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Revised Regulatory Submission for period 2021/22 to 2025/26

POWERCOR - REVIEW OF ASPECTS OF PROPOSED WOOD POLE REPLACEMENT

Report prepared for:

AUSTRALIAN ENERGY REGULATOR

February 2021

Preface

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be applied to the prescribed distribution services of Powercor from 1st July 2021 to 30th June 2026. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER). This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods.

This report relies on information provided to EMCa by AER/Powercor. EMCa disclaims liability for any errors or omissions, for the validity of information provided to EMCa by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose.

In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments. EMCa's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided to EMCa prior to 12 February 2021 and any information provided after this time may not have been taken into account.

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ABBREVIATIONS

Term	Definition
ACS	Added Control Serviceable
AER	Australian Energy Regulator
AFAP	As Far As Practicable
AGL	Above Ground Line
Capex	Capital expenditure
CBA	Cost Benefit Analysis
CCA	Chromated Copper Arsenate
DNSP	Distribution Network Service Provider
ENA	Electricity Networks Association
EPC	Enhanced Pole Calculator
EDPR	Electricity Distribution Price Review
ERP	Enterprise Resource Planning
ESMS	Electricity Safety Management Scheme
ESV	Energy Safe Victoria
GL	Ground Line
GWT	Good Wood Thickness
LSD	Limit State Design
NDI	Non-Destructive Inspection
NEM	National Electricity Market
NER	National Electricity Rules
NSP	Network Service Provider
opex	Operating expenditure
PAL	Powercor
RCP	Regulatory Control Period
repex	Replacement (capital) expenditure
RP	Regulatory Proposal
RRP	Revised Regulatory Proposal
S1	Strength class 1
S2	Strength class 2
S3	Strength class 3
S4	Strength class 4
S6	Strength class 6

Term	Definition
SAMC	Strategic Asset Management Committee
SAP	Systems, Applications, and Products in Data Processing
SDD	Sound Dig and Drill
SI	Serviceability index
SW	Sound Wood
SWT	Sound Wood Thickness
US	Unserviceable

EXECUTIVE SUMMARY

Scope of our review

1. The AER has requested that EMCa advise on the reasonableness of the methods that Powercor has applied to determine the compliance driven–measured condition component of its proposed pole intervention volume. Specifically, AER has asked EMCa to advise whether those methods (as presented) as applied by Powercor are likely to result in an intervention volume forecast that meets the requirements of the NER.

Basis for our assessment

2. Under the propose/respond regulatory model in place in the NEM, the onus is on Powercor as the Network Service Provider (NSP) to present clear, consistent and compelling information and evidence to the AER and its consultants in support of its proposed capex allowance and included projects and programs. The regulatory review process also provides for the opportunity to review and respond to the AER's Draft Decision and matters raised in reports provided to the AER. To the extent that the regulatory review process concluded that Powercor did not provide sufficient information to support its original proposal, or that the proposal was in part or in full not considered to meet the requirements of the capex criteria, Powercor has had the further opportunity to provide such additional information as it deems necessary and/or appropriate through its revised proposal.
3. Powercor submits that its revised proposal has relied on updated methods that have been developed with, and in response to, an investigation of wood pole management undertaken by ESV and the recommendations provided therein. We have not been requested to assess whether the revised proposal has adequately addressed the concerns raised in the investigation by ESV, nor as stated above, the original proposal.
4. Powercor has undertaken a bottom-up forecast for the intervention volumes included in its revised proposal for wood pole management, and which it has characterised as 'compliance driven' in accordance with its own assessment against either sound wood or serviceability thresholds determined by its wood pole management policies and practices.
5. In accordance with our scope, we have assessed the methods that Powercor has applied to determine a component of its proposed intervention volumes. We have not been asked to review or advise on a prudent and efficient intervention volume. Similarly, we have not been asked to review or advise on an efficient level of expenditure for wood pole management, nor any component of wood pole replacement as a part of Powercor's revised proposal.

Our approach

6. We first reviewed the composition of the revised compliance-driven measured condition intervention volume forecast to understand the forecasting method applied by Powercor, and specifically any trends and variances compared to the original proposal and the AER's Draft Decision.
7. In accordance with the scope of this report, we then reviewed a copy of the Pole trial Enhanced Pole Calculator (EPC) model as a representation of the EPC and approach applied by Powercor to the pole population to determine the intervention volume included in its revised proposal. Specifically, to address the key assessment factors nominated by the AER, we sought to determine whether the forecasting method applied by Powercor is consistent with the capex criteria in the NER.
8. We reviewed the inputs, assumptions and outputs of the Pole trial EPC, based on information provided by the AER. This approach relied on the information provided by

Powercor in its revised proposal, and responses to requests for information provided to the AER and which the AER made available to EMCa. The information relied upon in our review is listed in Appendix A. Accordingly, we have relied on this material to assess the extent to which Powercor's revised proposal meets the NER expenditure criteria. We are of the view that the onus is on the NSP, and not the AER and/or its technical consultant(s), to provide sufficient information and evidence for this. review.

9. We have also considered the guidance material available to Powercor to provide the necessary evidence to support its revised proposal, including as published by the AER and Energy Safe Victoria (ESV), as relevant.

What Powercor has proposed

For its revised proposal, Powercor has updated its forecasting methodology

10. In preparing its revised forecast, Powercor has made several methodology updates which include taking account of calibration and testing of its EPC and removing poles less than 30 years old from its intervention volume forecast.

Powercor has forecast fewer interventions overall, but its forecast for compliance driven measured condition interventions is higher

11. In its revised proposal, Powercor has proposed 28% fewer interventions than in its original proposal for wood pole management overall, but with an increased proportion being replaced (as represented by a decrease in the corresponding reinforcement rate from 48% to 38%). While less than in its original proposal, Powercor's proposed interventions nevertheless represent a substantial increase relative to the intervention volumes that it has achieved on average over the current and previous RCP.

12. For the compliance-driven measured condition component of its revised proposal, Powercor's proposed intervention volumes are derived from its Enhanced Pole Calculator, and which it identifies as being 'compliance-driven'. The forecast intervention volume resulting from Powercor's application of this method for this compliance-driven measured condition component of its overall forecast, is around 25% greater than Powercor had included in its original proposal.

Summary of findings

The Pole trial EPC is maturing and is likely be a useful tool, but at its current stage of development there are a number of issues

13. We consider that the Pole trial EPC is an improvement on the methods previously applied by Powercor to assess the serviceability of its pole population. We expect that the EPC should in future, as it is progressively refined and calibrated, be a useful operational tool and serve as a useful input to development of reasonable forecasts of wood pole intervention volume requirements. However, at the current stage of development of the Pole trial EPC, we have observed a number of issues in the underlying data and in the application of its Pole trial EPC. These include:

    - gaps in measurement data, which translate inappropriately to values of zero Serviceability Index and which result in an intervention earlier than may be prudent to do so;
    - applying Ground Line criteria for reinforced poles, thereby ignoring the structural benefit provided by the reinforcement stake, and which similarly result in an intervention that may be earlier than is otherwise prudent to undertake;

- an assumed reinforcement rate that has been limited to that which Powercor has historically undertaken, and not demonstrated as being reflective of an efficient level; and
- results of Powercor's own destructive testing which indicate a three-fold increase in the classification of unserviceable poles by the Pole trial EPC compared with the actual measured condition.

The current issues make this model unsuitable for sole and unadjusted reliance in producing a forecast that meets the capex criteria of the NER

14. In our opinion, the nature of the issues we have identified reflect a level of conservatism that when reflected in the sole forecasting method applied by Powercor are likely to:
    - result in a higher estimate of the number of poles deemed 'unserviceable' than Powercor may actually treat; and
    - limit the opportunity for higher levels of reinforcement than Powercor has proposed.
15. From our experience of reviewing regulatory proposals for network businesses, it is common to see evidence of application of more than one forecasting method, or as a minimum, reasons why the forecasting method applied has determined that the proposed volume is prudent and efficient. This is reflected in the requirements of the NER, and guidance material that is available to Powercor in developing its revised proposal. Powercor has also not provided a cost benefit analysis, or evidence of a quantified risk assessment to demonstrate that the most beneficial option has been proposed. Absent the inclusion of other methods to validate and provide greater confidence in the results of the Pole trial EPC, and the underlying data that the Pole trial EPC relies upon, Powercor's sole reliance on the model yields results with a conservative bias.
16. Whilst it is not possible to determine whether the total forecast intervention volume reasonably reflects the capex criteria from a review of one component only, we consider that the Pole trial EPC is not sufficiently developed to meet the requirements of, or reasonably reflect the capex criteria as a sole forecasting method for the component of the forecast we were asked to review.

1 INTRODUCTION

1.1 Scope and approach

1.1.1 Requested scope

17. This report provides our assessment of a certain aspect of Powercor's revised proposal for wood pole interventions, involving the forecasting methods that the business has used to establish the proposed volume.

18. The AER has requested that we have regard to the following assessment factors:

(i) Is the underlying pole population data sufficiently robust to form the basis of the forecast?

(ii) Is the enhanced pole calculator (EPC) fit for use as a forecasting tool in its current stage of development?

(iii) Are Powercor's assumptions sound, including assumptions applied:

a. to the underlying pole data (including any data cleansing process or process of substituting or filling in any missing data)

b. in the EPC (in particular, the wood fibre strength age factor)

c. on decay rates to forecast future pole condition (including applying the decay rate through to the end of the next RCP to all poles), and

d. to forecast staking rates.

(iv) Is the calibration of the EPC (in particular, the serviceability index threshold) reasonable given its application in producing the volume forecast?

(v) In the absence of cost-benefit analysis, does Powercor's volume forecasting methodology reasonably reflect the capex criteria?

19. Our report addresses each of these assessment factors, focussing on whether the methods applied by Powercor to determine the compliance-driven measured condition component of the forecast wood pole intervention volume are reasonable.

1.1.2 Matters arising from scope of review

20. In accordance with the scope of this report, we have reviewed:

- information provided by the AER, as listed in Appendix A; and
- a copy of the Pole trial Enhanced Pole Calculator (EPC) model as a representation of the EPC and approach applied by Powercor to the pole population to determine the intervention volume included in its revised proposal.

21. We have reviewed the compliance-driven measured condition component of the forecast intervention volume only. Accordingly, all findings relate to this component of the forecast intervention volume and may not be directly related to other components of the forecast intervention volume. We have not been asked to independently review or audit the operation of the Pole trial EPC model used by Powercor, rather to focus the review on the inputs, outputs and methodology as described by Powercor.

22. We have relied on advice provided by the AER, including but not limited to the operation of the Pole trial EPC model and the AER's representations of the formulas in the Pole trial EPC model.

23. We have not been asked to review or to independently determine a prudent and efficient level of expenditure for wood pole management, or any component of the revised proposal.

1.1.3 Approach steps

24. In undertaking our assessment, we firstly reviewed the composition of the revised forecast compliance-driven measured condition intervention volume forecast.

25. We then reviewed the input assumptions, methodology and outputs from the Pole field trial EPC model.

26. Finally, we considered the factors described by the AER in preparing our assessment and findings.

1.2 This report

1.2.1 Structure of this report

27. The items within our scope are covered as follows:

- In section 2, we provide an overview of the composition of the revised proposed intervention volume that we have been asked to assess;
- In section 3, we provide the results of our review of the assessment factors nominated by the AER and relevant aspects of forecasting methodologies; and

28. In Appendix A, we provide contextual information we have relied upon in assessing the forecast compliance-driven measured condition intervention volume component of Powercor's revised pole replacement program.

1.2.2 Definitions

29. Powercor has used the terms 'original proposal' and 'revised proposal' to indicate the Regulatory Proposal (RP) and Revised Regulatory Proposal (RRP) submissions that it has provided to the AER, respectively. For clarity, we have adopted Powercor's terms in our report.

1.3 Assessment framework

1.3.1 NER Capex Objectives and Criteria

30. In undertaking our review, we have been cognisant of the relevant aspects of the NER under which the AER is required to make its determination. The most relevant aspects of the NER are the 'capital expenditure criteria' and the 'capital expenditure objectives'. Specifically, the AER must accept the DNSP's capex proposal if it is satisfied that the capex proposal reasonably reflects the capital expenditure criteria, and these in turn reference the capital expenditure objectives.

31. We have taken particular note of the following aspects of the capex criteria and objectives:

- Drawing on the wording of the first and second capex criteria, we interpret this for this review as encompassing the extent to which the need for a project or program has been prudently established and the extent to which the proposed solution can be considered to be an appropriately justified and efficient means for meeting that need;
- The capex criteria require that the forecast '*reasonably reflects'* the expenditure criteria and in the third criterion, we note the wording of a '*realistic expectation'* (emphasis added). In our review we have sought to allow for a margin around what we consider to be reasonable and realistic, and we have formulated negative findings where we consider that a particular aspect is outside of those bounds;

- We tend towards a strict interpretation of compliance (under the second capex objective), with the onus on the DNSP to evidence specific compliance requirements rather than to infer them; and
- We note the word '*maintain*' in capex objectives 3 and 4 and, accordingly, we have for this review sought evidence that the DNSP has demonstrated that it has properly assessed the proposed program as being required to reasonably maintain, as opposed to enhancing or diminishing, the aspects referred to in those objectives.

32. The NER's capex criteria and capex objectives are reproduced below.

NER capital expenditure criteria

(c) The AER must:

(1) subject to subparagraph (c)(2), accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (the capital expenditure criteria):

(i) the efficient costs of achieving the capital expenditure objectives;

(ii) the costs that a prudent operator would require to achieve the capital expenditure objectives; and

(iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.

Source: NER 6.5.7(c) Forecast capital expenditure, v111

NER capital expenditure objectives

(a) A building block proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Distribution Network Service Provider considers is required in order to achieve each of the following (the capital expenditure objectives):

(1) meet or manage the expected demand for standard control services over that period;

(2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;

(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:

(i) the quality, reliability or security of supply of standard control services; or

(ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent:

(iii) maintain the quality, reliability and security of supply of standard control services; and

(iv) maintain the reliability and security of the distribution system through the supply of standard control services; and

(4) maintain the safety of the distribution system through the supply of standard control services.

Source: NER 6.5.7(a) Forecast capital expenditure, v111

1.3.2 AER capex assessment outline

33. We are also cognisant of the relevant aspects of the capex assessment outline for electricity distribution determinations published by the AER. [1]

34. We have taken particular note of the principles identified by the AER, as reproduced below.

[1] AER capex assessment outline | electricity distribution determinations, February 2020

Assessment principles

The assessment principles we have regard to include:

- *validity: the technique must be appropriate for what is being assessed in terms of accounting for the appropriate factors and using reliable data*
- *accuracy and reliability: the technique should produce unbiased and consistent results under similar conditions*
- *robustness: robust techniques demonstrate completeness and remain valid under different assumptions, parameters and initial conditions*
- *transparency: techniques should be able to be tested to assess the results in the context of the underlying assumptions, parameters and conditions*
- *parsimony: techniques with fewer free parameters that measure equally against other principles are typically preferred*
- *fitness for purpose: the technique should be appropriate for the task and reasonably reflect the expenditure criteria.*

When assessing capex forecasts, we also consider that:

- *the prudency and efficiency criteria in the NER are complementary. Prudent and efficient expenditure reflects the lowest long-term cost to consumers for the most appropriate investment or activity required to achieve the expenditure objectives*
- *past expenditure was sufficient for a distributor to manage and operate its network in previous periods, in a manner that achieved the capex objectives*

Source: AER capex assessment outline | electricity distribution determinations, February 2020

35. Whilst our scope of work does not require us to form a view of the prudent or efficient cost of the revised proposal, we have been asked to consider whether the revised proposal reflects an efficient option, specifically with regards to the intervention option of replacement versus reinforcement of a wood pole.

36. We refer also to the AER's specific guidance on making a decision in relation to proposed capex by DNSPs (shown below) and have considered the extent to which Powercor has adequately justified the methods relied upon in determining the proposed intervention volume, and whether this method, in absence of an economic analysis, is in accordance with the capex criteria and objectives.

Making a decision

When making a decision, we require a range of data to support our assessment of total forecast capex. We expect distributors to submit regulatory proposals that include:

- *economic analysis demonstrating the forecast expenditure is prudent and efficient. This should include documentation and underlying data sufficient to support the economic analysis*
- *reasons for new programs or higher costs compared with historical expenditure*
- *explanations of trade-offs between capex and opex to demonstrate that the preferred option is prudent and efficient (e.g. a capex ICT program to reduce opex). A distributor will also need to demonstrate that it has fully accounted for any benefits in its capex and opex forecasts (e.g. a negative step-change).*

Without adequate economic justification, we may conclude that the distributor's forecast expenditure is not prudent and efficient. A distributor must demonstrate that it is making expenditure decisions under a quantitatively-based economic framework, consistent with minimising the long-run cost of achieving the expenditure objectives.

Source: AER capex assessment outline | electricity distribution determinations, February 2020

2 BACKGROUND INFORMATION

In its revised proposal, Powercor has proposed 28% fewer interventions than in its original proposal for wood pole management overall, but with an increased proportion being replaced (as represented by a decrease in the corresponding reinforcement rate from 48% to 38%). While less than in its original proposal, Powercor's proposed interventions nevertheless represent a substantial increase relative to the intervention volumes that it has achieved on average over the current and previous RCP.

For the compliance-driven measured condition component of its revised proposal, Powercor's proposed intervention volumes are derived from its Enhanced Pole Calculator, and which it identifies as being 'compliance-driven'. The forecast intervention volume resulting from Powercor's application of this method for this compliance-driven measured condition component of its overall forecast, is around 25% greater than Powercor had included in its original proposal.

2.1 Introduction

37. This section provides a high-level overview of Powercor's revised proposal for wood pole intervention volumes, and how this compares to the AER's Draft Decision and Powercor's original proposal. This section also compares the forecasting methods applied by Powercor in its original proposal and revised proposal, as context for the assessment that follows in section 3 of this report.

2.2 Overview of Powercor's revised proposal for wood poles

2.2.1 Total intervention volume

38. In its revised proposal, Powercor has proposed a revised wood pole intervention volume of 28,352 poles over the five-year RCP, or an annual average of 5,670 poles.[2] This reflects a reduction of 28% compared with its original proposal.

39. The forecast is comprised of three components, two of which Powercor has described as compliance-based to meet its safety obligations, as shown in the table below. Powercor's forecast of its compliance-driven measured condition volumes has increased by 26% compared with its original proposal.

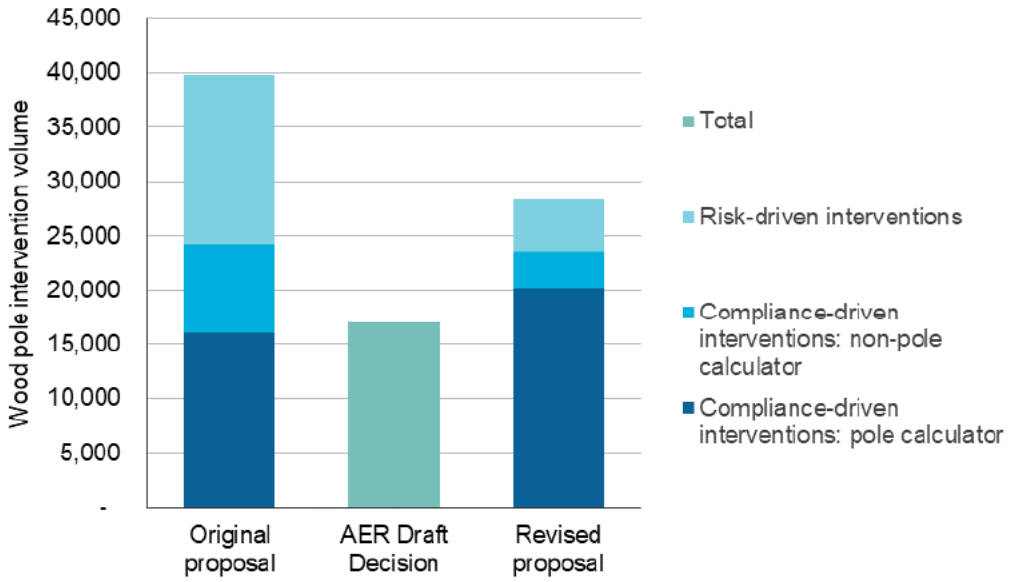
[2] The data relied upon in this report does not include fault-driven wood pole replacements.

Table 2.1: Comparison of Powercor's forecast total wood pole interventions for next RCP

Forecasting component	Original proposal	AER Draft Decision	Revised proposal
Compliance-driven interventions: measured condition (pole calculator)	15,983		20,117
Compliance-driven interventions: observed condition (non-pole calculator)	8,231		3,479
Risk-driven interventions	15,556		4,756
Total	**39,770**	**16,969**	**28,352**

Source: Powercor Business Case BUS4.02 Pole replacement forecast Dec2020, Table 1.1

Figure 2.1: Comparison of total wood pole interventions for next RCP



Source: Powercor Business Case BUS4.02 Pole replacement forecast Dec2020, Table 1.1

40. The ratio of total reinforcement to total wood pole interventions for the forecast is 38% and is a reduction from the 48% forecast reinforcement rate in Powercor's original proposal.

Table 2.2: Composition of total intervention volume for next RCP in Powercor's revised proposal

Volumes	Replace	Reinforce	Total
Compliance-driven: measured condition (pole calculator)	14,000	6,117	20,117
Compliance-driven: observable defects (non-pole calculator)	3,479	-	3,479
Risk-driven	35	4,721	4,756
Total	**17,514**	**10,838**	**28,352**

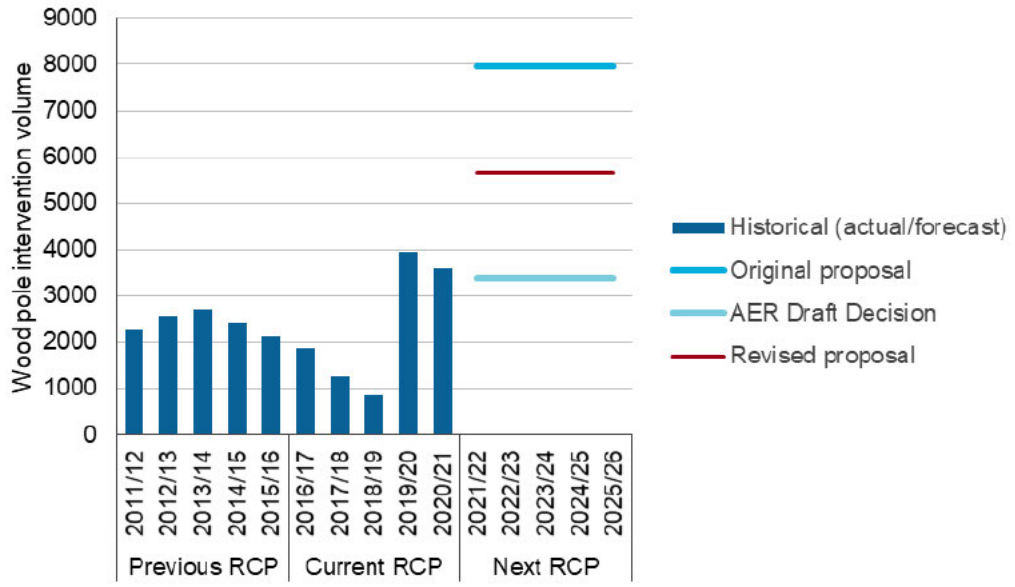
Source: Powercor RRP MOD 4.15 – Pole summary Dec2020

2.2.2 Trend of wood pole interventions

41. In the figure below, we compare Powercor's proposed total wood pole interventions relative to the historical total wood pole interventions for the previous and current RCPs. Despite the reduction from its original proposal, Powercor nevertheless proposes a significant increase in the total wood pole interventions volume compared to its historical levels. As is shown in this graph, the intervention volume implied by the AER's Draft Decision would also

be considerably greater than Powercor's historical average taken over the current and previous RCPs.

Figure 2.2: Comparison of total wood pole interventions for previous, current and next RCP



Source: EMCa analysis of Powercor Business Case BUS4.02 Pole replacement forecast Dec2020, and information provided by Powercor with its original proposal

2.3 Revised compliance-driven measured condition intervention volume

2.3.1 Overview

42. The composition of the compliance-driven measured condition volume forecast is shown in the table below.

Table 2.3: Composition of the revised compliance-driven: measured condition intervention volume for next RCP

Asset category	Replace	Reinforce	Total
Staking of a wooden pole	-	6,117	6,117
< = 1 kV; Wood	5,051	-	5,051
> 1 kV & < = 11 kV; Wood	38	-	38
> 11 kV & < = 22 kV; Wood	8,671	-	8,671
> 22 kV & < = 66 kV; Wood	240	-	240
Total	**14,000**	**6,117**	**20,117**

Source: Powercor RRP MOD 4.15 – Pole summary Dec2020

43. The ratio of reinforcement to total wood pole interventions for this component of the forecast is 30%.

2.3.2 Forecasting method for the original proposal

44. In its original proposal, Powercor generated a Serviceability Index (SI) for each pole using the version of its pole calculator current at that time and mapped the volume of poles in

each serviceability classification (using SI criteria) to bushfire consequence areas based on the location of the pole (e.g. whether it was in an LBRA, HBRA, or ELCA).

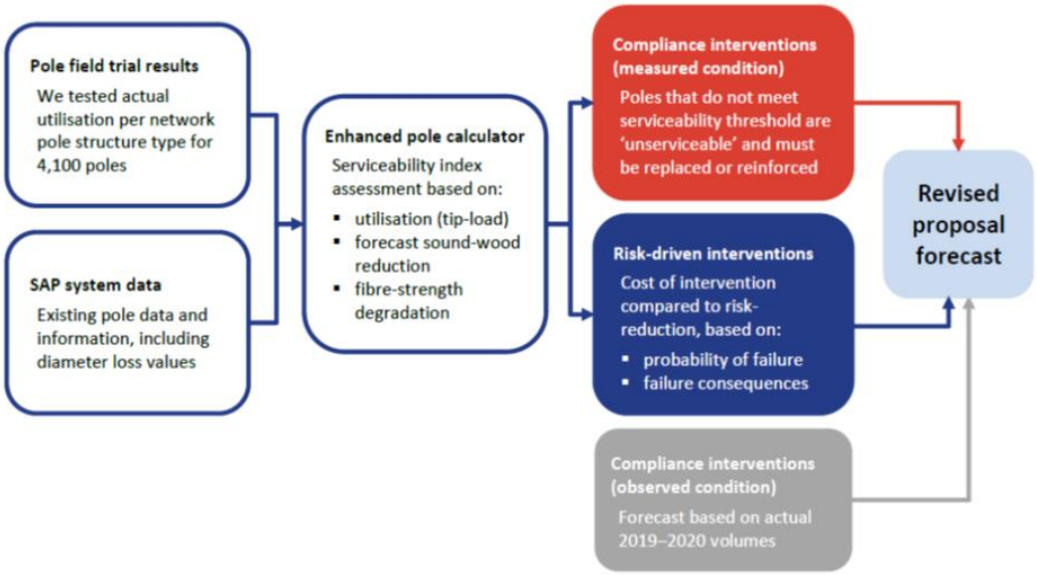
45. The compliance-driven measured condition forecast of 15,983 poles included in Powercor's original proposal, and which is directly comparable to the same component of the revised proposal, was comprised of:

- 15,207 Unserviceable poles (SI<0.65) across all bushfire consequence areas; and
- 776 Added control serviceable poles (0.65≤SI<0.70) and a consequence level of C2 in the highest bushfire consequence area, ELCA.

2.3.3 Forecasting method for the revised proposal

46. Powercor's revised proposal is a bottom-up forecast using the methods described in the figure below.

Figure 2.3: Overview of development of revised wood pole intervention forecast



Source: Powercor Business Case BUS4.02 Pole replacement forecast Dec2020, Figure 4.1

47. In addition, Powercor has removed poles that are 30 years old or younger from the compliance-driven measured condition forecast.

48. Powercor states that the pole calculator for the revised proposal (referred to as the EPC) has been updated following calibration and testing undertaken by Powercor as described in section 3, including:

- results of Powercor's pole trial; and
- results of the destructive wood pole testing that Powercor commissioned.

49. The EPC is relied on for two components of the revised forecast intervention volume, comprising 83% of proposed pole interventions.

50. Based on the limited scope of our review, we have considered only the compliance-driven measured condition component of the forecast pole interventions.

2.3.4 Changes to the forecasting methodology since the original proposal

51. For its revised proposal, we understand that the combination of SI and classification of wood poles by bushfire consequence area that was presented for the original proposal has not been applied in deriving the revised proposal. Instead, all poles included in the compliance-driven measured condition volume forecast of 20,117 are considered to have an unserviceable classification according to the results from the EPC.

52. In documentation that we have been asked to review, Powercor has not provided an explanation of how the EPC model has been developed or applied. This includes an absence of the rationale for how the bushfire consequence mapping is used, among other things.

53. At the direction of AER, we have reviewed the Pole field trial EPC as representative of Powercor's method for development of the compliance-driven measured condition pole intervention volume forecast. We understand that the Pole trial EPC uses the same assessment methods and classification as those used for the revised forecast.

54. The determination of the wood pole serviceability classification from the Pole trial EPC is derived from an assessment of:

- Serviceability index (SI) being an assessment of the bending moment divided by capacity of pole at ground line (GL) or above ground line (AGL), against a set of acceptance criteria,
- Sound wood thickness (SWT) being an assessment of sound wood thickness measured at GL or AGL against a set of acceptance criteria, and
- Inspection holes, being an assessment of the number of drilled holes within 500mm of one another against a set of acceptance criteria.

55. The Pole trial EPC includes additional features to assess visual inspection results and non-destructive inspection methods, however these methods were not relied upon in the determination of pole serviceability. The unserviceable poles from the Pole trial EPC are derived from the SI and SWT assessment methods only.

56. The final serviceability classification is determined in the Pole trial EPC which generally seeks to find the minimum result (or worst-case condition) for each pole derived from applying the various assessment methods.[3]

[3] In the results we reviewed there were a small number of cases where the results were not the minimum, none of which resulted in a final serviceability classification of unserviceable

3 REVIEW OF KEY ASSESSMENT AREAS

In this section, we present the results of our review of the five key assessment areas that the AER has asked us to consider.

We consider that the Pole trial EPC provides information that can be used by Powercor to better understand the condition of its wood pole population. The results of serviceability classification arising from the Pole trial EPC represent a more accurate means of identifying unserviceable poles than its current pole calculator.

We expect that the EPC should, as it is progressively refined and calibrated, be a useful operational tool and serve as a useful input to development of a reasonable forecast wood pole intervention volume.

However, absent the inclusion of other methods to validate and provide greater confidence in the otherwise conservative results of the Pole trial EPC, and the underlying data that the Pole trial EPC relies upon, the confidence that can be placed on this tool in satisfying the NER capex criteria is limited.

We consider that the use of the Pole trial EPC as the sole forecasting tool, given the issues identified in our review and its current stage of development, is not likely to produce a forecast that necessarily meets the capex criteria and objectives.

3.1 Introduction

57. We reviewed the information provided by the AER pertaining to the limited scope of our review. A list of the information is provided in Appendix A. Our focus was to consider the assessment factors identified by the AER as detailed in section 2 of this report.

58. We first reviewed the composition of the revised compliance-driven measured condition intervention volume forecast to understand the forecasting method applied by Powercor, and specifically any trends and variances compared to the original proposal and the AER's Draft Decision.

59. As discussed in section 2, the overall forecast intervention volume for wood pole treatment included in the revised proposal reflects a reduction relative to the original proposal and is higher than the AER's Draft Decision. However, Powercor's proposed intervention volume for the **compliance-driven measured condition** component has increased relative to its original proposal.

60. The compliance-driven measured condition component of the forecast is based on the combination of results of application of Powercor's EPC and removal of younger poles.

61. We have reviewed the application of the EPC using the version supplied by Powercor that it used for its Pole field trial, and that we refer to as the Pole trial EPC. This has been used as a representation of the EPC and of what we understand to be the approach applied by Powercor to the pole population to determine the intervention volume included in its revised proposal.

3.2 Powercor's data and assumptions

62. In this section we present our findings following review of the following key assessment factors:

- Is the underlying pole population data sufficiently robust to form the basis of the forecast?
- Are Powercor's assumptions (including on the underlying pole data and in the EPC) sound, including assumptions applied:
  - to the underlying data (including any data cleansing process or process of substituting or filling in any missing data)
  - in the EPC (in particular, the wood fibre strength age factor)
  - to decay rates to forecast future pole condition (including applying the decay rate through to the end of the next RCP to all poles)
  - to forecast staking rates.

3.2.1 Underlying data

63. We understand that Powercor captures the physical data of its pole population in its corporate ERP (referred to in Figure 2.3 as its SAP system). We are not aware of any material changes made to the standing or static physical data for its wood pole population since the original proposal.

64. Individual wood pole sound wood thickness and pole diameter vary over time and are determined via field measurement at inspection intervals. The accuracy of these measured values is critical to the assessment of the remaining strength of a pole, and its serviceability state.

65. In its investigation of Powercor's wood pole management practices, ESV was critical of Powercor's inspection and testing method, and specifically the robustness and repeatability of the measured data captured throughout this process:[4]

> *'The sound test is part of the 'sound, dig and drill' inspection technique. It is a critical aspect of wood pole inspection and condition assessment as it identifies where further testing of the pole may be required.*
>
> *The sound test procedure in the Powercor's Asset Inspection Manual does not clearly articulate when and how it is to be undertaken. As a consequence, ESV found evidence of the sound test being poorly understood and applied inconsistently by inspectors. This undermines condition assessment accuracy and repeatability.'*

66. We have not seen evidence of improvements made by Powercor or planned to address these concerns. We explore further issues with the measured and calculated data in subsequent sections of this report.

67. In addition to the measured data, collected at time of inspection, Powercor relies on data held in its systems for the calculation of the tip load for each pole. In its revised proposal Powercor states that:[5]

> *'Since our original proposal, several key assumptions reflected in our enhanced pole calculator have been refined. These include our assumed tip-load and pole decay rates.'*

68. We understand that the EPC was run for the entire timber pole population to forecast pole volumes expected to transition to the US condition on the next inspection cycle. In its internal recommendations paper supporting the changes to its EPC, Powercor states:[6]

> *'The following assumptions were made and applied to using the EPC to revise the volume forecast:*

4 ESV, 2020, Detailed technical report Powercor wood pole safety management

5 Powercor RRP BUS4.02 – Pole replacement forecast – Dec2020

6 Powercor SI_RBAM_AS7000 PMIP recommendation paper

- *Pole utilisation by structure*
  - *Pole tip-loads were calculated for the 4,129 EPC trial poles. From this data, an average utilisation by structure type was determined and extrapolated across the entire timber pole population to establish an indicative pole tip-load for each timber pole on the CP/PC network.*
  - *Utilisations were determined based on 80% of the EPC trial pole volume. The outcomes at this stage of the trial were confirmed as being consistent with the results at conclusion of the trial in section 2.3.5.1 of this paper.*
- *Sound wood loss*
  - *Sound wood loss of 1mm/year was assumed for Powercor, to estimate the sound wood degradation that would ensue over the coming 5-year period.*
  - *Estimated sound wood loss was conservatively based on estimates devised by United Energy's timber poles, which estimated between 3-10mm per year of sound wood loss.*
- *Apply the pole condition data as at last inspection for all remaining condition fields to populate the EPC.'*

69. We consider each of these changes below.

Tip load calculation and pole utilisation

70. As a part of its original proposal, Powercor applied a utilisation assumption of 0.8, 0.9 or 1.0 based on the bushfire consequence of pole failure, as determined by the bushfire risk area of where the pole was located. The higher the utilisation factor (or assumed tip load), the lower the SI result for a particular pole.

71. A key feature of the Pole trial was to test the actual utilisation of the network. Powercor first calculated the actual tip load for each pole in the field trial through design modelling based on a first-principle design approach. It applied two different systems to provide confidence in the accuracy of the modelling. An average utilisation was then determined from the calculated results by structure type.

72. We understand that Powercor has applied the average utilisation rates for each pole in the population according to its structure type for the forecast intervention volume:[7]

> *'The outcomes of our wood pole trial were used to re-calibrate our enhanced pole calculator for our revised proposal. That is, rather than relying on broad assumptions based on the location of a pole (as per our original proposal), we determined the average tip-load per structure type.'*

73. For the Pole trial EPC that we reviewed, the tip load values were input from an external data set assigned to each pole, and which we understand were likely from one of the design tools utilised during the Pole trial, held in its SAP system.

74. Powercor's analysis of these calculations resulted in a change in the loading assumptions of the poles in its population, and which resulted in large changes to the assumed condition of poles in the population. The majority of pole condition changes from the original proposal to the revised proposal relate to higher durability class poles and intermediate structures (lower utilisation). Powercor states that:[8]

> *'These outcomes indicate that the EPC is sensitive to the pole tip-load with most of the condition improvements being lesser loaded structures (Intermediate) using the EPC,*

7 Powercor RRP BUS4.02 – Pole replacement forecast – Dec2020

8 Powercor SI_RBAM_AS7000 PMIP recommendation paper

compared to the EPDR [sic] outcome that did not consider pole top structure specific loading.'

75. In our Technical Report to the AER regarding aspects of Powercor's original proposal, we raised a concern that Powercor's assumed utilisation factors were likely to overstate the tip load, and hence overstate the number of unserviceable poles. The assumptions now adopted by Powercor directly reflect the results of the Pole trial, and therefore are more likely to represent the average tip load at each pole location.

Sound Wood loss and pole diameter measurement

76. We understand from the AER that Powercor has applied a reduction of 5mm, being 1mm per annum for the 5 year forecast period, to the SWT measurements held for each pole in the EPC used for the forecast. We further understand that this reduction was made to the recorded SWT measurements, and outside of the model. We did not observe this reduction adjustment in the Pole trial EPC that we reviewed.

77. Powercor supplied the data it had relied upon to determine the annual average decay rate of 1mm that it had proposed. As stated elsewhere in this report, we observe material variability in the measurement data held by Powercor, and which Powercor has also acknowledged as limitations inherent in its data.[9] As a result, Powercor has adopted a decay rate that is lower than their own data would suggest.

78. The EPC model is sensitive to the data inputs, including the SW measurement for determination against the SWT criteria, and the pole diameter for calculation of the pole's residual section modulus and, ultimately, the pole's SI.

79. We assume that Powercor has applied its decay rate assumption for the purposes of internal decay only, and not for external decay (i.e. affecting the pole diameter). We did observe that input data was provided for external decay from its SAP system, however the majority of the data for the Pole trial indicated zero external diameter loss.

80. In a small number of cases, we observed that the residual pole diameter increased from the value originally recorded (and resulted in an increase in pole capacity);

81. Whilst a degree of error is associated with the type of measurements being undertaken for wood poles, the robustness of the conclusions based on the underlying data remains an area of concern.

Pole condition data

82. We expect that Powercor would seek to make use of the latest information available. However, we were not able to confirm that Powercor had applied the latest pole condition data as at last inspection for the forecast, or whether there was any material change overall to the underlying data it had relied upon for its original proposal.

83. We did not see evidence of any data cleansing activities, or explanation of the output of any such activities that may have been applied to improve the quality of the pole data prior to use in the EPC.

Treatment of reinforced poles

84. Our simple review of the SI values identified a number of anomalies. For example, we found evidence in the Pole trial EPC of data inconsistencies which resulted in the calculation of SI above ground level (AGL) for reinforced poles determined to be zero. A smaller number of SI results were zero for GL also. On closer examination, the residual section modulus appears to be too low, resulting from a value input from the use of Woodscan. The input value was a single digit and does not align with the range of values commensurate with the units used in the Pole trial EPC for residual section modulus. As the methodology makes use of NDI techniques where data is available, the resulting SI was recorded as zero. This is likely to be an error, and underscores concerns with the input data. We have

[9] Powercor's response to information request AER IR PAL079 Wood pole repex (full response incl Q8 and Q12)

selected this example, and which was present on 192 occasions, to highlight that the result of a zero SI value for AGL results in the pole being classified as US, where it may not be.

85. We also found that when considering the SI AGL, the model determines the minimum SI value from that calculated for the GL and AGL for reinforced poles. Where a pole is reinforced, the reinforcing stake provides the structure capacity for the pole, and can do so with limited capacity remaining at the GL. To classify a reinforced pole based on the SI at the GL is overly conservative and ignores the benefit offered by the reinforcing system.

86. These examples suggest that the number of unserviceable poles identified by the Pole trial EPC, particularly those that are already reinforced, is likely to be overstated.

Summary

87. We have observed a number of issues with the robustness of the underlying input data, which casts some doubt on the reliability and robustness that can be attributed to this data and therefore on the ability to make direct use of the outputs of the EPC model.

88. As a consequence, any issues associated with the measurement data held by Powercor are likely to persist, and where this data is relied upon for the population, will likely have a material impact on the determination of serviceability

3.2.2 EPC (in particular, the wood fibre strength age factor)

Wood fibre strength age factor

89. In response to a question from the AER, Powercor has confirmed the inclusion of fibre-strength degradation with age factors in the EPC:[10]

> *'The recognition of fibre-strength degradation is particularly relevant to our networks given the underlying characteristics of our wood pole population (e.g. we have over 120,000 lower durability wood poles, and almost 60 per cent of these are over 50 years old). As recognised by ESV in its detailed technical report, for wood poles over 45 years old, loss of fibre strength in the residual wood becomes a governing factor for the end-of-life reliability of the pole.'*

90. Also, in relation to the source of the fibre-strength degradation values relied upon by Powercor: [11]

> *'The fibre degradation values used in our enhanced pole calculator are set out in table 5 of our Network Asset Maintenance Policy – Serviceability Assessment of Poles (previously provided to the AER). These values are taken from the ENA report.'*

91. We have observed that the modelling of wood fibre strength degradation with age is consistent with AS/NZS 7000 and the ENA study. However, the selection of the individual parameters used in the many equations to calculate the residual section modulus, fibre strength and residual pole strength have not been adequately explained by Powercor. The application of these parameters results in reducing the assumed remaining capacity of older, lower durability poles. Whilst older, lower durability poles are likely to be the poles which exhibit the greatest safety risk, we expected to see, and did not see, greater analysis to justify the selection of the parameters that Powercor has used.

92. For example, we note that in selecting the parameters for calculating the fibre strength degradation factor for each pole in its pole population, Powercor has:

- Added an adjustment factor (k_v) to account for the use of different characteristic fibre strength (f'_b) values between the ENA study and Powercor's AS/NZS 7000 based design standards;

[10] Powercor's response to information request AER IR PAL079 Wood pole repex (full response incl Q8 and Q12)

[11] Powercor's response to information request AER IR PAL079 Wood pole repex (full response incl Q8 and Q12)

- Assumed strength age factor inputs by pole strength group from the ENA study based upon the following preservative treatment assumptions: all S3 poles are creosote treated, S1 & S2 are CCA or none, S4 is any treatment and S6 are CCA treated;
- Assumed the design load is the maximum working load limit converted to a LSD load; and
- Used the 50th Percentile values for the SDD method.

93. We have not undertaken a first principles engineering review of these parameters. Rather, we reviewed the outcomes of the studies undertaken by Powercor and the output results of application of its model, as discussed below.

Safety factor assumption

94. Powercor has traditionally adopted a safety factor as part of its work stress based design methodology. The SWT criteria were developed to align with the inspection intervals, based on retaining a minimum safety margin for pole capacity. In response to the bushfires that occurred in 2018, Powercor increased its historical safety factor from 1.25 to 1.4, which had the effect of increasing the required sound wood thresholds for ACS and US.

95. In response to a question from the AER regarding the impact of changing the safety factor from 1.25 to 1.40 (and that occurred in 2019) to its revised forecast, Powercor was not able to directly model the change. Powercor instead offered the results of an approach which sought to provide a 'proxy for the impact' by using the EPC and only having regard to changing the sound wood threshold classifications, and not considering other factors such as SI. Powercor concluded that:[12]

> *'This shows the impact on forecast volumes from increasing the sound wood threshold to 35mm is limited (i.e. around 10 per cent). It is also evident that forecast interventions are largely driven by our serviceability index.'*

96. We understand that the adoption of the higher SWT threshold is consistent with the higher safety factor of 1.40. This appears inconsistent with the statement by Powercor that it has calibrated its EPC, following the Pole trial, to deliver an equivalent safety outcome to what has been delivered historically, equivalent to a safety factor of 1.25 and varying to 1.40 only for specific coastal areas.[13]

97. Absent another explanation, this appears to provide an increased level of conservatism in Powercor's approach to serviceability classification.

Other assumptions

98. Powercor considers that its assumptions are more likely to result in an under-statement of intervention volumes, due to:

- Low decay rate assumption, as applied to the SWT measurement, which is likely to result in an understatement of sound wood and therefore interventions based on sound wood criteria.
- Comparison to 2020 volumes, which are higher than the forecast and based on the current pole calculator and safety factor of 1.40.

99. This conclusion is based on its existing data and current practices, and which Powercor has itself determined are likely to result in a higher number of unserviceabe classification of poles than its proposed methods.

12 Powercor's response to information request AER IR PAL079 Wood pole repex (full response incl Q8 and Q12)

13 Powercor's response to information request AER IR PAL073 Wood poles repex

Separately accounting for SWT and SI

100. The inclusion of both the sound wood thickness and serviceability index in the serviceability classification is described by Powercor as:[14]

> *'…our revised wood pole management approach appropriately classifies the condition of poles as 'unserviceable' based on either our sound wood threshold or our serviceability index threshold. This recognises that pole capacity decreases over time due to a combination of loss of wood in the cross-section (i.e. sound wood), and reduction in fibre-strength of the residual wood.*
>
> *Our sound wood threshold and serviceability index capture the above impacts (largely) independently. For example:*
>
> *• our serviceability index only has limited regard to the loss of sound wood, but is critical as it takes account of the structure and residual capacity of the entire pole (whereas sound wood is measured at ground line only)*
>
> *• our sound wood threshold has no regard to fibre-strength degradation, but recognises that beyond a certain threshold there will simply be insufficient wood thickness remaining to avoid sectional collapse or localised buckling.'*

101. As a part of its calibration of the EPC, Powercor commissioned the destructive testing of 34 poles by the Revo group. The results of this testing are discussed in later sections of this report. Included in its report to Powercor, the Revo group referred to three main functions for the GWT (or SWT) criteria being separate to the SI measurement:

- Provides a limit for diameter to thickness ratio to prevent localised buckling (e.g. part of the cross-section buckling in/out);
- Provides a limit for diameter to thickness ratio to prevent section collapse; and
- Compensation of unavoidable GWT measurement inaccuracy (a function of any drilling inspection method).

102. We consider that the rationale provided for separate recognition of SWT and SI appears to have merit for Powercor's current pole population, and which should be reviewed in the future. This decision incorporates a further level of conservatism into the decision making, and, in our opinion, underscores the need for a risk assessment to be undertaken for the pole population.

103. We also observe that the Pole trial EPC includes additional assessment methods for determining the serviceability classification as described in section 2. However, these additional assessment methods do not result in a classification of unserviceable for poles included in the Pole trial EPC.

3.2.3 Forecast staking rates

Overview

104. As shown in Table 2.3, the forecast level of reinforcement for the compliance-driven measured condition component is approximately 30%. Powercor has based this on its average historical staking ratio over the period 2016–2019.[15]

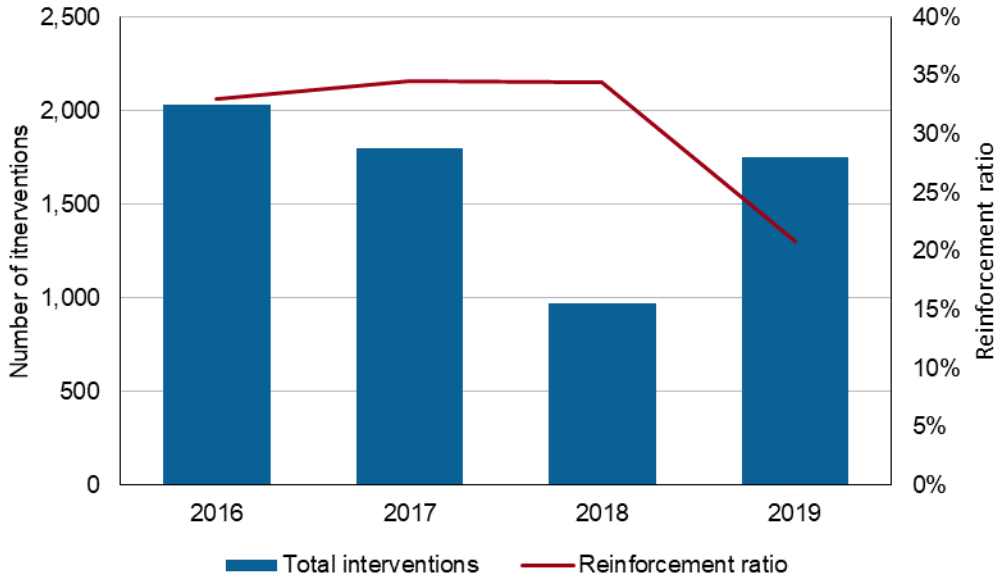
105. Across all three components of the forecast, the proportion of reinforcement to total interventions is 38%, as shown in Table 2.2. Both figures are significantly lower than the 48% reinforcement rate (of total interventions) included in Powercor's original proposal.

106. The data provided by Powercor in its determination of the average historical staking ratio is reproduced in the figure below.

[14] Powercor's response to information request AER IR PAL079 Wood pole repex (full response incl Q8 and Q12)

[15] Powercor PAL RRP MOD4.15 – Pole summary - Dec2020

Figure 3.1: Historical reinforcement ratio



Source: EMCa analysis of PAL RRP MOD 4.15 – Pole summary – Dec2020

107. In response to a question by the AER regarding what appear to be a low forecast staking rate, Powercor stated that:[16]

> *'The historical ratio has been applied to all poles forecast by our enhanced pole calculator to become unserviceable. This approach results in a conservative forecast, as based on the outputs shown in the 'Compliance-driven (measured)' tab, the majority of poles forecast to become unserviceable are already reinforced.'*

108. This explanation does not provide adequate justification to support the assumed much lower reinforcement rate included in its revised proposal.

Objective of pole reinforcement

109. The objective of pole reinforcement is to extend the service life of a wood pole, assuming that the pole has sufficient strength (amongst other factors) to accommodate the installation of a reinforcement stake to support the tip load.

110. Based on the proposed changes to the EPC, Powercor claims to be able to theoretically model the strength of the pole with a higher level of accuracy than it has historically been able to achieve.

111. It follows that Powercor should also be able to intervene earlier in the service life of a pole and to identify poles for reinforcement. Assuming the identified poles are suitable for reinforcement, the level of reinforcement should be able to be increased above historical levels.

Results of pole trial

112. Based on the Pole trial EPC, the level of reinforced poles that are deemed Serviceable represents approximately 7% of the poles included in the trial and 49% of those deemed Unserviceable, as shown in the table below.

[16] Powercor's response to information request AER PAL073 Wood poles repex

Table 3.1: Composition of Pole trial

Final serviceability classification	Number	Percent of total	>50yrs old	Reinforced
Unserviceable P42	364	9%	261	243
Unserviceable P1	23	1%	17	5
Unserviceable P2	194	5%	110	37
AC Serviceable P3	272	6%	197	32
Serviceable P4	3,277	78%	1215	250
Serviceable P5	89	2%	23	1
Total	**4,219**			**285**

Source: EMCa analysis

113. We also observe that a high proportion of the poles included in the pole trial that are classified as Unserviceable are >50 years old (67%).

Extrapolating pole trial results to reinforced poles

114. If the results of the Pole trial are extrapolated for the pole population, the effective reinforcement rate (of the poles that are suitable for reinforcement) may be much higher than has been stated by Powercor.

115. All else being equal, a similar percentage of poles that are classified unserviceable and are already reinforced[17] may also exist in the pole population. Given that they are deemed unserviceable and already reinforced, they must be replaced. The remaining poles are therefore candidates for reinforcement.

116. Applying this same percentage of poles that are already reinforced to the forecast of unserviceable poles for the compliance-driven measured condition component, results in 9,857 unserviceable poles that are likely to be existing reinforced poles, and according to Powercor must be replaced. While relatively simplistic and ignoring bias that may be present in the pole trial results, recalculating the reinforcing rate for the remaining poles that are suitable for reinforcement suggests a rate of 60%. However, no such analysis to support the proposed reinforcement rate in Powercor's revised proposal, and which Powercor is likely to achieve, was not evident in the revised proposal.

117. Notwithstanding the above simplistic analysis, a higher reinforcement rate than has been proposed by Powercor is also more commensurate with a strategy of early identification and intervention in the pole's life to rapidly and cost effectively reduce risk. In reality there are a number of factors that determine the reinforcement level, however given the focus of Powercor on risk reduction and modelling of its pole population, there should be opportunity to improve on the historical pole reinforcement level of 30%.

118. Whilst we have not considered other parts of the pole intervention volume forecast, we did not see sufficient justification for retaining the historical reinforcement level in the component of the forecast we reviewed, as representative of an efficient level.

3.2.4 Summary

119. We remain concerned with the reliability and robustness of the data and assumptions applied by Powercor for the following reasons:

- Sound wood thickness - the analysis Powercor relies on in determining an average internal decay rate of 1mm per annum underscores that the SWT measurements are not reliable. Similar issues were present in the EPC model;
- In a small number of cases, the residual pole diameter increased from the value originally recorded (and resulted in an increase in pole capacity);

[17] 285 (or 49%) of the 581 unserviceable poles identified from the Pole trial are reinforced

- Decay rates were part of input data from SAP, and did not correspond with the claims made by Powercor; and
- Tip loads were part of input data from SAP without demonstration of the calculation method or application of average values.

120. We found examples which may result in overstating the number of poles that are likely to be replaced:

- Gaps in measurement data, which translate inappropriately to values of zero SI;
- Basing the assessment of SI on GL rather than AGL for reinforced poles, thereby ignoring the structural benefit provided by the reinforcement;
- Basing the assessment of SWT on the minimum of GL and AGL measurements for reinforced poles, whereas AGL should be the governing factor;
- Relying on NDI assessments of SI (THOR and WoodScan), which are based on low confidence input data from SAP, and applied for both GL and AGL measurements – these are likely to understate the condition of the pole; and
- An assumed reinforcement rate that has been limited to that which Powercor has historically undertaken, but which may realistically and prudently be able to be higher.

3.3 Calibration and testing

121. In this section we present our findings following review of the following key assessment factor:

- Is the calibration of the EPC (in particular, the serviceability index threshold) reasonable given its application in producing the volume forecast?

3.3.1 Assessment criteria

122. The criteria applied for the sound wood thickness and serviceability index, being the two assessment methods included in the Pole trial EPC that result in an unserviceable classification, remain unchanged from the criteria included in the original proposal. For example, the SI for unserviceable was and remains ≤0.65.

123. In 2019, Powercor increased its sound-wood threshold. This change effectively reflected a change in safety factor from 1.25 to 1.40.

124. At the time of submitting the original proposal, Powercor planned to undertake further field testing to calibrate its EPC and destructive testing of a sample of poles. At that time, Powercor considered that its sound-wood threshold will be superseded by the development of its serviceability index:[18]

> *'..the decision to amend our sound-wood requirement was not driven by detailed cost benefit analysis. Our sound-wood threshold, however, will be superseded by our proposed serviceability index criteria (once calibrated).'*

125. As noted earlier in this report, we observed that the sound wood threshold has not been superseded as was proposed by Powercor, instead it has been retained as a condition classification method in the revised proposal.

126. We further note that Powercor claims to have calibrated its EPC based on application of an equivalent safety factor of 1.23 in its EPC:[19]

> *'In further developing our serviceability index—which was a key recommendation by ESV following its review of our wood pole management practices—our enhanced pole calculator has since been calibrated to deliver an equivalent safety factor to what has*

[18] Powercor's response to information request PAL – IR010 – response to poles repex

[19] Powercor's response to information request PAL073 – wood pole repex -v1.0

being delivered historically. That is, as above, our revised proposal forecast is equivalent to only classifying condition-driven poles as unserviceable where the equivalent safety factor is less than or equal to 1.23 (in comparison to an historical safety factor of 1.25, or since March 2019, a safety factor of 1.40).'

127. However, we observe the previous sound wood threshold amounts of 35mm sound wood in the Pole trial EPC, represent a safety factor of 1.40.

128. The sound wood threshold and serviceability index are both used in the Pole trial EPC to determine the serviceability classification of the pole, and in general, the worst-case condition is determined.

129. Overall, the approach by Powercor results in a more conservative forecast of pole intervention volume than may be prudent, particularly in the absence of cost-benefit analysis.

3.3.2 Observations from pole trial results

130. The Pole trial was undertaken from June to October 2020 as a part of Powercor's asset inspection program. Powercor considers that the poles selected for the Pole trial are a representative sample of poles in the population.

131. Powercor describes the outcome of the Pole trial as:[20]

'Through this trial, additional wood pole condition data was collected for 4,129 poles. This sample size represents a 95% statistical confidence interval, including 14 different construction types and covering all timber types and durability classes.

The application of the field trial results (as reflected in our Network Asset Maintenance Policy for Strength Assessment of Poles, and our revised proposal forecast) was endorsed by our SAMC in December 2020. This includes the derivation of an average utilisation by structure type (as per the trial data), and extrapolating these across the entire timber pole population to establish an indicative pole tip load for each timber pole on our networks.'

132. We had expected to see, and did not see, a report (i) detailing the results of the Pole trial, (ii) the impact of any calibration undertaken by Powercor, and (iii) contrasting the results of the calibrated method to the forecasting methods applied for the original proposal.

133. However, Powercor has provided a copy of the material provided to its asset management committee, and which compares the results of the EPC compared with what it refers to as its 'current pole calculator'.

134. We found this problematic, as the relationship between the current pole calculator and EPC was not clear to us. We could not confidently determine whether Powercor was referring to the version of the pole calculator relied upon as the basis of the original proposal. This would be necessary for a more meaningful comparison.

135. We did find a definition for the current pole calculator by Powercor in a response to an information request,[21] as being the pole calculator applied during 2020, as distinct from the EPC which is proposed to be applied in 2021. The latter includes the introduction of the serviceability index-based approach. Therefore, we consider that reference to the 'current pole calculator' as different to that which was applied in deriving the original proposal. This is further supported by Powercor referring to its forecast intervention volume for the EDPR (otherwise referred to as the original proposal) separately from that derived from the current pole calculator.

136. Although not ideal, we have relied upon the comparisons made by Powercor to the outcomes of its methods, where they have been provided.

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20 Powercor's response to information request PAL073 – wood pole repex -v1.0

21 Powercor's response to information request AER IR PAL079 Wood pole repex (full response incl Q8 and Q12), Q8

3.3.3 Calibration using Pole (field) trial

137. The results from the trial of 4,219 poles in the Pole trial, indicate that:

- Approximately 14% (581 poles) were classified as unserviceable poles;
- 66% of the unserviceable poles are Class 3 poles;
- 67% of poles are 50 years or older; and
- 49% of unserviceable poles are already reinforced.

138. The breakdown of the serviceability classification from the Pole trial by durability class is shown in the table below.

Table 3.2: Pole trial serviceability classifications by durability class

Condition classification	Class 1	Class 2	Class 3	Class 4	Class 6	Grand Total
Unserviceable P1	3	3	14		3	23
Unserviceable P2	23	50	113	3	5	194
Unserviceable P42	34	68	257	2	3	364
Total	**60**	**121**	**384**	**5**	**11**	**581**
Total (%)	**10%**	**21%**	**66%**	**1%**	**2%**	**100%**

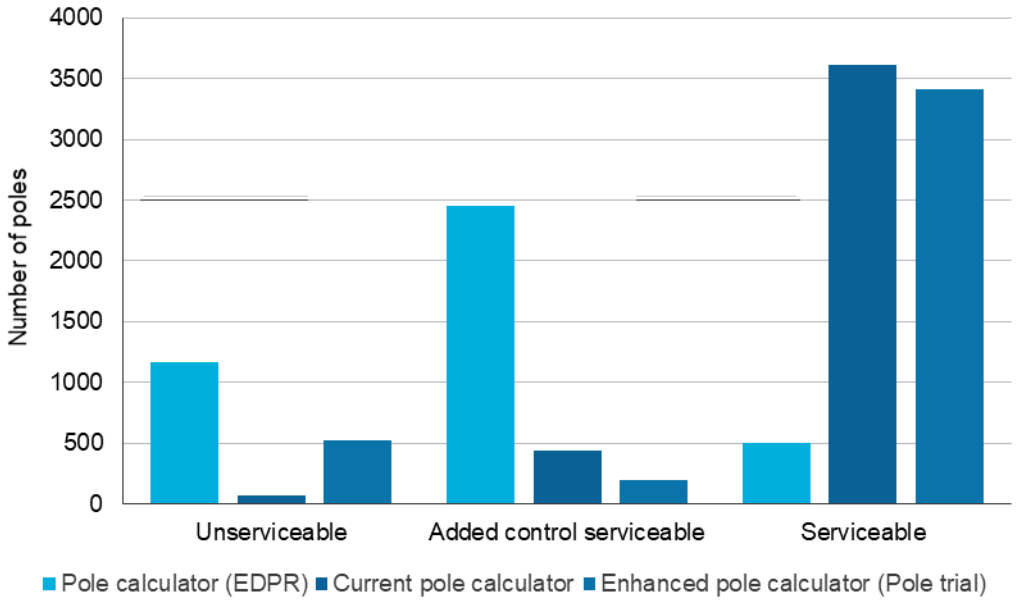
Source: EMCa analysis

139. The characteristics of the poles classified as unserviceable from the Pole trial appear to align with the poles that are considered most at risk of failure as identified by ESV in its review, being older lower durability poles. When considered alongside the assessment by Powercor and by the Revo Group that compares the results of the Pole trial EPC to the current pole calculator, the Pole trial EPC more accurately identifies the condition of the pole.

140. In the results, we observe clear movements in the classification of condition when compared with the current pole calculator. Whilst Powercor broadly describes the changes it has made, the specific factors that have resulted in the observed changes, and their relative contribution, remain unclear. Given the size of the movement in serviceability classification, specifically the changes in the number of unserviceable poles from its current pole calculator method, we would have expected to see greater evidence and analysis by Powercor to support the changes made in the EPC from the Pole trial results.

141. We show a comparison of the serviceability classifications from different versions of the pole calculator as reported by Powercor in the figure below.

Figure 3.2: Comparison of serviceability classification from pole calculator versions



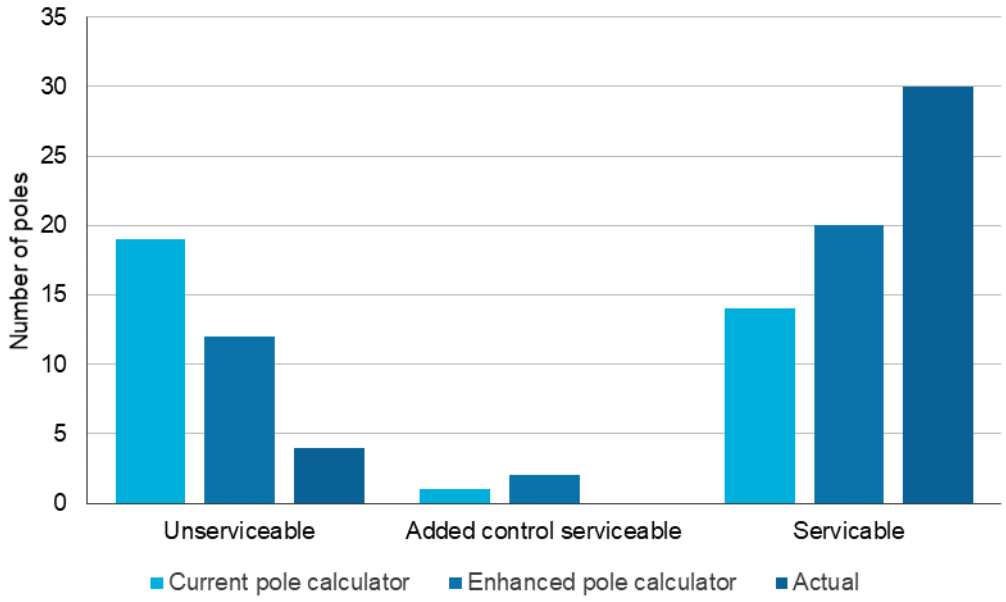
Source: EMCa analysis of Powercor SI_RBAM_AS7000 PMIP recommendation paper

142. Beyond the steps to verify the calculation of the pole tip load, and develop new pole utilisation factors by structure type, we are not clear how the Pole trial results were used to calibrate the SI used in the EPC.

3.3.4 Observations from destructive pole testing

143. In the figure below we show a comparison of the serviceability classification arising from the destructive pole testing. Whilst the number of unserviceable poles reduced when comparing the EPC and current pole calculator, the derived number of Unserviceable poles significantly exceeded the actual condition as measured by Revo Group (i.e. by a factor of three).

Figure 3.3: Comparison of serviceability classifications during destructive testing



Source: EMCa analysis of Revo Group pole strength testing report

144. In the report by Revo Group this is explained as the result of the GWT (or SWT) result being the governing factor, if it indicates a lower serviceability classification than the SI result. The GWT results account for 10 of the 12 derived Unserviceable classifications observed in this test sample.

145. The report also notes the potential for observation bias in the serviceability classifications, where:

- Whilst all poles were removed due to an unserviceable classification, the reasons for the unserviceable classification were not recorded by Powercor, and may not have been as a result of the SWT or pole calculator result; and
- The results are highly dependent on the measured data by inspectors, and hence any natural variation of the quality of the inspectors and inspection sample will influence the results.

146. In the same report, the Revo Group also referred to examples of data that was not accurately recorded in Powercor's systems as a part of the destructive pole testing. The recommendations made in the report include:[22]

> *'Doing a reproducibility and repeatability study on the inspection techniques is also recommended.'*

147. Finally the Revo Group concludes that: [23]

> *'Based on the results of this testing the proposed EPC settings appear to give reasonable results. We do not recommend making any changes to the proposed EPC criteria on the basis of this test and we feel comfortable with the initial roll-out of the EPC into general field use based on the current version.'*

148. All poles included in the destructive testing were determined to be unserviceable by Powercor in accordance with their current inspection and condition assessment method. Accordingly, any conclusions drawn from the results are a reflection of the reliability of the current inspection and condition assessment method.

22 Powercor's response to information request AER IR079A Revo Group – pole strength testing

23 Powercor's response to information request AER IR079A Revo Group – pole strength testing

3.3.5 Summary

149. Powercor has not provided sufficient evidence to demonstrate how, if at all, the Pole trial results have been used in appropriately calibrating the SI used in the Pole trial EPC, particularly given the significant movement in serviceability classification observed.

150. We understand that Powercor did not make any changes to the Pole trial EPC following the destructive testing. Rather, its consultant recommended further calibration and testing with a larger sample of poles and a reproducibility and repeatability study of its inspection methods, amongst other matters.

151. The decision to retain both the sound wood threshold and serviceability index assessment methods appears to rely on advice from its consultant, Revo Group, where it concludes it is reasonable to consider GWT separately to SI based on the characteristics of Powercor's wood pole population.

152. Whilst we have not undertaken a detailed audit of the Pole trial EPC model, we have identified a number of concerns with the input data and assumptions that lead us to consider that the model is more likely than not to overstate the pole intervention volume. We found that the results of Powercor's own destructive testing supports this supposition. Specifically, the destructive testing indicated a three-fold increase in the classification of unserviceable poles by the Pole trial EPC compared with the actual measured condition.

153. We consider that the results of the testing that Powercor has undertaken support the role of the Pole trial EPC as an operational or engineering tool to aid in understanding of pole condition. Further, we consider that the model should continue to be developed based on Powercor's experience and should be subjected to further calibration and testing.

3.4 Forecasting method

154. In this section we present our findings following review of the following key assessment factors:

- Is the enhanced pole calculator (EPC) fit for use as a forecasting tool in its current stage of development?
- In the absence of cost-benefit analysis, does Powercor's volume forecasting methodology reasonably reflect the capex criteria?

3.4.1 AER Capex assessment guideline

155. Whilst explicit consideration of forecast expenditure is not within our scope of review, consistent with the requirements of the capex assessment guideline, we would expect to see economic analysis (such as a cost benefit analysis) to demonstrate that the forecast intervention volume is prudent and efficient. This should include documentation and underlying data sufficient to support the economic analysis.

156. A cost-benefit analysis should incorporate a quantified risk assessment, where the most beneficial option is selected, through assessment of multiple options. Options may be based on different assumptions or variables using the same forecasting method.

157. No such economic analysis was provided by Powercor.

158. The intervention volume forecasting method that Powercor has used, and which it has designated as 'compliance-based', does not seek to balance risk, consequence and efficiency, rather it is a deterministic approach.

3.4.2 Absence of an economic assessment

Demonstration of AFAP

159. As a part of the wood pole management business case, Powercor states that the Electricity Safety Act:[24]

> *'..explicitly refers to our requirement to minimise as far as practicable the hazards and risks of damage to the property of any person arising from our supply network'*

160. Powercor's obligations, including those expressed in the Electricity Safety Act are further described in in Appendix A of Powercor's business case for wood pole management. These obligations are included to support the risk-driven component of the wood pole intervention forecast.

161. However, in Powercor's justification of the proposed intervention volumes of the compliance-driven measured condition component, and more specifically the application of the forecasting method to arrive at the proposed intervention volumes, we did not find reference to AFAP.

162. We also considered guidance provided by the AER in its Industry practice application note for asset replacement planning, which reinforces the need for a form of safety risk assessment to be demonstrated:[25]

> *'In making safety assessments, NSPs are subject to the application of the So Far As Is Reasonably Practicable (SFAIRP) principle. In applying the SFAIRP principle, NSPs should apply the As Low As Reasonably Practicable (ALARP) test to demonstrate the reasonably practicable requirement.*
>
> *The overarching principle is that extreme and high risks should be proactively reduced until the cost of doing so becomes grossly disproportionate to the benefits. Within an economic context, this test requires monetisation of safety risk, with an event causing a fatality being a typical test case. Good industry practice is to apply the value of statistical life (VSL) to monetise the risk associated with a fatality.'*

163. Energy Safe Victoria also provide guidance on application of a risk assessment method and which may be reasonably applied to network assets such as poles as a part of the Electricity Safety Management Scheme (ESMS) required by the Electricity Safety Act:[26]

> *'An [sic] MEC has the flexibility to adopt any risk assessment methodology so long as it provides a clear case for the selection of risk controls based on consideration of the frequency and consequence of incidents, the available risk control means, and practicability. AFAP is demonstrated where all controls that can be implemented are implemented and any controls that are not implemented are justifiable by being impractical. If this is due to costs, the costs must be grossly disproportionate to risk reduction to be deemed not practicable.'*

Economic assessment

164. The AER notes that demonstration of ALARP requires an economic test:[27]

> *'The common and relevant aspects of ALARP are that it requires an assessment of the response to an unacceptable hazard that it is reasonably practicable to implement. Determining what is reasonably practicable is achieved by undertaking an economic test for options in which risk is reduced to 'as low as reasonably practicable', by incurring expenditure up to the point at which the expenditure would be 'grossly disproportionate'*

[24] Powercor RRP BUS 4.02 – Pole replacement forecast – Dec2020

[25] AER, Industry practice application note, Asset replacement planning, January 2019, p. 59.

[26] ESV, Electricity Safety Case (ESMS) Preparation and Submission Guideline for MECs Safety Guideline, 2019

[27] AER, Industry practice application note, Asset replacement planning, January 2019, p. 60.

to the benefit (risk reduction) achieved. That is, if it is not grossly disproportionately uneconomic to do so, then the source of the risk should be eliminated.

Conversely, if it is not reasonably practicable (i.e. not economically justified, not technically possible, etc.) to eliminate the source of risk, then expenditure should be incurred to mitigate the risk to as 'as low as reasonably practicable.'

165. Whilst our scope of work does not require us to form a view of the prudent or efficient cost of the revised proposal, Powercor has not adequately demonstrated that the revised proposal reflects an efficient option.

166. We consider that a reasonable interpretation of the available guidance material for demonstration of a safety risk assessment, and which also requires a form of economic test, is that these are similarly required to meet the capex criteria. Powercor refer to having undertaken such an assessment to support other components of its wood pole management forecast, and which we were not asked to review.

167. In response to questions from the AER to ascertain what economic assessment was undertaken, Powercor stated that:[28]

'Given the equivalent safety threshold has not changed for the majority of our pole population, as per our current thresholds, we expect our serviceability index based approach will continue to minimise safety risk as far as practicable. '

'We also note that consistent with our revised proposal business case (PAL RRP BUS 4.02), our enhanced pole calculator is used to forecast unserviceable poles based on condition. We are required to intervene on unserviceable poles under our compliance obligations (rather than any economic assessment). This contrasts to our risk-driven forecast, for which the details of our economic assessment are provided in PAL RRP BUS 4.02.'

168. The changes made to the EPC, and which are reflected in material changes in both the historical and proposed intervention volumes, raise questions as to what constitutes a compliance obligation. Particularly given the proposed increase in wood pole interventions above historical trend, and specifically the increase in stated compliance-driven measured condition interventions (as shown in section 2) for the next RCP.

169. We consider that it would have been prudent to demonstrate that application of the forecasting method (using the EPC) by Powercor reflected a level of risk that was ALARP, and that an intervention volume that was lower than that arising from application of the EPC, was by extension, was not.

170. Whilst it was beyond our scope of review, we would expect to see, and did not see, evidence that Powercor had assessed the residual safety risk presented by its wood pole management program. In that context, comment on the contribution of its proposed compliance-driven measured condition intervention volume to the residual risk reduction and related benefits.

171. Similarly, and as Powercor has stated, we did not see evidence that Powercor had quantified the proposed risk reduction, or level of residual risk in financial terms, that could be used to demonstrate that the proposed intervention volume is efficient.

3.4.3 Reasonableness of EPC as the sole forecasting tool

172. We found issues with the level of confidence that can be attributed to both the input data and some of the output data which, without sensitivity analysis and explanation, casts doubt on the robustness of using the tool in isolation as the basis of a forecast in accordance with the NER. Powercor has not provided any sensitivity analysis on key input and modelling assumptions to demonstrate how these factors have been taken into account, or how sensitive the outputs are based on changes to the inputs and assumptions. This is

[28] Powercor's response to information request AER IR PAL073 – Wood pole repex – V1.0

particularly important given the concerns with the quality and accuracy of the standing and measured condition data.

173. Powercor has provided an example of scenario testing, however this does not sufficiently consider the sensitivity of the inputs and assumptions made in the model.

174. The Pole trial EPC provides information that can be used by Powercor to better understand the condition of its wood pole population. Based on statements by Powercor and by its advisors, the Pole trial EPC appears to be an improvement over its current methods. However, absent the inclusion of other methods to validate and provide greater confidence in the results of the EPC tool, the reliance that can be placed on this tool as a reasonable and reliable sole forecasting tool given its stage of development is limited.

3.4.4 Summary

175. Whilst our scope of work does not require us to form a view of the prudent or efficient cost of the revised proposal, we have been asked to consider whether the EPC is fit for use as a forecasting tool. In this context, we have considered the assessment principles included in the AER's guidance on capex assessments, requirements of the capex objectives and criteria as reproduced in section 1 of this report, and other guidance available to assist Powercor in developing its revised proposal.

176. Having regard to the capex assessment principles, we consider that Powercor has not adequately justified the sole use of the EPC method relied upon in determining the proposed intervention volume. We consider that the EPC is not sufficiently developed to meet the requirements of, or reasonably reflect the expenditure criteria.

177. Powercor has not provided a cost benefit analysis, or evidence of a quantified risk assessment to demonstrate that the most beneficial option has been proposed. The residual level of risk proposed to be achieved by the revised proposal is not described, or how Powercor has determined that the residual level of risk has been minimised AFAP consistent with its safety obligations, and which includes a form of economic assessment. Axiomatically, through lack of exploration of options and analysis of those options, Powercor has not sought to discount a lower level of interventions as a reasonable alternative. Similarly, Powercor has not sufficiently demonstrated that the ratio of reinforcement to replacements is efficient.

178. Accordingly, we consider that Powercor has not adequately demonstrated that it has taken account of the capex criteria or the AER's capex assessment guidelines.

APPENDIX A – INFORMATION PROVIDED

179. The following list of documents were provided to EMCa for this review:

- PAL Revised regulatory proposal 2021-2026 - final version.pdf
- PAL RRP ATT30 - CAP - Updated poles management numbers - Public.pdf
- PAL RRP ATT61 - CutlerMerz - Pole model peer review - Dec2020 - Public.pdf
- PAL RRP BUS 4.02 - Pole replacement forecast - Dec2020 - Public.pdf
- PAL RRP MOD 4.15 - Pole summary - Dec2020 - Public.xlsx
- IR073\AER IR - PAL073 - Wood poles repex - V1.0.pdf
- IR073\IR073 - BFM Plan_Powercor_Rev 9.0_clean.pdf
- IR073\IR073 - SAMC recommendation paper - Wood Pole Serviceability Index.pdf
- IR073\IR073 - Strength Assessment of Poles_Policy_Draft doc D.406_v0.2.pdf
- IR079\AER IR - PAL079 - EPC - field trial outcome.xlsx
- IR079\AER IR - PAL079 - Sound wood data.xlsb
- IR079\AER IR - PAL079 - Wood poles repex (full response, incl. Q8 and Q12).pdf
- IR079A\AER IR079A - Revo Group - pole strength testing.pdf
- IR089\AER IR - PAL089 - Pole calculator algorithm.pdf
- Meetings with PAL\EPC Technical Workshop_ AER_ESV - final.pdf
- Meetings with PAL\Poles roundtable - Jan 2021 - final.pdf