | AER calibrated life is materially higher than the industry average life, and could distort the forecast expenditure. |
| Switchgear - <=11 kV; circuit breaker | 7 | 0.0 | 5 | 62.1 | 40-45 | AER calibrated life is materially higher than the industry average life, and could distort the forecast expenditure. |
| Switchgear - <=11 kV; switch | 204 | 0.0 | 78 | 63.6 | 35-45 | AER calibrated life is materially higher than the industry average life, and could distort the forecast expenditure. |
| Switchgear - <=11 kV; fuse | 9 | 0.0 | 14 | 25.2 | 35-45 | AER calibrated life is materially lower than the industry average life. |

The following observations demonstrate some of the key issues identified in the approach of the calibrated model.

- No replacement lives were nominated by ActewAGL Distribution. It is unclear how the asset lives adopted in the calibrated model were determined, and the adopted lives are generally much longer than what industry experience suggest.

    The replacement lives adopted in the model are not reflective of industry experience.

- The replacement volumes derived in the calibrated model are generally much lower than those proposed by ActewAGL Distribution

The calibrated model adopts asset lives that are not reflective of industry experience.