energysafe VICTORIA

Creating a safer state with electricity and gas

Powercor – Wood Pole Management

Sustainable Wood Pole Safety Management approach

Detailed Technical report

December 2019

VICTORIA State Government

Preface

This report has been prepared by Energy Safe Victoria (ESV) pursuant to the objectives, powers and functions conferred on it by The *Electricity Safety Act 1998* (Act).

Specifically, this report provides a summary of the detailed technical review undertaken by ESV into the Wood Pole Management policies and practices of Powercor following the investigations into the state of power poles in the South West Region of Victoria.

Approval

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Contents

1. Executive Summary

1.1. Purpose

The Energy Safe Victoria (ESV) Technical Investigation Report dated July 2019 resulted from ESV's investigation of Powercor's pole management following the St Patrick's Day fires in March 2018. Started by electricity assets, the fires destroyed a significant amount of property and livestock leaving property owners fearful that further fires may occur. Several community members questioned the adequacy of Powercor's maintenance regime, particularly its inspection and pole replacement practices.

Although Powercor's power pole inspection and maintenance process were found to be fit for purpose and there is no immediate systemic risk of pole failures at that time, to ensure that no safety concerns existed, ESV decided a more detailed technical investigation was required to assure itself that Powercor's asset management practice relating to wood pole management will deliver sustainable safety outcomes for the community. This report addresses the findings of that further work.

The purpose of this document is to advise ESV of the approach, findings and further recommendations as part of this detailed review.

1.2. Approach to review

ESV adopted a structured end to end approach to the assessment of the processes and activities supporting the key elements of Powercor's wood pole asset management life cycle. The assessment framework is shown in Figure 1, which identifies six 'elements'.

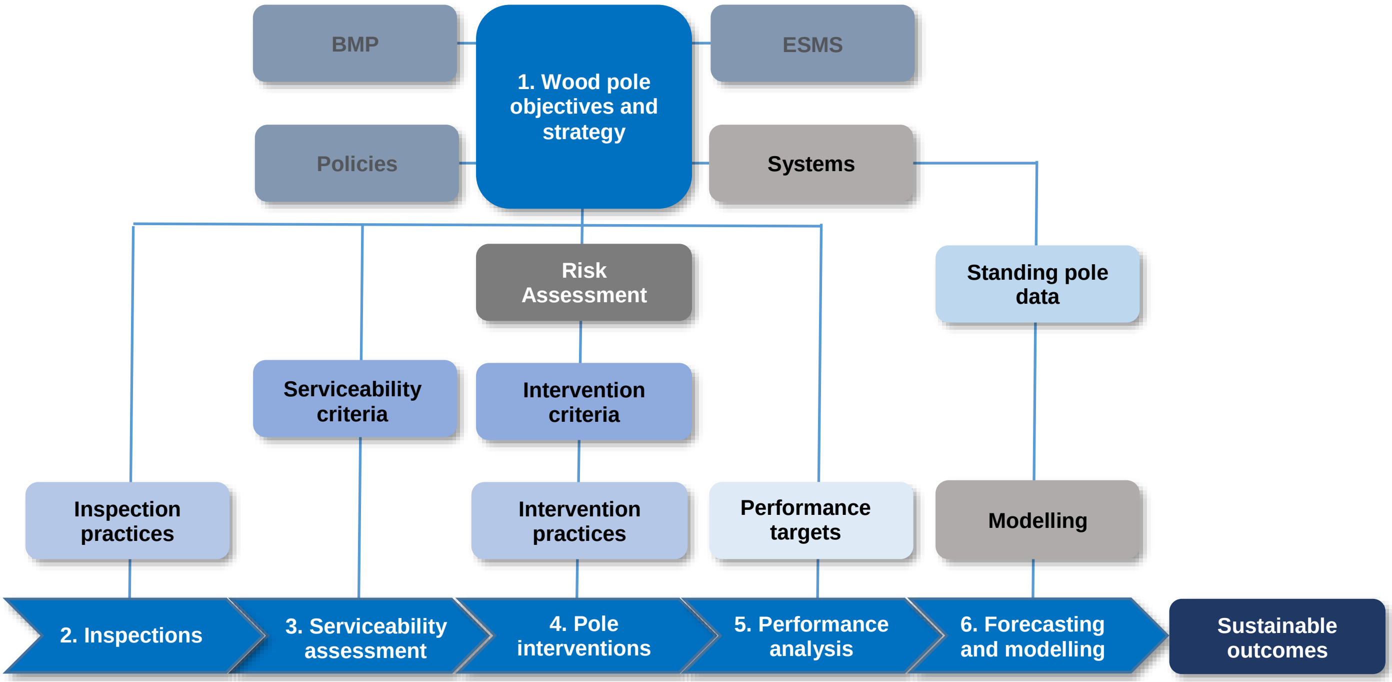
The approach was based on a combination of:

- desktop analysis of Powercor's documentation, including asset management strategies and plans, work practices, models, and pole asset data
- field visits
- meetings/workshops with Powercor representatives and representatives of service providers to Powercor
- written information requests for additional detail or clarification of Powercor's past, current, and proposed methodologies and the outcomes from applying them.

ESV relied upon Regulatory Information Notice (RIN) data from the Australian Energy Regulator's (AER) web site wherever possible. Additionally, even though the other Distribution Network Service Provider's (DNSP) are not part of the scope of this review, ESV sought information from them to help confirm its understanding of general industry practices relating to the management of poles.

The review was aided by the contribution of Powercor representatives through a series of wide-ranging discussions and requests for information. The review was also assisted through a series of discussions with the Director Networks Distribution and team at the Australian Energy Regulator, and by field inspections of asset inspection practices managed by Powercor's asset inspection service provider [redacted]. ESV was only able to undertake a brief high level desk top view of [redacted] training approach, material and competency assessment, as no supporting documentation was provided to validate detail of training content. This limited ESV's ability to perform a detailed assessment of the training and competency of inspection resources and form an objective view.

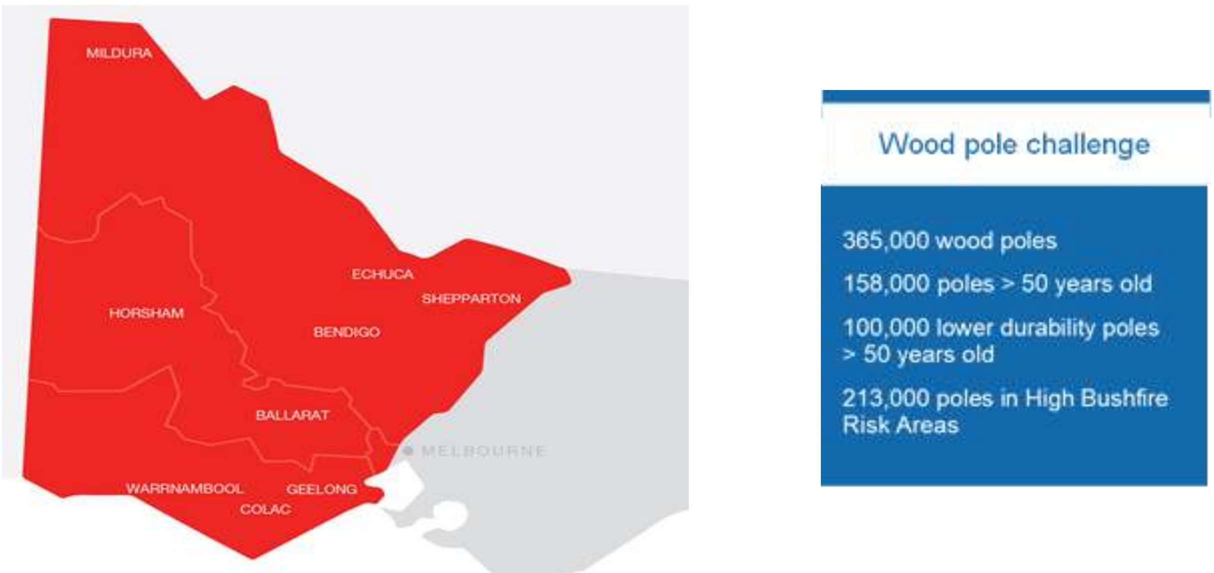
Figure 1: ESV's wood pole management assessment framework



1.3. Powercor's network

Powercor owns a relatively large fleet of 577,000 power poles that support the overhead electricity network throughout central and western Victoria, as well as in Melbourne's outer western suburbs. The network contains 82,000 kilometres of power lines that traverse 145,650 square kilometres and provides electricity for nearly 750,000 customers. It is the largest of the Victorian distribution networks with regional centres as shown in Figure 2.

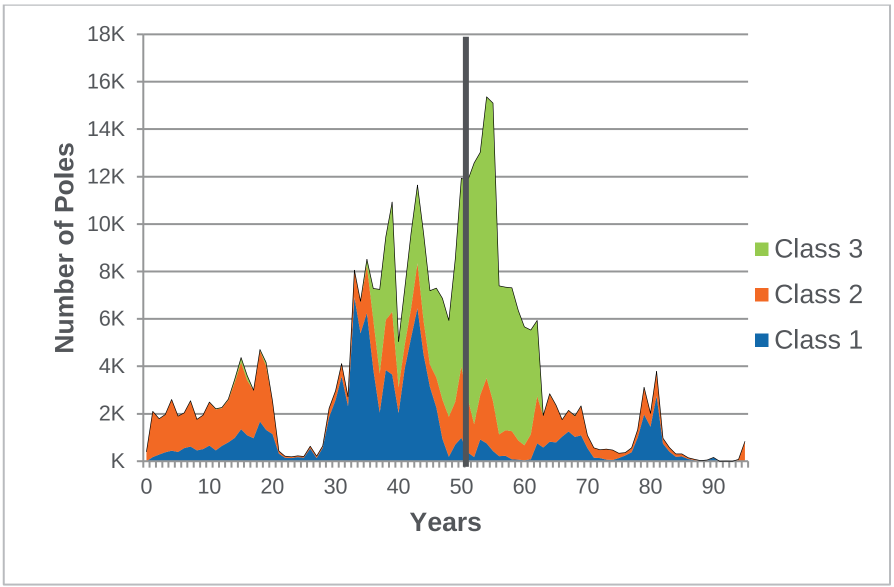
Figure 2: Powercor's network area[1]



[1] CitiPower and Powercor Electricity Safety Management Scheme (ESMS) V2.24, Page 24

As shown in the Figure 3 below, Powercor has over 365,000 wood poles, with over 158,000 poles (42per cent) over 50 years old. Approximately 100,000 poles over 50 years old are (lower) durability class 3 poles. The average age of the pole population is 44 years and the average age of poles that fail is 51 years. This large number of wood poles approaching their end-of-life is a challenge for Powercor's wood pole management system.

Figure 3: ESV's wood pole age profile



1.4. Key Findings

ESV has reviewed Powercor's wood pole management approach. The findings in each of the six key 'elements' are summarised as follows:

1.4.1. Wood Pole Management Objectives and Strategy

Powercor is currently updating its asset management system, of which wood pole management is an important component, to align it with the internationally recognised asset management framework, ISO55001. Powercor's asset management system includes an Asset Class Strategy document for Poles and Towers.

ESV's findings are that:

- Powercor's current asset management principles, risk framework, and wood pole management objectives are adequate
- Powercor's proposed wood pole management strategy is based on risk-based pole interventions which, when implemented, should support better wood pole management outcomes
- The current version of Powercor's 2019 wood pole strategy document is inadequate

1.4.2. Inspection Practices

The objective of wood pole inspection is to provide sufficient information to reliably establish the condition of individual poles. Like most utilities, Powercor uses a combination of visual inspection techniques and the 'sound, dig, and drill' technique to determine the presence and impact of internal decay/rot, termite attack, and other causes of wood pole strength reduction which, if the pole is not replaced or reinforced, lead to pole failure. Powercor also deploys a supplementary inspection wood scanning technology to provide an enhanced method of determining a pole's residual strength.

ESV's findings are that:

- Powercor's current inspection practices align with documented procedures, and are consistent with general industry practices
- Powercor's sound test procedure is inadequately documented and inconsistently implemented
- Powercor's auditing of the quality of inspection practices is inadequate
- compliance of the asset inspection training and competency modules has not been demonstrated
- The Powercor-asset inspection service provider contractual arrangement for inspection services is reasonable
- Powercor's pole inspection delivery performance is adequate
- Powercor's asset inspection performance reporting can be improved.

1.4.3. Serviceability Assessment

Powercor, like all other utilities, takes into account its pole inspection results to decide whether the pole is fit-for-purpose ('Serviceable') or not. A relatively small proportion of Powercor's poles are classified as either 'Added Control Serviceable', 'Unserviceable Priority 2' or 'Unserviceable Priority 1', representing descending order of estimated remaining strength and serviceability. Individual poles are allocated to one of the four serviceability classifications based on assessment criteria.

ESV's findings are that:

- Powercor's serviceability classifications and definitions are reasonable
- with the exception of its Visual Appearance criterion, Powercor's methods of converting condition information to serviceability classifications are reasonable
- Powercor's superseded serviceability criteria were not identifying enough Unserviceable poles
- Powercor's serviceability assessment improvement initiatives have accelerated in 2019
- Powercor's current serviceability criteria are not likely to support sustainable outcomes
- Powercor's proposed introduction of Serviceability Index (SI)-based serviceability criteria is a positive initiative
- Powercor's use of external expertise to improve its serviceability assessment is prudent
- Powercor's decision to not adopt currently available wood scanning technology for inspection of all wood poles is prudent
- Powercor's serviceability assessment improvement initiatives are likely to result in a higher number of poles being classified as Unserviceable

1.4.4. Pole Intervention

Powercor currently replaces or reinforces wood poles classified as Unserviceable and inspects poles classified as AC Serviceable more frequently than Serviceable poles.

ESV's findings are that:

- Powercor's current wood pole intervention methodology is inconsistent with good practice and is unlikely to support sustainable safety outcomes
- Powercor's proposed risk-based pole intervention criteria are likely to improve its management of pole risk
- Powercor's planned risk asset based management (RBAM) intervention criteria are likely to improve its management of pole risk
- Powercor's pole reinforcement/replacement ratio is likely to improve if it implements its proposed risk-based pole intervention criteria
- Powercor is using a recognised pole reinforcement method
- Powercor's implementation of pole interventions is adequate
- Powercor's pole material selection is consistent with current industry practice
- Powercor's consideration of an alternative reinforcement methodology is positive

1.4.5. Performance Analysis

ESV's findings are that:

- Powercor's assessment and reporting of unassisted pole failure statistics should be independently verified
- Powercor has experienced a decrease in find rates for wood poles in poor condition leading to a reduction in wood pole interventions, whilst observing an increasing number of wood pole failures
- Powercor's large wood pole population of unknown timber species is managed as Class 3 durability poles; this is a conservative and acceptable approach.

1.4.6. Forecasting and Modelling

Powercor has updated its forecasting methodology, modelling and forecast wood pole replacement and reinforcement volumes over the last few months. Powercor's proposed forecasting methodology comprises three components: 'Enhanced Pole Calculator', 'Non-pole calculator', and Risk Based Asset Management ('RBAM').The changes account for the impacts of Powercor's proposed changes to its wood pole management strategy, serviceability assessment methodology, and pole intervention methodology. Powercor now forecasts an average of 7,954 poles to be replaced or reinforced each year over the period 2021/22 – 2025/26, a very significant increase from the average of 1,969 poles per annum over the last five years. It forecasts replacing or reinforcing approximately 8,500 wood poles per year on average over the subsequent five-year period.

ESV's findings are that:

- Powercor's current forecasting methodology was not leading to sustainable outcomes
- the intent of Powercor's proposed new forecasting methodology is aligned with regulatory requirements
- Powercor's proposed forecasting methodology is based on three components, two of which have not yet been approved nor implemented (i.e. Enhanced Pole Calculator and RBAM)
- the reasonableness of the non-pole calculator forecast has not been demonstrated by Powercor
- Powercor's forecast wood pole interventions for 2021/22 – 2025/26 is 39,770 poles, a four-fold increase from current levels
- using high pole strength utilisation factors for different bushfire zones is conservative
- Powercor has not yet demonstrated that its forecast interventions will consistently minimise safety risks presented to persons and property by its wood pole assets, as far as practicable
- ESV's comparison of Powercor's proposed forecast with alternative forecasting methodologies shows Powercor's forecast is relatively high

1.4.7. Wood pole intervention delivery

ESV's findings are that:

- ESV has no significant concerns with the deliverability of Powercor's forecast replacement and reinforcement volumes.

1.5. Conclusions

The above findings along with the detail in this report lead ESV to conclude that:

- The wood pole management system in place in March 2018, at the time of The Sisters fire at Garvoc, would not deliver sustainable safety outcomes for the future
- Since March 2018, Powercor has improved its wood pole management system, which has the effect of increasing the volume of wood pole replacements and reinforcements. However, these changes alone will not deliver sustainable wood pole safety outcomes for the future
- Powercor is progressing further improvements to its wood pole management system based on a more comprehensive risk assessment and better inspection practices that, if fully implemented, will as far as practicable, deliver sustainable safety outcomes for the community.

1.6. Recommendations

ESV has reviewed and assessed Powercor's wood pole management approach findings, reconciled them to the review's overall objectives, and requires the following summary recommendations to be addressed. Further detail of recommendations are outlined in section 12.

The timing for completion of the recommendations requiring Powercor's action will be agreed between Powercor and ESV and included in Powercor's (required) wood pole management improvement plan.

1.6.1. Wood pole management objectives and strategy

Recommendation 1

Powercor is to develop a wood pole management improvement plan incorporating all recommendations and associated initiatives, and submit it to ESV no later than 5.00pm, 28 February 2020. The plan is to include clear and measurable milestones that can be monitored through evaluation and reporting (see Recommendation two). When the plan is accepted by ESV, the plan commitments must be incorporated into an updated Powercor Bushfire Mitigation Plan for ESV to monitor and enforce compliance.

Recommendation 2

ESV is to, in consultation with Powercor, establish a regulatory reporting protocol by 28 February 2020 for monitoring Powercor's progress against its wood pole management improvement plan (as referenced in the updated Powercor Bushfire Mitigation Plan). Powercor will report progress to ESV quarterly until all planned recommendations have been delivered.

Recommendation 3

Powercor is to update its wood pole management documentation to incorporate its revised wood pole objectives, strategies, performance measures, forecast, plans and improvement initiatives (and to otherwise address ESV's findings regarding the shortcomings of its Asset Class Strategy document).

1.6.2. Inspection practices

Recommendation 4

Powercor is to revise its Asset Inspection and Training Manual (or equivalent) to clearly articulate the 'sound test' procedures and practices to provide a rigorous basis for inspector training, application in the field, and auditing.

Recommendation 5

Powercor is to revise its inspection auditing process and performance reporting to improve the quality and consistency of inspections.

Recommendation 6

Powercor is to provide evidence to ESV that the asset inspector training and competency modules and assessment undertaken by the asset inspection service provider comply with National Certificate II accreditation and with Powercor's asset inspection standards

1.6.3. Serviceability assessment

Recommendation 7

Powercor is to complete the development and implementation of its Serviceability Index (SI)-based serviceability assessment methodology, to lead to a more accurate representation of the likelihood of pole failure over time.

Recommendation 8

Powercor is to proactively explore (if feasible with broader industry), the development of non-destructive wood pole inspection technology to improve the accuracy of pole condition assessments.

1.6.4. Pole interventions

Recommendation 9

Powercor is to complete the development of its pole risk-based asset management intervention methodology to improve the management of pole risk. If implemented appropriately, this approach will enable Powercor to prioritise the poles for intervention in higher risk areas by considering the consequence of failure to the community.

1.6.5. Performance analysis

Recommendation 10

Powercor is to improve its asset performance monitoring by developing pole asset performance metrics and health reporting dashboards, with appropriate targets to monitor and review performance levels.

Recommendation 11

ESV, in consultation with MEC's, is to revise the reporting guidelines to include performance indicators relating to wood pole management in the quarterly and annual performance reporting. This will include the establishment of leading and lagging indicators and clarification of the classification of assisted and unassisted pole failures, allowing ESV to monitor wood pole performance. This should build on and extend existing safety performance reporting by ESV.

1.6.6. Forecasting and modelling

Recommendation 12

Powercor is to finalise its proposed forecasting methodology, its forecast pole replacements/reinforcements and include the forecast pole interventions in its Bushfire Mitigation Plan.

Recommendation 13

ESV is to monitor quarterly wood pole performance and delivery of Powercor's forecast intervention volumes (up to and including 2025/26). The approved volumes are to be included in the updated Bushfire Mitigation Plan, with ESV using its powers to hold Powercor to account for delivery.

2. Introduction

2.1. Purpose

The purpose of this document is to advise ESV of the approach, findings and further recommendations to address the findings outlined in the technical investigation report dated July 2019 titled 'The Condition of Power Poles in South West Victoria' being:

- ESV to assure itself that Powercor's asset management practice relating to wood pole management will deliver sustainable safety outcomes for the community in the long term.
- Provide a publishable report ('Public Report') by 20 December 2019 addressing the below matters, and outline ESV's assessment and findings, of testing the Powercor system, and highlight any potential improvements required to ensure Powercor's wood pole management is fit for purpose to deliver enduring safety outcomes.

Specifically, the report will:

1. Assess the sustainability of Powercor's wood pole management approach; and
2. Investigate the efficacy of Powercor's pole condition assessment process.

2.2. Objectives

In assessing the sustainability of Powercor's wood pole management approach, ESV has sought to address the following objectives established in the technical investigation report dated July 2019, and outlined in Table 1:

1. ESV will continue its investigations into Powercor's power pole asset management practice to determine if it:
   - replaces poles at an appropriate rate to ensure sustainable asset performance
   - replaces the right categories of poles at the right time to ensure sustainable safety performance
   - takes into account different pole degradation rates according to local conditions, wood type, etc.
   - uses the right data for essential decisions
   - reaches the right conclusions
   - inspects at appropriate times to ensure up to date pole condition data implements suitable reinforcement activities, such as staking.
2. ESV will investigate the efficacy of Powercor's pole condition assessment process, including:
   - the completeness of the work instructions and guidance material for hammer testing, dig and drill inspections[2] and non-invasive technologies such as wood scanning technologies
   - whether non-destructive testing (e.g. wood scanning technologies) should be triggered earlier in the life of a pole to better track the rate of degradation of poles
   - staff training and assessment of competency to ensure consistency of practice
   - the completeness and currency of training materials and records
   - the nature and entirety of asset inspection records
   - condition assessment results that lead to informed decision making.

[2] Referred to in this report as 'sound, dig, and drill'

Table 1: Cross reference of objectives to relevant sections of this Report

Objective	Section
1. ESV will continue its investigations into Powercor's power pole asset management practice to determine if it:	
• replaces poles at an appropriate rate to ensure sustainable asset performance	Section 9
• replaces the right categories of poles at the right time to ensure sustainable safety performance	Section 8 Section 9
• takes into account different pole degradation rates according to local conditions, wood type, etc.	Section 6 Section 7
• uses the right data for essential decisions	Section 6 Section 7 Section 8 Section 9
• reaches the right conclusions	All
• inspects at appropriate times to ensure up to date pole condition data implements suitable reinforcement activities, such as staking.	Section 5 Section 7
2. ESV will investigate the efficacy of Powercor's pole condition assessment process, including:	
• the completeness of the work instructions and guidance material for hammer testing, dig and drill inspections and non-invasive technologies such as wood scanning technologies	Section 5
• whether non-destructive testing (e.g. wood scanning technologies) should be triggered earlier in the life of a pole to better track the rate of degradation of poles	Section 5 Section 6
• staff training and assessment of competency to ensure consistency of practice	Section 5
• the completeness and currency of training materials and records	Section 5
• the nature and entirety of asset inspection records	Section 5
• condition assessment results that lead to informed decision making	Section 5 Section 6

2.3. Background

The ESV July 2019 Technical Investigation Report resulted from ESV's investigation of Powercor's pole management following the St Patrick's Day fires in March 2018. Started by electricity assets, the fires destroyed a significant amount of property and livestock leaving property owners fearful that further fires may occur. Several community members questioned the adequacy of Powercor's maintenance regime, particularly its inspection and pole replacement practices.

Specifically, the community raised significant concerns and questioned relating to Powercor's pole management practices including:

- the potential for further fires to be caused by electricity distribution assets
- the confidence in Powercor to manage its network safely
- Powercor's compliance with legislative and statutory requirements

ESV's draft report titled *'The Condition of Power Poles in South West Victoria'* dated 31 May 2019, reviewed Powercor's arrangements to determine if there was an immediate risk to communities. The process included giving the community and stakeholders the opportunity to provide their feedback on the findings through an open consultation process, which were considered when finalising the report.

The final version of the Technical Investigation Report was released on 25 July 2019[3].

Although Powercor's power pole inspection and maintenance process were found to be fit for purpose and there is no immediate systemic risk of pole failures at that time, to ensure that no safety concerns existed, ESV decided a more detailed technical investigation was required to assure itself that Powercor's asset management practice relating to wood pole management will deliver sustainable safety outcomes for the community. This report addresses the findings of that further work.

ESV will provide a comprehensive, publishable report ('Public Report') on its assessment and findings addressing the above matters, by 20 December 2019.

Following the completion of this review into Powercor's wood pole management, ESV will commence similar audits and investigations into the pole management practices of the other Victorian distribution businesses in 2020.

2.4. Glossary of Terms (Definitions)

Definitions of the main terms used in this Report

ACT	Electricity Safety Act 1998
ACS	Added Control Serviceable are poles assessed as having sufficiently deteriorated to warrant an increased inspection frequency (previously referred to as Limited Life)
AER	Australian Energy Regulator
AFAP	As far as practicable' – is established in the energy safety acts as the test to be applied to show that the risk control efforts made by the MEC are adequate for meeting its statutory general duties and obligations.
AS/NZS 7000	Australian Standard AS/NZS 7000:2016 Overhead Line Design
BCA	Bushfire Construction Area – termed used by Powercor to define the electric line construction area (ELCA) as prescribed in regulation 7(1)(h) of the Electricity Safety (Bushfire Mitigation) Regulations 2013. Defines a location/area that requires a higher standard for electric line works.
BFM	Bushfire Mitigation Management Plan, as required by the Electricity Safety Act 1998, describes preventative strategies, procedures and processes within Asset Management System used to mitigate the risk of fire ignition associated with supply networks.
CBRM	Condition-based risk management
CCA	Copper Chrome Arsenate is treatment for poles to prevent attack from microbes or insects
DELWP	Department of Environment, Land, Water and Planning is the Victorian government body working industry and community to develop a secure and sustainable energy future for Victoria
DNSP	Distribution Network Service Provider
EDPR	Electricity Distribution Price Review - involves Distribution Businesses submitting their plans every five years for managing the networks to the Australian Energy Regulator for approval of revenue streams through customer network charges

[3] ESV, *Technical Investigation Report, 'The Condition of Power Poles in South West Victoria,* 25 July 2019

ENA	Energy Networks Association
Enhanced Pole Calculator	As for Pole Calculator but with proposed new Serviceability Index algorithms and parameters
ESV	Energy Safe Victoria which is the technical regulator in Victoria
ESMS	Electricity Safety Management Scheme as required under the Electricity Safety Act 1998 and Electricity Safety (Management) Regulations 2019 for the provision of an asset management system to safely design, construct, operate, maintain and de-commission supply networks.
HBRA	Hazardous bushfire risk area as defined in section 3 of the Electricity Safety Act 1998.
HSE	Health Safety Environment
HI	Health Index
Inspections	Ground based visual inspection program that includes intrusive test and treatment of timber poles in accordance with the Asset Inspection Manual
ISO 31000	International Standards series ISO 31000: 2018 Risk Management
ISO 55000	International Standards series ISO 55000: 2014 Asset Management
LBRA	Low bushfire risk area.
LSD	Limit State Design
MEC	Major Electricity Company (being a licensed electricity distribution or transmission company)
NDI	Non-destructive inspection technology used for the examination of materials and components in such a way that allows materials to be examined without changing or destroying the serviceability
NEO	National Electricity Objective
NER	National Electricity Rules set out the regulatory framework for electricity networks.
Pole Intervention	Where a pole is actioned for either replacement or reinforcement in a timeframe designated by Powercor’s priority policy.
Pole Calculator	software embedded in Powercor’s mobile computers to calculate wood pole serviceability based on inspection inputs and embedded parameters and algorithms
RCM	Reliability Centred Maintenance
RBAM	Risk Based Asset Management, used by Powercor to refer to a component of its forecasting methodology and to its asset management strategy
Regulations	Electricity Safety (Management) Regulations 2009 Electricity Safety (Bushfire Mitigation) Regulations 2013 Electricity Safety (Electric Line Clearance) Regulations 2015
Repex	Replacement expenditure
R Factor	A measure of residual strength versus Working Strength of the pole
RFD	Pole reinstatement system method used for pole intervention reinforcement
RIN	Regulatory Information Notice
SAP	SAP is Powercor’s real time information management system
SF	Safety Factor is the measure of the safety margin above the initial design strength of a wood pole
SDD	Sound, dig, drill inspection methodology

Serviceability	An assessment about the condition of the wood pole – specifically is fit for purpose ('Serviceable') or not
SI	Serviceability Index is the ratio of the residual capacity (strength) of a pole to the design load on the pole
Sound wood	A measurement of the amount of remaining wood (i.e. unaffected by rot/decay or termite attack) in the wood pole annulus; also referred to as 'good wood'
UET20612	Asset Inspectors National qualification Certificate II in ESI – Asset Inspection – UET20612
Unassisted Failure	The pole has fallen or the base has no resistance to bending moment, for example: only being supported by conductor or stay. Excludes vehicle impact.
Unserviceable Priority 2	These poles are assessed as having deteriorated to a point which requires reinforcement or replacement
Unserviceable Priority 1	These poles are assessed as having deteriorated to a point which requires priority replacement
VESI	Victorian Electricity Supply Industry
Visual Appearance criterion	A set of three indicators of an Unserviceable introduced by Powercor in 2019 to supplement its existing pole intervention criteria (including existing criteria established through visual inspection)
WSD	Working Strength Design
Wood scanning	Wood scanning is a non-destructive inspection (NDI) technique used as a non-invasive inspection method to compliment traditional invasive pole testing methods

2.5. Approach

The review is centred on the two key questions raised in the objectives and is structured around an end-to-end view of Powercor's wood pole asset management life cycle process. It identifies and reviews key inputs to, and activities within, the process.

A list of all information resources referred to during the review is found in appendix 1.

ESV developed the wood pole management assessment framework (refer Figure 4), which incorporates six key 'elements' and has been used to structure the assessment, including the detailed scopes of work (refer to Appendix 2).

The six assessment elements are:

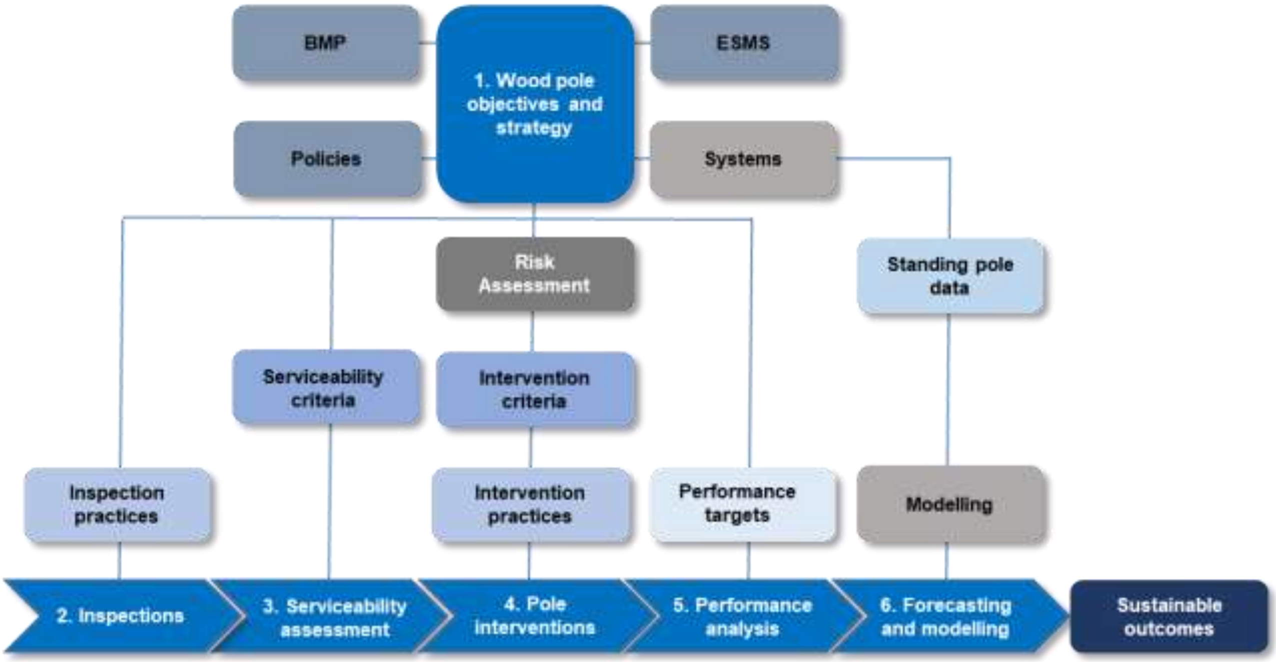
1. Wood pole management objectives and strategies
2. Inspection
3. Serviceability assessment
4. Pole interventions
5. Performance analysis
6. Forecasting and modelling.

ESV explored the key elements during discussions, workshops, meetings and information requests with and to Powercor and key service provider representatives. As indicated in Figure 4, ESV reviewed objectives, strategies, criteria, practices, models, pole asset data, and forecasts. In addition to meetings and other discussions with Powercor, ESV accessed key Powercor documents and other information relevant to the assessment framework to support the findings and recommendations in this report.

The AER will commence its review of the DNSP's EDPRs in 2020. ESV held discussions and workshops with the AER to understand its assessment approach and how ESV can contribute to the assessments. ESV will continue to foster this relationship and work closely to ensure that the AER is aware of ESV's concerns regarding network safety. As part of the ESV assessment described in this Report, ESV has referred to:

- Powercor's RIN data on the AER's website
- Powercor's repex model (which is based on the AER's repex model).

Figure 4: ESV's wood pole management assessment framework



A series of formal Information Requests (refer appendix 3) to acquire Powercor's documents, data and information (including Powercor's own analysis and independent reports) were utilised to support ESV's investigations. Throughout the assessment phase Powercor was very co-operative, providing information within the requested timeframes.

Powercor and ESV representatives held an on-site workshop on 19 September 2019. The purpose of the workshop was to provide Powercor with the opportunity to inform and confirm ESV's understanding of Powercor's approach to managing its wood pole assets.

The structured session (refer to appendix 4), provided a forum for open, constructive and interactive discussion, with Powercor regarding its wood pole asset challenges, strategies, and improvement initiatives. Powercor tabled a report to address ESV's requested topic areas.[4]

The ESV project team undertook desktop reviews of documentation pertaining to the inspection services, concentrating on inspection work practices and procedures. ESV conducted four field pole inspections, one inspection using wood scanning technology.

ESV was only able to undertake a high-level desk top review of [redacted] training approach, material and competency assessment, as no supporting documentation was provided to validate detail of training content. This limited ESV's ability to perform a detailed assessment of the training and competency of inspection resources and form an objective view whether this complied with the National Certification II accreditation requirements or included relevant information pertaining to Victorian, Acts, Regulations, Codes of practice, Safety Rules, and Industry Guidelines.

[4] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019*

ESV endeavoured to source supporting inspection information from [redacted], however due to impending legal action [redacted] refused to provide this information to ESV. ESV may have used its powers under the Electricity Safety Act to compel [redacted] to provide documents, but, due to uncertainty of the use of these powers in this case, and the potential to inhibit any other legal actions, chose not to enforce this requirement upon [redacted].

ESV sought information from other Victorian MECs to compare some of Powercor wood pole management practices.

As part of finalising this Report, ESV has ensured that key stakeholders, DELWP and Powercor have been provided with the opportunity to provide feedback and responses. ESV has taken into account feedback provided.

The development of this report was greatly assisted by constructive engagement through a series of wide-ranging discussions with the General Manager Electricity Networks, Head of Network Asset Management, his leadership team and other employees of Powercor and by prompt responses to ESV's requests for information.

The development of this report was also assisted through the series of discussions with the AER's Director Networks Distribution and team.

3. Wood pole management objectives and strategy

3.1. Introduction

In this section, ESV first considers the obligations and implications of relevant regulations and other legislative instruments on a MEC's wood pole management objectives and strategies. This provides a reference point to establish whether Powercor's wood pole management system is aligned with the requirements of legislation.

ESV then presents its view of what sustainable wood pole management entails. With this context, ESV assesses Powercor's wood pole management objectives and strategies.

3.2. Regulations and legislative instruments

3.2.1. Requirements of Electricity Safety Act

Division 1 of Part 10 of the Electricity Safety Act 1998 (the Act), section 98, General duty of major electricity companies requires a major electricity company (MEC) to:

design, construct, operate, maintain and decommission its supply network to minimise as far as practicable

> *(a) the hazards and risks to the safety of any person arising from the supply network; and*
>
> *(b) the hazards and risks of damage to the property of any person arising from the supply network; and*
>
> *(c) the bushfire danger arising from the supply network.*

Practicable means having regard to:

> *(a) the severity of the hazard or risk in question; and*
>
> *(b) the state of knowledge about the hazard or risk and any ways of removing or mitigating the hazard or risk; and*
>
> *(c) the availability and suitability of ways to remove or mitigate the hazard or risk; and*
>
> *(d) the cost of removing or mitigating the hazard or risk.*

To demonstrate that it meets the requirements of the general duties, a MEC is required to submit an electricity safety management scheme (ESMS) in accordance with section 99 of the Act. The Act requires the ESMS to:

> *2 (a) be in writing; and*
>
> *(b) in accordance with the regulations, specify the safety management system being followed or to be followed by the major electricity company*
>
> > *(i) to comply with the major electricity company's duties under Division 1; and*
> >
> > *(ii) in relation to any other matters relating to the safe design, construction, operation, maintenance and decommissioning of the supply network that are prescribed.*

(2A) Without limiting subsection (2)(b), an electricity safety management scheme must include a plan for the mitigation of bushfire danger in relation to the major electricity company's supply network.

The 'regulations' referred to in section 99(2(b) are the Electricity Safety (Management) Regulations 2019. The objective of the regulations is to *provide for the requirements, procedures and other matters relating to the acceptance of electricity safety management schemes*.

The content of an MEC's ESMS must comply with the requirements of AS5577 *Electricity network safety management systems.*

In relation to section 99(2A) of the Act, the details of a plan for the mitigation of bushfire danger are specified in the Electricity Safety (Bushfire Mitigation) Regulations 2013.

3.2.2. Implications of Electricity Safety Act for wood pole management

The electricity infrastructure safety regime (inclusive of Safety Cases & Electricity Safety Management Schemes) utilises principle, performance and outcome-based regulatory approaches. The primary reason is that the safety risks are complex, geographically diverse, have significant consequences (regardless of frequency), and often require tailored solutions.

ESV's role is to monitor and enforce the safety of the design, construction, operation, maintenance and decommissioning of Victorian major electricity companies' electrical transmission and distribution networks. It monitors the compliance of MECs with their obligations under the Electricity Safety Act 1998 (the Act) to minimise risk "as far as practicable" as articulated in each MEC's Electricity Safety Management Scheme (ESMS) and Bushfire Mitigation Plan (BMP).

This approach recognises that distribution and transmission businesses best understand their network risks and have the accountability for maintaining a safe network as outlined in their ESMS and BMP.

ESV undertakes an iterative review process with the MECs of their ESMS and BMP plans, and when satisfied that it meets the requirements of the Act and relevant Regulations, ESV will accept ESMSs and BMPs.

ESV regularly conducts both systems (office based) audits and outcomes (field based) audits against prescribed ESMS and BMP undertakings, ensuring processes and work practices are being carried out as documented in the MEC's manuals and procedures. This ensures the MEC's network safety systems continue to evolve to manage risks in accordance with statutory obligations and their general duties.

Audit topics or areas of focus are reviewed and determined annually in a systematic and structured approach informed by:

- analysis of all major risks, including critical control priorities
- critical control relationships to system audit findings
- review of ESMS audit findings, including ESMS validation and bushfire mitigation system audits
- review of field audit findings, including work practices observation and pre-summer audits
- analysis of causal factor trends of serious incidents reported to ESV
- consideration of the recommendations of the Independent Review of Victoria's Electricity Safety Framework

The outcomes of ESV audit programs are publicly reported each year in ESV's Annual Performance Report on Victorian Electricity Networks as well as specific audits that can be found on ESV's website.

3.3. National Electricity Rules requirements

3.3.1. National Electricity Rules capex objectives and criteria

The National Electricity Law and the National Electricity Rules (NER) set out the regulatory framework for electricity networks. Regulated network businesses must periodically apply to the Australian Energy Regulator (AER) to assess their revenue requirements (typically, every five years). Chapters 6 and 6A of the NER lay out the framework the AER applies in undertaking this role for distribution and transmission networks respectively.

Of most relevance to this Report on the sustainability of Powercor's wood pole management are the capital expenditure objectives and criteria (from Rule 6.5.7) and the operating expenditure objectives and criteria (from Rule 6.5.6) of the NER. The 'capital expenditure objectives and criteria' are stated in Figure 5 and

Figure 6 below. The operating expenditure objectives and criteria are very similar to the capital objectives and criteria.

Figure 5: NER capital expenditure objectives – Chapter 6: Distribution Network Service Providers

(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).

Figure 6: NER capital expenditure criteria – Chapter 6: Distribution Network Service Providers

(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).

3.3.2. Impact of the NER on wood pole management

The NER requires the AER to set a ceiling on the revenues or prices that a network can earn or charge during a regulatory period. In determining the revenues or prices that a network business can charge, the AER forecasts how much revenue a business needs to cover its efficient costs (including operating and maintenance expenditure, capital expenditure, asset depreciation costs and taxation liabilities) and provide a commercial return on capital.[5] The AER must accept a regulated network business' capex proposal if it is satisfied that the total forecast capital expenditure is prudent, efficient and reasonable, pursuant to the NER capex objectives and criteria.

Importantly, the AER does not allocate expenditure to discrete asset categories, such as wood poles. The responsibility for allocation of expenditure to asset categories remains with the utility.

[5] AER website

The AER published an 'Industry practice application note' (Application Note) on asset replacement planning in January 2019 to assist distribution and transmission network service providers to assess their own replacement expenditure requirements and presenting the justification for it to the AER. The Application Note addresses two separate decisions to:

- retire or de-rate an asset
- invest or commit to an ongoing operational action after making an asset retirement or de-rating decision where a network or service constraint exists.

Both of these decisions are relevant to the scope of wood pole management. The Application Note also explains the principle for aligning replacement expenditure proposals with the National Electricity Objective (NEO), the NER and good industry practice, as follows:

'To align with the NEO and to satisfy the requirements of the NER, asset management practices should enable demonstrably prudent and efficient expenditure decisions that accord with good electricity industry practice. This should, among other things, provide transparency of key information, practices, and methodologies so key stakeholders are sufficiently informed about NSP's planning and decision making processes.[6]

The AER expects to see economic as well as technical justification for proposed replacement expenditure to demonstrate the proposed costs are what '*a prudent operator would require to achieve the capital expenditure objectives*.'

The overlap between the AER's role and ESV's role is with the approach to and cost of maintaining a safe wood pole network. The AER also takes into account the MEC's justification for expenditure on the wood pole population required to maintain safety, reliability and security.

3.4. ESV's interpretation of 'sustainable outcomes' for wood pole management

As the Technical Safety Regulator, part of ESV's role is to give the public and affected communities' confidence that Powercor's wood pole management systems will deliver enduring safety outcomes for the future. In reviewing a MEC's asset management practice to deliver sustainable safety outcomes for the community in the long term, it is prudent to define 'sustainable outcomes for wood pole management' as a benchmark for ESV's assessment of Powercor's approach.

The obligation on MEC's requires them to proactively eliminate, where practicable, the risk of an incident before it occurs, or otherwise to minimise the risk of failure to the extent that the cost of doing so is not disproportionate to the risk reduction achieved. This is the effect of legislative and regulatory requirements that oblige MEC's to maintain a safe workplace, safe systems of work, a safe supply and the safety of staff and the public[7]. This goes beyond an obligation to mitigate the risks when a safety incident, despite precautions, actually occurs.

The required practice is to determine what is practicable by undertaking an economic test where risks should be reduced to as far as practicable, incurring expenditure as necessary up to the point at which the expenditure would be grossly disproportionate to the benefit achieved.

Figure 7 outlines ESV's view of the governance and management building blocks to achieve sustainable network asset performance, which is defined as consistently minimising the safety risks presented to persons and property by the network, as far as practicable.

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[6] AER, *Industry practice application note – Asset replacement planning,* January 2019, p. 9

[7] For example: Occupational Health and Safety Act 2004 (Vic); National Electricity Objective, National Electricity Rules, Electricity Safety Act 1998 (Vic).

Figure 7: ESV's definition of sustainable network safety management

SUSTAINABLE NETWORK SAFETY MANAGEMENT

Consistently minimising safety risks presented to persons and property by networks as far as practicable

Safety risks presented by MECs networks must be proactively managed until the cost of doing so becomes grossly disproportionate to the risk reduction benefits

GOVERNANCE AND MANAGEMENT BUILDING BLOCKS

Policies, Objectives, and Strategies

MECs risk management policies and framework should combine with its asset class performance objectives and strategies to meet its regulatory obligations

Asset Class Management Plan

The detailed plan identifying the investment (activity and cost) and prioritisation methodology to ensure the asset class management objectives are consistently achieved or improved over the next 5 – 10 years

Asset Class Management Criteria and Practices

MECs must apply design, construction, operation and maintenance criteria and practices in the management of its assets to ensure that safety risks are effectively managed AFAP in accordance with applicable standards and regulations, e.g. for poles this includes:

- Electricity Safety Act: 1998 - bushfire mitigation
- Australian Standard 5577:2013 - Electricity network safety management systems
- Australian/New Zealand Standard AS/NZS 7000:2016 - Overhead Line Design

Asset Class Management Resources

MECs must ensure it has sufficient capacity (personnel, equipment, and materials) and sufficient competent personnel to effectively develop and deliver the Asset Class Management Plan

Continuous improvement

MECs must apply continuous improvement principles to all aspects of governance and management of its assets, including application of new technologies, to ensure its asset investment is as prudent and efficient as possible

Monitoring and control

MECs must demonstrate that its performance is monitored, and appropriate corrective action is taken to prudently and efficiently achieve its objectives and plans (short term and long term) to maintain or improve levels of performance AFAP.

3.5. Powercor's wood pole management

3.5.1. Overview

Wood pole management is within the scope of Powercor's asset management system, a suite of documents that governs the lifecycle management of assets to meet its business objectives. While Powercor is not certified to the international standard for asset management, ISO 55000:2014, Powercor advises that it intends to align its Asset Management Plan to it by the end of 2019 by:[8]

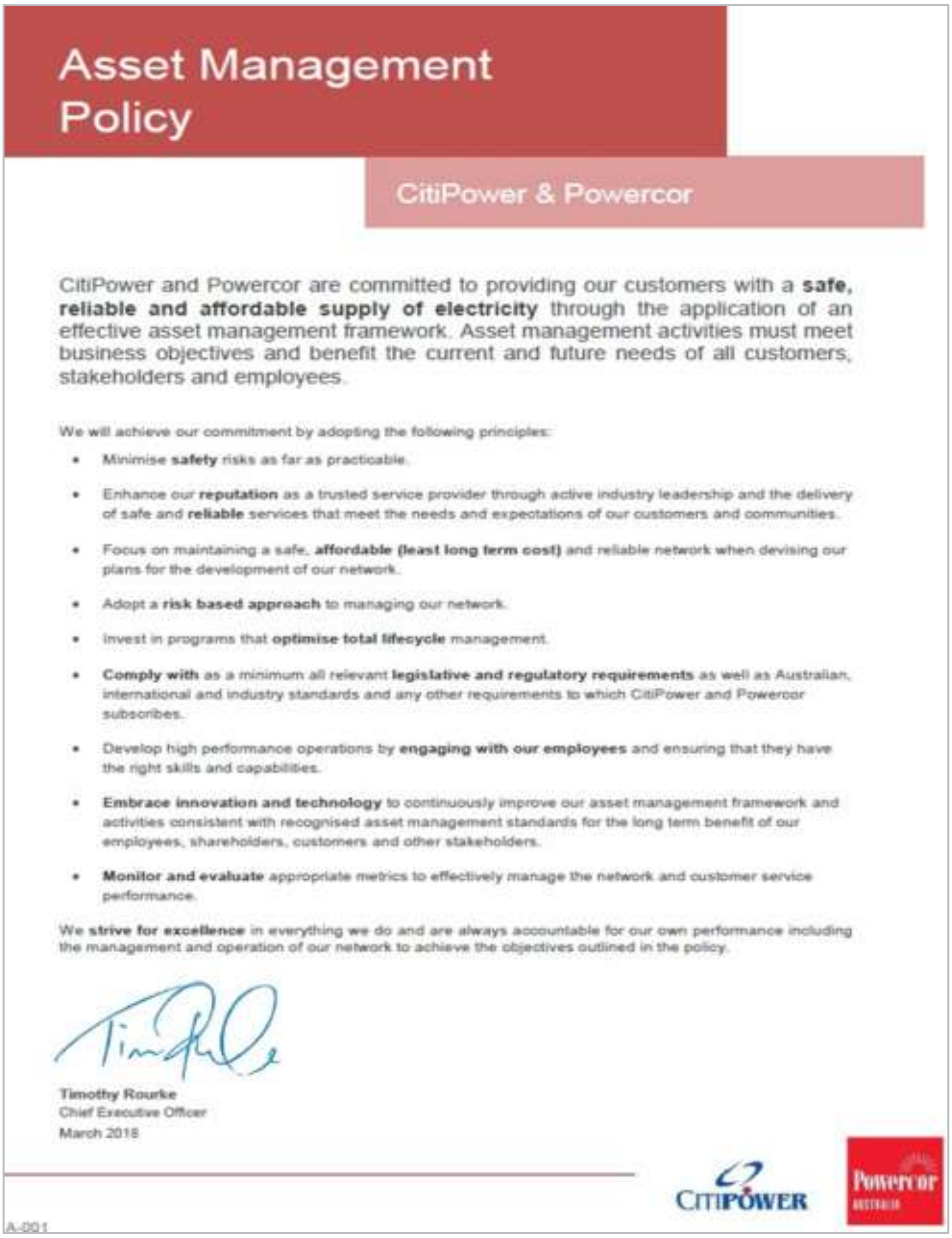
[8] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019,* slide 20

- linking each asset management action to overall company objectives
- embedding a strong asset management focus into processes at each phase of the asset life cycle, enabling effective short and long term decisions to be made
- placing a focus on sound asset information as the basis for effective decision-making
- assigning clear responsibilities and accountabilities for each element of the System.

3.5.2. Asset management policy

Powercor's Asset Management Policy (Figure 8) identifies the nine asset management principles.

Figure 8: Powercor Asset Management policy



Asset Management Policy

CitiPower & Powercor

CitiPower and Powercor are committed to providing our customers with a **safe, reliable and affordable supply of electricity** through the application of an effective asset management framework. Asset management activities must meet business objectives and benefit the current and future needs of all customers, stakeholders and employees.

We will achieve our commitment by adopting the following principles:

- Minimise **safety** risks as far as practicable.
- Enhance our **reputation** as a trusted service provider through active industry leadership and the delivery of safe and **reliable** services that meet the needs and expectations of our customers and communities.
- Focus on maintaining a safe, **affordable (least long term cost)** and reliable network when devising our plans for the development of our network.
- Adopt a **risk based approach** to managing our network.
- Invest in programs that **optimise total lifecycle** management.
- **Comply with** as a minimum all relevant **legislative and regulatory requirements** as well as Australian, international and industry standards and any other requirements to which CitiPower and Powercor subscribes.
- Develop high performance operations by **engaging with our employees** and ensuring that they have the right skills and capabilities.
- **Embrace innovation and technology** to continuously improve our asset management framework and activities consistent with recognised asset management standards for the long term benefit of our employees, shareholders, customers and other stakeholders.
- **Monitor and evaluate** appropriate metrics to effectively manage the network and customer service performance.

We **strive for excellence** in everything we do and are always accountable for our own performance including the management and operation of our network to achieve the objectives outlined in the policy.

Timothy Rourke
Chief Executive Officer
March 2018

CITIPOWER

Powercor

A-001

3.5.3. Asset management objectives

Powercor's asset management objectives are:[9]

- 'manage and operate the network safely
- meet our network reliability performance targets
- manage our assets on a total lifecycle basis at least cost
- manage our compliance obligations
- empower and invest in our employees
- monitor opportunities and drive continuous improvement'

Powercor's asset management objectives and principles align to its Corporate 'Strategic Pillars' as outlined in Figure 9.

Figure 9: Mapping of Powercor's asset management principles and objectives to its corporate objectives[10]

Corporate Strategic Pillars					Asset management policy principles	Asset management objectives					
Improve stakeholder engagement	Build a network for the future	Optimise regulatory outcomes	Drive operational excellence	Deliver customer outcomes		Manage and operate the network safely	Meet our network reliability performance targets	Manage our assets on a total life cycle basis at least cost	Manage our compliance obligations	Empower and invest in our employees	Monitor opportunities and drive continuous improvement
			✓	✓	• Minimise safety risks as far as practicable	✓					
✓				✓	• Enhance our reputation as a trusted service provider through active industry leadership and the delivery of safe and reliable services that meet the needs and expectations of our customers and communities	✓	✓				
✓			✓	✓	• Focus on maintaining a safe, affordable (least long term cost) and reliable network when devising our plans for the development of our network	✓	✓	✓			
			✓		• Adopt a risk based approach to managing our network			✓			
	✓	✓	✓		• Invest in programs that optimise total lifecycle management			✓			
			✓		• Comply with as a minimum all relevant legislative and regulatory requirements as well as Australian, international and industry standards and any other requirements to which CitiPower and Powercor subscribes				✓		
	✓		✓		• Develop high performance operations by engaging with our employees and ensuring that they have the right skills and capabilities					✓	
	✓	✓	✓	✓	• Embrace innovation and technology to continuously improve our asset management framework and activities consistent with recognised asset management standards for the long term benefit of our employees, shareholders, customers and other stakeholders						✓
✓			✓	✓	• Monitor and evaluate appropriate metrics to effectively manage the network and customer service performance	✓	✓				✓

3.5.4. Powercor's risk management framework

Powercor states that: '*Our Board at CP-PAL is responsible for monitoring corporate risk governance. The responsibility of the Board includes ensuring that the significant hazards and risks faced by our business have been identified. It also ensures that appropriate and adequate controls, monitoring, accountabilities and reporting are in place and that risks are being managed in accordance with the Board approved risk appetite. The CEO is accountable to the Board to ensure that management and staff members achieve the business objectives including management of risk*.[11]

Powercor provide statements of its risk tolerance to assist with business decision making and any necessary action in response to the relevant residual risk rating, as summarised in Table 2.

[9] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019*, slide 21

[10] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019,* slide 21

[11] CitiPower Powercor *Safety Case* 2017, p. 19

Table 2: Powercor risk tolerance[12]

Residual Rating	Risk acceptability	Action	Timeframe
Extreme Risk could cause or is causing major adverse effects on the achievement of Business objectives	*Unacceptable Region – Risk can only be allowed to continue under extraordinary circumstances and with approval from the Risk Management and Compliance Committee (RMCC).*	Immediate notification to Corporate Risk who will report to RMCC Chairman and CEO. Risk activity is to cease, unless Risk Owner obtains approval from the RMCC for activity to continue. Risk Owner to develop and implement a Risk Treatment Plan as a high priority matter. All Extreme risks and Risk Treatment Plans are reportable to RMCC via Corporate Risk.	Interim action required within 10 days. Detailed plan of action required within 30 days. Expected resolution within 60 days.
High Risk could have or is having a significant adverse effect on the achievement of Business objectives)	*Tolerable region – Increase risk mitigation efforts to reduce risk as reasonably practicable unless cost significantly outweighs the benefit or reduction is impracticable.*	Immediate notification to Corporate Risk which will report to CEO. Risk Owner to develop and implement a Risk Treatment Plan. All High risks and Risk Treatment Plans are reportable to RMCC via Corporate Risk.	Prompt action required within 30 days. Expected resolution within 3 months.
Medium Risk could have or is having an adverse effect on the achievement of Business objectives	*Tolerable region – Increase risk mitigation efforts to reduce risk as reasonably practicable unless cost would exceed the benefit gained.*	No Risk Treatment Plan required. Control Improvement Plan to be developed for controls rated less than Satisfactory.	Action required within 30 days. Expected resolution within 3-6 months.
Low Risk has minimal impact on the achievement of Business objectives	*Broadly Acceptable Region – No further risk reduction measures are usually required unless the benefits are substantial.*	No Risk Treatment Plan required. Control Improvement Plan to be developed for controls rated less than Satisfactory.	Expected resolution within 6-12 months subject to competing priorities.
Negligible **(Risk does not pose a threat to the achievement of Business objectives)**	*Acceptable Region – Potential over control. Consider reducing risk control measures.*	No Risk Treatment Plan required. Control Improvement Plan to be developed for controls rated less than Satisfactory. Consider reducing control environment for important, routine and trivial controls. Reduction in the risk controls to be endorsed by a General Manager.	No required timeframe.

[12] Powercor Enterprise Risk Management Framework Document no: 13-10-CP0006, v3, p.42

3.5.5. Powercor's current wood pole management strategy

Powercor's wood pole management strategy is not explicitly stated in its Asset Class Strategy for Poles and Towers. However, ESV's understanding is that Powercor's current overarching strategy to achieve its wood pole management objectives is to apply reliability centred maintenance (RCM).[13] Powercor advises that it '*is making further improvements to its pole maintenance system to address improvement opportunities; this is headlined by a refresh of the wood pole RCM.*[14]

3.5.6. Powercor's target levels of wood pole performance

Powercor states that: *'The network is required to meet safety and performance benchmarks set by ESV and the AER. These requirements focus on fire safety and consistency of delivery of service to customers, which can be impacted by the condition and performance of poles and towers and their components.*[15] Its existing wood pole performance indicators and targets are shown in Table 3.

Table 3: Powercor's pole performance measures[16]

Type	Performance measure	Target
Leading	Pole health index	Target to be established
Lagging	Asset failures	Maintain average pole failures below 5- yearly failure threshold for the asset class
	Significant HSE incidents	Zero incidents as a result of asset performance (excludes third party causes)
	Public safety	Zero incidents as a result of asset performance (excludes third party causes)
	STPIS reliability impacts	Target to be established

3.5.7. Planned changes to Powercor's wood pole management objectives, strategies, and performance targets

Powercor's latest update to ESV on its forecasting methodology includes what appears to be an update to its wood pole management objectives:[17]

- Achieve a sustainable pole lifecycle management program
- Maintain acceptable performance levels
- Address the right poles at the right time
- Meet community and stakeholder expectations.

Powercor has advised that its strategy (which it is still developing) is to achieve its objectives by applying risk-based asset management (RBAM), also referred to by Powercor as condition-based risk management (CBRM). RBAM is based on using the likelihood and consequence of failure to help identify the assets that pose unacceptably high risk to safety, reliability, or security and to take appropriate risk mitigation measures.

Powercor has not provided any information (up to 11 November 2019) indicating that it has modified its performance targets.

[13] RCM is based on applying maintenance practices to ensure the assets perform according to their design functions

[14] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September, 2019,* slide 36

[15] Powercor, *Asset Class Strategy – Poles and Towers*, May 2019, p. 19

[16] Powercor, *Asset Class Strategy – Poles and Towers,* May 2019, p. 19

[17] Powercor, *Powercor's Risk Based Asset Management Approach – Wood pole forecast update, 11 November 2019,* slide 2

3.5.8. ESV assessment

This section provides ESV's assessment of Powercor's asset management principles and wood pole management objectives, strategies and performance targets.

Powercor's asset management principles are consistent with good industry practice

Powercor's asset management principles, as described in its Asset Management Policy are consistent with the precepts of ISO 55001:2014.[18] The principles also align with the requirements of the Electricity Safety Act and the National Electricity Objectives.

Powercor's latest wood pole management objectives are adequate

Powercor's wood pole management objectives are not explicitly stated in its Asset Class Strategy document, which is a significant shortcoming. Powercor has provided in separate documentation its six asset management 'objectives', which in ESV's view are a mixture of an objective ('*meet our network reliability performance targets*') and five strategies for achieving the objective. Powercor's wood pole management objectives as stated in its latest wood pole forecasting update to ESV are more coherent and ESV has no significant concerns with them, noting that:

- they are aligned to the Asset Management Policy and principles
- they are aligned to Powercor's 'Corporate Strategic Pillars'
- Powercor is updating its Asset management System to align with ISO 55001, with Asset Management Plans the remaining gap to alignment to be completed in 2019[19]
- Powercor's ESMS and BMP objectives are linked to the wood pole asset management objectives through the safety objectives and that these were validated by ESV during the 2018 audits of the BMP and ESMS.

Powercor's risk management framework is adequate

Powercor's corporate risk management framework is consistent with the precepts of ISO 31000:2018: Risk Management. ESV has no significant concerns with Powercor's framework.

Powercor's current pole management strategy is not aligned to good industry practice

Powercor itself notes that its current RCM-based strategy has limitations: '*Replacement of poles and towers assets is currently driven by condition monitoring via the asset inspection and maintenance programs, and asset defects and faults. While there is an overall appreciation of risk and consequence associated with HBRA versus LBRA, the asset management programs for poles and towers are reactive and based on the condition and monitoring programs. Quantified risk across the asset population is not currently used to drive asset replacement programs, which is a key opportunity for improvement going forward.*[20]

Powercor's proposed approach of deploying RBAM/CBRM is a positive step that requires changes to its Asset Management System. When implemented it should enable Powercor to select these poles present the highest pole failure risk and treat them in priority order to meet its pole performance targets.

Powercor's pole performance targets are incomplete

As indicated in Table 3, Powercor intends to develop a condition-based 'pole health index' (HI) and then set a performance target based on the HI.

In ESV's opinion, the aggregate failure risk presented by the wood pole population is a superior performance measure to a condition-based health index as it takes into account safety, reliability and other consequences and is consistent with good industry practice.

[18] ISO 55001: 2014, *Asset Management – Overview, principles and terminology,* pp. 6-9

[19] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019*, slide 20

[20] Powercor, *Asset Class Strategy – Poles and Towers*, May 2019, p. 26

ESV understands that Powercor's Asset failure metric includes only unassisted pole failures. The target is a form of 'rising lid' target in which continued performance above the five-year rolling average target will constitute a breach of the target but also have the effect of raising the target. Allowing the target to rise because of continued breaches of the current target is not consistent with maintaining sustainable performance.

Powercor's Significant HSE incidents, and Public safety measures and targets of zero incidents are reasonable.

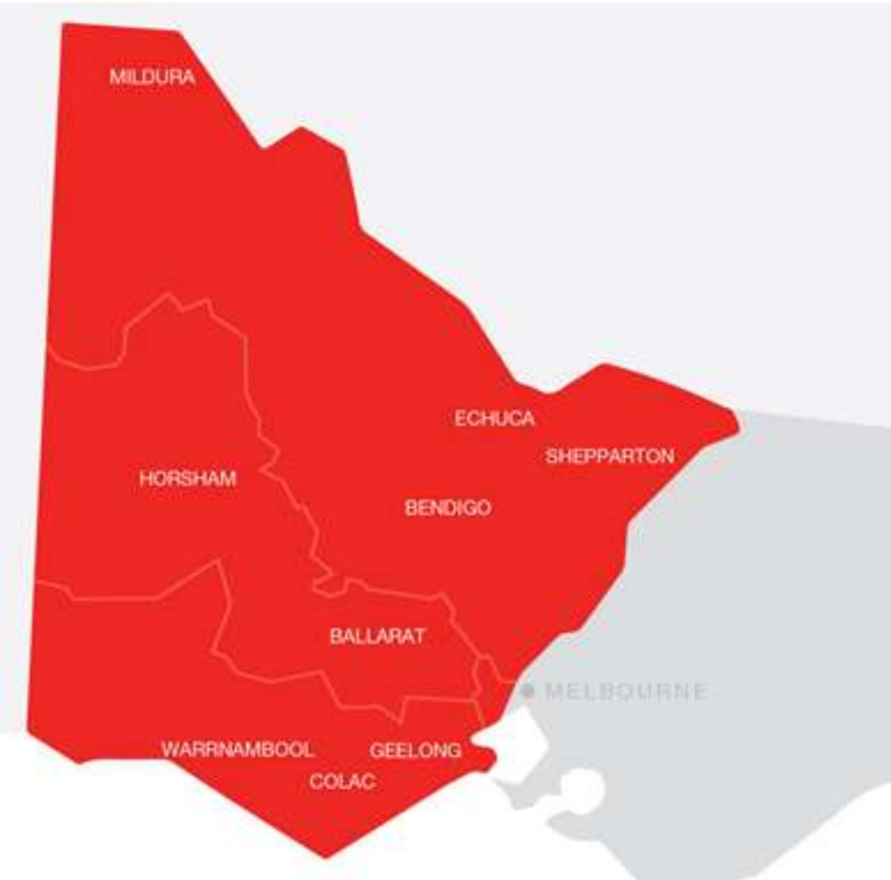
4. Pole Population Characteristics

4.1. Overview

This section provides an overview of the characteristics of Powercor's wood pole population to provide context for subsequent assessment of Powercor's approach to managing its wood poles and the challenges in doing so. The information on the pole asset base characteristics are sourced from a combination of Powercor's documents, the RIN data (on the AER's website), and responses from Powercor to ESV information requests.

Powercor owns a relatively large fleet of 577,000 power poles, which support the overhead electricity network throughout central and western Victoria, as well as in Melbourne's outer western suburbs. The network contains 82,000 kilometres of power lines which traverse 145,650 square kilometres and provides electricity for nearly 750,000 customers. It is the largest of the Victorian distribution networks, covering more than half the state with many of the poles located in Hazardous Bushfire Risk Areas (HBRA) in regional Victoria, shown in Figure 10.

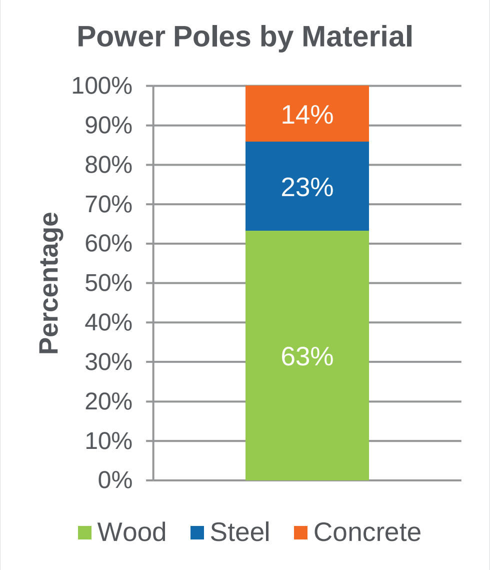
Figure 10: Powercor network coverage[21]



Powercor's fleet of poles is installed in urban and semi-urban environments, rural towns, national parks, farms, mountains and coastal environments. Its pole fleet consists of concrete, steel, and wood poles, with the latter constituting 63 per cent of the pole asset base, of which 58 per cent are located in HBRA, as shown in Table 4.

[21] CitiPower and Powercor Electricity Safety Management Scheme (ESMS) V2.24, Page 24

Table 4: Types of power poles by Bushfire Risk area



	Material Type			
Bushfire Risk Area	**Wood**	**Concrete**	**Steel**	**Total**
HBRA	212,185	73,909	12,753	298,847
LBRA	152,715	56,181	69,196	278,092
Total	**364,900**	**130,090**	**81,949**	**576,939**

Like other Victorian distribution businesses, Powercor uses wood and concrete poles as the standard material for overhead distribution line construction. Steel poles are predominantly used for public lighting. Powercor's standard for new construction South of the Great Dividing Range is Copper Chrome Arsenate (CCA) treated wood poles while concrete poles are the standard for areas north of the Great Dividing Range.[22]

4.2. Population Profile

4.2.1. Wood pole durability class profile

In Victoria, 74 per cent of all DNSP in-service poles are wood, and at least 50 per cent of them were installed over 40 years ago. There are approximately 80 species of timber used to make wood poles and the timber is classified by strength and durability, (i.e. Class 1, 2, 3 and 4) poles[23]. Timbers of the same class may deteriorate at different rates due to local environmental conditions. The national timber pole standard states that only durability Class 1 and 2 timber can be used for power poles without preservative treatment.[24]

Powercor utilises treated timber poles across all durability classes. Powercor's wood pole population is predominantly treated[25] Class 3 wood poles.

The classification system shown below in Figure 11 is an extract from the AS/NZS 7000:2016 and shows the suggested range of nominal service life of timber poles by durability class. This guidance is based only on non-preservative treated wood poles. The table has been included to provide a background on the durability ratings, however it is less relevant to Powercor's fleet as the majority of poles have been treated.

[22] Powercor Asset Class Strategy – Poles and Towers 2019, Page 6

[23] Durability is classified according to a timber's inherent resistance to decay and insect attack

[24] ESV, *Final Report - The Condition of Power Poles in South West Victoria,* Page 9

[25] Typically pressure impregnated CCA (copper chrome arsenate) to prevent attack from microbes and insects

Figure 11: Classification of natural timber durability – probable life expectancy[26]

TABLE 1

NATURAL DURABILITY—PROBABLE LIFE EXPECTANCY*

Class	Probable in-ground life expectancy (years)	Probable above-ground life expectancy (years)
1	Greater than 25	Greater than 40
2	15 to 25	15 to 40
3	5 to 15	7 to 15
4	0 to 5	0 to 7

* The ratings in this Table are based on expert opinions and the performance of the following test specimens:

(a) In-ground: 50 × 50 mm test specimens at four sites around Australia.

(b) Above-ground: 35 × 35 mm test specimens at eleven sites around Australia.

NOTES:

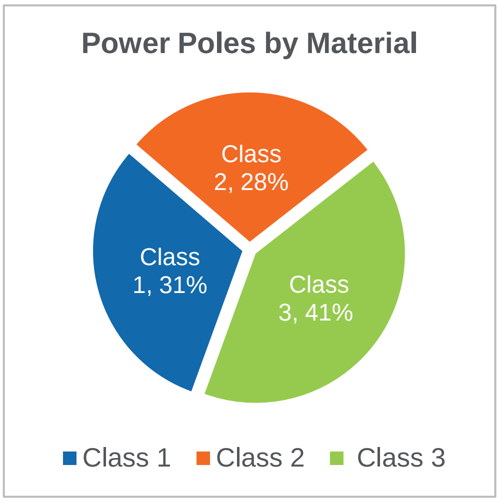
1 As further reliable evidence becomes available, these ratings may require amending.

2 The heartwood of an individual piece of timber may vary from the species' nominated classification.

3 Above-ground conditions equate to outside above-ground subject to periodic moderate wetting when ventilation and drainage are adequate.

Figure 12 shows the breakdown of Powercor's wood pole fleet by durability class, with durability Class 3 timbers comprising 41 per cent of the wood pole asset base. Powercor's pole life expectancy varies widely from pole to pole, even when they are from the same forest and installed in the same locality,[27] with many poles still in-service after more than 50 years.

Figure 12: Powercor's wood pole fleet by durability class[28]



	Wood Durability Class			
Bushfire Risk Area	**Class 1**	**Class 2**	**Class 3**	**Total**
HBRA	58,510	60,887	92,788	212,185
LBRA	53,647	41,856	57,212	152,715
Total	**112,157**	**102,743**	**150,000**	**364,900**

[26] Australian Standard on the natural durability ratings of timber, AS5605-2005

[27] Characteristics of Timber Poles, Asset Inspection Manual v3.2 , Appendix A p.833

[28] Full Pole asset register, Spread sheet, S132 April 2019, Analysis – Powercor Pole Population Data

Table 5 presents information extracted from Powercor's Asset Inspection Manual and shows how various timber species and classes have been used over the years, depending on availability of timbers and business policy.

Table 5: History of Powercor pole timber procurement by durability class[29]

Period	Timber Type(s)
Pre 1947	Mixtures of dressed and natural round Class 1 and Class 2 poles
1947 – 1956	Mainly natural round Class 2 poles plus some dressed Class 1 and 2 poles
1956 – 1971	Majority Class 3 timbers, pressure treated with creosote plus some dressed Class 1 and pressure treated Class 4 (Pinus Radiata) Notes: 1. In this period, the 'Mountain Grey Gum' poles were identified as GG, but they should not be confused with the highly durable Grey Gum, which had been bought in the dressed and natural round conditions, also in smaller numbers, from 1972 to 1983, for creosote pressure treatment. 2. Pinus Radiata poles have been grouped into class 1 durability timber in the Powercor database because of the long lives being achieved.
1972 – 1984	Majority Class 3 timbers plus some Class 1, creosote pressure treated with some dressed Note: some of the dressed (de-sapped) Class 1 poles in this period were dressed almost round instead of the usual octagonal dressing
1984 – 1999	Dressed Class 1 timbers
1999 – to date	CCA treated Class 1 and 2 poles from NSW with a few Class 3 and 4 timbers from Tasmania

Also, it can be seen that in recent years Powercor no longer installs large volumes of Class 3 timbers, however they were installed in vast quantities from the mid-1950s to the mid-1980s.

Powercor's wood pole fleet contain a variety of timber species. Figure 13 illustrates the top ten timber species, which collectively constitute over 80 per cent of the entire Powercor wood pole population. There are:

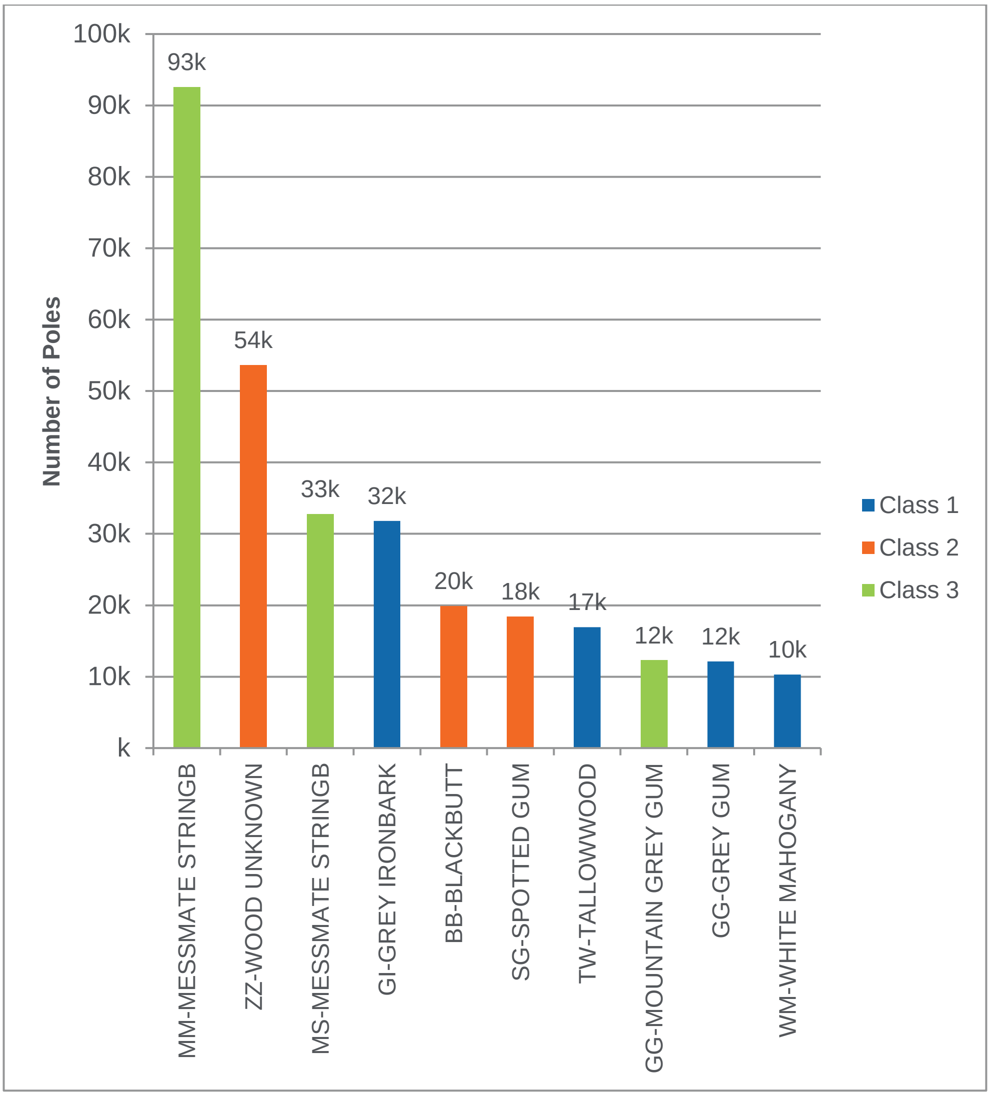
- 125,000 Class 3 Messmate poles
- 54,000 poles of unknown species.

Poles identified as ZZ – wood unknown are conservatively managed as Class 3 poles. Refer to section 6 for further information.[30]

[29] History of Timber Poles, Asset Inspection Manual v3.2 , Appendix C p.845

[30] Clarification on treatment of unknown wood species, Email, [redacted] 16 October 2019,

Figure 13: Powercor top 10 wood pole species by volume[31]



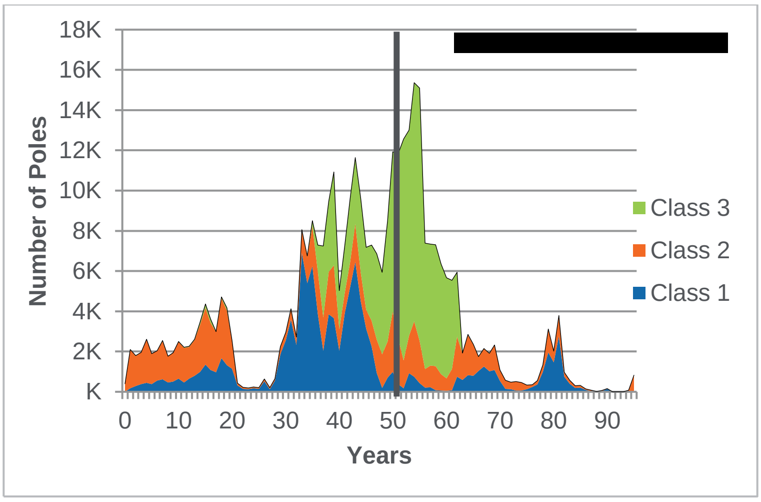
4.2.2. Wood pole age profile

Powercor's wood poles age profile is shown in Figure 14, and indicates that most of the electricity network was constructed 40 to 60 years ago. It reflects a snapshot of the network after years of installation and decommissioning activities through changes in policy and business practice. Approximately 158,000 poles (43 per cent of the total wood pole population) are over 50 years of age, with:

- approximately 22,000 Class 1 poles (i.e. 20 per cent of the class 1 poles) are 50 years old or older
- approximately 36,000 Class 2 poles (i.e. 34 per cent of the class 2 poles) are 50 years old or older
- approximately 100,000 Class 3 poles (i.e. 67 per cent of the class 3 poles) are 50 years old or older.

[31] Full Pole asset register, Spread sheet, S132 April 2019, Analysis – Powercor Pole Population Data

Figure 14: Age profile of All Powercor Wood pole by class[32]

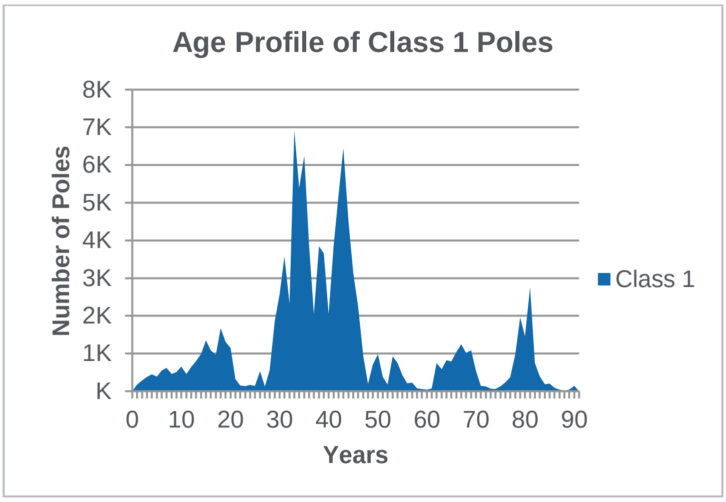


Age Metric	Average Age
In-Service	44
Replacement	53
Unassisted Failure	51

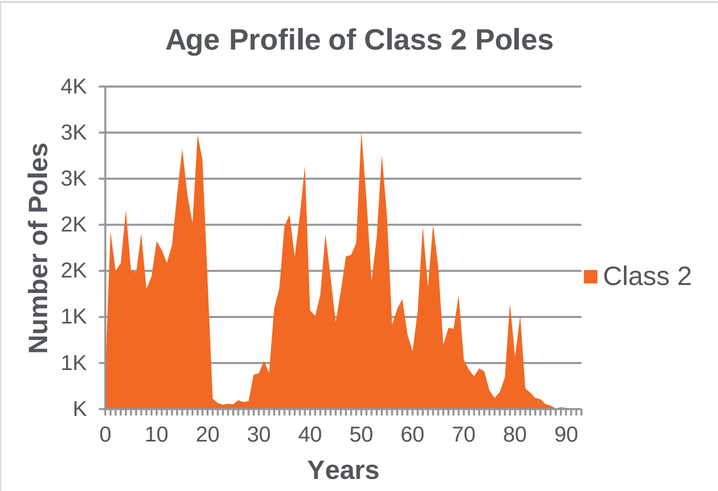
Figure 15 shows the age profile of poles within each durability class. The analysis includes three high level indicators: the average age of in-service poles, the average age at replacement, and the average age at failure. The in-Service average age is the average age of all poles currently installed on the network, 44 years. The replacement age is the average age a pole is taken out of service, 53 years. The average age for an unassisted failure is 51 years. Whilst these age metrics are aggregated numbers and don't give indication of any poles particular condition they do warrant a closer investigation as it appears on average poles are not being replaced quickly enough.

[32] Full Pole asset register, Spread sheet, S132 April 2019, Analysis – Powercor Pole Population Data

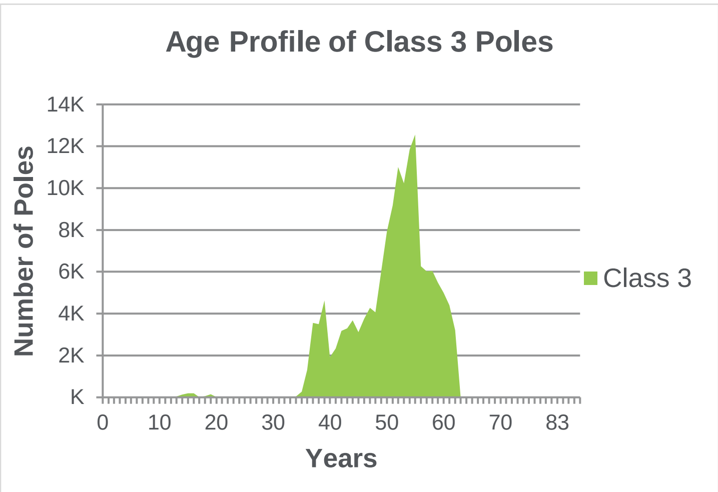
Figure 15: Powercor wood pole Age profile by durability class[33] [34] [35]



Age Metric	Average Age (years)
In-Service	41
Replacement	49
Unassisted Failure	52



Age Metric	Average Age (years)
In-Service	37
Replacement	56
Unassisted Failure	50



Age Metric	Average Age (years)
In-Service	51
Replacement	55
Unassisted Failure	51

[33] Powercor, Replaced and Reinforced Poles, Spread sheet, S132 August 2019, Item 3.1

[34] Powercor, Unassisted failures, Spread sheet, S132 August 2019, Item 3.6

[35] Full Pole asset register, Spread sheet, S132 April 2019, Analysis – Powercor Pole Population Data

4.2.3. Reinforced vs unreinforced poles

In managing its wood poles, Powercor undertakes cyclic condition assessments and classifies the poles as Serviceable, AC Serviceable or Unserviceable (P1, P2).

As shown in Table 6, at the time of this analysis, Powercor has identified 1,045 Unserviceable wood poles. It is assumed that Class 3 poles will be the predominant class of poles classified as AC Serviceable and Unserviceable in the coming years as they near their end of life.[36]

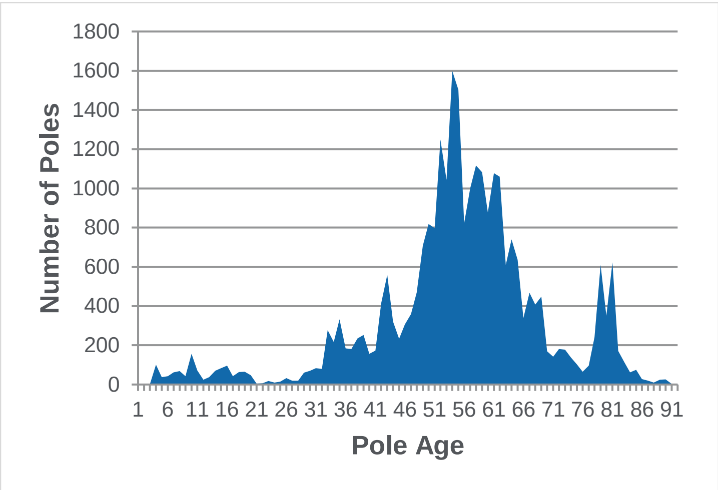
Table 6: Current number of Powercor poles by condition (as at April 2019)[37]

Pole Condition	Number of Poles	Percentage
Serviceable	348,475	95.5%
Added Control Serviceable	15,376	4.2%
Unserviceable[38]	1,045	0.3%

Powercor's risk control measure for Unserviceable poles is to extend their life by either reinforcement (also referred to as nailing or staking) or replacement.

Figure 16, shows approximately 26,500 (7 per cent) of the wood pole fleet has been reinforced and been classified as serviceable.

Figure 16: Age profile for reinforced wood poles[39]



Age Metric	Average Age (years)
In-Service	55
Quantity	**Pole Count**
Total Volume	26,494

[36] Powercor, *Powercor Asset Class Strategy – Poles and Towers 2019*, Page 8

[37] Full Pole asset register, Spread sheet, S132 April 2019, Analysis – Powercor Pole Population Data

[38] Note: Powercor had identified one Unserviceable P1 pole which was replaced within 24 hours in accordance priority policy

[39] Full Pole asset register, Spread sheet, S132 April 2019, Analysis – Powercor Pole Population Data

5. Inspection Practices

5.1. Introduction

Inspection is the primary method employed to undertake a condition based assessment of overhead electric line assets, and to confirm pole characteristics such as the location and configuration of overhead line assets.

A pole and pole top structure is designed to support electrical conductors at an acceptable height while resisting the bending forces placed on it by the attached conductors. The ability of a pole to resist these bending forces depends on:

- the type of timber;
- the external diameter of the pole in relation to its height; and
- the internal condition of the pole.

Therefore when timber poles are inspected for their ability to perform their function, the above items should be carefully assessed.

The objective of this section is to review and assess Powercor's Inspection methodology, including the standards and work practices employed and its application in the full inspection of wooden poles. The objective is to understand:

- Powercor's inspection practices and how they are applied, compared to legislative requirements, industry standards, and practice
- the training process, competency evaluation and refresher training against Certificate II competency
- governance and management of quality of inspection practices
- inspection techniques and technologies being employed.

5.2. Powercor's inspection criteria

5.2.1. Powercor's current approach

Cyclic asset inspection is the routine inspection of poles and pole top assets carried out at defined intervals, being a dedicated program that forms an integral component of the network asset maintenance plan. Specifically the inspections assess the condition of poles, pole top assets, associated hardware and attachments, and is conducted over regular cycles of 1, 2.5 and 5-years depending upon the type of inspection being undertaken (refer to Table 7), in accordance with the timeframes set out in the Electricity Safety (Bushfire Mitigation) Regulation 2013.

The inspections incorporate either:

(i) a **full inspection** covering the entire pole above and below ground level (generally includes pole-top and ground-line inspection zones),[40] or

(ii) on alternative cycles an **above ground inspection**, which includes the section of pole above ground level including the pole top.[41]

[40] Asset inspection manual, document 05-M450 section G.12-WI issue 3.1 p.7

[41] Asset inspection manual, document 05-M450 section G.12-WI issue 3.1 p.7

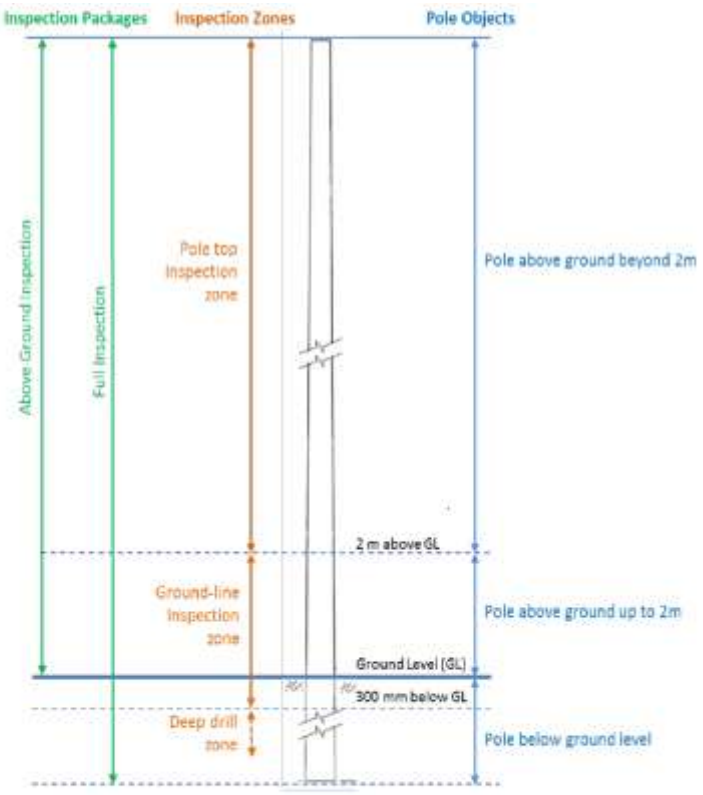
Table 7: Powercor pole inspection definitions[42]

Type of pole	Type of Inspection	Inspection cycle	Area Inspected
All Powercor Added Controls Serviceable poles	Year 1 : Above ground inspection Year 2 :Full inspection (on alternative years)	12 months	Yr 1: From ground level to top of the pole; Yr 2 : 300mm below ground to top of pole
All Powercor serviceable poles in HBRA	Above ground inspection	2.5 years	From Ground level to top of the pole
Privately owned low voltage poles	Full inspection (above and below ground)	2.5 years	From 300mm below ground level to top of pole.
All Powercor serviceable poles	Full inspection (above and below ground)	5 years	From 300mm below ground level to top of pole.

Figure 17, provides an illustration of the types of inspection criteria. During a full inspection, wood poles are inspected both externally and internally using a combination of visual examination, sounding, probing and drilling.

The above ground inspection is an external inspection of the entire pole section above ground level, using a combination of visual examination and sounding. Visual inspection is carried out from the ground line to the top of pole whilst sounding is only carried out from ground line to 2 metres. The SDD inspection encompasses the ground line inspection zone.

Figure 17: Powercor's illustration of the types of inspection zones[43]



[42] Powercor Asset Inspection manual Document no: 05-M450 Section G.12-WI Issue No: 3.0, p.4

[43] Powercor Asset Inspection manual – Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.6

The wood pole inspection practices are documented within the Powercor asset inspection manual ('Manual'). The Manual contains 30 Work Instruction sections and 11 Training reference manuals that detail the work practises for inspectors working in the Powercor Network and activities that need to be completed during the inspection of assets.

The Manual was originally issued in November 2005, with extensive updates documented in the Manual's revision history. The current version is Issue 3.2, which was issued on 6 September 2019.

Powercor stated *when updates to the Manual are issued the current Asset Inspection contractor is notified of the changes and a presentation of these changes is provided to all Asset Inspectors and evidence of attendance documented and provided to Powercor.*

Table 8 below summarises the current and previous approach to cyclic asset inspection, highlighting the differences between the two. Added Control Serviceable poles were historically referred to as Limited Life Poles and the other Victorian DNSP asset inspection manuals still use the term Limited Life.

Table 8: Type of Powercor inspection package – illustration of previous vs current approach[44]

	Type of pole	Type of Inspection	Cycle	Area Inspected
Current Approach	All Powercor Added Controls - Serviceable poles[45]	Year 1 : Above ground inspection Year 2 :Full inspection (on alternative years)	12-months	Year 1: From ground level to top of the pole; Year 2 : 300mm below ground (includes drill test) to top of pole
	All Powercor serviceable poles in HBRA	Above ground inspection	2.5-years	From Ground level to top of the pole
	Privately owned low voltage poles	Full inspection (above and below ground)	2.5-years	From 300mm below ground level to top of pole.
	All Powercor serviceable poles	Full inspection (above and below ground)	5-years	From 300mm below ground level to top of pole.

	Type of pole	Type of Inspection	Cycle	Area Inspected
Previous Approach	All Powercor Limited Life poles	Ground level inspection - Above ground and below ground-line inspection	2.5-years	From 300mm below ground-line to 2m above and to the top of pole
	All Powercor serviceable poles in HBRA	Above ground inspection	2.5-years	From Ground level to top of the pole
	Privately owned low voltage poles	Ground level inspection - Above ground and below ground-line inspection	2.5-years	From 300mm below ground-line to 2m above and to the top of pole
	All Powercor serviceable poles	Ground level inspection - Above ground and below ground-line inspection	5-years	From 300mm below ground-line to 2m above and to the top of pole

[44] Definition: Previous approach - Leading up to and around March 2018 - Asset Inspection Manual Doc 05-M450 Section A dated 19/12/2017 issue 2.7 p.4; Current approach Asset Inspection Manual Document no: 05-M450 dated 6/9/2019 issue 3.2 p.4

[45] Previously referred to as Limited Life poles

Asset Inspection Manual standard and comparison to the general industry approach

The Powercor Manual outlines how and when wood poles are inspected both externally and internally using a combination of visual examination, sounding, probing and drilling in the applicable inspection zone.

A significant change in version 3 of the Manual is the additional detail during above ground and full inspections as summarised in Table 9. The main differences between above ground and full inspections are the requirement to excavate around the pole and undertake preservative treatment.

This has provided clarity to the requirement to undertake a sound test when performing an above ground inspection which, based on anecdotal evidence,[46] caused some confusion in the past.

Table 9: Summary of Powercor's inspection steps for various inspection types[47]

Step	Above Ground Inspection (P)	Full Inspection (G)
1	Record information on pole.	Record information on pole.
2	Assess the surrounding area for safety issues.	Assess the surrounding area for safety issues.
3	Visually assess the condition of pole from two metres above ground level to the top of the pole.	Visually assess the condition of pole from two metres above ground level to the top of the pole.
4	Assess the condition of pole from ground level to two metres above. Where an area of concern is identified through sounding or visual assessment, undertake a full inspection of the pole.	Assess the condition of pole below the ground level and from ground level to two metres above. Use built-in pole calculator to assess condition of the pole.
5	Apply visual appearance criteria to the section from ground level to 2m above for a pole with a Serviceable or AC Serviceable classification.	Apply visual appearance criteria to the section from ground level to 2m above for a pole with a Serviceable or AC Serviceable result from the condition assessment in Steps 3 and 4.
6	Identify wood destroying insects.	Identify wood destroying insects.
7		Undertake preservative treatment of hardwood poles.
8	Report any identified defects	Report any identified defects
9	Carryout any minor maintenance tasks as required.	Carryout any minor maintenance tasks as required.
10	Fit inspection tag. Stamp date of inspection (month and year) and letter "P" (for above ground inspection) on the tag. The prefix P means the pole strength has not been assessed. Do not remove the previous full inspection tag.	Fit inspection tag. Stamp date of inspection (month and year) and letter "G" (for full inspection) on the tag. The prefix G means the pole strength has been assessed. Remove the previous inspection tags.

Table 10 below provides a summary comparison of Victorian DNSP cyclic inspection criteria compiled from distribution businesses inspection manuals.

[46] Discussed further in section 5.3.2

[47] Powercor Asset Inspection manual – work instruction for inspection of poles Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.8

Powercor undertakes additional steps as part of the HBRA mid-cycle above ground inspection activities associated with sound test and visual appearance. Powercor and AusNet Services conduct a mid-cycle above ground inspection in HBRA's.

Table 10: Comparison of VESI businesses cyclic inspection practices

	Powercor		AusNet Services		Jemena	United Energy
Inspection timeframe	Above ground inspection	Full Inspection (above and below ground)	Above ground inspection	Full Inspection (above and below ground)	Full Inspection (above and below ground)	Full Inspection (above and below ground)
HBRA	2.5 years	5 years	37 months	60 months	37 months	37 months
Non-HBRA	N/A	5 years	N/A	61 months	61 months	61 months
Visual Assessment from ground level to top of pole	Yes	Yes	Yes	Yes	Yes	Yes
Excavate to 300mm deep	No	Yes	No	Yes	Yes	Yes
Probe Surface	Yes	Yes	No	Yes	Yes	Yes
Sound Test	Yes	Yes	No	Yes	Yes	Yes
Bore into pole	No	Yes	No	Yes	Yes	Yes
Measure Girth	No	Yes	No	Yes	Yes	Yes
Visual Appearance criteria[48]	Yes	Yes	No	No	No	No
Undertake preservative treatment	No	Yes	No	Yes	Yes	Yes

Powercor's Manual articulates the inspection requirements for the various types of wood poles such as durability rating, pole age, type of full-length preservative treatment, and the external inspection results.

These requirements are specified based on the following groups:

- Pressure Treated Timbers (incl. Class 1, 2, 3, 4 and Unknown)
- Dressed and Natural Round Timbers (incl. Class 1, 2 and Unknown)
- Pinus Radiata Poles
- Reinforced Poles (incl. HS2, Osmose, RFD and Powerbeam)
- Rebutted Poles.

The classes mentioned in the above categories refer to the durability class of timber poles in their non-pressure treated state.

Table 11 provides an overall summary illustrating the type of inspections for individual pole types, including poles, which have been reinforced.

[48] New initiative implemented in 2019 refer section 6.2.4

Table 11: Powercor's inspection criteria by pole type[49]

Pole Type	Sound and Visual Test Above Ground	Excavate	Visual Below Ground	Sound Test Below Ground	Drill
Pressure Treated Timbers	Every Inspection	10 Years after pole disc date[1]	When excavated	When excavated	10 Years after pole disc date[1]
Dressed and Natural Round Timbers	Every Inspection	5 Years after pole disc date[1]	When excavated	When excavated	10 Years after pole disc date[1]
Pinus Radiata	No Sound Test[2], Visual Test Every Inspection	10 Years after pole disc date[1]	When excavated	None	Do Not Drill
Reinforced poles (except rebutted poles)	Every Inspection	Every Inspection	Every Inspection	None	Every Inspection
Rebutted poles	Every Inspection	Every Inspection	Every Inspection	None	Every Inspection

[1] Excavation and drilling may be required earlier if problems are identified during the sound and visual tests. Any pole with a missing disc shall be excavated.

[2] Sounding of Pinus Radiata poles is not recommended as this can give a misleading result due to softness of wood. When wood is damp the sound produced will be dull or hollow, this may even occur when pole is in good condition.

5.2.2. ESV assessment

Powercor's inspection Manual incorporating the work instruction (standards) and training sections for inspection of poles, generally aligns with industry inspection practices.

ESV considers that the Manual provides insufficient information on the process of sounding of wood poles, which is designed to assist with the identification of internal decay and the existence of termites. Specifically, the references in the Manual to 'sound' test are limited to:

- Above ground – All wood poles (excluding Pinus Radiata) Sound test pole to ascertain possible internal defects.[50]
- Below ground when excavated, sound test the pole below ground to ascertain possible internal defects.[51]

Similarly, the Powercor training section of the Manual fails to outline the criteria or provide detailed instruction for the method and approach required to be undertaken to complete a quality 'sound' test for the different types of inspections.

ESV's review of all DNSP inspection manuals is summarised in Table 12 and highlights this as a- common Victorian DNSP gap with minimal information provided on sounding requirements and minimal guidance in using a rigorous and methodical process to help ensure defects are detected.

[49] Asset Inspection manual – work instruction for inspection of poles Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.8

[50] Asset Inspection manual – work instruction for inspection of poles Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.10

[51]Asset Inspection manual – work instruction for inspection of poles Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.15

Table 12: Comparison VESI business' Sound test instructions

Manual Owner	Sound Test Procedure	Things to look for	Resulting test action
Powercor / CitiPower	Sounding is used to assist in the identification of internal decay and the existence of termites. Poles should be struck firmly with a hammer above and at ground level and when excavated down into the excavation.	The inspector needs to be aware of the different effects that can be produced when sounding, particularly with the checks that occur with the class 3 timbers and items attached to poles such as possum guards.	Listen carefully to the sound of the pole during sounding test and target internal inspection based on the results of the visual and sounding tests.
AusNet Services	Hit pole with hammer or similar instrument, all around and at all heights from highest you can reach, down into excavation. Test can sometimes be unreliable due to different sounds caused by attachments and timber quality.	Dead, hollow or flat sound or lack of "bounce" in feel of hammer. A sound pole will have a solid ring.	Look to see if associated with a flatter area on the pole surface indication presence of an internal check. You must bore to confirm or otherwise any defects indicated (other than checks).
Jemena and United Energy	Hit pole with hammer or back of axe all around and at all heights from highest you can reach, down into excavation. This test can sometimes be unreliable.	Dead, hollow or flat sound or lack of 'bounce' in feel of hammer. Sound poles will have solid ring. Listen for hollow sounding locations.	If you get a localised hollow sound – determine if associated with internal checks. Bore (creosote treated poles only) to confirm any defects (as above) other than checks.

ESV reviewed [redacted] (NSW DNSP) asset inspection manual,[52] observing that it has a robust process for the sounding of wood poles. Its standards provide greater detail on the sound test criteria, including the use of tools when undertaking sounding both above and below the ground line.

In summary:

- Powercor's asset inspection practices are consistent with general Victorian industry practice
- Powercor fails to clearly articulate the purpose of the 'sound' test
- Powercor does not provide adequate instruction for the method and approach required to be undertaken to complete a quality 'sound' test for the different types of inspections. As described later in the report, in ESV's view, this will lead to inconsistent application and assessments of pole condition, noting that the sound test is one of the key elements in determining the condition of a pole.

5.3. Ground Line Inspection process

5.3.1. Powercor's current approach

The ground line inspection using the Sound, Dig and Drill method has been institutionalised in the electricity industry for many years, providing a relatively effective and efficient method to understand the internal condition of wood poles.

Powercor's training manual on basic practices for wood pole inspections notes that wood poles deteriorate substantially in the limited length from 100 mm above ground level to 300 mm below. This is the region where both moisture and air are available for most of the year, and without those components, wood rotting

[52] [redacted] Network Standard NW000-S0098 NS145 pole inspection and treatment p.36-39

fungi cannot thrive. In addition, this is the region where termites can most readily live, although they may range somewhat further up or down the pole.[53]

Because of this, Powercor's inspection process concentrates in this area. However, visual inspection is also required over the first 2 metres above ground level as well as the need to look for signs that deterioration may actually extend below the 300 mm excavation depth.

The objective of Powercor's wood pole inspection method is to: [54]

- estimate the remaining strength of the pole
- detect the presence of rot/decay, fungal, and termite activity.

To achieve the above objectives, Powercor's ground line inspection of wood poles is divided into two processes: external inspection, and internal inspection (drilling). Each of the processes varies depending on the age, durability grouping, and the preservative treatment of the timber. The ground line inspection zone extends from 2 metres above ground to 300mm below ground level, requiring excavation at the pole base.

1. External inspection of the pole is the most critical process and includes the following:[55]
   - excavation - this allows the inspector to assess the most vulnerable area of the pole for rot/decay, fungal, or termite attack
   - visual examination - this is an examination of the external surface of the pole above, at and below ground level. The examination includes probing the surface, taking measurement points, identifying the number of inspection holes and the identification of internal checking[56]
   - sounding test - used to assist in the identification of internal decay and the existence of termites.
2. Internal inspection or drilling of the pole is designed to identify the extent of internal decay and includes the following;[57]
   - drilling in an attempt to identify the extent of internal decay
   - obtaining the internal measurement using a hook-end rod with 5mm graduations to measure the depth of sound timber – note: in March 2019, Powercor amended the measurement of sound wood from rounding down to nearest 10mm graduations to rounding down to the nearest 5mm graduations
   - recording the internal measurement when internal deterioration is found. The amount of sound timber measured shall be recorded. If no internal deterioration is identified, then 150mm is entered as the amount of sound timber.

The assessment of the condition of a wood pole is then undertaken using the Powercor Pole Calculator

Powercor developed the Pole Calculator to overcome the issue of inspectors having to assess the combination of external and internal degradation, particularly the inconsistencies in the criteria for handling external degradation on full-length pressure treated poles. Powercor identified that despite a good record in containing pole failure numbers, its inspectors required assistance to improve the quality and timeliness of the inspection practice.[58] The Pole Calculator is discussed further in section 7.

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[53] *Asset Inspection manual – training manual for inspection of poles* Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.9

[54] Powercor, *Asset Inspection manual – training manual for inspection of poles,* Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.9 and 10

[55] Powercor *Asset Inspection manual – training manual for inspection of poles Document* no: 05-M450 Section G.12-WI Issue No: 3.1, p.10-11

[56] Definition Internal checking: This term (in full: "barrel checks") refers to radial splits running along the pole. Reference Asset Inspection manual – training manual for inspection of poles Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.52

[57] Powercor *Asset Inspection manual – training manual for inspection of poles* Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.11-12

[58] Powercor *Asset Inspection manual – training manual for inspection of poles* Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.13

The Pole Calculator is installed in the inspector's mobile computer and requires the following information:[59]

- Overall pole height
- Strength
- Species
- Girth or diameter,
- Depth of external decay
- The width of splits and cracks in relation to the poles girth/diameter
- The internal measurement
- The number of previous inspection holes in relation to the direction of load on the pole.

The Ground-line inspection is a key area in the systematic examination of wood poles to assess its condition. Powercor divides the Ground-line inspection into the following two sections:[60]

1. Ground level to 2 metres above
   - The inspection extends from ground level to two metres above ground and is to be undertaken at each inspection. This inspection includes a visual examination and may also include probing, sounding and internal examination of the pole depending on the results of the visual examination.
2. Below ground (nominally 300 mm below ground)
   - The inspection extends from ground level to a nominal depth below ground and if necessary should be extended to satisfy that the pole condition can be realistically assessed. This inspection is only undertaken on wood and steel poles based on the results of the "Ground level to two metres above" and other nominated criteria.

Inspection of reinforced wood poles, Powercor require the following tasks for routine inspections to be undertaken:[61]

- visually inspect the external surfaces of the pole from 2 metres above ground to the pole top for signs of:
  - fungal attack
  - lightning strikes
  - significant cracking
  - significant bowing
  - Deterioration
  - Termite infestation.
- inspect externally surfaces of the pole below ground to a maximum depth of 300mm to check for:
  - Termite infestation.
  - Corrosion of the reinforcement system.
- inspect internally, reinforced hardwood poles using a wood scanning method[1] or with a 12mm auger bit to ascertain depth of sound timber as follows:
  - for staked poles, at 400mm below the top of the reinforcement system
  - for rebutted poles, in the area above the steel sleeve.

[59] Powercor *Asset Inspection manual – training manual for inspection of poles* Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.6

[60] Powercor *Asset Inspection manual – training manual for inspection of poles* Document no: 05-M450 Section G.12-WI Issue No: 3.1, p.5

[61] Powercor *Network asset maintenance policy for inspection of poles*, Document no: 05-C001. D-390 Issue no: 4.8 p.16

Other pole conditions assessed during the inspection of wood poles include the following:

- footing assessment of poles - the footing strength of a pole can impact on the capacity of the pole to perform to the required standard. Effects to be considered include wind erosion, water erosion, incorrect installation and mechanical excavation
- leaning poles - angle is measured with an approved device and the measurement recorded and priority reported.

5.3.2. ESV assessment

Powercor's inspection Manual (work instruction and training manuals) provides minimal information on how and what is expected when performing sounding of wood poles to assist in the identification of internal decay and the existence of termites.

A site visit was undertaken by ESV officers of a Powercor inspection at three separate pole locations to validate the application of the inspection techniques compared to the standards and procedures. The same inspector was at each of these locations.

Overall the inspections undertaken were in line with Powercor's and general industry SDD work practices, with the exception of sound testing which was found to have the following inconsistencies were noted for each pole inspected:

1. the first pole was sound tested ad-hoc both above and below ground line
2. the second pole was not sound tested at all
3. the third pole was sound tested above the ground line but not below ground line in the excavation.

During the inspection, the asset inspector was asked about whether a 'sound test' is required as part of the above ground inspection. The inspector stated that "*a sound test was not required as part of this test*." This was a sample of a single inspector's understanding and it may not be a true reflection of the other inspector's understanding of the inspection work practices.

Audit results, discussed further in section 5.8.3, provide no indication of a systemic issue as zero non-conformances have been identified by Powercor in 2019 to date.

Nonetheless, the inconsistencies evidenced during the site visit, where on two out of three occasions the inspector failed to perform the sound test to the specified standard, is of concern. Further information obtained recently from ESV asset inspection officers confirms these gaps and inconsistency in application and understanding.

This reconfirms ESV's view that Powercor's inspection Manual and work practices fail to:

- clearly articulate the criteria relating to the purpose of the 'sound' test, and
- provide adequate instruction in the method and approach required to be undertaken to complete a quality 'sound' test for the different types of inspections. This is leading to inconsistent application and assessment of pole conditions.

It is noted that other Victorian DNSP asset inspectors have no documented process for undertaking a sound test. *Responses varied on questions regarding proper practice which included:*[62]

- "I strike the pole with the side of the hammer head to leave a mark so an auditor knows I conducted a sound test."
- "It isn't really a test as it doesn't prove anything."
- "I just give it a hit where I think there may be an issue."

[62] ESV Works practice adviser and Asset Inspectors

5.4. Wood scanning

5.4.1. Powercor's application of Wood scanning technologies

In 2017, Powercor implemented a wood scanning (NDI) technology for wood poles, an initiative undertaken to improve wood pole condition assessment. Wood scanning was chosen by Powercor after trials comparing the results of three NDI toolkits and the existing SDD methodology on in-service wood poles.

Figure 18 shows pictures of the wood scanning device, noting that no drilling of the pole is required. It uses sound waves to scan a cross-section of a pole, [redacted] This method takes into account the whole cross section of a pole, accounting for the measured rot profile and calculates the section modulus of the pole at the scanned level. This is then used with the pole fibre strength to calculate the residual pole tip load capacity.

Figure 18: Wood scanning pole inspection technique.[63]

[redacted]

Powercor use wood scanning after a pole has been assessed as 'P2 Unserviceable not suitable to reinforce' through the SDD method. The scan is conducted at the same location as the SDD internal inspection. Additional scans may be undertaken where a suitably qualified and authorised person deems this is required to assess the pole condition.

[63] Powercor – Wood scanning summary for ESV dated 14 July 2017 p.2

Asset Inspection manual – work instruction for inspection of poles Document no: 05-M450 Section G.12-WI Issue No: 3.1,p.46

Powercor does not apply the wood scanning inspection method under the following circumstances:[64]

- poles with termite, fire, vehicle impact, third party or lightning defects
- poles that are suitable to stake
- poles that are made not suitable to stake due to a condition above 2 m
- poles that have been made "Unserviceable" below the excavation depth by a deep drill process.
- poles with a lean greater than or equal to 4 degrees.

Poles that have previously undergone a wood scanning inspection are inspected using a wood scanning method on all subsequent cyclic or non-cyclic inspections.

From October 2018, wood scanning has been used to assess the condition of double-reinforced poles as part of the normal full inspection cycle process.

Wood scanning assessments completed from April 2017 – April 2018 resulted in 60 per cent of Unserviceable P2 poles being reclassified to Serviceable or AC Serviceable, and 5 per cent being assessed as Unserviceable P1.

5.4.2. Role of [redacted]

[redacted] own the rights to a wood scanning inspection system, including the development of work practices and training packages required to undertake the task. Asset inspectors are required to have the appropriate National qualification Certificate II in ESI – Asset Inspection – UET20612, to be able to use wood scanning technologies.

As the number of AC Serviceable poles increases, so will asset inspection resourcing requirements due to the increase inspection frequency. [redacted] *stated, the workload associated with the introduction of wood scanning inspections, both in terms of the added number of inspections and the additional time to complete, has led to* [redacted] *increasing its inspector numbers. Groups of trainee asset inspectors commenced the 12-month training program in September 2018 and February 2019 to help deliver the inspection program, which is currently behind schedule, but is within the inspection policy*.

5.4.3. ESV assessment

ESV believes that Powercor's application of the wood scanning technique to complement the SDD technique, and its rationale for limiting its use on unserviceable and double staked poles in the immediate term, is prudent.

The currently available wood scanning technology has significant limitations. Further research and development of NDI technology is required to find a technology that is cost effectively able to assess 'whole of pole' condition, including by assessing pole strength degradation above 2m.

ESV's review of NDI technologies development across a number of Victorian industry and interstate distribution businesses shows the businesses continue to conduct their own independent investigations, including trialling of the various NDI technologies, requiring significant investment. There is evidence of some inter-business discussions occurring, but there is not a coordinated approach to the research.

[64] Network asset maintenance policy for inspection of poles, doc 05-C001.D.390 issue 4.8 p.18

5.5. Visual appearance criterion

5.5.1. Powercor's approach

In March 2019, Powercor introduced a Visual Appearance criterion that applies to Serviceable and AC Serviceable poles during cyclic inspection. Based on visual appearance, healthy poles displaying visual traits likely to concern a customer are identified for replacement.[65]

Figure 19 shows the three pole attributes which Powercor apply to classifying an AC Serviceable or Serviceable pole as Unserviceable P2, noting that the Visual Assessment criterion is applied after the other inspection techniques. [66]

- see-through split greater than 10mm in width.
- deterioration of pole cross-section greater than 25 per cent
- 100mm or greater void or loss of wood (knot hole or damage) including staked poles with no timber above ground level.

Figure 19: Pole attributes in Powercor's new Visual Appearance criterion[67]

Photo: Criteria 1

Photo: Criteria 2

Photo: Criteria 3

[65] Powercor, *Powercor wood pole management, ESV – Powercor workshop*, 19 September 2019, slide 12

[66] Powercor, *Asset Inspection manual* Document no: 05-M450 Section G.12-WI Issue No: 3.1,p.79-80

[67] Powercor, *Asset Inspection manual* Document no: 05-M450 Section G.12-WI Issue No: 3.1,p.79-80

5.5.2. ESV assessment

This will be discussed in section 6 Serviceability.

5.6. Inspection training and competency

5.6.1. Powercor's approach

Powercor's asset inspection service provider [redacted] utilises inspectors with National qualification Certificate II in ESI – Asset Inspection – UET20612, certified by a Registered Training Organisation (RTO).

All qualified asset inspectors are approved by Powercor to work on its network, prior to undertaking any work, ensuring the inspectors' qualifications meet the following requirements:

- completed the approved training course 22109VIC (State based) - Certificate II in Asset Inspection up to 30 June 2015
- after 30 June 2015, assessed to the National competency UET20612 Certificate II in Electricity Supply Industry (ESI) Asset Inspection. This was recently superseded by UET20619 in September 2019
- Victorian electricity supply industry training and/or refresher courses.

Powercor confirmed that these approvals have been made prior to any new asset inspector working on Powercor's network.

For the past ten years, asset inspectors in Victoria have been assessed to the relevant qualification at the time through recognition of prior learning (RPL). This involves assessing the inspector's relevant prior learning (including formal, informal and non-formal learning) to determine the outcomes of an individual application.

Until 2018, [redacted] has relied on the existing qualified resources to undertake the services for Powercor. Refresher training for all inspectors was managed and conducted by [redacted] qualified Certificate IV trainers for the Powercor-specific inspection standards and by external providers for Victorian electricity supply industry training.

[redacted] have developed a training program for its trainees, and are partnering with [redacted] a certified registered training group accredited to deliver the National Certificate II asset inspection qualification. In August 2018, [redacted] commenced the induction of seven trainee asset inspectors. The training program comprised the following:

- an [redacted] and Client induction as well as Awareness Training in line with the VESI Training Matrix for Trainee Asset Inspectors
- then a 3 – 6 month period with an authorised "A class" level inspector in the field
- structured training to UET20612 Cert II in Asset Inspection by a Certificate IV qualified [redacted] trainer utilising a set of slides consisting of brief dot points that are presented to trainees in a booklet as a training resource. The training provided knowledge to safely comply with relevant requirements while inspecting and treating poles and inspecting live electrical apparatus. The training is not Powercor specific. Assessments are conducted through a written and practical check of understanding assessment, which are video recorded as part of the evidence building process for the RPL portfolio. This training is conducted over three days.
- further field training with an inspector who is currently working at the "A class" level of the audit competency. The trainee Inspector is also issued with a trainee log book to document and assess the trainees' level of competency. The log book is directed to meet the Powercor specific knowledge and requirements and is signed off by their current mentor. This is then provided as evidence to demonstrate prior achievement of the learning outcomes of particular qualification components.
- a final full day assessment by a qualified Certificate IV assessor with a selection of practical tasks and an open book assessment on the CP/PAL Asset Inspection manual. Copies of all assessment documents, log book and videos are provided in a portfolio to the [redacted] Personnel for assessment to determine that the trainee meets the requirements of the qualification.

Once qualified, the inspector will commence as a Class C Inspector for auditing purposes. A second intake of trainees commenced in February 2019 and they are still in the training program.

[redacted] provided a summary of the training approach, material and competency assessment during a meeting on 25 September 2019 with the Powercor Inspection Delivery Manager. During the meeting ESV was shown some of the content and the process undertaken as part of the training. This helped us to understand the asset inspection training process relative to the required competency standards. However, no supporting documentation was made available to ESV following this meeting to review and validate the training content in detail.

ESV endeavoured to source supporting inspection information from [redacted], however due to impending legal action [redacted] refused to provide this information to ESV for assessment.

ESV was not provided with sufficient training and competency material and documentation to form an objective view of whether the training complies with the National Certificate II accreditation requirements and whether it also satisfies the Powercor asset inspection network training standards.

To date, as prescribed in regulation 7(1)(j) of the “Electricity Safety (Bushfire Mitigation) Regulations 2013”, neither Powercor or [redacted] has sought ESV’s approval of the course training material.

[redacted] certified registered training group for delivering the National Certificate II asset inspection qualification.

5.7. Governance and management - quality of implementation of current practices

In this section, ESV reviews the overall governance and management of Powercor’s inspection process, including the contractual arrangements with [redacted], to ensure the appropriate process and systems are in place for the delivery of safe and quality inspection services.

5.7.1. Powercor’s approach to inspection contract services

Governance and management

Powercor advises that [redacted] has been providing period based contracted services to it for over 20 years,[68] *which enables:*

- consistency of criteria application through the contract and scope of works
- consistent and reliable contract program delivery and audit management

Powercor renewed the contract on 1 July 2019 for another 3+1+1 years. The services are market tested every 3-5 years.

The governance and management of the Powercor asset inspection program is split into process hierarchy layers, which are illustrated in Figure 20 below. Figure 21 shows Powercor’s pole inspection and maintenance program accountabilities being delivered via the ‘manage and raise lines maintenance work procedure’.

1. Electricity Networks (Asset Owner)
   - Network Asset Management is responsible for the lines asset strategy, which includes the asset management policy, asset strategies and plans. This group is the process owner for asset inspection and lines maintenance, including the Asset Inspection Manual, Pole Calculator and the asset inspection mobility system (Click).

[68] Powercor, *Powercor wood pole management, ESV – Powercor workshop*, 19 September 2019, slide 14

2. Powercor Network Services (delivery business stream)
   - Asset Inspection is responsible for the overall inspection contract management, adherence to policy and standards, inspection program compliance and delivery of the program
   - Maintenance Services/Delivery is responsible for auditing of asset inspectors' safety and quality of work.
3. [redacted] – the Asset Inspection Contractor that is responsible for the scheduling, delivery and contract performance reporting of inspection works in accordance with Powercor's asset inspection Manual

Figure 20: Illustration of Powercor's inspection and maintenance process hierarchy

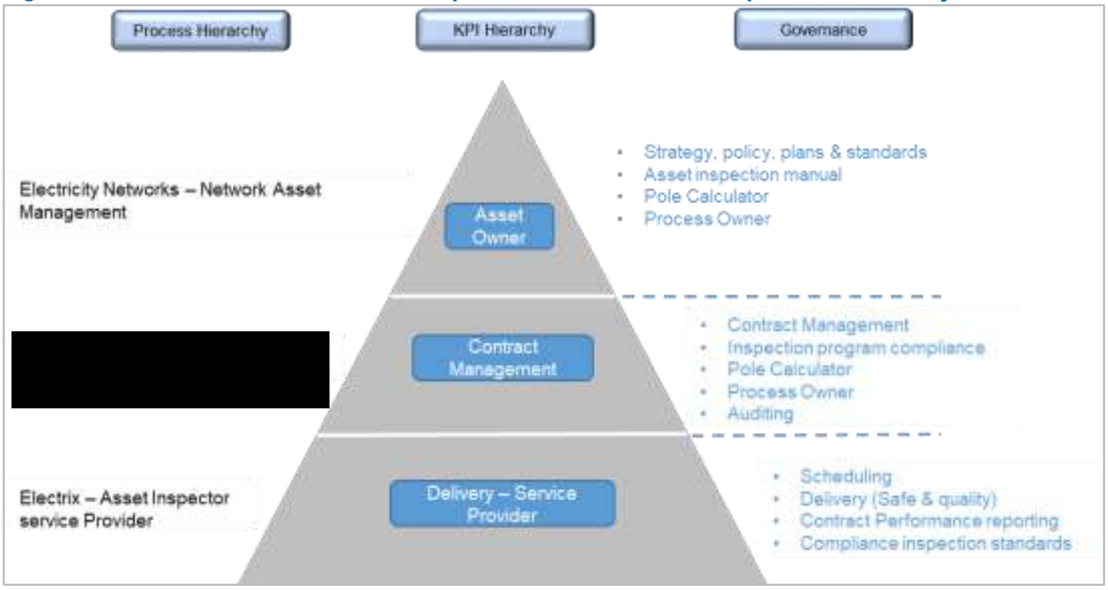
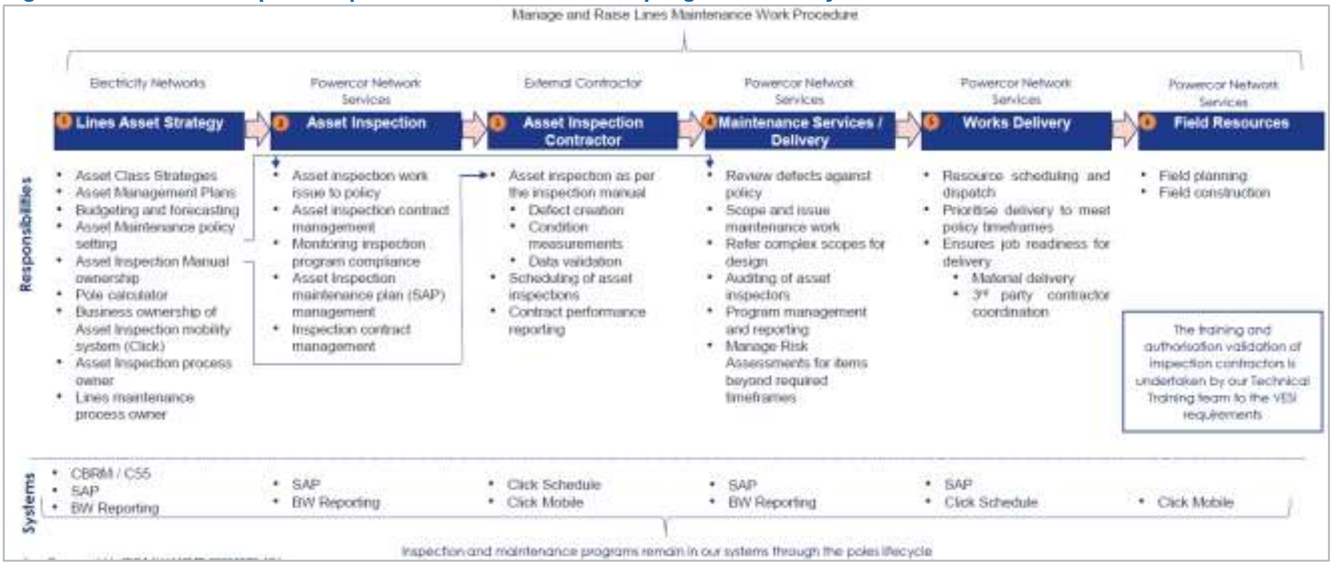


Figure 21: Powercor's pole inspection and maintenance program delivery model[69]



[69] *Powercor wood pole management, ESV – Powercor workshop*, 19 September 2019, slide 9

Powercor meets monthly with [redacted] for an operational meeting to discuss safety performance, program status, audit findings and the implementation of changes to the Asset Inspection Manual to enable consistent application.

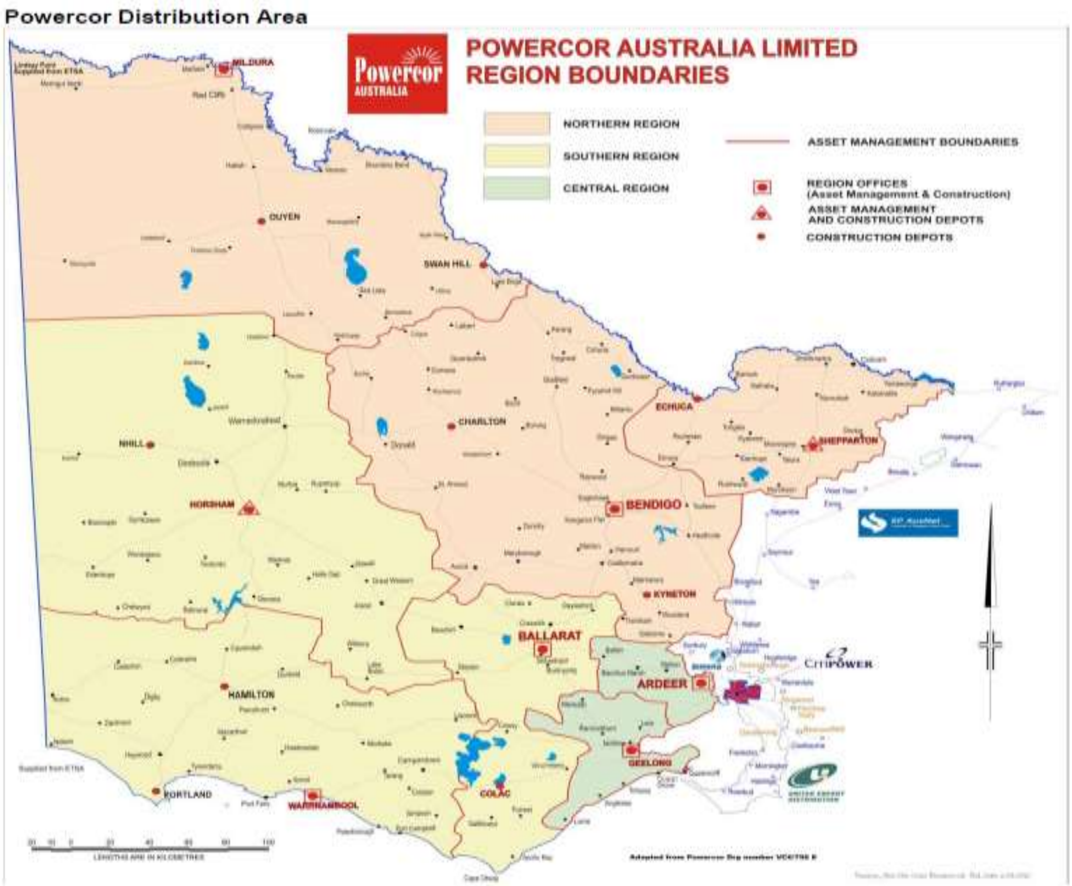
A monthly inspection operational report incorporates the following:[70]

- a Health and Safety and Environmental Performance report regarding the previous month's health, safety and environmental related hazards and incidents; it includes copies of any reports or related documentation issued to, or received from, ESV in relation to incidents which have arisen in connection with the performance of the Services.
- a summary report of the number of quality audits undertaken by the Supplier in the previous month and the outcomes and findings of the audits. The format of the report is prescribed by Powercor and may change from time to time.
- an electronic report in a format acceptable to Powercor that lists the information in relation to each invoice submitted to Powercor for the previous month and must accompany the Supplier's monthly invoice.

The monthly meeting and report is supported by daily and weekly automated reports, monitoring delivery performance and inspections approaching their policy due dates.

The [redacted] management structure oversees the delivery of asset inspection services, headed by the 'Powercor inspection delivery manager' with three contract managers who are assigned to services provided in Powercor's regional boundaries. Each of the contract managers are responsible for approximately 20 asset inspectors in each of Northern, Southern and Central regions (refer Figure 22).

Figure 22: Powercor's regional boundaries[71]



[70] Extract from 7024129[redacted] - Supply of Asset Inspection Services_commercials redacted p.74-75

[71] Extract from 7024129[redacted] - Supply of Asset Inspection Services_commercials redacted p.51

Performance incentive scheme

When undertaking the inspection services, [redacted] must comply with the relevant Technical Specifications, Work Procedures and Work Instructions including any updates and changes, and with any subsequent technical specifications or bulletins provided.

To facilitate this, Powercor provides [redacted] with access to the relevant parts of Powercor's website to enable it to readily view and download copies of the Technical Specifications, Work Practices and Work Instructions that are applicable to Powercor's distribution networks. [redacted] must comply with these when performing the Services[72].

A performance regime is included, which incentivises [redacted] through a gain/pain model by measuring its delivery of services performance relative to a set of Mandatory Performance Standards and designated Key Performance Indicators (KPIs). A performance payment is calculated by combining the results of both the performance results which is capped at 5 per cent of contract value, as follows:

Performance Payment (PP) = Performance Payment Mandatory PPM) + Performance Payment KPI's (PPK)

The Mandatory Performance Standard requires that each pole will be inspected within the timeframes specified below:[73]

(a) *All pole inspections within the High Bushfire Risk Area (HBRA) must be scheduled to occur on a 30 month cycle and the inspection for each pole must occur within 31 months of the date of its previous inspection, except as modified under paragraph (c) below.*

(b) *All pole inspections within the Low Bushfire Risk Area (LBRA) must be scheduled to occur on a 60 month cycle and the inspection for each pole must occur within 61 months of the date of its previous inspection, except as modified under paragraph (c) below.*

The Supplier's performance in delivering the Services is measured against Performance Targets for key criteria designated by Powercor as the Key Performance Indicators (KPIs), referred to in Table 13.

[72] Extract from 7024129 [redacted] - Supply of Asset Inspection Services_commercials redacted p.54

[73] Extract from 7024129 [redacted] - Supply of Asset Inspection Services_commercials redacted p.67-68

Table 13: [redacted] performance targets and KPIs[74]

KPI	Weight	Score Range			Description of Measure
		0	50	100	
SAFETY	15%				
Powercor compliance audits	15%	<80%	90%	100%	Powercor's audit is a composite index of objectively-measurable items including both preventative practices ('leading' measures') and safety-related outcomes ('lagging' measures')
QUALITY	45%				
Data quality	25%	<94%	97%	100%	A measure of the accuracy, timeliness and completeness of data entered into Powercor's systems. Inspection data is to be uploaded into the Powercor's SAP system or nominated systems within 48 hours of completion.
Audits of completed works by Supplier	10%	<94%	97%	100%	Measures the percentage completion of all audits scheduled within the Supplier's audit plan against the actual audits completed.
Corrective actions closed by due date (non HSE related)	10%	<94%	97%	100%	Measures the number of actions completed to Powercor's satisfaction in the month compared with the number of actions that were due to be completed within that month.
Customer satisfaction	5%				
End customer complaints escalated to Powercor	%	>1	1	0	Measures the number of complaints from end customers, related to the Supplier's activities in delivering the Services that have not been successfully resolved by the Supplier and have been escalated to Powercor for resolution.
POWERCOR SATISFACTION	35%				
Powercor Satisfaction Survey	35%	<80%	90%	100%	Powercor will quantify the extent of its satisfaction with performance of the Services on a (nominally) monthly basis as part of the processes for service governance.

5.7.2. ESV assessment

Governance and management

The governance and management of the Powercor asset inspection program provides clear lines of accountability differentiating between Asset Management, delivery contract management and performance and service provider delivery of works.

[74] Extract from 7024129[redacted] - Supply of Asset Inspection Services_commercials redacted p.65-66

ESV considers that Powercor's governance and management structure adequately complements the monthly operational meeting, providing the appropriate forum to discuss and disseminate information relating to safety performance, program status, quality audit compliance and findings, training and development and innovation activities.

Performance incentive scheme

ESV considers that the contractual arrangement between Powercor and [redacted] supports delivering safe, timely and quality inspection services and performances, at the same time collaboratively identifying improved inspection 'ways of working' through technology or processes.

The contract is structured with a balanced approach to technical expectations and performance outcomes providing a framework to help incentivise delivery of quality asset inspection services.

5.8. Inspection program progress

5.8.1. Powercor's inspection program – SAP maintenance plans

SAP contains pole data including functional location, asset type, manufacturer, serial number, age and active status within the distribution network. SAP is also used to manage the inspection and maintenance tasks, linking these directly to the asset within the database and providing notification history, records of work completed and asset status changes for each pole and tower asset.[75]

Powercor's SAP maintenance plans are developed for each asset by linking the maintenance item to a specific Maintenance strategy and associated Plant Maintenance 'PM' task list. The routine running of the data monitoring program will then call all the maintenance plans that will fall due within the coming period and create the corresponding work order.[76]

Work is planned and issued to inspectors using the 'Click' Field Mobility device which can remotely access Powercor's corporate system.

[redacted] has the ability to divide the packages into smaller work packets, to allow flexibility in its resourcing of inspection staff to meet the required completion time frames. Powercor specifies packages to be completed by a given date, and within a given period. The first pole inspected determines the package's completion date and must be completed and updated in SAP within 28 calendar days of its inspection of the first pole in the package.

Inspection of poles is a dedicated program that is conducted over cycles of 1, 2.5 and 5 years and is generated from the following work packages outlined in Table 14.

[redacted] *advises that the overall volume of poles for the end of 2019 and the start of 2020 is still being analysed and further work is required to determine the volumes for this period. This is due to the movement of cycles and additional activities now required as part of the program.*

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[75] Powercor, *Asset Class Strategy – Poles and towers*, May 2019, p.28

[76] Powercor, *Network asset maintenance policy for inspection of poles*, Document no: 05-C001. D-390, Issue no: 4.8, p.7

Table 14: Powercor's Preventative Maintenance work packages criteria[77]

Scheduling of Planned Maintenance Packages			
PM Package	Schedule		Remarks
	Interval	Tolerance	
Class 1 – C1[1]	2.5 years	+/- 1 month	Includes the above ground inspection of poles classified as 'serviceable' in HBRA.
Class 2 – C2	5 years	+/- 1 month	Includes the full inspection of poles classified as serviceable.
Class 3 – C3[2]	1 year	+/- six months	Includes the above ground inspection of poles classified as AC Serviceable.[3]
Class 4 – C4	2 years	+/- six months	Includes the full inspection of poles classified as AC Serviceable.[3]

Notes:

[1] 2.5 years Class 1 work package coincides with 5 year Class 2 work package.

[2] 1 year Class 3 work package coincides with 2 year Class 4 work package.

[3] A Class 3 or Class 4 inspection will occur on an AC Serviceable pole every calendar year. The +/- six months scheduling tolerance for these packages is to allow the Class 3 or Class 4 inspections to be aligned with any Class 1 or Class 2 inspections occurring on the relevant feeder in the same calendar year.

5.8.2. ESV assessment of Powercor's inspection performance

Inspection program delivery performance is adequate

Powercor's September 2019 monthly asset inspection report prepared by [redacted] identifies that the cyclic inspection program is behind schedule by 19,490 poles. There are no poles inspected after their policy due date. Twenty six poles were due for inspection but, because of access issues, had not been completed. In accordance with Powercor's procedures, a risk assessment has been completed on each of these poles and they have been classified as 'outside policy date - risk assessed'.[78]

The data for the monthly asset inspection report is generated from Click not SAP.

An extract of SAP inspection data as at 1 October 2019 is shown in Table 15 .

Table 15: SAP number of inspection work orders[79]

	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Due in 30 days	1604	1958	1050	596	493	737	908	1265	**8611**
Outside inspection inside policy	38	44	255	26	46	125	13	15	**562**
Outside policy (risk assessed)		2	2	5		4	10	3	**26**
Sum:	**1642**	**2004**	**1307**	**627**	**539**	**866**	**931**	**1283**	**9199**

A comparison of the SAP data with Powercor's September 2019 inspection report shows an apparent discrepancy between the two sources. The difference is due to 10,044 ACS poles that are currently being reinspected as part of the transition to the new yearly inspection cycle.

[77] Powercor, *Network asset maintenance policy for inspection of poles* Document no: 05-C001. D-390, Issue no: 4.8 p.9

[78] Powercor/CitiPower, *Asset Inspections Services*, September 2019 Monthly Report, p.4

[79] Powercor information request response email dated 25 October 2019 RE: Asset Inspection progress extract attachment 'poles outside policy and due date.

The maintenance plans in SAP for these ACS poles are based on the superseded 2.5 year inspection cycle and therefore do not show up on the report as being due. This will be readjusted when the ACS inspections are completed, and Powercor has advised that the subsequent report will then show consistent reporting numbers.

Click is used by [redacted] to manage the scheduling of all pole inspections, which includes a 1-month buffer in the programming of pole inspections to ensure they are inspected by their due date.

As part of the transition plan all AC Serviceable poles are to be inspected by the end of October 2019. As of 25 October 2019, Powercor advised that only 1,304 AC Serviceable poles are outstanding, so the inspection program is on target to complete.

The majority of the 26 poles 'outside policy date - risk assessed' relate to restricted access with either vegetation around the pole or poles located in newly paved footpaths (which require council approval to disturb). Table 16 shows an extract from the September report of two poles which have been 'outside policy risk assessed' for the longest period, with explanations of the delays.

Table 16: Extract poles outside policy date – risk assessed.[80]

Feeder	Equipment Number	Description	Inspection Policy Date	Comments
[redacted]	[redacted]	[redacted]	31/07/2018	For inspection this will require temporarily blocking the water with soil or sandbags and disposal afterwards. A crane required for placement of barrier, traffic management for lane blockages and an outage of the SWZ due to crane use. Very expensive exercise for single inspection and needs further discussion as to cost and options for long-term solution.
[redacted]	[redacted]	[redacted]	18/05/2019	In a swamp - will continue to monitor. Expected access in summer months.

Powercor advised that the inspection follow up is managed manually, external to SAP. Powercor is currently reviewing this process and is planning to transition all risk assessments into SAP. This SAP notification requires a system change. A SAP enhancement request is currently being prepared, with no confirmed date for completion. This will improve the data and process integrity and is to be encouraged.

The increase inspection volume is challenging but is likely to be manageable

Inspection volumes have increased in 2019 as a result of the following changes instigated by Powercor:

- 19,500 poles inspection associated with South-West project
- AC Serviceable inspection cycle changed from 2.5-years to annual
- introduced wood scanning of double staked poles.

[redacted] was aware through planning discussions with Powercor of the upcoming increase in workload, leading [redacted] to recruit seven trainees in August 2018. [redacted] currently has 58 qualified asset inspectors in addition to seven new trainee asset inspectors who commenced in February 2019. They collectively complete an average of between 850 and 1150 inspections per day, depending upon the type of inspections and the areas of inspection.[81]

[80] Powercor/CitiPower *Asset Inspections Services – September 2019 Monthly Report* p.8

[81] Powercor information request response email dated 25 October 2019 RE: Asset Inspection progress

[redacted] states that, *'our concern at present is the effect some additional activities are having on productivity. Additional PoleCam and photo requirements will see this productivity reduce over the coming weeks and we are unsure of the impact it will have.*[82]

From reviewing the progress report, validation of current inspection performance, and noting Powercor/[redacted] increased inspection resources, ESV considers that although the impact of the changes in inspection frequency has been challenging, Powercor and [redacted] are managing the program and the transition of works adequately.

The monthly report is adequate but could be improved

Overall the report is an adequate reporting tool, however ESV considers that it could be improved by including additional information to understand and monitor risk and trends, including a summary of progress against mandatory performance standards and key performance indicators.

5.8.3. Auditing and Compliance

[redacted] has an audit strategy and procedure to monitor inspectors' performance, including their compliance or otherwise with technical standards. Satisfactory levels of compliance are necessary for inspectors to retain their authorisation to work on the Powercor network.

The audit schedule that is in place is in line with the inspection frequencies in the [redacted] audit strategy procedure. *The audit may be completed using one of the following options:*

- working with the inspector
- selecting completed work from the database that has been inspected no later than six weeks from the inspection date
- selecting poles at random in the field and then comparing the information with the inspector, or in the database.

All inspectors working on Powercor's network will be classified as either an A, B or C class inspector depending on audit results and experience,[83] as shown in Table 17 below.

Table 17: Inspector quality class classification

Auditing	A Class inspector	B Class Inspector	C Class Inspector
Number of audits	Minimum of 2 poles per month	Minimum of 3 poles per month	Minimum of 4 poles per month

An inspector requires a minimum of three successful audit results before moving to the next classification level. If an unsatisfactory audit is found, the audit frequency may be increased. The sample of poles selected for the audit is selected to give a good cross section of the poles inspected. Audits are documented on the Technical Audit form which details the acceptable levels for each section of the audit.

Following the audit, minor corrective actions that can be rectified by the Auditor at the time of the audit are recorded on the Technical Audit Form Summary sheet attached to the Technical Audit form and are presented monthly in the monthly report to Powercor by [redacted].[84]

Where major corrective action or non-conformances are identified, an [redacted] Continuous Improvement Action (CIA) form <u>may</u> be implemented. If an Asset Inspector peer has identified the non-conformance, then the form must be submitted to the responsible Contract Manager.

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[82] Powercor/CitiPower *Asset Inspections Services – September 2019 Monthly Report* p.3

[83] [redacted] audit strategy and procedure Document No: AICP800D001F Revision: 3 Date: 5 January 2016 p.9

[84] Powercor/CitiPower, *Asset Inspection Services - September 2019 monthly report*

5.8.4. ESV assessment - auditing and compliance

A major corrective actions and non-conformance should lead to an [redacted] CIA

This process should be mandatory and not at the discretion of the Contract Manager or others.

Powercor's records do not identify the type of audit that has been completed

It was unclear where the records identifying an inspector's classification were recorded as it is not represented on the annual audit schedule. As shown in Table 18, the audit schedule only uses a coloured box to denote the completion of the audit. The sample of poles selected for the audit are required to give a good cross section of the poles inspected, however there is no documented identifier of, or for the options used.

Furthermore, there's no way of telling whether an inspector's work has been audited in the field or any documentation of the type of work audited (i.e. above ground inspection, full inspection, inspection of a staked pole, class of timber or the pole type).

Table 18: [redacted] audit compliance summary – September 2019[85]

Non - Conformance	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	YTD
Correctness of CLICK Data Information	0	0	0	0	0	0	0	0	0	0	0	0	0
Pole Marking	0	0	1	0	1	0	3	1	0	0	0	0	6
Pole Information	0	0	0	0	1	1	0	0	0	0	0	0	2
Plant & Equip ID	0	0	0	0	1	0	0	2	0	0	0	0	3
Excavation	0	0	0	3	0	2	0	0	0	0	0	0	5
Pole Condition Assessment	0	0	0	0	0	0	0	0	0	0	0	0	0
Sound Testing	0	0	0	0	0	0	0	0	0	0	0	0	0
Internal Inspection	0	0	0	0	0	0	0	0	0	0	0	0	0
External Inspection	0	0	0	0	0	0	1	0	0	0	0	0	1
Termites	0	0	0	0	0	0	0	0	0	0	0	0	0
Deteriorated Xarm ID	0	1	0	0	0	1	0	0	0	0	0	0	2
Loose or Missing Hardware	0	1	1	0	3	1	1	1	0	0	0	0	8
Damaged Insulators	0	1	1	0	0	0	2	0	1	0	0	0	5
Service Defects	0	0	2	1	1	1	1	0	0	0	0	0	6
Conductor Defects	0	0	0	0	0	0	0	1	0	0	0	0	1
Conductor Clearances	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Identification	0	0	0	0	0	0	0	0	0	0	0	0	0
Defective Plant	0	0	0	1	1	2	0	1	1	0	0	0	6
Chemical Treatment	1	0	1	0	0	1	0	0	0	0	0	0	3
Minor Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0
POEL Defects	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Non-conformances identified during the Month	1	3	6	5	8	9	8	6	2	0	0	0	48

Powercor's audit reporting could be improved

Table 19 illustrates the audit non-conformance performance as at end of September 2019. ESV observes that in 2019 there are currently no non-conformances for pole condition assessment, sound testing or internal inspection, which are the elements of the SDD process.

The [redacted] audit strategy does not define the meaning of a minor or major corrective action. The audit non-compliance action register for 2019 only references the term non-compliance and requires the same action for all non-compliances.

All audits are currently conducted by Powercor maintenance service officers or [redacted] contract managers. There are no independent external audits undertaken by Powercor of [redacted] Asset Inspectors.

[85] Powercor/CitiPower *Asset Inspections Services – September 2019 Monthly Report* p.9

Table 19: Inspection quality non-Conformances identified[86]

Item	Number Minor non-Conformances Month	Number Minor Non-Conformances YTD	Number Major non-Conformances Month	Number Major Non-Conformances YTD
Quality	2	48	0	0
Health and Safety	10	43	0	0
Environmental	0	0	0	0

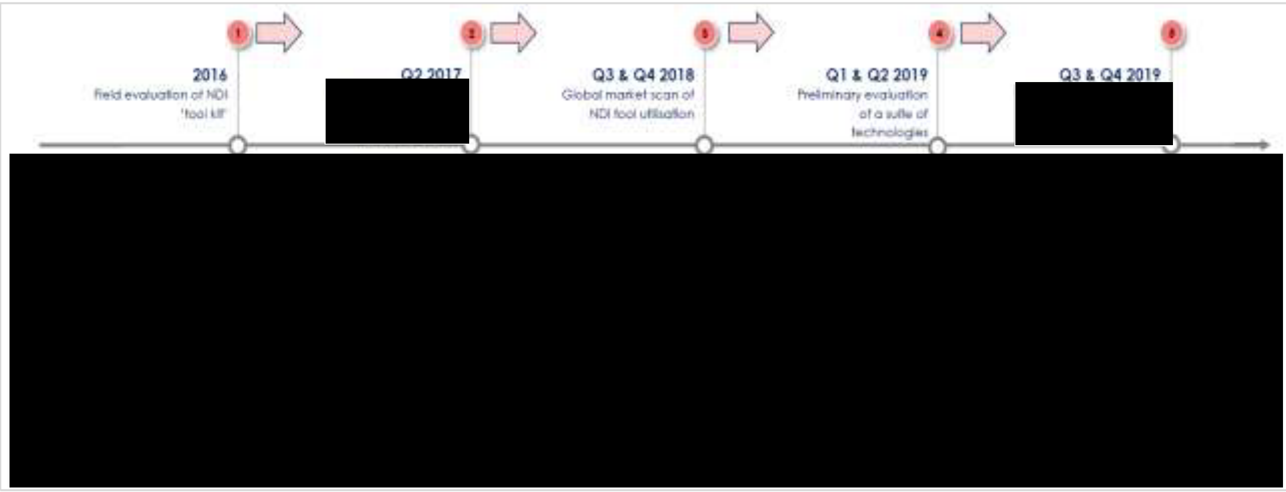
5.9. New Technologies, techniques or methodologies

5.9.1. Powercor's approach

The key challenge associated with Inspection practices for Powercor and the Electricity Industry more broadly is how to improve the accuracy of wood pole condition assessment while eliminating the need to perform destructive invasive testing. The ground line inspection methodology has served the industry well for many years, but drilling does weaken the pole cross section and the holes are a path for water and microbe ingress.

Replacing the intrusion inspection technique with a reliable non-destructive inspection (NDI) technology is a focus of Powercor. Figure 23 shows Powercor's NDI program through to the end of 2019. Introduction of a wood scanning technology in 2017 was a significant step towards fulfilling the objective, however it does not satisfy all of Powercor's NDI technology objectives.

Figure 23: Powercor's NDI program[87]



[redacted]

In late 2018, Powercor engaged a consulting organisation to undertake a global market scan of technologies to determine a further suite of NDI technologies to evaluate as part of a study. A summary of the instruments and technologies assessed are outlined in Table 20.[88]

[86] Powercor/CitiPower *Asset Inspection Services - September 2019 monthly report* p.9

[87] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019,* slide 17

[88] Source: coauthors [redacted] – Preliminary evaluations of NDI testing of timber power pole for Powercor

Table 20: Summary of NDI instruments and technologies assessed[89]

Instrument	Manufacturer/Developer	Inspection Technology (claimed + output)	Developmental status	Instrument Operator (Distributor
[redacted]	[redacted]	Acoustic response (pole strength)	[redacted]	[redacted]
[redacted]	[redacted]	Microwave radar (Decay detection)	[redacted]	[redacted]
[redacted]	[redacted]	Resistance to penetration and moisture content	[redacted]	[redacted]
[redacted]	[redacted]	X-ray (densitometry)	[redacted]	[redacted]
[redacted]	[redacted]	Seismic wave analysis	[redacted]	[redacted]
[redacted]	[redacted]	Acoustic resonance (pole strength)	[redacted]	[redacted]
[redacted]	[redacted]	Acoustic / ultrasonic analysis	[redacted]	[redacted]

The scope of the NDI evaluation project involved several stages with the Phase 1 tests designed to evaluate a suite of instruments in order to facilitate the selection of those devices that could accurately predict the strength or material properties of poles for further (Phase 2) testing and potential development work.

The purpose of this study, which commenced in early 2019, was to evaluate the performance of six NDI methods together with Powercor's current inspection practices (wood scanning and SDD) when compared against measures of pole performance established through breaking tests and forensic examination.

In-field test assessments coupled with breakage tests and autopsies were conducted on twenty-nine (29) unserviceable or AC Serviceable poles predominantly of strength group 3 from Western Victoria.

All poles were transported to Grafton, NSW and tested in cantilever bending to destruction, following which sections of the poles (discs) were excised and forensically examined to estimate the residual cross-section and stages of progressive degradation.

The combination of testing and forensic examination produced tip load, section modulus, fibre strength, density, and moisture content for the ground line (region of interest for NDI) and the failure zone. The overall aim of any inspection method is to estimate tip load of the in-service pole.

Powercor's current inspection methods (SDD and wood scanning) both target estimations of section modulus. The testing showed that, the [redacted] technology gave a better correlation between its outputs and forensic section modulus than SDD or wood scanning techniques.

Powercor's phase 1 study concluded by recommending further evaluation of [redacted] to investigate its potential to directly estimate residual tip load on a wider range of poles from the pole population managed by Powercor. The study also recommended that further destructive testing is carried out by pull-down tests to better simulate in-service ground conditions than the Grafton cantilever test rig.

[89] Source: coauthors [redacted] – Preliminary evaluations of NDI testing of timber power pole for Powercor p.8

Powercor concluded that [redacted] would be selected to continue further extensive field testing due to its superior output, 'effective diameter', correlated well with residual strength.

Field evaluation test of [redacted] NDI technology commenced in July 2019, however issues were identified, including:[90]

- inconsistencies in readings by individual inspectors for the same pole
- issues with calibrating for hardwood poles
- 'False-Positive' results (overestimating pole strength).

Powercor spoke to other Australian distribution businesses who have been using or trialling [redacted]*. Similar issues were evident and one business had discontinued using the* [redacted] *device.* In October 2019 Powercor stopped its [redacted] evaluation trial. The technology developer has been advised of the issues and has been requested to investigate the issues and revert to Powercor before further trials are considered.

5.9.2. ESV assessment

Powercor has introduced a wood scanning technology but its use is limited as the application is inflexible, more costly than SDD, and does not assess the full length of pole.

Distribution networks with wood poles recognise that accurate wood pole inspection results as huge volumes of poles approach end of life are of fundamental importance to cost effective wood pole management. Australian and New Zealand businesses are investing significant time and money working with manufacturers and universities to find a universal technology solution. This is particularly evident with the research undertaken in Victoria by Powercor and AusNet Services, two DNSPs with large rural networks and exposure to fire-start risk.

NDI products have improved over time, as demonstrated by the global market scan undertaken by Powercor. In 2016, [redacted] was not considered for Powercor's in-field evaluation, however Powercor subsequently decided from the latest round of research that the device had improved sufficiently to be worthy of a field trial.

A collaborative industry-wide approach to developing an NDI technology to improve the flexibility, objectivity, accuracy and efficiency of pole condition assessment is required channelling the right investment into finding a solution to a common need.

Powercor has participated in an inaugural Australian utility pole conference hosted by the University Sunshine coast National centre for timber durability and design life. The conference included representatives from distribution businesses and timber pole industry experts. This potentially would be useful avenue for Powercor to cost-effectively participate in relevant research to accelerate improvements to NDI technology.

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[90] Powercor advised at meeting dated 10 October 2019

6. Serviceability Assessment

6.1. Introduction

The objective of this section is to assess whether Powercor's 'serviceability assessment' methodology is likely to support sustainable wood pole management.

In simple terms, if a pole is classified by Powercor as Serviceable it is assessed as able to withstand the loading forces on it. Conversely, if a pole's residual strength is assessed as not being capable of withstanding the loading forces on it, then it is at elevated risk of 'unassisted' failure.[91] Depending on the assessed remaining strength capacity in relation to expected loading forces, the pole and is assumed to be at an elevated likelihood of failure and is classified by Powercor as either Added-Controls Serviceable ('AC Serviceable') or Unserviceable and some form of action is required to mitigate the pole failure risk.

ESV's approach to assessing whether Powercor's serviceability assessment methodology is likely to support sustainable wood pole outcomes is based on:

- understanding Powercor's current serviceability assessment methodology, taking into account recent changes it has made
- understanding Powercor's planned improvements (if any)
- comparing its current approach with what ESV consider to be necessary to support sustainable wood pole outcomes – to this end, ESV take into account relevant industry information about good practice and Powercor's planned improvements.

6.2. Powercor's Serviceability Assessment Methodology

In this section ESV describe Powercor's serviceability assessment methodology, including recent changes and planned enhancements.

6.2.1. Current Serviceability assessment methodology

Table 21Table 21 shows Powercor's definitions of the four possible service classifications. Also shown in this table is the 'likelihood of failure' that Powercor assigns (directly or indirectly) to the serviceability classifications by referring to (i) Powercor's Priority Policy, and (ii) the time limits on control measures. The Priority Policy identifies the 'risk of failure' within certain timeframes[92] for various priority allocations.

[91] Assisted failure is where forces beyond the design strength of the pole cause failure – examples include 'excessive' wind loading, vegetation impact (such as a fallen tree across conductors, or impacting the pole) and vehicle impact

[92] Powercor, *Network Asset Maintenance Priority Policy,* July 2019, p. 5: for priorities P1, FFU14, FFU28, P42, P2, P3, POPP

Table 21: Powercor's serviceability definitions

Classification	Definition[93]	Likelihood of failure[94]
Serviceable	These poles are assessed as being serviceable	Unlikely to fail within the next five years
AC Serviceable	These poles are assessed as having sufficiently deteriorated to warrant an increased inspection frequency	Without added control measures, elevated risk of failure beyond 12 months
Unserviceable Priority 2	These poles are assessed as having deteriorated to a point which requires reinforcement or replacement	Without intervention, likely to fail within 12 months but not within the next 8 months
Unserviceable Priority 1	These poles are assessed as having deteriorated to a point which requires priority replacement	Without intervention, likely to fail in the near future

6.2.2. Recent changes to Serviceability classifications

Powercor has recently changed its labelling of Limited Life to AC Serviceable. No other aspects of the definition were changed.

6.2.3. Proposed changes to Serviceability Classifications

Powercor has not indicated any planned changes to the Serviceability classification definitions.

6.2.4. ESV assessment

Powercor's classifications of pole condition as either Serviceable, AC Serviceable, Unserviceable Priority 2 or Unserviceable Priority 1 are aligned with industry practice. ESV's understanding is that Powercor's change from 'Limited Life' to 'AC Serviceable' was driven by concern from the public that poles identified as Limited Life[95] had not been replaced, even though it was not necessary to replace or reinforce the pole based on Powercor's condition assessment.

ESV also observe that:

- the timeframes in the Priority Policy relate to 'likelihood of failure', not 'risk of failure' – risk encompasses consideration of consequence and should be expressed in accordance with Powercor's 'Levels of Risk' matrix
- there is no priority allocation in the Priority Policy that is directly applicable to:
  - Serviceable wood poles – these poles are inspected every five years, therefore ESV have assumed that Powercor assesses that the poles are unlikely to fail within 5 years[96]
  - AC Serviceable wood poles – these are inspected every 12 months, therefore ESV assume that Powercor has assessed that the poles are unlikely to fail within 12 months.

Powercor has indicated that it intends to update its next version of the Asset Inspection Manual by 30 June 2020.[97] Including explicit reference to pole management priorities would be an improvement.

[93] Powercor, *Asset Class Strategy – Poles and Towers*, May 2019, Table 4, p. 9

[94] Inferred from Powercor's control measures

[95] Via markings in the form of a white cross on the pole

[96] Whilst Powercor inspects Serviceable poles in HBRA every 2.5 years (above ground inspection) and Serviceable privately owned poles every 2.5 years (full inspection), our understanding is that this is a risk-based decision, not a condition-based decision

[97] Powercor, *Powercor wood pole management – ESV – Powercor workshop – 19 September 2019,* slide 43

6.3. Powercor's Serviceability criteria

There are three key tasks in assessing the serviceability of a wood pole:

- determining the residual strength of the pole
- determining the loading on the pole
- comparing the two and assigning a serviceability rating based on serviceability criteria which are aligned with the risk tolerance of the organisation.

As residual strength declines over time, regular assessment is required.[98]

6.3.1. Powercor's current serviceability criteria

Powercor uses three approaches to determine the condition of the pole: visual inspection and measurements, SDD, and NDI. Each of these are common within the industry, although the details vary somewhat. Powercor:

- estimates serviceability from visible features of the pole (i.e. above the ground line) that may indicate an elevated risk of failure, including:
  - fruiting bodies
  - large splits or holes
  - termite infestation
  - external rot / loss of cross sectional area
  - excessive or dangerous leaning
- estimates residual strength from measurements:
  - Powercor captures or reconfirms existing data (such as pole age) and other data critical to Powercor's condition assessment algorithms
  - the key measurement is the original girth of the pole and loss of 'good wood (annulus) via measurement of the internal and external loss of pole diameter;[99] this supports derivation of estimated residual pole strength, from which Powercor determines a health index (Safety Factor or an R Factor, depending upon inspection technique).

Determining residual strength

Residual strength is the measure of the pole's remaining strength. It decreases over time due to three factors:

- Loss of external wood
- Loss of internal wood
- Loss of fibre strength.

Powercor currently estimates the loss of internal and external wood from its inspection process, including the SDD technique. The loss of internal and external wood could be from '*decay, termites, other wood destroying organisms, mechanical damage, inspection holes, or vandalism*.[100] The measurement of loss of fibre strength is not explicitly included in Powercor's current serviceability assessment, however the design capacity of wood poles includes an allowance for strength loss over time. ESV's understanding is that the currently utilised wood scanning technique does not include an estimate of fibre strength degradation with age.

[98] The loading on a pole can also change from its original design assumptions (e.g. if a pole top transformer has been added)

[99] As explained in section 5 (inspections), measurement of the external diameter is subject to instructions to help ensure reasonable repeatability and reproducibility

[100] Powercor, *draft Network Asset Maintenance Policy for Serviceability Assessment of Poles,* p. 11 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT in response to an Information Request)

Powercor calculates the residual strength (or Working Strength, kN) of the pole by dividing the calculated bending moment capacity of the pole (kNm) by the pole length (m). The residual strength is determined taking into account:

- the strength grouping of the pole timber species
- the durability class of the timber species
- the section modulus of the pole at or below ground level determined via the good wood (or 'sound wood') measurement by the inspector or, in limited circumstances, via the current wood scanning technique. [101]

Powercor has a number of timber poles of unknown species as there is no pole disc or distinguishing features to identify the species of timber. These poles are identified as 'ZZ – wood unknown' and are conservatively managed as durability Class 3 poles that have the same serviceability assessment threshold applied as Class 2. ESV has observed that Powercor's pole asset database shows all unknown poles as Class 2 durability poles. Powercor have advised *that the auto assignment of ZZ poles to Class 2 in its SAP database is likely to be a legacy arrangement from the original configuration of its enterprise SAP system*[102]

Serviceability criteria

Table 22 shows Powercor's serviceability criteria – there are four factors to the criteria:

- Safety Factor – the residual strength is compared to the Working Stress Design (WSD) capacity of the pole (i.e. Pole disc ID rating) which includes a Factor of Safety of 2.5; thresholds below which the likelihood of failure increase is established from empirical data and Powercor's risk tolerance
- R-factor – another measure of residual strength versus Working Strength of the pole, where the latter is determined by dividing the bending moment capacity by the length of the pole above ground level, normalised by 1.875,[103] the R-Factor results are calculated by the current wood scanning system[104]
- Sound wood measurements – thresholds below which the likelihood of failure increases is established from empirical data and Powercor's risk tolerance
- Visual criteria – which are visual indicators, such as large checks through the pole, which are potentially issues that indicate insufficient residual strength which are used to estimate the likelihood of failure.

Powercor translates standing data and inspection data for each pole into one of the four condition classifications directly via its 'Pole Calculator' or from the wood scanning device. The Pole Calculator is a program in Powercor's Asset Inspection mobility software, which in turn is within a portable computer which pole inspectors use to enter the pole inspection data. The wood scanning device is part of a separate system, as described later in this section.

The software algorithms convert the input data and assumptions into the serviceability classifications depending on the results of the calculation of either the Safety Factor or R Factor. The distinction between species (including strength or durability class) in the management of timber poles occurs in the Pole Calculator or wood scanning device via lookup tables. In Powercor's systems there is no difference between the management of durability Class 2 and durability Class 3 poles - the same serviceability criteria apply to both durability classes.

[101] As a validation tool only for those poles assessed as Unserviceable and for double-staked poles

[102] Clarification on treatment of unknown wood species, Email, [redacted] 16 October 2019,

[103] This is to normalise the R Factor threshold for Serviceable poles to 1.00, which is equivalent to allowing up to 25% strength degradation. The Safety Factor equivalent is 1.875 because this is 25% less than the assumed original Factor of Safety of 2.5

[104] Powercor, *Network Asset Maintenance Policy for Inspection of Poles*, v4.8, Nov 2019, p. 18

Powercor advises that the method underpinning the pole calculator is more conservative (i.e. more poles will be classified as Unserviceable) than the Victorian Electricity Supply Industry (VESI) criteria, but still relies upon the engineering basis for the VESI criteria.[105] It also advises that the introduction of the Pole Calculator has:[106]

- addressed 'areas of uncertainty in the interpretation of the Victorian Electricity Supply Industry serviceability criteria, including:
  - the appropriateness of the criteria for assessing pole strength
  - the impact of the combination of internal and external loss of sound wood and drill holes
  - the application of criteria requiring averages across multiple measurements
- improved consistency in interpretation of criteria across inspections
- improved consistency of serviceability determination
- enabled the introduction of pole strength class to the determination of required strength
- improved management of undersized poles.

The minimum Safety Factor threshold for serviceability is 1.40, which is equivalent to allowing the pole to lose 44 per cent of the original design capacity before it is deemed unserviceable; the equivalent R Factor is 0.75.[107] As shown in Table 22, there are other criteria for classifying a pole as AC Serviceable or Unserviceable, based on either the remaining amount of good wood, or defects (most of which are discernible from visual assessment).

[105] Such as the empirical relationships between the diameter of the pole, girth of the pole, sound wood measurement and the % original design strength of the pole

[106] Powercor, *Powercor wood pole management, ESV – Powercor workshop*, 19 September 2019, slide 11

[107] 1.4/2.5 = 0.56 or 44% loss of original strength; 1.4/1.875 = 0.76, which Powercor has rounded to 0.75

Table 22: Powercor's current serviceability criteria[108]

Classification	Safety Factor (SF) range	R Factor range	Other
Serviceable	SF ≥ 1.875	R ≥ 1.00	For a Durability Class 1 pole: sound wood thickness of the annulus ≥ 40mm For other durability class poles: sound wood thickness of the annulus ≥ 50mm
AC Serviceable	1.40 ≥ SF < 1.875	0.75 ≥ R < 1.00	For a Durability Class 1 pole: 35mm ≤ sound wood thickness of the annulus < 40mm For other durability class poles: 35mm ≤ sound wood thickness of the annulus < 50mm
Unserviceable Priority 2	1.00 ≥ SF < 1.40	0.53 ≥ R < 0.75	One or more of: • Visual Appearance criterion (between ground level and 2m above ground):[109] – 'see through' splits > 10mm in width – Or >25 per cent of pole cross-section is lost – Or >100mm void or loss of wood • a hardwood pole having an internal measurement between 30 and 16mm • any of the defect causes: fire, vehicle impact, third party or lightning • a defect has been identified below the excavation depth by the deep drill process • poles identified with Dampwood (Glyptotermes) termite infestation • wood poles found with fungal fruiting bodies above 2 metres • pole stable and leaning greater than 5 degrees over a carriageway or greater than 10 degrees elsewhere [1] • leaning and has the potential to cause damage to other assets [1]
Unserviceable Priority 1	SF < 1.000	R < 0.53	Sound wood thickness of the annulus less than 16mm

[1] The priority is upgraded where the leaning pole is resulting in a hazardous situation (i.e. has the potential to be struck by vehicles, or to encroach on clearances)

6.3.2. Recent changes to Serviceability criteria

Introduction of wood scanning R Factor criteria

The wood scanning inspection tool was introduced in mid-2017 to provide an alternative, non-destructive method to the SDD inspection technique for estimating the residual strength of individual poles. In contributed to replacement and reinforcement volumes being significantly lower than previous years, as discussed further in sections 7 (Pole Intervention) and 9 (Forecasting and Modelling).

[108] Powercor, *Network Asset Maintenance Policy for Inspection of Poles, v4.8, Nov 2019,* pp. 12-15, 18

[109] Powercor, *Network Asset Maintenance Policy for Inspection of Poles, v4.8, Nov 2019,* p. 18

Increased minimum Safety Factor

Powercor has recently changed the minimum Safety Factor threshold for classifying a pole as Unserviceable to 1.40, an increase from 1.25. This is equivalent to requiring the amount of sound wood to be 35mm rather than the previous requirement of 30mm (the VESI requirement).[110] It is also equivalent to changing the permitted strength degradation to 44 per cent, up from 50 per cent. This change has the effect of increasing the number of poles that will be classified as Unserviceable. The basis for this change is stated by Powercor as being '…*to provide increased assurance to our customers'.*[111] This has also led to a change in the R-Factor criteria (i.e. to match the Safety Factor serviceability criteria).

Introduced an extra Visual Appearance criterion

Powercor now also classifies an otherwise 'healthy' pole as Unserviceable P2 if it is '…*displaying visual traits likely to concern a customer.'*[112] Powercor advised that community stakeholders consider that poles with one or more of the features that the new criterion cover should be replaced because they are unsafe. Powercor applies the Visual Appearance criterion after the SDD and wood scanning processes (i.e. and have led to a Serviceable classification) and it applies from the ground line to a height of 2m above the ground line. Powercor considers that this approach is aligned with ISO 55001:2014, which, among other things, requires the organisation to determine…*the requirements and expectations of these stakeholders with respect to asset management'.*[113]

6.3.3. Planned changes to the serviceability criteria

Enhanced Pole Calculator

Powercor advises that it is enhancing its Pole Calculator to provide a potentially more conservative and accurate engineering basis for residual strength calculation for wood poles. The major change is to explicitly recognise wood fibre strength degradation in determining residual pole strength (or 'structural capacity'). In doing so, it will introduce an age-based strength reduction in the calculation, which will impact a large proportion of the wood pole population.[114]

In addition to the explicit introduction of fibre strength loss over time based on species and diameter loss, the revised approach provides the flexibility to account for contemporary Limit State Design (LSD) loadings calculated in accordance with AS/NZS 7000:2016 Overhead Line Design (AS/NZS 7000).

Instead of the Safety Factor, the Pole Calculator will determine serviceability based on the Serviceability Index (SI) as shown in Equation 1, where:

Equation 1: Serviceability Index[115]

$$SI = \frac{\text{Residual Capacity}}{\text{Design Load}}$$

The Serviceability Index is a measure of the LSD residual structural capacity ('Residual Capacity') of the pole divided by the ultimate LSD load ('Design Load'). The Residual Capacity, F_{rs}, is determined from the following equation:

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[110] Powercor, *Powercor wood pole management*, *ESV – Powercor workshop*, 19 September 2019, slide 12

[111] Powercor, *Powercor wood pole management*, *ESV – Powercor workshop*, 19 September 2019, slide 12

[112] Powercor, *Powercor wood pole management*, *ESV – Powercor workshop*, 19 September 2019, slide 12

[113] Powercor, feedback on Draft Internal Technical Report, received 12 November 2019

[114] Powercor, *Powercor wood pole management*, *ESV – Powercor workshop*, 19 September 2019, slide 13

[115] Powercor, *draft Network Asset Maintenance Policy for Serviceability Assessment of Poles*, p. 7 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT), p.7

Equation 2: Residual capacity[116]

$$F_{rs} = \frac{\phi f_{bs} Z_s}{h} \times 10^{-6}$$

where:

ϕ is the strength reduction factor for wood poles, derived from AS/NZS 7000

f_{bs} is the residual fibre strength of the pole

Z_s is the residual section modulus of the pole at the section 'h' distance from the tip of the pole to the ground.

The fibre strength degradation factor for the age of the pole is accounted for in the derivation of f_{bs} and is derived from ENA research.[117]

The ground line strength of reinforced poles will be determined from the strength of the reinforcement and the strength of the timber at the top of the reinforcement.[118]

Checks, splits, and inspection holes are accounted for through the nominal degradation factor to be applied to the pole based on its age.[119]

The Design Load is the Ultimate Limit State[120] (LSD) design load calculated using the pole top configuration, and include all sources of load and resistance, including wind loads at each 15º rotation around the pole in accordance with the requirements of AS/NZS 7000:2016 Overhead Line Design. However, Powercor does not yet have the required LSD loads for each pole, so Powercor's proposed interim approach is to assume that the LSD load is given by the WSD rating of the Pole, converted into an equivalent LSD load.[121] The full definitions and derivations of the parameters are provided in Powercor's draft (updated) *Network Asset Maintenance Policy – Service Assessment of Poles*.

The draft SI ranges applicable to six serviceability grades are outlined in Table 23 below.

Table 23: Powercor's draft serviceability grading's based on Serviceability Index

Serviceability classification	Serviceability Index (SI) [122]
Serviceable	SI ≥ 1.00
Serviceable	0.75 ≤ SI < 1.00
AC Serviceable	0.70 ≤ SI < 0.75
AC Serviceable	0.65 ≤ SI < 0.70
Unserviceable P2	0.5 ≤ SI < 0.65
Unserviceable P1	SI <0.50

[116] Powercor, *draft Network Asset Maintenance Policy for Serviceability Assessment of Poles*, p. 7 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT), p.12

[117] ENA Power Poles and Crossarms Forum, Collective (industry) destructive test data on power poles to determine the influence of preservative treatment type and species on residual fibre strength, 2015

[118] A 20% strength reduction of the wood at the top of the reinforcement is to be applied for bolted reinforcement types

[119] The exception is if the checks/spits are over 35mm wide or there is more than 15 inspection holes (AC Serviceable) or 20 holes (Unserviceable P2)

[120] The Limit state is the state of impending failure, beyond which a structure ceases to perform its intended function satisfactorily, in terms of either safety or serviceability

[121] Powercor, *draft Network Asset Maintenance Policy for Serviceability Assessment of Poles*, p. 7 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT)

[122] Powercor, *Powercor wood pole management plan risk modelling – ESV Update, 14 Oct 2019*, slide 14

Establishing LSD design loads

Powercor advises that it intends to 'work towards' having an LSD load calculation for every pole, but that this is not currently a priority. The expected benefits of individual LSD loading data are *'…increased longevity of poles that are over-sized to their design requirements, and the ability to better distinguish between the likelihood of failure of poles; allowing for better risk management.*'[123]

Calibrating the SI ranges

Powercor advises that with LSD, '…*the components of load and capacity are broken down into smaller elements that take into consideration the different sources of load, and strength reducing factors, to produce a site/material specific design that ensures greater efficiency and reliability of design. The problem is that applying regular structural design rules from normal structural design standards would mean a much higher level of required strength and expense than has historically been shown to perform.'*[124]

In Powercor's view, this means that it is prudent to calibrate the serviceability criteria, *'…with a clear understanding that current practices appear to be reasonable, but may be a higher risk than anticipated, and that the requirements of AS/NZS 7000 have already been reduced compared with normal structural design requirements.'*[125]

The draft SI ranges in the table above have been based on 60 per cent allowable loss of strength (from section and fibre strength loss) as the threshold for Unserviceable P1, which is the same criterion currently applied using the WSD factors. The draft SI ranges in the table above also assume 50th percentile age degradation factors taken from the ENA research.

There are many other assumptions underpinning the SI calculation for each pole and are representative of a 'first draft' and are subject to change.[126] Powercor advises that the draft settings have '*…been tailored to improve on historical pole calculators, whilst not giving an excessively conservative result that would require excessive additional expenditure over current practices.'* Powercor also notes that *'Ongoing performance monitoring and replaced or failed pole investigation will enable continuous development of the calculations contained herein.'*[127]

Australian Utility Pole Network

During consultation, Powercor has mentioned how it has participated in an inaugural Australian utility pole conference hosted by the University of the Sunshine Coast with the intention to create a national centre for timber durability and design life research at its campus. If it is established, this centre may be a useful means for Powercor to cost-effectively participate in relevant research to accelerate improvements to its wood pole serviceability assessment. This remains a work in progress.

[123] Powercor, *draft updated Network Asset Maintenance Policy for Serviceability Assessment of Poles*, p. 7 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT)

[124] Powercor, *draft updated Network Asset Maintenance Policy for Serviceability Assessment of Poles*, p. 17 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT)

[125] Powercor, *draft updated Network Asset Maintenance Policy for Serviceability Assessment of Poles*, p. 17 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT)

[126] For example, wind span, design life, conductor diameter, wind region, topographic multiplier

[127] Powercor's, *draft updated Network Asset Maintenance Policy for Serviceability Assessment of Poles*, Table 1, p. 11 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT)

6.3.4. ESV assessment

With the exception of its Visual Appearance criterion, Powercor's methods of converting condition information to serviceability classifications is reasonable

The three most common methods of converting condition information into an estimate of the remaining life are:

- age-based – using age as a proxy for condition and remaining life against an assumed 'characteristic life' (or 'technical life') which may vary for different species of wood; this approach is generally recognised as overly conservative, given that relatively young poles can fail due to poor condition and relatively old poles can still perform adequately
- Heath index (HI):
  - qualitative assessment: typically based on visual appearance of the pole to derive a health index, which is then mapped to remaining life ranges
  - quantitative assessment: based on algorithms for converting inspection data and wood pole characteristics into a health index which is then mapped to remaining life ranges.

Powercor uses a combination of the quantitative (Safety Factor and R-Factor, and measurements) and qualitative (visual inspection) approaches to determine the serviceability classification for individual poles, relying on its own and industry-wide experience. Powercor does not explicitly estimate remaining life for a pole, instead estimating the period beyond which the likelihood of failure is unacceptably high.

The SDD condition assessment technique is an industry standard that has been applied for many years and is generally regarded as a reasonable approach that has served the industry well. Its primary purpose is to establish areas of loss of internal wood and to measure the remaining 'sound wood', as described in section 5 (Inspections). It is by no means perfect, with the key limitations being the difficulty in reliably establishing the amount of remaining good wood.

Whilst Powercor's quantitative approach is more sophisticated than the qualitative HI and age-based approaches as the basis for determining the safe remaining life of poles, it is strongly dependent on the quality of information from the inspection process and assumed parameters. In the absence of a perfect means of determining the remaining life of a wood pole (which is the case even with NDI techniques), calibration of the serviceability criteria against actual performance is the key to striking the balance between being too conservative (generating too many false positive[128] results) or optimistic (generating excessive false negative[129] results).

In ESV's view, Powercor's new Visibility Assessment criterion, discussed further below, is not consistent with good industry practice.

Powercor's recently superseded serviceability criteria were not identifying enough Unserviceable poles

Powercor has approximately 194,000 wood poles over 45 years old, with the majority (158,000) of them over 50 years old. Without intervention, a further 43,000 poles will be older than 45 years in 5 years' time. At this age and beyond, loss of fibre strength in the residual wood becomes a governing factor for the end-of-life reliability of the pole, as discussed further below.

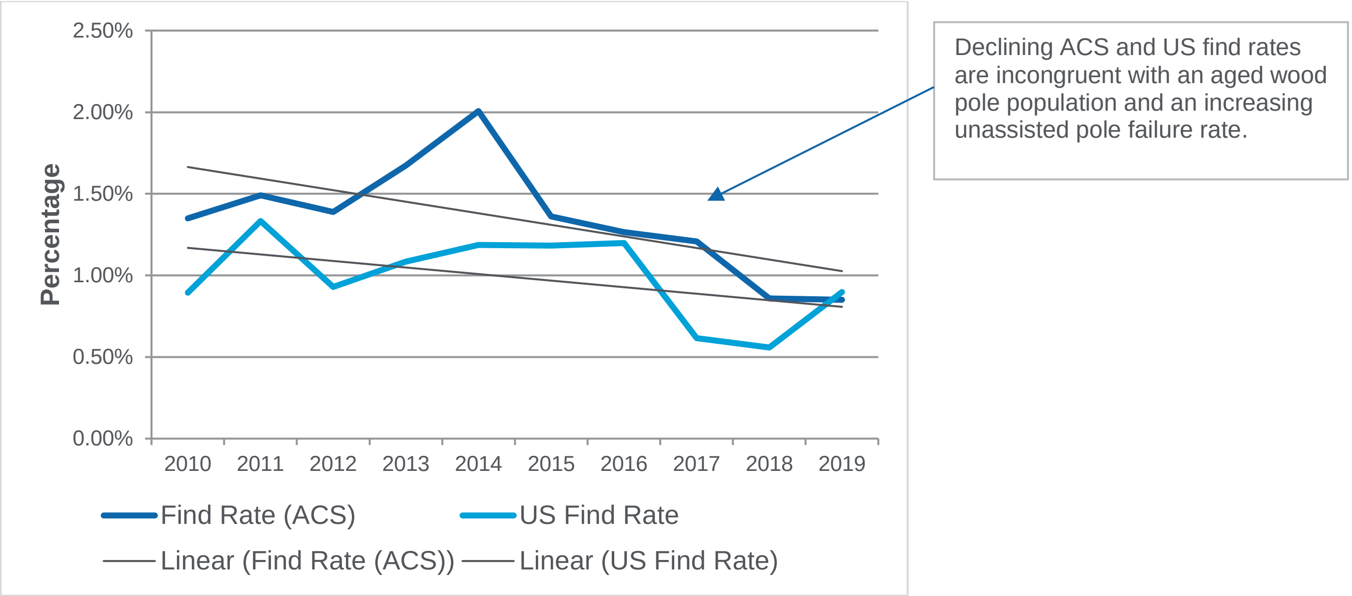
The reasonable expectation is that the combination of Powercor's condition assessment process and its serviceability criteria would lead to an increasing Unserviceable (and AC Serviceable) pole 'find rate' over at least the last few years and into the future. However, as shown in Figure 24 either Powercor's condition assessment process or its superseded serviceability criteria (or both) has led to declining find rates of

[128] Poles that are classified as unserviceable but are actually Serviceable

[129] Poles that are classified as serviceable but are actually Unserviceable

Unserviceable and AC-Serviceable poles from 2014 onwards. Powercor itself has identified that this trend is not sustainable.[130]

Figure 24: Powercor's AC Serviceable (ACS) and Unserviceable (US) find rate



Powercor studied its wood pole condition assessment (using the current Pole Calculator results) as part of its 'RCM refresh' project in 2019, and identified:[131]

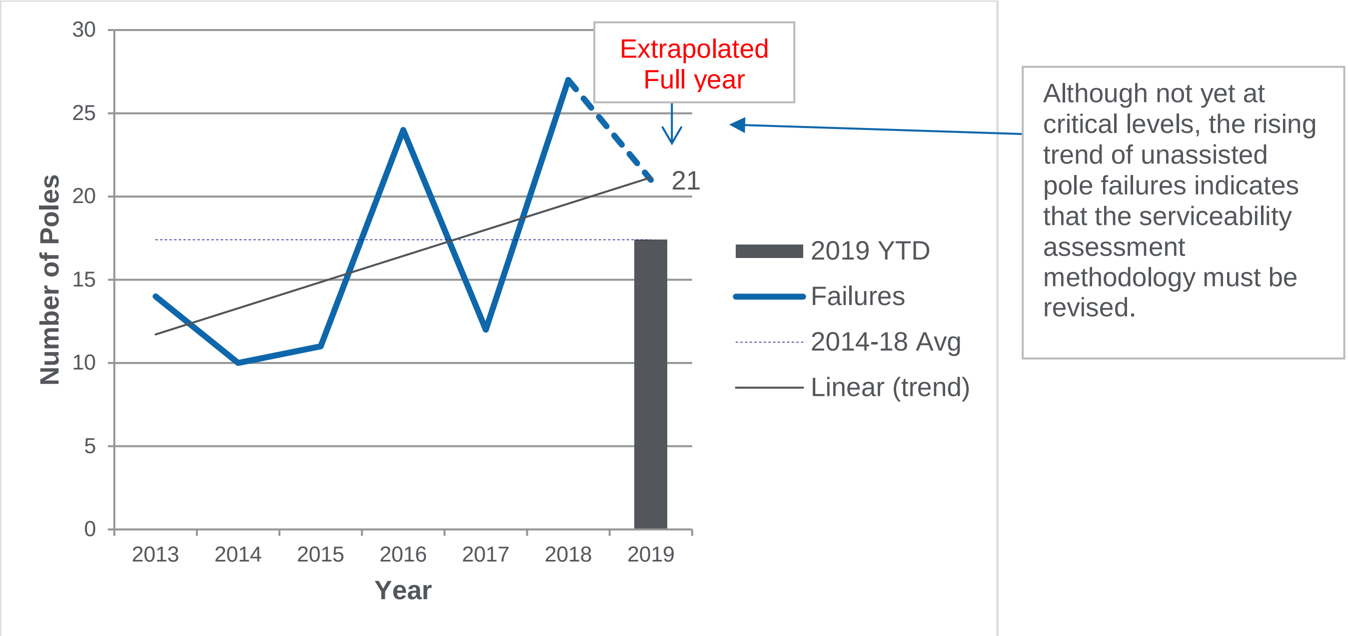
- 'an increasing number of poles transitioning from the Serviceable state to both lower states and it is reasonable to project a continued increase / acceleration
- the previous inspection cycles for Added controls – serviceable poles can be optimised to improve performance
- a number of poles are bypassing the Added Controls – Serviceable state which requires analysis and ongoing monitoring.'

Further evidence that Powercor's superseded serviceability criteria were not supporting sustainable wood pole performance outcomes is the increasing trend of unassisted wood pole failures, shown in Figure 25.

[130] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019*, slide 30

[131] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019*, slides 4, 36

Figure 25: Powercor's unassisted wood pole failures



Powercor has advised that the results of wood scanning condition assessment have led it to reclassify 60 per cent of the wood poles inspected using this technique from Unserviceable to AC Serviceable. However, as this accounts for a relatively small proportion of the poles inspected since 2014, ESV does not consider it to be the major contributing factor in declining 'find' rates. Powercor advises that other contributing factors to the reduction in total volume of Unserviceable and AC Serviceable poles are:[132]

- different pole population (material and location) inspected from year to year due to cyclic inspection patterns
- retraining of asset inspectors undertaken in 2016 resulted in a reduction in the number of poles transitioning to Unserviceable due to fabricated inputs (human intervention) to downgrade a pole
- starting in mid-2017, diameter tape was used for measuring average pole diameter, replacing the previous instruction to use callipers to measure a pole's smallest diameter.

Powercor also advised that '*the reduced total volume does not, we believe, reflect the true condition of the wood pole network and Powercor's response to this has been to reassess the Pole Calculator, addressing any deficiency that may have driven this downward trend by improving the calculation method*.'

This statement and the improvement initiatives Powercor is pursuing and plans to pursue indicate that it has assessed the effectiveness of its current methodology, has confirmed that corrective action is required, and it is working to improve outcomes.

Powercor's current serviceability criteria are not likely to support sustainable outcomes

Powercor has changed its serviceability criteria by introducing:

- a higher Safety Factor threshold for classifying poles as AC Serviceable by changing the minimum Safety Factor from 1.25 to 1.40
  - Powercor estimates that this will increase the number of Unserviceable poles by 1,000 poles p.a.

[132] Powercor, response to ESV IR WPM-010, Item 4,'Replacement vs Reinforcement ratios.xls'

- an additional Visual Appearance criterion, classifying the pole as Unserviceable if there is a 'see through' split, or large void, or 25 per cent or more loss of cross section within 2m of the ground line
  - in its first 4.5 months of operation, Powercor reports classifying 174 poles as Unserviceable based on this new criterion, which is approximately 460 poles p.a.

Whilst the change in the Safety Factor threshold is likely to increase the number of poles classified as Unserviceable, the selection of SF = 1.40 is not adequately supported by analysis to confirm that this is the appropriate threshold. However, Powercor has positioned this adjustment as an interim measure (i.e. until its proposed SI-based criteria are implemented) and ESV accept that detailed calibration is not warranted provided that Powercor focusses on implementing and calibrating the SI-based serviceability criteria.

The Visual Appearance criterion[133] is applied after the pole has been assessed as AC Serviceable or Serviceable from the standard inspection process. Therefore, Visual Appearance is being used to classify poles as Unserviceable that have been assessed using the other condition assessment techniques as having an acceptable likelihood of failure. Whilst this criterion will increase the number of Unserviceable poles, it is not consistent with good asset management practice as visual appearance is not a good indicator of residual strength. Whilst Powercor argues that its criterion is consistent with ISO 55001, ESV's view is that the majority of stakeholders would prefer to ensure that any funds are spent on addressing pole risk established by recognised practices.

Powercor also notes (refer to section 6.3.3) that its proposed SI-based methodology accounts for the effect of checks and splits are accounted for through the nominal degradation factor to be applied to the pole based on its age.

Despite the improvements, it is unlikely that these initiatives will collectively result in sustainable wood pole performance based on the forecast volumes Powercor attributes to what Powercor refers to the 'enhanced Pole Calculator policy' (refer to section 9).

ENA research provides a reasonable basis for Powercor's enhancements of its Pole Calculator algorithms to incorporate strength degradation more explicitly

The ENA conducted pole strength research in 2015 and, whilst ESV does not have access to the full report, Powercor provided an extract of a presentation on the research.[134] From this information ESV know that the aim of the research project was to:

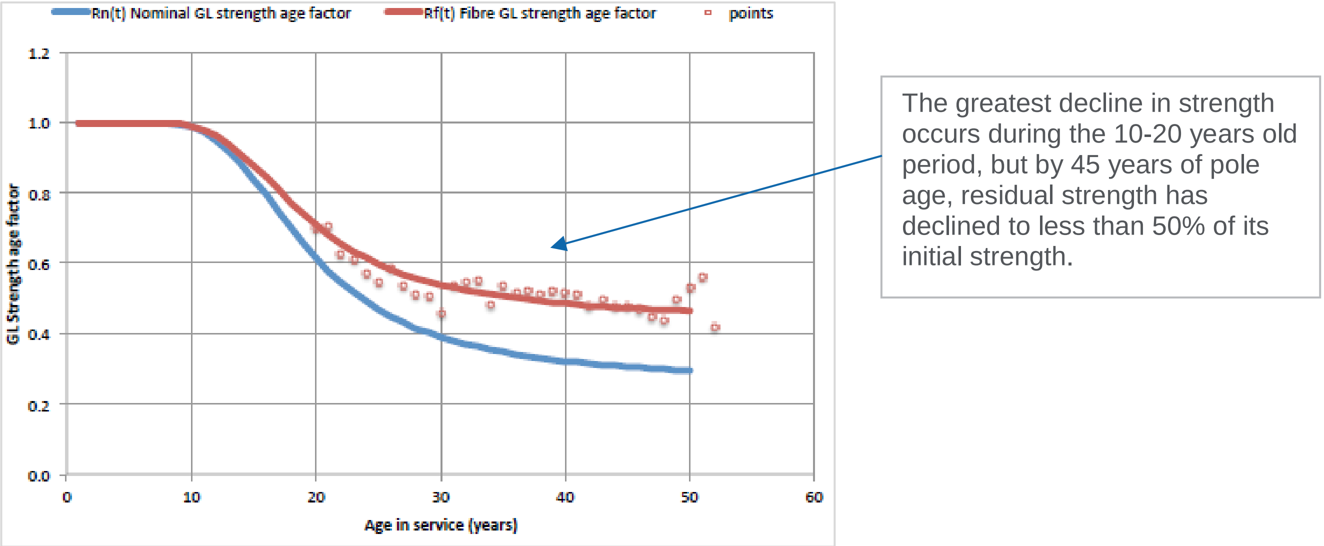
- determine the effect of age on pole strength at the ground line (GL), considering the effect of species, natural durability classification, strength group and preventative treatment (CCA or creosote)
- where data was available, determine the effect of age on pole strength above the ground (AGL).

Figure 26Figure 26 (red line) from this research shows that by 45 years of age the wood pole fibre strength at the ground line has reduced to less than 50 per cent of the original strength and continues to degrade, albeit at a reducing rate.

[133] Which is to classify poles as Unserviceable based on one or more of: excessive split, hole/void, or cross-sectional loss.

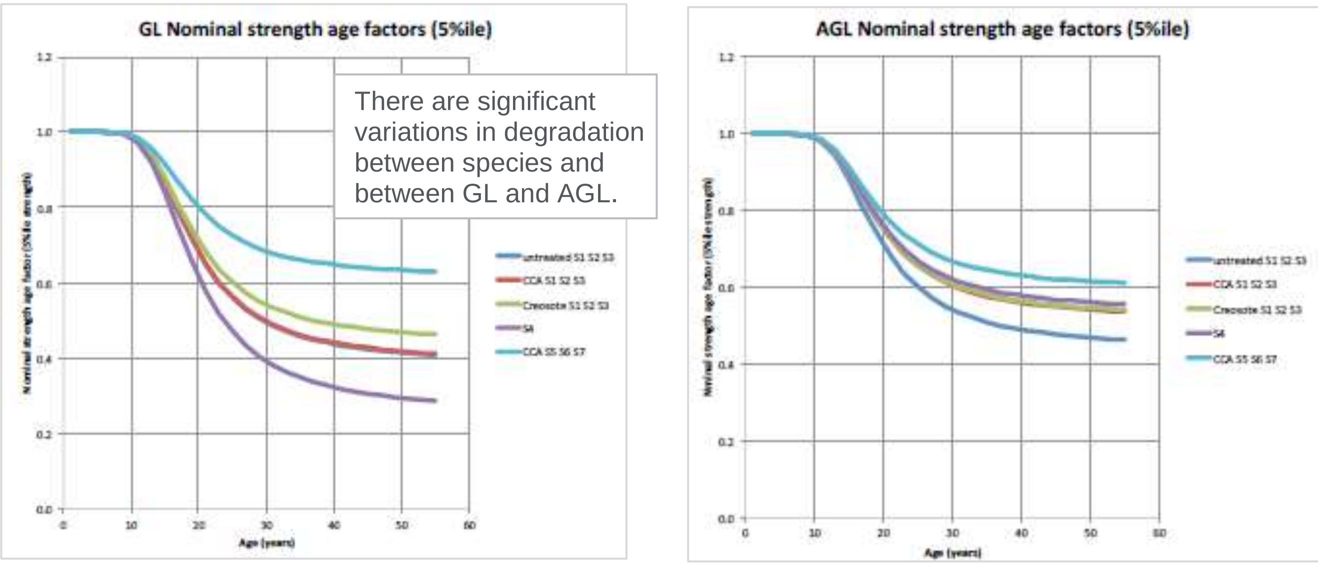
[134] Powercor, response to ESV IRxxx, *Item 1b_ Australian Utility Pole Workshop - pole strength excerpt 2019*

Figure 26: Fibre strength age factor[135]



As shown in the Figure 27 below, the ENA research also shows that (i) capacity reduction and treatment effectiveness varies with species and, (ii) on average, residual pole strengths are higher above the ground line.

Figure 27: Wood pole Ground Line (GL) and Above Ground Line (AGL) strength degradation with age[136]



Based on the example in Figure 28 below from the ENA research, there is a large variation in strength versus age even within a single species. The 5th percentile curve is clearly much more conservative than the 50th percentile curve because of the large variation in residual strength between poles of the same age and species. A conservative approach would be to adopt the 5th percentile, but as discussed below, this is likely to be overly conservative, generating a very high number of false positive results (i.e. classifying low risk poles as Unserviceable).

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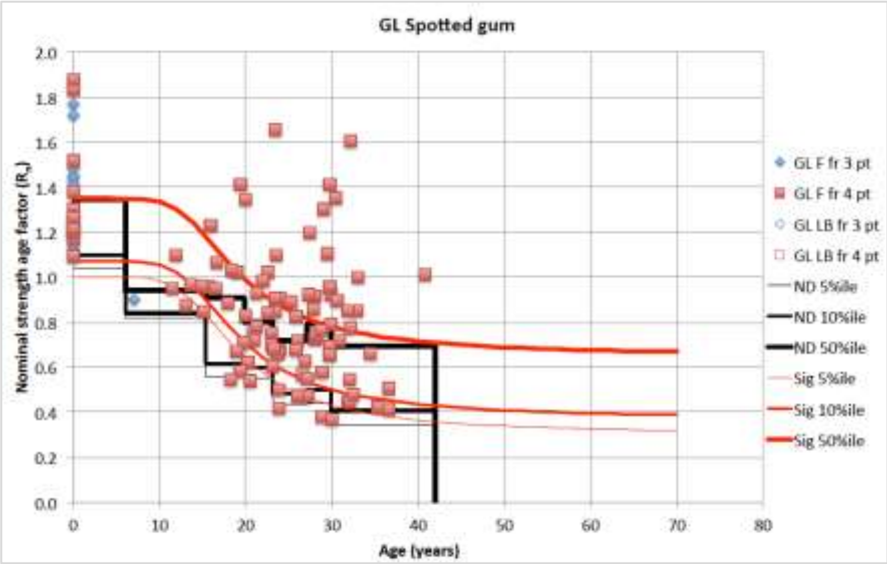
135 Powercor, response to ESV IR WPM-010, Item 1b, *Australian Utility Pole Workshop - pole strength excerpt 2019*

136 Powercor, response to ESV IR WPM-010, Item 1b, ENA, *Destructive test data on power poles, Draft Report, 2015*

Figure 28: Strength versus age curves (GL) for spotted gum from ENA research[137]



ESV consider that Powercor's application of the ENA research is reasonable to help calibrate its SI calculations and, by extension, its serviceability criteria.

Powercor's proposed introduction of SI-based serviceability criteria is a positive initiative

Whilst ESV considers that the draft updated *Network Asset Management Policy – Serviceability Assessment of Poles* indicates that Powercor is pursuing a comprehensive basis for improving its serviceability assessment of wood poles, it remains a work in progress. Powercor's proposed introduction of SI-based serviceability criteria:

- accommodates LSD loading data (and in the interim provides a hybrid WSD/LSD loading derivation)
- explicitly incorporates loss of fibre strength over time
- incorporates the wood scanning results
- is intended to replace the WSD-based Safety Factor criteria.

ESV consider that there is sufficient evidence that:

- more explicit recognition of fibre strength degradation in determining serviceability will be a significant improvement to Powercor's methodology
- if adopted, this approach is consistent with leading industry practice (including the capability for alignment with AS/NZS 7000)
- once it is introduced and calibrated, it is more likely to underpin sustainable wood pole performance than the Powercor's Safety Factor and R Factor criteria.

However, as discussed, calibration of input assumptions and other parameters are required to demonstrate that the SI calculations do not lead to poor outcomes. The figure below shows the projected AC-Serviceable and Unserviceable find rates with different Pole Calculator settings.[138] Powercor's average pole intervention volume over the last 5 years is ~1,969 poles p.a.[139] and the current unassisted pole failure rate is not excessive.[140] Therefore, selection of 80 per cent strength utilisation and 50th percentile fibre strength degradation with age from the ENA research appears to be a reasonable starting point for the Enhanced Pole Calculator. However, as shown in Figure 29, there is a lot of variation with these parameters and the

[137] ENA, *Destructive test data on power poles, Draft Report*, 2015 (provided in response to ESV IR WPM-010

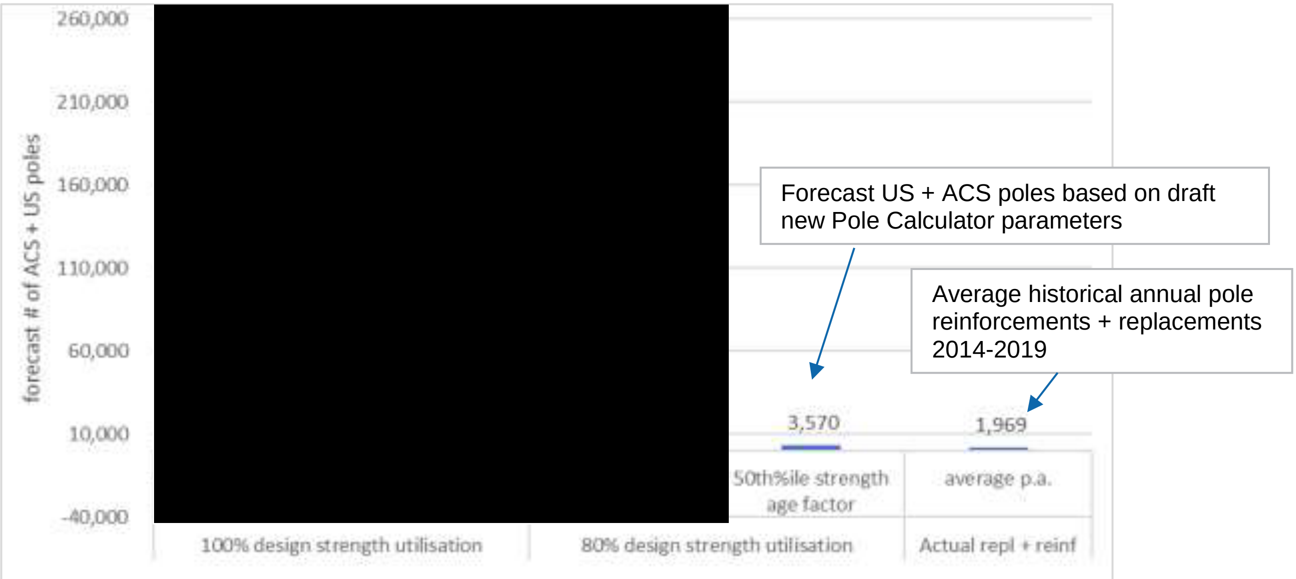
[138] Powercor, *draft updated Network Asset Maintenance Policy for Serviceability Assessment of Poles*, Tables 7, 9 (provided to ESV as Item 10 01403 Pole Calculator_1st DRAFT)

[139] *Analysis-CA RIN TAB 2.2.xlsx'*, Data Source: Australian Energy Regulator – Regulatory Information Notices

[140] As discussed in more detail in section 10 (Forecast and modelling)

draft settings are not a sufficiently robust basis for concluding that the Enhanced Pole Calculator settings will support sustainable wood pole performance. There are also a number of other parameter assumptions in the draft Policy supporting the Enhanced Pole Calculator which need to be verified as reasonable by Powercor.

Figure 29: Projected number of ACS + US poles in the population for different Pole Calculator settings



The draft updated *Network Asset Maintenance Policy for Serviceability of Poles* identifies several continuous improvement opportunities:

- calculate LSD loadings for poles per AS/NZS 7000 requirements – particularly for poles identified as Unserviceable or AC Serviceable
- ongoing performance monitoring and investigation of replaced and failed poles to calibrate the assumptions and parameters in the draft Policy.

Business-as-usual feedback from replaced and failed pole investigations will take at least two years from the introduction of the Enhanced Pole Calculator to provide statistically meaningful data to support calibration of the Pole Calculator.[141] At an onsite discussion with Powercor,[142] ESV asked how Powercor could accelerate the calibration of its Pole Calculator settings/assumptions. The advice (without notice) was that a trial of about 500 poles in each of several various regions (to pick up the diversity of factors across Powercor's service area) may provide sufficient data, noting that this does not mean that 500 poles need to be forensically examined. ESV suggested that Powercor should explore this option, and further consider a joint program with AusNet Services and CitiPower (and possibly other utilities).[143]

6.4. Powercor's improvement timeline

6.4.1. Powercor's proposed improvement schedule

Figure 31 and Figure 30 show Powercor's latest draft wood pole management improvement timelines for 2019 and 2020. The improvement steps related to serviceability assessment are highlighted.

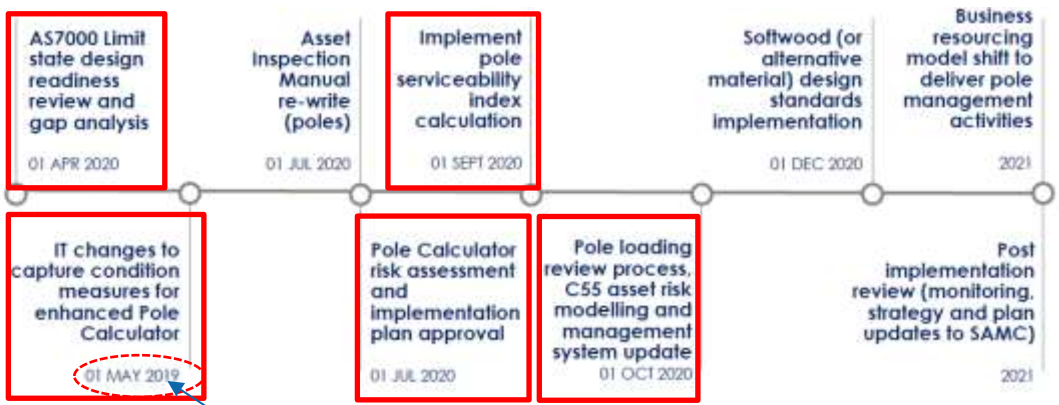
[141] Planned for September 2020

[142] 10 October 2019

[143] Noting that the ENA Poles and crossarms committee has been discontinued and that possible establishment of a timber research centre at the University of the Sunshine Coast may provide a cost effective vehicle for this research

Figure 30: Powercor's draft 2020-2021 wood pole management improvement timeline[144]

Figure 31: Powercor's 2019 wood pole management improvement timeline[145]



ESV has been advised that this is a typographical error and should read 1 May 2020[146]

6.4.2. ESV assessment

Powercor has undertaken a large number of serviceability assessment improvement initiatives since 2016 and plans to undertake a 'Post implementation review (monitoring, strategy and plan updates)' in 2021.[147]

However, ESV regards the initiative timelines as subject to change, as they are labelled draft and ESV has been presented with four different timelines in the period 19 September to 14 October 2019.

Powercor's serviceability assessment improvement initiatives have accelerated in 2019

As shown in the list below, the majority of Powercor's initiatives related to serviceability assessment have been undertaken in 2019, with more planned for 2020 and 2021.

2016 - 2018

- Commenced the NDI toolkit assessment project (2016)
- Implemented wood scanning technology (2017)
- Undertook a global market scan of NDI tools (2018).

[144] Powercor, Powercor wood pole management plan risk modelling – ESV update, 14 Oct 2019, slide 20

[145] Powercor, *Powercor wood pole management plan risk modelling – ESV update,* 14 Oct 2019, slide 19

[146] Powercor advised at Internal report draft review meeting dated 11 November 2019

[147] Powercor, *Powercor wood pole management plan risk modelling – ESV briefing, 03 Oct 2019,* slide 20

2019

- RCM Workshop (10 year data analysis)
- NDI technology trial
- Changed the Safety Factor threshold from 1.25 to 1.40
- Increased frequency of inspections of AC Serviceable poles
- Commenced enhancement of Pole Calculator
- Introduced wood scanning for inspecting double-staked poles
- Introduced Visual Appearance criterion
- Undertook field trials of [redacted] NDI
- *Planned* – Final Policy for Serviceability Assessment (31 Nov)
- *Planned* – NDT trial progress report/decision point (10 Dec)
- *Planned* – SAMC[148] to endorse pole management approach and timeframes (30 Dec)

Powercor's Enhanced Pole Calculator is scheduled to be implemented in September 2020, with the IT changes to support it to be implemented in early 2020. Powercor also plans to progress initiatives to determine LSD pole loading data in 2020. These are constructive progressions of important initiatives that commenced in 2019.

Powercor's use of external expertise to improve its serviceability assessment is prudent

Powercor has been using a combination of external expertise and industry research to inform its wood pole management improvement initiatives.

ESV considers that it would be prudent for Powercor to continue to access relevant expert advice as it progresses its serviceability assessment improvement initiatives.

The mooted timber research centre at the University of the Sunshine Coast may be a useful avenue for cooperative industry and academic research in lieu of leadership from the ENA, with utility finances and other resources concentrated on activities relevant to wood pole serviceability.

Powercor's decision to not adopt wood scanning techniques for inspection of all wood poles is prudent

Powercor advises that it decided against applying the wood scanning technique to all poles for the following reasons:[149]

- 'It not meeting our NDI objectives (hence only considered as an interim solution)
- The increased skill required (i.e. all inspectors would need to be trained)
- The significant increase in time to conduct the pole condition assessment (i.e. ~4 times longer than the "dig and drill" method if undertaking a single scan and increasing with more scans)
- The scan not being able to be undertaken for all poles due to physical restrictions around the pole (i.e. multiple cables blocking testing points)
- The good historical performance of the 'dig and drill' method (low pole failure rates)'.

ESV consider that Powercor's decision to retain the SDD technique and to supplement it with wood scanning technology in higher risk circumstances is economically prudent.

[148] Strategic Asset Management Committee

[149] Powercor response to ESV IR WPM-016 (Item 3 – [redacted] use case). ppt

7. Pole Intervention

7.1. Introduction

If a power pole has been classified as AC Serviceable or Unserviceable, a decision is required about managing the risks arising from pole failure. Combining the likelihood of failure with the consequences of failure enables the risks of pole failure to be evaluated. Once the risks of failure is established, interventions should be initiated to prudently manage the risk.

In this section ESV assess Powercor's approach to managing the risks arising from individual pole failure with the objective of establishing whether its approach is likely to support sustainable wood pole outcomes.

ESV's approach is based on:

- understanding Powercor's current risk assessment methodology, including:
  - recent changes
  - planned improvements
- understanding Powercor's risk mitigation methodology, including:
  - the form of intervention
  - recent changes
  - planned improvements
- comparing its current approach with what ESV consider to be necessary to support sustainable wood pole outcomes – to this end, ESV take into account relevant industry information about good practice and Powercor's planned improvements.

7.2. Pole failure risk assessment methodology

7.2.1. Current pole failure risk assessment methodology

Powercor's current wood pole failure risk assessment methodology is based on the likelihood of failure

Based on the estimated residual strength, Powercor has determined the likelihood of failure for each of the four serviceability classifications. As shown in Table 24, Powercor has assessed that the failure risk posed by Unserviceable P1 Poles is not acceptable for more than 24 hours from the time of 'discovery' from the inspection process. It requires intervention (pole replacement, reinforcement) within this time period. Similarly, for Unserviceable P2 poles, Powercor has assessed that the risk of failure is unacceptably high after 32 weeks from the inspection and imposes a time limit for intervention of 32 weeks.

AC Serviceable poles are assessed as presenting an elevated likelihood of failure, but the failure risk is assessed to be tolerable for up to 2-years and, because of the lower risk of failure compared to the two Unserviceable classifications, the control measure is a full inspection before this time, not intervention. Serviceable poles are not expected to fail before the next scheduled (full) inspection in five years' time.

Table 24: Control measures for serviceability classifications

Serviceability classification	Control measure	Control measure time limit
Serviceable	Inspection	5 years
AC Serviceable	Inspection	2 years
Unserviceable P2	Replace or reinforce	32 weeks
Unserviceable P1	Replace or reinforce[150]	24 hrs

7.2.2. Recent changes

To mitigate risk further, the AC Serviceable poles inspection frequency was changed from a full inspection every two and a half years to include an above ground inspection every 12 months (i.e. two-year cycle for full inspection). This is one of the four 'added controls' that Powercor has introduced in 2019 *'…to provide assurance to [its] customers.'*[151]

Note: Serviceable poles are inspected via an above ground inspection every 2.5 years with a full inspection every alternate 2.5 years (i.e. five-year cycle for full inspection).

7.2.3. Planned improvements

Power advises that it *'…will use its recently deployed condition based risk management models in Copperleaf C55 to monitor asset risk and forecast required interventions*.'[152]

As described by Powercor, 'Copperleaf C55' is a software tool that will enable Powercor to identify and prioritise the assets that, if reinforced or replaced, will deliver the greatest risk reduction. Powercor states that: *'The poles model has been deployed in C55 but requires more testing, calibration and system enhancement before being used to influence the 21-26 period.'*[153]

Powercor's most recent version of its improvement initiative timeline shows this work being completed by October 2020.

7.2.4. ESV assessment

Context

A key objective of wood pole management is to minimise the lifecycle cost of providing the service from each pole, noting that safety is an element of the service a pole performs. The lifecycle cost includes the installed cost of the pole, the operating cost of the pole (including maintenance, repair, life extension, and, if it fails in service, failure-related costs), and the retirement cost of the pole (including the replacement cost).

The cost of service escalates rapidly if the pole fails in service (i.e. before it is retired or replaced), with the cost of unserved energy, and any cost of damage to people and/or property added to the cost of repair. Generally accepted practice to minimise the lifecycle cost of wood poles is based on:

- regular inspection to assess the pole condition
- preventative measures (e.g. to avoid termite attack) to help ensure the pole achieves its technical life
- repairs to address minor defects to help ensure the pole achieves its technical life
- extending the life of the pole to defer pole failure (e.g. by reinforcement)
- aiming to replacing the pole just before it fails.

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[150] The action is actually to make the pole safe within 24 hrs – if necessary, a temporary support (strut) can be installed to provide an extension of time before replacement or reinforcement is completed

[151] Powercor, *Powercor wood pole management – ESV – Powercor workshop*, 19 September 2019, slide 12

[152] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 15

[153] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 23

Powercor's current wood pole failure risk assessment methodology is not consistent with good practice

Determining exactly when a pole will fail is not possible with current technology. Powercor relies on a condition-based approach to decide when and how to take mitigating action. The likelihood of pole failure is determined through condition assessment. ESV referred to Powercor's Priority Policy to seek to understand how Powercor links the likelihood of pole failure, consequence of failure, and risk of pole failure, to its intervention criteria. ESV considers that the linkages are inconsistently expressed:

The Priority Policy:[154]

- defines the Priority 1 (P1) rating in terms of avoiding: '…immediate or significant risk to public or employee safety and/or to the reliability of the Electricity Network.' This definition:
    - uses the terms 'immediate' and 'significant', which are not defined in Powercor's Levels of Risk matrix (Table 25, below)
    - does not refer to the consequence of damage to property (e.g. from bushfires that might be initiated by pole failure)
- defines Priority 2 (P2) and Priority 3 (P3) by conflating the likelihood of failure with risk of failure
- does not provide priority definitions that align with Powercor's AC Serviceable and Unserviceable P2 classification definitions.

Table 25: Powercor's assessment of the 'Level of Risk'[155]

LIKELIHOOD	CONSEQUENCE				
	Minimal	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Low	Medium	High	High
Unlikely	Negligible	Low	Low	Medium	High
Rare	Negligible	Negligible	Low	Medium	High

Although reference to wood pole assets is not explicit, Powercor's Priority Policy refers to information reproduced in Table 26 mapping likelihood of failure to Levels of Risk and timeframes for taking action.

Table 26: Powercor's response/action based on 'Level of Risk'[156]

Level of Risk	Response/action
Extreme	Immediate action required
High	Control measures must be deployed [1] Control measures must be approved by the appropriate senior manager or their delegated authority
Medium	Control measures must be deployed [1] Control measures must be approved by the appropriate senior manager or their delegated authority
Low	Manage through existing policies and procedures
Negligible	No action required

[1] Must be deployed before entering the 'at risk of failure' timeframe.

[154] Powercor, Network Asset Maintenance Priority Policy, July 2019, pp. 5-7

[155] Powercor, Network Asset Maintenance Priority Policy, July 2019, p. 11

[156] Powercor, *Network Asset Maintenance Priority Policy,* July 2019, p. 11

The 'control measures' referred to in this table must be deployed within 24 hrs for Unserviceable P1 defects, 32 weeks for Unserviceable P2 defects, and 3 years for P3 defects.[157] Powercor notes that '…*the risk of failure for each asset must be considered on a case by case basis'*.[158] ESV assume from the Priority definitions above that:

- Unserviceable P1 poles are assessed as posing an Extreme risk
- Unserviceable P2 poles are assessed as posing a High risk.

However, it is not clear what level of risk AC Serviceable poles are assumed to pose, nor how the time limits for Unserviceable P2 and AC Serviceable poles were derived. Whilst recognising that pole performance and risk tolerance varies between utilities, based on the ESV team's experience:

- Powercor's Unserviceable P1 pole intervention time to 'make safe' within 24 hours is at the lower end of utility response times. This is viewed as a conservative approach.
- Powercor's Unserviceable P2 pole intervention time limit is within the typical 3 to 12 months limits applied by other utilities
- Powercor's inspection frequency for AC Serviceable poles of one year is relatively high and ESV considers it to be a conservative approach compared to the typical industry range for Limited Life inspection frequency of 1.0 to 2.5 years, varying with bush fire risk classification.

Powercor's current risk assessment methodology does not account for the possibility that an AC Serviceable pole in a location with a very high consequence from a pole failure event (e.g. ignition of a bushfire in a high risk area) may present a higher risk than some Unserviceable P2 poles.

Powercor's current approach is not aligned with good industry practice, which is to apply condition-based risk management (CBRM) which, among other things, requires an explicit link between likelihood of pole failure (in this case) and the consequences of pole failure to establish the risk of pole failure. This finding is more applicable to AC Serviceable poles than Unserviceable poles.

Powercor recognises the limitation of its current approach and proposes introducing consequence assessment into its pole failure risk assessment methodology.

If implemented, Powercor's proposed modelling of poles in its Copperleaf C55 software is aligned with good industry practice

As Powercor notes, '*Combining the likelihood of failure, the likelihood of consequence and the consequence value together generates a risk value for each asset…'* and *'The assets with the greatest risk improvement can be prioritised for action through reinforcement or replacement.'*[159]

Powercor has advised that the process for deriving the risk value using the C55 software will be based on:[160]

- deriving 'A health score for each asset based on its measured condition information and its age… this health score represents of [sic] the likelihood of failure.
  A number of consequence factors (risk) are modelled including safety and bushfire
  Each consequence factor contains multiple levels of consequence
  Each modelled consequence factor has a likelihood of the consequence occurring
  Each modelled consequence factor has a consequence value associated'.

Based on Powercor's description of what it intends to achieve through populating the C55 software model, the proposed approach is aligned with the AER's recent 'Practice application note' to industry which, among things, describes a simplified quantified approach to determine risk cost, as expressed in Equation 3.

[157] Powercor, *Network Asset Maintenance Priority Policy,* July 2019, p. 10, although an extension of time for P1 poles is possible if the pole is 'made safe'

[158] Powercor, *Network Asset Maintenance Priority Policy*, July 2019, p. 10, referring to the timeframes for the 'rare' fault likelihood column in the (un-numbered) second table on this page

[159] Powercor, *Powercor wood pole management – ESV – Powercor workshop*, 19 September 2019, slide 40

[160] Powercor, *Powercor wood pole management plan risk modelling ESV Update 14 October 2019*, slide 23

Equation 3: Derivation of annualised risk cost[161]

The annual asset-risk cost is calculated as the sum of the risk costs per year for each failure event according to:

Equation 4: Derivation of annual risk cost per event[162]

$$Risk\ cost\ per\ year\ of\ event\ n\ (\$) = \sum_{n=0}^{n} (\mathrm{PoF}_n \times No_n) \times (LoC_n \times CoC_n)$$

Where:

PoF_n = Annual probability of asset failure for failure event n ($per\ cent$)

No_n = Number of assets considered for event n

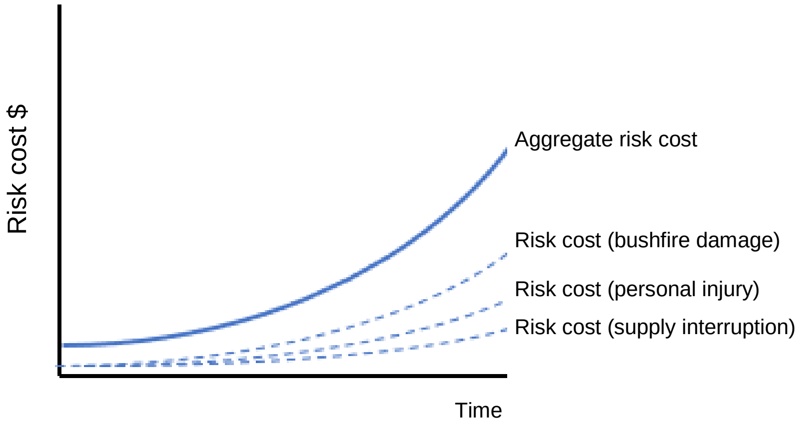
LoC_n = Likelihood of consequence of failure event n (%)

CoC_n = Cost of consequence of failure event n ($)

n = individual failure event (or failure mode)

The total risk cost per year for an unassisted pole failure is the sum of the annual risk costs for each of the credible consequences. For a pole failure, the possible costs of consequences include those arising from injury (or death), damage to property (including from bushfire ignition), and supply interruption, as illustrated in Figure 32, below. The annual risk cost typically shows an increasing function over time, because of the wear-out characteristic of many asset classes, including poles. Software such as Isograph's Availability Workbench and (ESV assume) Copperleaf C55, can convert historical failure data into a forecast failure rate, PoF(t).[163]

Figure 32: Illustrative risk cost model – wood pole failure[164]



[161] AER, *Industry practice application note Asset replacement planning*, January 2019, Figure 2, p. 39

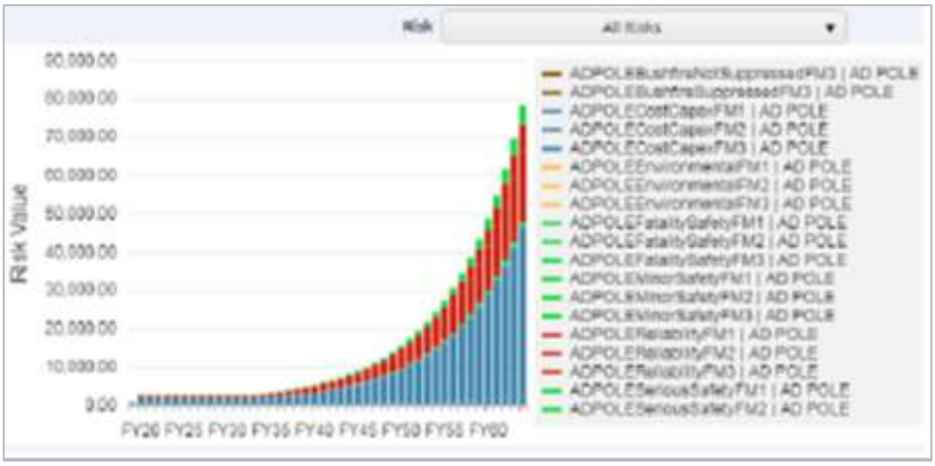
[162] AER, *Industry practice application note Asset replacement planning*, January 2019, Figure 2, p. 39

[163] Using a Weibull curve-fit algorithm or an alternative technique such as Crow-AMSAA

[164] AER, *Industry practice application note Asset replacement planning,* January 2019, Figure 2, p. 79

The illustrative diagram in Figure 32 appears to be conceptually the same as the sample output provided by Powercor to explain its application of the Copperleaf C55 model, shown in Figure 33, below. This analysis should enable Powercor to improve its intervention criteria by considering risk more explicitly.

Figure 33: Example of output from Powercor's CBRM model[165]



7.3. Powercor's intervention criteria

7.3.1. Current intervention criteria

Powercor's current intervention criteria are directly linked to the serviceability classification of the pole:

- Serviceable poles - inspect double staked poles with wood scanning technology as part of the routine inspection
- AC Serviceable Poles:
  - annual inspection (above ground inspection and full inspection on alternate years)
  - inspect double staked poles with wood scanning technology as part of the inspection
- Unserviceable P2 poles – within 32 weeks of classification as P2:
  - extend service life with pole reinforcement where the pole is suitable for reinforcement
  - recheck the condition assessment using wood scanning technology on poles deemed not suitable to reinforce
  - replace if not suitable for reinforcement
- Unserviceable P2 poles – within 24 hrs of being classified as P1 - replace the pole (or otherwise make it safe until it is replaced).

Powercor's criteria for determining that a pole is unsuitable for reinforcement is the existence of one or more of the following features:[166, 167]

- knot holes, termite infestation or deterioration occurring above the ground line inspection zone
- less than 60 mm of sound timber internally one meter above ground
- leaning excessively and/or leaning with the potential to cause significant damage
- pole diameter less than permitted in the reinforcement system design.[168]

[165] Powercor, *Powercor wood pole management plan risk modelling ESV Update 14 October 2019*, slide 23

[166] Powercor, Powercor, *Network Asset Maintenance Policy for Inspection of Poles, Policy No. 05-C001.D-390*, Nov 2019, p.17

[167] Powercor, *Network Asset Maintenance Policy for Management of Leaning Poles, Policy No. 05-C001.D-393*, Feb 2016, p. 5

[168] As determined by the supplier, [redacted]

Powercor replaces wood poles with concrete poles in termite areas north of the Great Dividing Range, except where step and touch potential limits cannot be achieved or where a SWER isolating transformer or capacitor bank is installed.[169] Otherwise, Powercor replaces wood poles with wood poles.

7.3.2. Planned changes to intervention criteria

Powercor intends to introduce Risk Based Asset Management

In addition to increased intervention volumes arising from the application of the Enhanced Pole Calculator, Powercor proposes to reduce risk further by undertaking Risk Based Asset Management (RBAM) interventions based on fire, reliability and safety consequence.

Powercor states that: *'Through implementing a Risk Based Asset Management (RBAM) approach, Powercor will be replacing poles before they are unsafe and minimising risk as far as practicable by targeting high consequence poles.'*[170]

Powercor has provided an example of the application of its RBAM approach to target high consequence poles by taking into account bushfire consequence, as shown in the Figure 34 below. ESV's understanding is that Powercor will risk-rank all of its poles and will replace or reinforce AC Serviceable poles with the volume in any 12 month period determined by what Powercor considers to be '*a volume to prevent unsustainable volumes into the future'*.[171] The basis for determining this volume is discussed in Section 9 (Forecasting and Modelling). ESV's understanding is that the poles will be selected in order of highest risk.

Figure 34: Powercor's proposed pole condition and fire consequence mapping[172]

	Consequence mapping to fire classification				
Pole condition[3]	LBRA	HBRA	REFCL (non-SWER)	REFCL (SWER)	BCA (ELCA)
Unserviceable (Serviceability Index[3] < 0.65)	C2	C2	C1	C1	C1
AC Serviceable 0.65 ≤ Serviceability Index[3] < 0.70	C4	C4	C3	C3	C2
AC Serviceable 0.70 ≤ Serviceability Index[3] < 0.75	C4	C4	C4	C3	C3
Serviceable (Serviceability Index[3] ≥ 0.75)	C5	C5	C5	C5	C4
Serviceable (Serviceability Index[3] ≥ 1.0)	C5	C5	C5	C5	C5

Unserviceable Interventions (Compliance Driven)	C1	Highest Risk
	C2	↓
RBAM Interventions	C3	
	C4	
Ongoing Monitoring and Inspection	C5	Lowest Risk

Note 3: The pole condition Serviceability Index criteria used [in this table] are taken from Table 1 in the draft Serviceability Assessment of Poles that includes new pole calculator thresholds; this is not the serviceability criteria currently being applied by the maintenance policy.

Powercor summarises its proposed approach in Figure 35. Powercor plans to include '…*interventions driven by risk, including pole condition and consequence rather than solely the failure likelihood*[173] and expects that

[169] Powercor, *Asset Management Plan for Poles,* February 2015, p. 21

[170] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 14

[171] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM), Wood pole forecast update, 11 November 2019,* slide 7

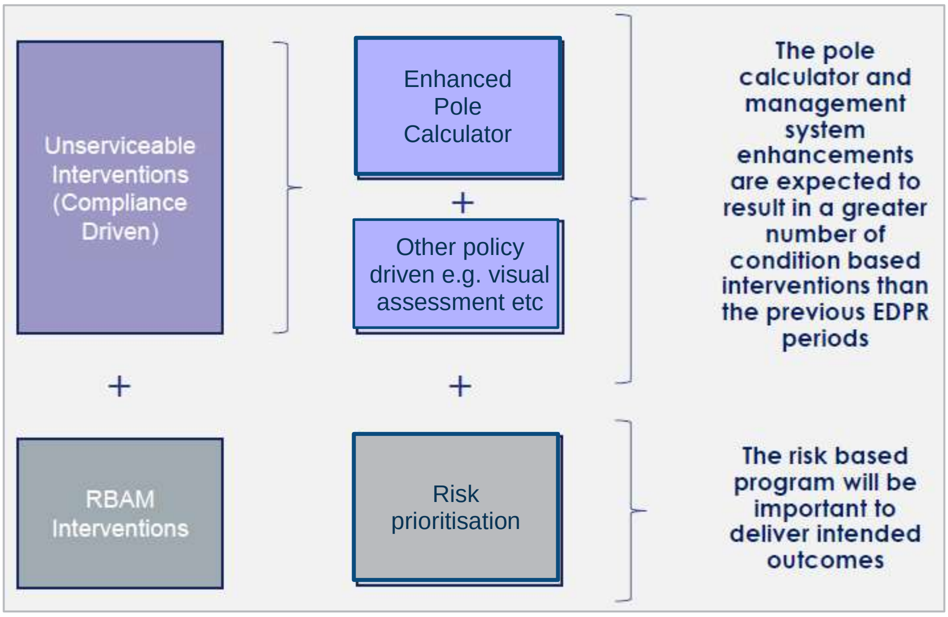
[172] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 14

[173] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 16

this approach will result in *'… sustainable management of entire pole population through prudent replacements and reinforcements.*[174]

ESV's understanding is that Powercor's intended strategy is to reinforce poles rather than replace them if they are suitable for reinforcement.

Figure 35: Powercor's planned approach for managing poles[175]



7.3.3. ESV assessment

Powercor's current pole intervention criteria are unlikely to support sustainable outcomes

The major issues with Powercor's current intervention criteria are that:

- risk is not adequately taken into account – Powercor's criteria offer limited discrimination between wood poles based on event consequences and the likelihood of the consequences occurring:
  - the consequence of a pole failing can vary dramatically with the location of the pole. For example, although the likelihood of a pole failing and igniting a bushfire is very low, if the failure occurs in an extreme bushfire risk area, a severe consequence is more likely than if a fire is started in a low bushfire risk area
  - a pole failure can lead to multiple consequences, including loss of electricity supply, impact damage, electrocution, and bushfire damage
  - as a hypothetical example, an AC Serviceable pole in an extreme bushfire risk area may pose a higher risk than an Unserviceable P2 pole in a low bushfire risk area and if so should be scheduled for replacement or refurbishment
- the basis for the response times for the Unserviceable P1, Unserviceable P2 and AC Serviceable poles are not apparent.

The most important of these issues is that without taking into account the consequences of pole failure to determine the risk of pole failure, Powercor's intervention criteria are likely to mis-prioritise poles for replacement/reinforcement. ESV considers that it is likely that based on a risk-cost assessment, some AC Serviceable poles should be scheduled for replacement/reinforcement, rather than reinspection.

[174] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 16

[175] Powercor, *Powercor wood pole management plan risk modelling – ESV Update*, 14 October 2019, slide 15

Powercor's pole reinforcement/replacement ratio is likely to improve if it implements its new intervention criteria

When a pole is reinforced, it is re-classified by Powercor as Serviceable,[176] which is prudent. If the pole is suitable for reinforcement, this form of intervention is a very economical means of managing wood pole lifecycle costs,[177] given industry experience that:

- reinforced poles last 10-15 years or even longer before needing to be replaced
- reinforced wood poles do not have high in-service failure rates.

Whilst the overall volume of pole replacement and reinforcements is more of a concern for ESV than the ratio or reinforcements/replacements in the short term, the latter ratio is important over 15-20 years as it affects deliverability and future work volumes and risk.[178]

Powercor's ratio of wood pole reinforcement to replacement has been declining since 2014, from a ratio of approximately 45:55 to 30:70 in 2018. ESV asked Powercor to explain the decline in the ratio from 2015-18 and was advised that the causes were:[179]

- application of a 'minimum pole diameter' criterion (i.e. below which poles cannot be reinforced)
- ceasing to reinforce poles with history of termite attack.

These criteria are typical in the industry and are unlikely, by themselves, to explain the significant decline in the ratio. ESV has also confirmed that the proposed enhancements to the Pole Calculator will not affect the reinforcement/replacement ratio.

As the RBAM interventions will primarily affect AC Serviceable poles, which by definition are in better condition that Unserviceable poles, ESV expects the majority of the RBAM poles to be suitable for reinforcement. This is likely to lead to a higher proportion of poles being reinforced rather than replaced. Nonetheless, ESV considers that Powercor should investigate the application of its reinforcement criteria with the objective of ensuring that the maximum prudent proportion of Unserviceable wood poles are reinforced

ESV understands that Powercor is investigating alternative types of reinforcement that do not require drilling/bolts for strength transfer. This may lead to reinforcing more poles rather than replacement.[180]

Powercor's planned RBAM intervention criteria are likely to improve its management of pole failure risk

Powercor's intention to introduce the RBAM condition-based asset management techniques and to supplement its intervention criteria with interventions based on risk of failure rather than likelihood of failure is likely to improve its intervention criteria. This is because:

- basing intervention criteria on risk will help Powercor identify the poles that present the highest risk
- Powercor intends to consider a range of consequences relevant to pole failure, including bushfire, loss of customer supply, and safety (impact damage, injury, or death). This approach is consistent with good industry practice
- Powercor will have a means of demonstrating that it is minimising risk as far as practicable (in accordance with the Electricity Safety Act) and/or maintaining service levels (in accordance with the NER capex criteria) by using the temporal risk-cost information to determine intervention volumes to achieve or maintain a target risk profile.

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[176] Powercor, *Network Asset Policy for management of Unserviceable Poles,* March 2019, p. 7

[177] The average cost of reinforcement is about $1,000 whereas the average cost of pole replacement is about $9,000

[178] Whilst reinforcement may be economical, pole replacement reduces risk more than reinforcement

[179] Powercor, response to ESV IR WPM-010, Item 4,'Replacement vs Reinforcement ratios.xls'

[180] For example, the [redacted]-Truss system does not require drilling/bolts for strength transfer, it may allow poles that are assessed as not being suitable for reinforcement with the [redacted] RFD System to be prudently reinforced. [redacted] also offers a 'band'-based reinforcement system.

7.4. Intervention Practices

7.4.1. Powercor's current practices

Powercor uses the [redacted] RFD Pole Reinforcement System

Whilst there are legacy reinforcements in the Powercor network, it has been using [redacted] proprietary RFD Pole Reinstatement SystemTM since 2000/01. Figure 36 below shows a typical installation using a steel stake, buried to a depth that depends on the design (i.e. to achieve the necessary strength), with bolts through the pole to provide load transfer from the (weakened) pole to the stake.

Prior to the use of the [redacted] RFD system, Powercor has used the Powerbeam, HS2 and RFD systems[181] as the preferred reinforcement system within its network area.

Figure 36: example of [redacted] RFD Pole Reinstatement[182]

[redacted] designs and installs the pole reinforcements for Powercor

Powercor uses [redacted] to design and install its RFD pole reinforcements on poles nominated by Powercor and within the timeframe designated by Powercor. The design and installation for each pole is guided by [redacted] Operational Manual.[183] It is at [redacted] discretion to schedule the work, but the intervention timeframes designated by Powercor must be met.

With regard to assuring the quality of the work undertaken by [redacted], Powercor advises that:[184]

- '…[redacted] provide[s] a photograph of the site following completion of the work. As a close out process for the work the photograph is reviewed and attached to the works record in Powercor systems.'
- Powercor have checks undertaken during the asset inspection process.

[181] That is, prior to the purchase of the RFD system by [redacted]

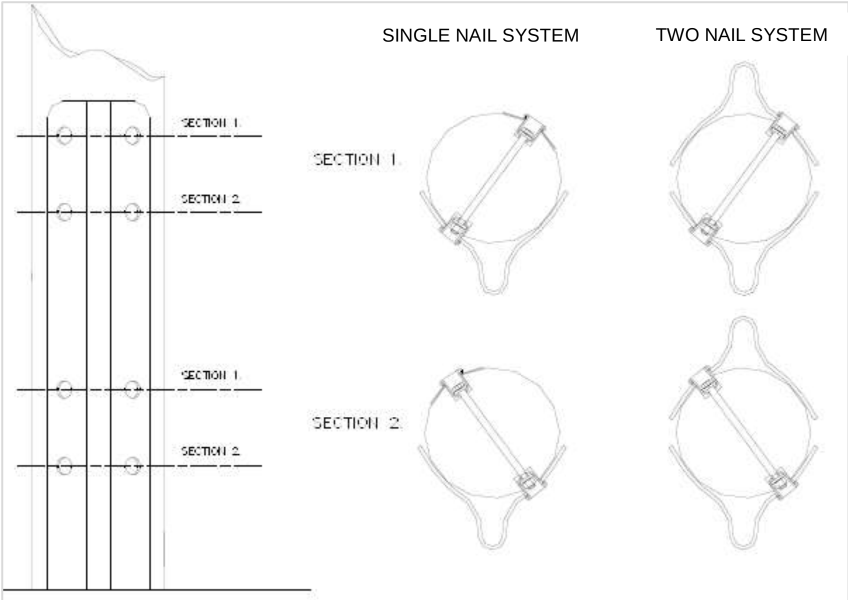
[182] [redacted] website

[183] [redacted], RFD Pole Reinstatement System™ Operational Manual, 01-06, Version 6.0, p. 21

[184] Powercor, response to ESV IR WPM 010 - ESV Information Request follow up Workshop.msg

[redacted] designs can include one or two stakes, with bolts that pass through the core of the pole (refer Figure 37)

Figure 37: [redacted] RFD Pole Reinstatement – Bolt positions on stake[185]



Powercor replaces the poles using its internal workforce

Powercor uses its own workforce to replace poles. With regards to assuring the quality of the reinforcements, Powercor advises that it '*utilises a number of business processes and their outputs to provide assurance of the quality of the design and installation of new and replacement wood poles:'* [186]

- its Technical Standards team maintains a material specification for wood poles which governs the quality required from suppliers
- its design teams apply the technical standards in the design process
- the distribution design process includes a quality assurance and a safety in design check
- its construction crews utilise the design outputs, with Construction Project Leaders responsible for ensuring the quality of the construction works completed
- construction quality audits are undertaken (sampling approach).

Powercor replaces wood poles with concrete poles in termite prone areas

Powercor's standard for new poles, including replacements of existing poles, South of the Great Dividing Range is CCA treated wood poles. Concrete poles are the standard for areas North of the Great Dividing Range, with concrete poles replacing Unserviceable wood poles. Principal factors involved in the selection of the replacement poles are height and strength requirements taking into account the estimated working stress, however other factors considered include pole lifespan (termite/corrosion impacts), pole conductivity, aesthetics and safety.[187]

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[185] [redacted], *RFD Pole Reinstatement System™ Operational Manual, 01-06*, *Version 6.0,* p. 21

[186] Powercor response to ESV IR WPM-017, Assurance of quality of replacement and new wood poles - design and installation.msg

[187] Powercor, *Asset Class Strategy – Poles and Towers,* May 2019, p. 6

7.4.2. Planned changes to intervention practices

Powercor is exploring the introduction of an alternative to the [redacted] reinforcement system

Powercor commenced exploring alternatives to the [redacted] RFD system in mid-2018. It plans to initiate a project in 2020 to investigate and trial an alternative pole reinforcement system(s) with intent to review the suitability for use on the network. Figure 38 below shows, an example of one new reinforcement system (which Powercor may evaluate), that does not involve drilling into the pole, instead it uses welded bands to provide the supporting strength from the steel stake(s).

Figure 38: Example of an [redacted] pole restoration system[188]

Powercor advises that it expects that [redacted] system will be retained: *'We believe that adequate controls (recently enhanced with wood scanning technology) are being applied to manage [redacted] system installed on the network and the ability to utilise multiple suppliers will assist in delivering our increased forecast.'*[189]

7.4.3. ESV assessment

Powercor is using a recognised pole reinforcement method

The [redacted] RFD System has been used successfully in Australia by a number of DNSPs for over 20 years and ESV is not aware of any significant concerns with the pole reinforcement methodology in terms of its life extension benefits.

Powercor notes that up until 2015: '*After nearly 20 years of experience with pole reinforcements, with over 40,000 in service throughout Victoria there have been, no un-assisted failures reported. The extent of corrosion of the stakes seen on poles removed from service has been minimal and this evidence indicates that deterioration of the wood pole within the stakes is the limiting factor in life of such poles.'* [190] Since then pole 4 of the Garvoc Spur, the Sisters, which was reinforced in 2018, failed above the reinforcement stake.

Whilst ESV note that the [redacted] RFD System has not been demonstrated to comply with AS/NZS 7000, given Powercor's and other DNSPs' good experience with the system, this does not appear to be a material issue.

Powercor's process for assuring quality of implementation of pole reinforcement is adequate

Based on the advice from Powercor about its quality assurance practices regarding [redacted] RFD designs and installations coupled with the good performance of the reinforcements, ESV has no concerns with the quality of implementation of the RFD system.

[188] [redacted] web site

[189] Powercor response to ESV IR WPM-014, Information Request WPM014 - Additional Staking Information Staking Information.msg

[190] Powercor, Asset Management Plan for Poles, p22 ,

Powercor's policy of using concrete poles in termite infested areas should reduce pole failure risk

ESV has not reviewed the business case justifying Powercor's policy of replacing wood poles with concrete poles north of the Great Dividing Range, however when considered from a risk management perspective only, it will reduce pole failures due to termite damage. They also have a greater bushfire withstand capacity than steel or wood poles.

Use of wood poles for new and replacement poles in areas that are not prone to termite infestation or other known locations that can significantly reduce the technical life of wood poles is a common approach in the industry. Treated wood poles, including CCA treated softwood poles, are a relatively cheap and durable alternative to steel and concrete poles in these locations:

- steel poles are not suitable for certain earthing configurations, are prone to rust, and are unlikely to withstand a bushfire
- wood poles have good insulation properties, and can be treated with fire retardant paint to improve their fire withstand capability (although they will not withstand intense bushfires)
- concrete poles are relatively expensive and have earthing challenges which vary with the construction type but have a lower risk of failing in bushfires compared to steel and wood poles.

Powercor's process for assuring the quality of implementation of replacement poles is adequate

Powercor's advice regarding its process for assuring the quality of pole replacements is consistent with ESV's 2018 ESMS system validation audit of Powercor's Technical Standards and Design. On this basis ESV has no material concerns with Powercor's process.

8. Performance Analysis

8.1. Introduction

This section examines the performance of Powercor's fleet of wood poles by referring to Powercor's wood pole performance measures and targets, shown in Table 5 in section 3. As ESV's orientation is safety, ESV has not considered the STPIS reliability impacts measure.[191]

8.2. Wood pole health index

8.2.1. Powercor's approach

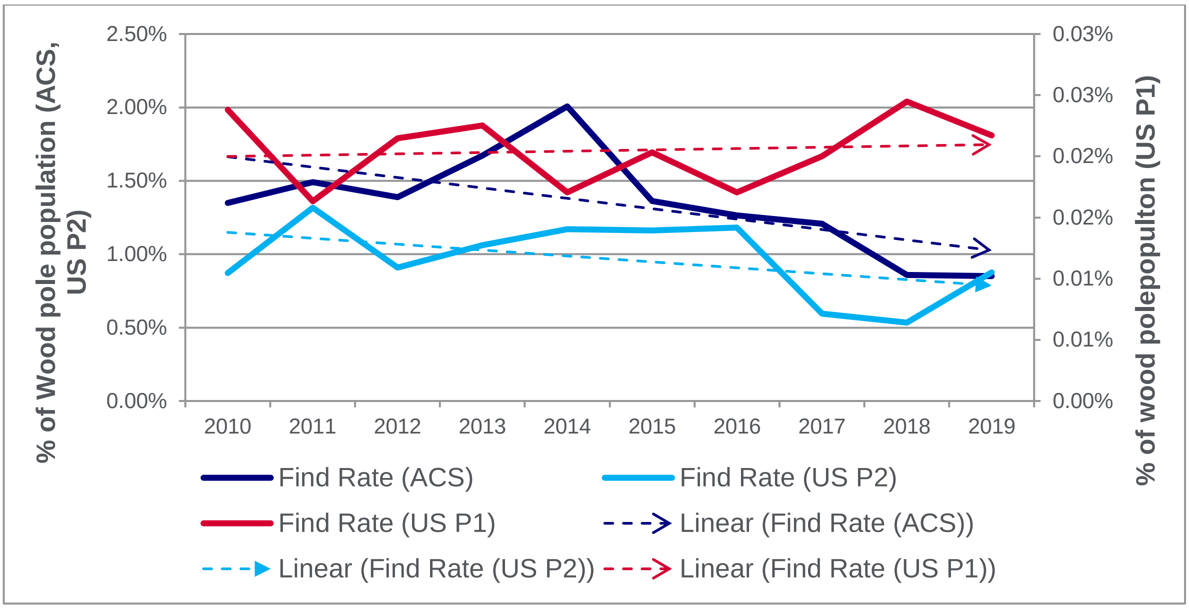
To understand the performance of its asset base, Powercor uses various leading and lagging indicators to assess the underlying health of the wood pole population. It is common industry practice to review metrics such as asset health indices, asset failures and defect find rates. Powercor's asset class strategy includes a Pole Health Index (HI) which is its leading indicator for pole condition. However, the HI measure has not been developed as yet and consequently there is no HI target.

8.2.2. ESV assessment

Figure 39 shows that the annual inspection find rates for AC Serviceable and Unserviceable P2 poles has been trending down over the last five years. The number of Unserviceable P1 poles has started to trend up (slightly) over the last three years. The key message from Figure 39 is that if Powercor had developed a wood pole HI, it is likely that it would have been increasing over the last five years, indicating an improving overall wood pole population asset condition. This trend also indicates a reducing pole failure likelihood from the wood pole population. This is not consistent with:

- the age profile of the wood pole population
- the effective age of wood poles indicated by the 'find rate' – which is many times higher than the expected life of 50-70 years, depending on durability class and other characteristics.

Figure 39: Wood pole condition find rates[192]

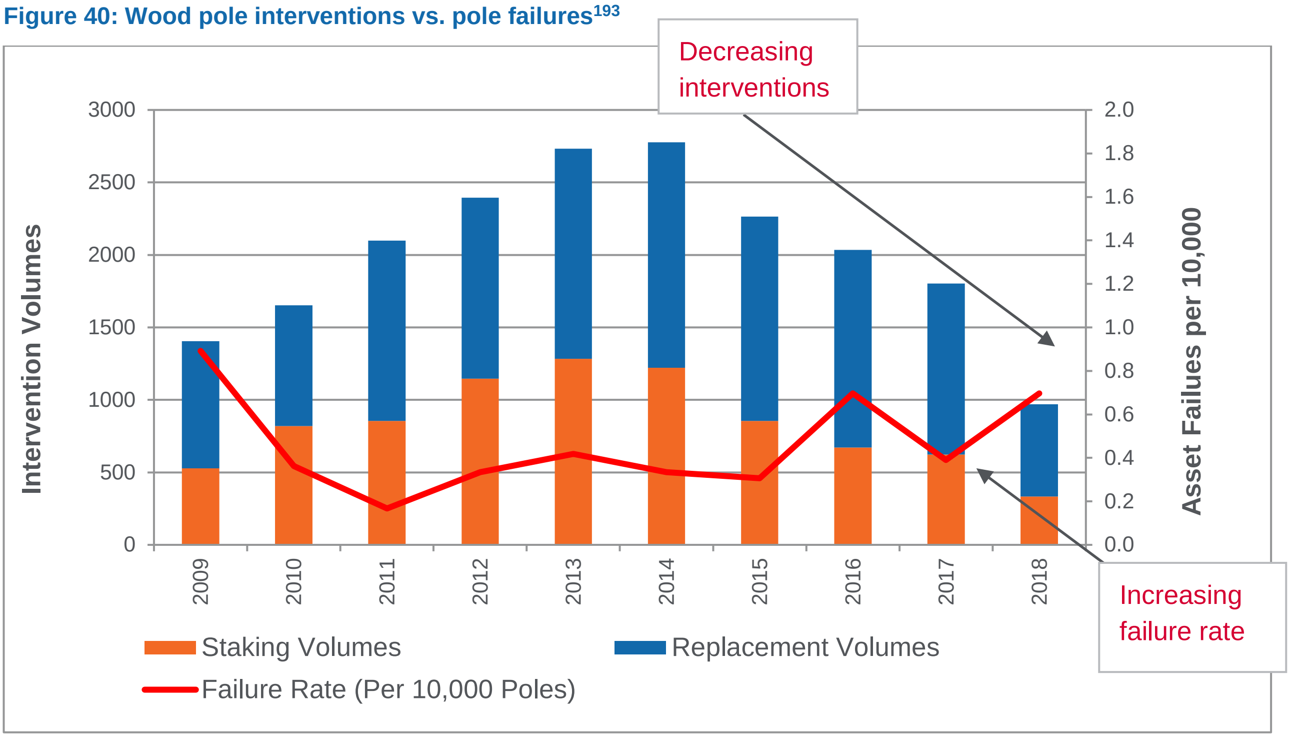


[191] Noting that there is no target for this measure in Powercor's Asset Class Strategy – Poles and Towers

[192] ,*'Analysis-CA RIN TAB 2.2.xlsx'*, Data Source: Australian Energy Regulator – Regulatory Information Notices

The results shown in Figure 39 are consistent with the declining trend in pole interventions over the last five years shown in Figure 40 confirms that declining AC Serviceable and Unserviceable P2 find rates leads to a declining pole intervention rate, all other things being equal.

Figure 40: Wood pole interventions vs. pole failures[193]



As discussed in section 6 (Serviceability assessment) and section 7 (Pole Interventions), ESV consider that the major contributors to the declining intervention rate are the changes in inspection practices and optimistic serviceability criteria (specifically the Safety Factor/good wood criteria).

The pole intervention volume is unsustainable, and as discussed in preceding sections and in section 9, Powercor has taken steps to address this trend and plans to do more.

8.3. Wood pole failures

8.3.1. Definition

Powercor defines an asset failure as an 'ESV reported asset failure'.[194] An 'ESV reported asset failure' where the asset is a wood pole equivalent to an unassisted pole failure.

8.3.2. Powercor's analysis of unassisted pole failure performance

Powercor's Asset Class Strategy – Poles and Towers document includes pole failure statistics from 2013 – 2017. Its summarises its analysis of the performance as follows: '*Annual volumes of failures have remained within the range of 18 – 21, with the exception of 2016 when recorded failures due to internal rot and termites were higher than the average for this period. The majority of these failures occurred in the northern region of Powercor in both serviceable and AC Serviceable poles averaging 52 years of age.'*[195]

[193] *Analysis-CA RIN TAB 2.2.xlsx'*, Data Source: Australian Energy Regulator – Regulatory Information Notices

[194] Powercor, *Powercor Asset Class Strategy – Poles and Towers*, May 2019, p. 30

[195] Powercor, Powercor Asset Class Strategy – Poles and Towers, May 2019, p. 22

Nonetheless, in the presentation pack provided to ESV at the joint workshop on 19 September 2019, it was clear that Powercor has undertaken strategic analysis not reported in its Strategy document based on 2018 and 2019 year-to-date information. From the information provided, Powercor has concluded that:[196]

- 'Following a period of stable performance, Powercor's wood pole failure trend has recently begun to increase
- Strategic planning for the 2021-2026 EDPR period has revealed a need to increase replacement numbers well above historic trends to sustainably manage future replacement volumes
- Our [2019] RCM study has highlighted a number of areas where our pole maintenance system can be further improved.'

8.3.3. ESV assessment

Powercor's unassisted pole failure statistics should be independently verified

Pole failures occur when the loading on the pole exceeds the capacity of the pole to withstand the bending moment from the loads on the pole. A pole failure is classified as an 'unassisted pole failure' when the pole fails despite the loading forces on the pole being within the original design strength capacity of the pole.[197] The primary standard for pole design is AS/NZS 7000:2016 Overhead Line Design,[198] which, among other things, specifies how to calculate the load on a pole, including wind pressure. Poles that fail due to excessive loading, typically from vehicle or vegetation impacts and cyclonic winds, are referred to as 'assisted pole failures.'

Powercor has autonomy in classifying pole failures as unassisted or assisted. It would help ensure effective wood pole management to confirm that appropriate investigations of wood pole failures of all condition-related unassisted pole failures are undertaken. If a pole failure is mis-classified as an assisted failure, this will not occur.

Powercor has experienced a decrease in find rates for poles in poor condition lending itself to a reduction in pole interventions, whilst observing an increasing number of failures

Powercor's target for wood pole failure performance is to 'maintain average pole failures below the 5 yearly failure threshold for the asset class.' The threshold for wood poles is currently 17.[199] This represents 0.47 pole failures per 10,000 poles, the common industry expression of this metric to normalise results for different pole population sizes.

Figure 41 shows an increasing trend in unassisted wood pole failures from 2014 to 2019[200] with 27 unassisted pole failures in 2018 the highest annual result in the period shown in the figure. The dotted line indicates the five-year average, which equals the target level. The number of unassisted failures in 2019 was at parity with the performance measure target of 17; however, it is likely that the end of year result will again exceed this threshold.

[196] Powercor, *Powercor wood pole management, ESV – Powercor workshop, 19 September 2019*

[197] Pole design standards have changed over the years and poles are not required to be retrospectively made compliant with current standards

[198] First introduced in 2010, replacing Electricity Supply Association of Australia (ESAA) – Guidelines for Design and Maintenance of Overhead distribution and Transmission Lines C(b)1.

[199] Five year average 2015 to 2019

[200] Using extrapolated data from YTD information in 2019

Figure 41: Unassisted pole failures[201]

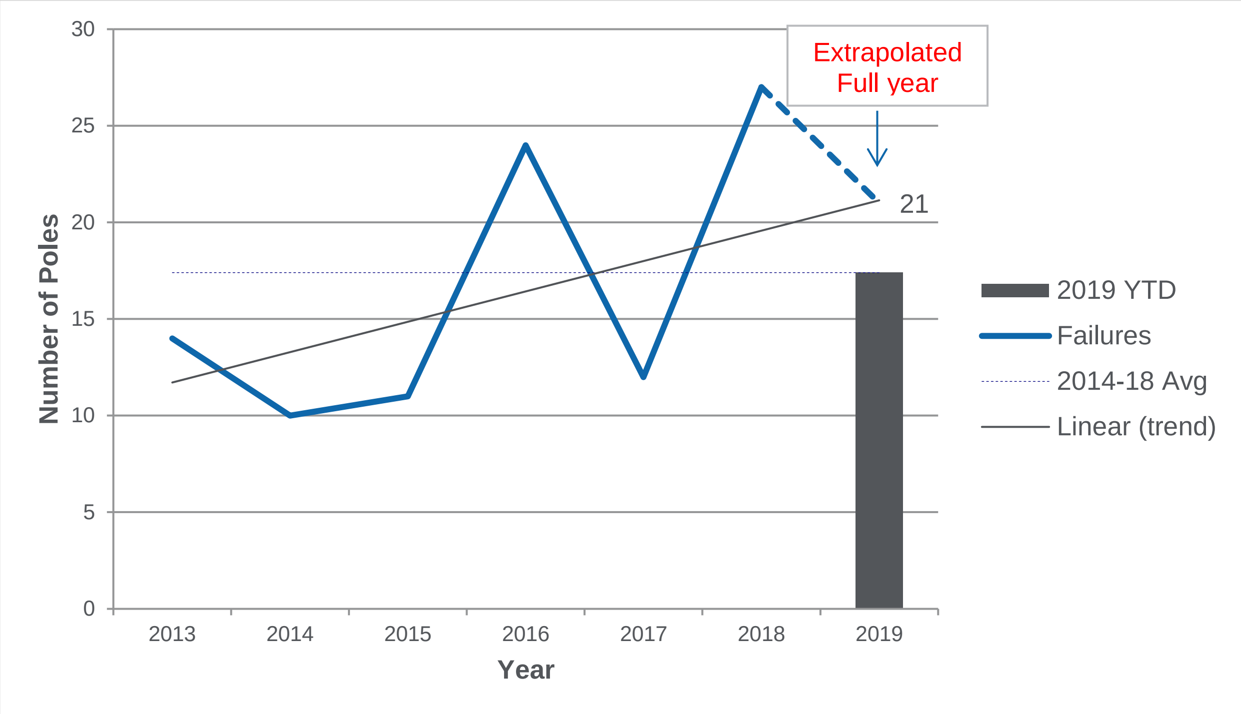
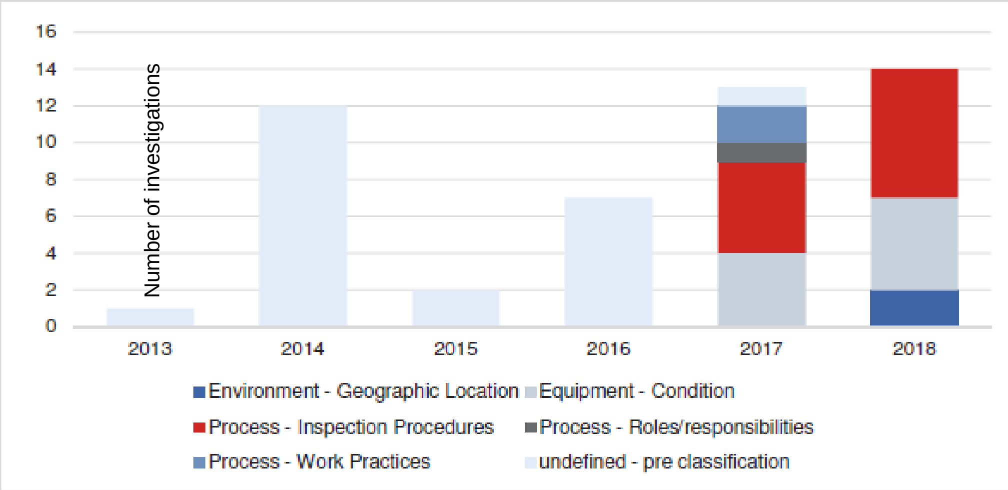


Figure 42 below is from Powercor's Asset Class Strategy document for poles and towers, and provides a summary of its investigation of pole failure root causes. There is little explanation of the results in the strategy document, however ESV infers from the descriptions and accompanying text that:

- 50 per cent of the failures resulted from poor inspection practices, which appear to be related to inaccurate girth measurement
- 50 per cent were due to poor asset condition, noting that:
  - the reference by Powercor to 'equipment' is incongruous with ESV's assumption
  - Powercor's reference to 'Environment – Geographic Location' appears to be related to termite infestation
- it appears that some of the pole failures were steel poles, but there is no discrimination between wood and steel in the figure or text
- Powercor's investigations prior to 2017 did not appropriately classify all the root cause of pole failures. The number of investigations do not align with the number of pole failures. This indicates that Powercor may not have investigated every pole failure.

[201] Powercor, Excel Workbook,S132 request, 3.6 unassisted and assisted pole failures

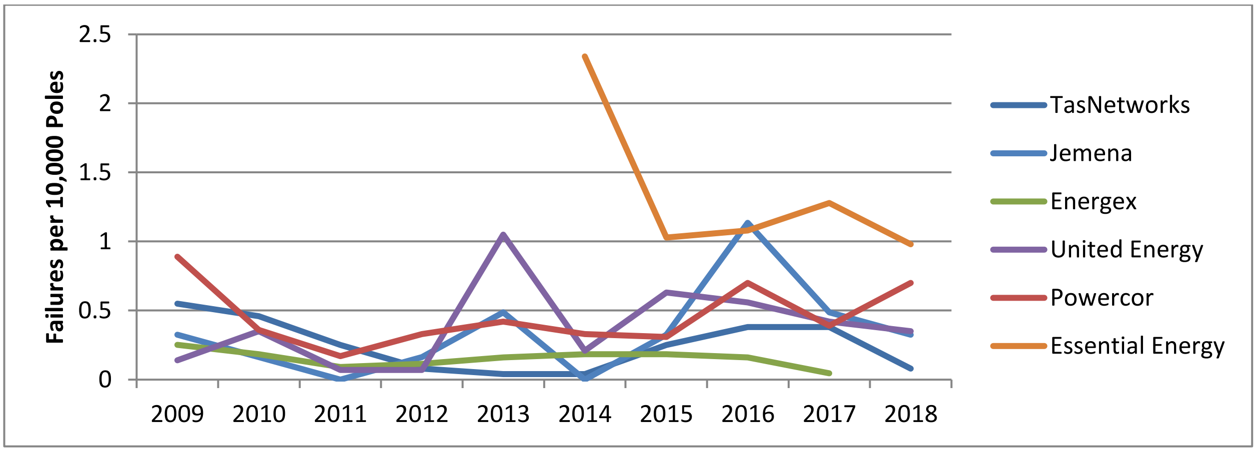
Figure 42: Powercor's pole failure investigation root cause classifications[202]



Powercor's Asset Class Strategy identifies that the majority of these failures occurred in the northern region of Powercor's supply territory, with failures of poles classified as Serviceable and AC Serviceable.[203] This indicates that either termites for wood poles, or rust in steel poles, are the primary reasons for pole failures in the statistics provided. However, only two Unserviceable poles failed in last 7-years, due to termite attacks.

Figure 43 provides a comparison of Powercor's pole failure rate with that of other DNSPs based on RIN data over a 10-year period.[204] It shows that until 2017, Powercor's pole failure level was within the range as the other DNSPs in the sample, with its 2018 result leading it to a position above all but one other DNSP in the sample.

Figure 43: 10-year average wood pole failure comparative analysis[205]



Powercor's 10-year average pole failure is above the median results of the six sample DNSPs (refer to Figure 44), at 0.47 unassisted failures per 10,000 poles and the second highest of the six utilities in the sample. However, Powercor's 10-year average normalised pole failure levels are less than half of the unofficial industry benchmark of 1.0 failure per 10,000 poles.

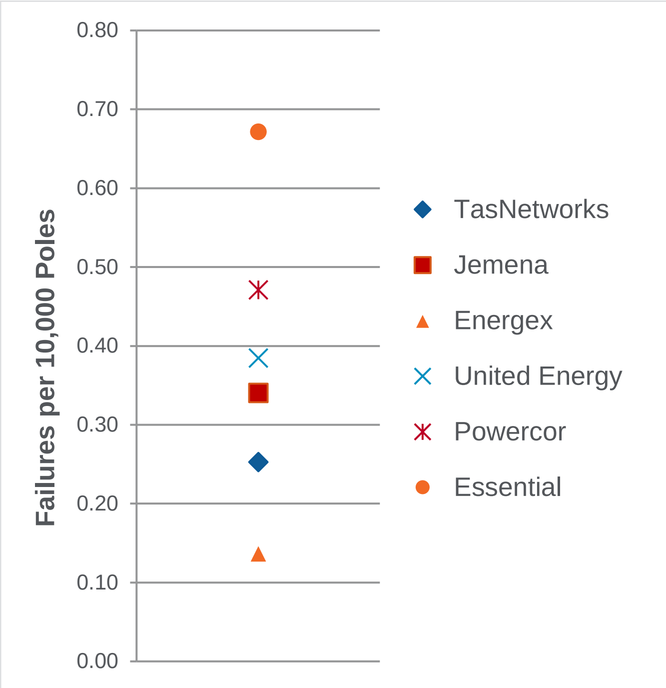
[202] Powercor, *Powercor Asset Class Strategy – Poles and Towers,* May 2019, Figure 16, p. 23, modified by ESV to include Y-axis label

[203] Powercor, *Powercor Asset Class Strategy – Poles and Towers,* May 2019, p. 22

[204] Note that the wood pole failure RIN data for Ergon, Energex and AusNet Services (all DNSPs with a combination of rural, semi-rural and urban wood pole populations, like Powercor, and therefore candidates for comparison) appear to be based on different definitions than for Powercor and the other five DNSPs in the sample and so appear not to be useful comparators

[205] ESV analysis of Regulatory Information Notices (per AER website)

Figure 44: 10-year average Wood pole failure comparison to other distribution businesses'[206]



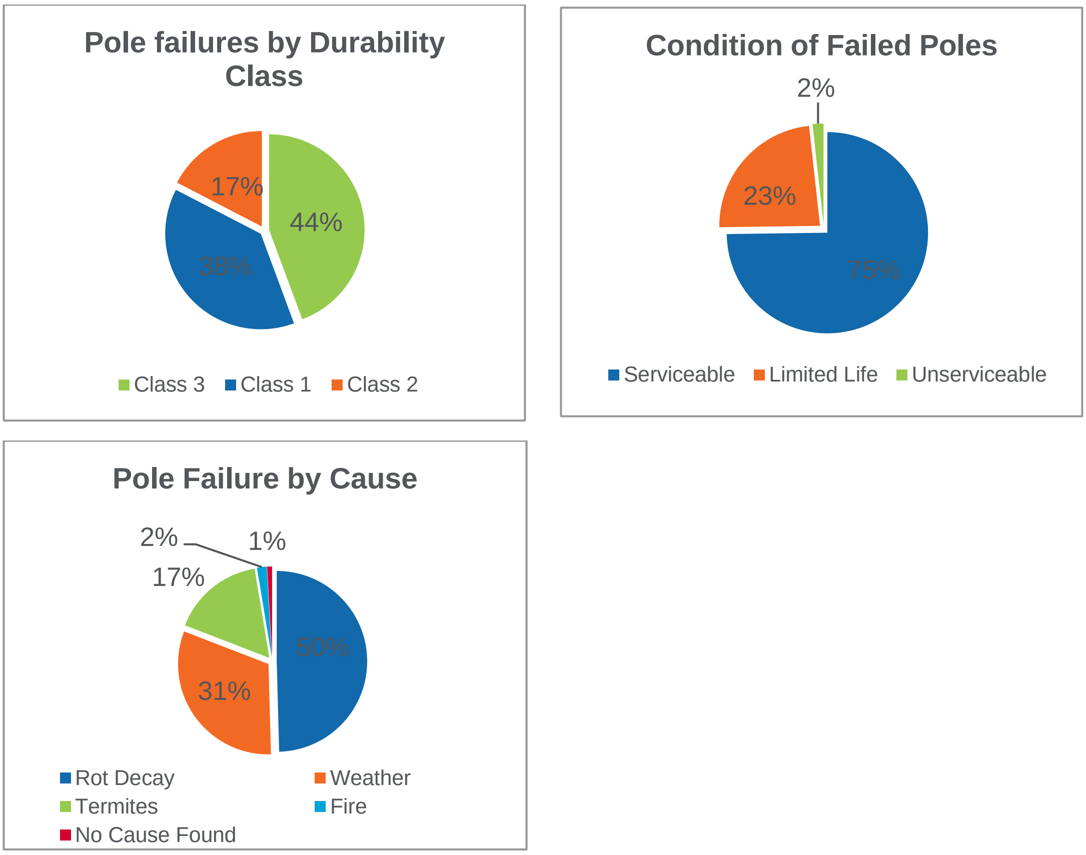
In response to an ESV information request, Powercor has provided separate fault investigation analysis information to that reported in its 2019 Asset Class Strategy document (per Figure 42). From the analysis of 115 wood pole failures since 2013, summarised in Figure 45, 44 per cent of all the failures were of Class 3 durability poles. This is well above the 29 per cent representation of Class 3 poles in the wood pole population.

[206] 10 Yr. Average failure analysis, Data Source: Australian Energy Regulator – Regulatory Information Notices

Figure 45 also shows that:

- 50 per cent of the failures were caused by wood rot/decay - this is a well understood failure mode for timber poles and is difficult to accurately detect
- 31 per cent of the failures were due to weather – ESV assumes this refers to high wind pressure, but within the limit state design wind pressure on poles specified in AS/NZS 7000
- 17 per cent of failures were due to undetected termite infestation.

Figure 45: Pole failure performance by durability, condition of pole and cause



8.4. Significant HSE incidents

8.4.1. Definition

Powercor's 2019 *Asset Class Strategy – Poles and Towers document* does not define 'HSE Incidents' despite it being one of its five performance indicators.

8.4.2. Powercor's analysis of HSE performance

Powercor's *2019 Asset Class Strategy – Poles and Towers document* does not present information on HSE incidents.

8.4.3. ESV's analysis of HSE performance

In the absence of any information from Powercor, ESV was unable to assess its HSE performance. ESV has instead considered its public safety metric in the following section.

8.5. Public safety

8.5.1. Definition

Powercor's 2019 *Asset Class Strategy – Poles and Towers document* refers to Public safety incidents as 'ESV reported incidents.'

8.5.2. Powercor's public safety performance analysis

2013 – 2017 performance

Powercor shows two graphs in its Asset Class Strategy document which both indicate strongly declining trends in asset failures resulting in (i) grass/vegetation fires, and (ii) pole cross arm fires.[207]

Powercor advises that '*In the past five years, there have been 18 recorded class 3, 4 or 5 safety incidents …Of these eighteen incidents, seventeen were as a result of a vehicle into a pole, and one due to grass/vegetation fire due to contact from assets by third party – all of which are influenced by external impacts, and not as a result of asset performance.'*[208] The five year period referred to by Powercor is from 2013 – 2017. No information is provided regarding performance in 2018 or 2019.

8.5.3. ESV assessment

2018 – 2019 performance

Whilst there is no information in Powercor's Asset Class Strategy document of relevance to public safety beyond 2017, ESV is aware of the 'Sisters fire' at Garvoc in March 2018. This was found by ESV to be caused by a broken power pole. '*Forensic analysis of the pole sections concluded that the structural failure was caused by long-term material degradation due to decay and termite infestation. This resulted in the timber's reduced compressive and flexural/bending strength, development of a sizeable internal cavity in the region of the point of failure, and a reduced overall capacity that saw the pole's actual remaining strength exceeded under the prevailing wind conditions.'*[209]

The technical investigations report presented a key finding that suggests a competent inspection and sound test of the pole in November 2017 would be likely to have identified the material degradation that was present when the pole failed. This Report considers Powercor's inspection practices.

2013 – 2019 performance

Perfectly accurate wood pole inspection results are not able to be achieved by any inspection practice or combination of inspection practices based on ESV's experience. From a combination of Powercor's analysis and ESV's assessment of the 2018 incident, ESV conclude that:

- Powercor has not met its public safety performance target of zero incidents (as a result of asset performance) in 2018, but it did in 2013 to 2017 and, so far it has had no such incidents in 2019
- the main pole-related source of asset caused fires is from cross arm failure, not pole failure.

[207] Powercor, Powercor Asset Class Strategy – Poles and Towers, May 2019, Figures 17 and 18, p. 24

[208] Powercor, *Powercor Asset Class Strategy – Poles and Towers*, May 2019, p. 25

[209] Garvoc Fire (The Sisters) Technical Report, 17 March 2018

9. Forecasting and Modelling

9.1. Introduction

In this section ESV assess Powercor's methodology for forecasting future pole replacement and reinforcement activity. ESV's assessment approach is based on:

- understanding Powercor's forecasting methodology and how it responds to these challenges, including
  - its forecast pole interventions over the next 10 years
  - scenarios it has considered
  - recent changes
  - planned improvements
- comparing its forecasting approach and outcomes with the relevant requirements of the Electricity Safety Act and the NER and Powercor's claims regarding the sustainability of its forecast volume.

9.2. Powercor's wood pole serviceability challenges

9.2.1. Current forecasting methodology

Powercor's current forecasting methodology is based on extrapolation of its historical defect rates, as shown in Equation 5 below. The steps are described as:

- Historic inspection volumes – extracted separately for each of eight key inspection activities
- Historic defect volumes – pole replacements and reinforcements are two of 31 defect categories
- Find rate – calculated for each defect category, including replacements and reinforcements
- Future inspection volumes – extracted separately for each of six inspection categories within each switching zone to be inspected in the forecast period
- Historic activity conversion rate – the proportion of defects completed in the field.[210]

Equation 5: Powercor's superseded intervention wood pole intervention forecasting methodology[211]

Historic inspection volumes × Historic defect volumes → Find rates × Future inspection volumes × Historic activity conversion rate = Historic baseline condition volumes

9.2.2. Proposed forecasting methodology

As illustrated in Figure 46, Powercor's wood pole intervention forecast is based on augmenting the results of its expected 'Compliance-driven' interventions with its expected 'Risk Based Asset Management' (RBAM) interventions to *maintain performance and minimise risks as far as practicable.'*[212]

Its proposed forecasting methodology is based on three components, also shown in Figure 46:

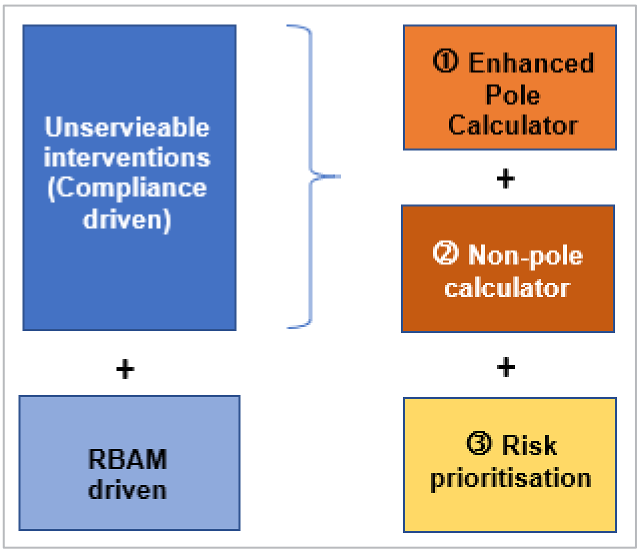
1. Simulation of the expected results from its Sustainability Index-based Enhanced Pole Calculator
2. Non-pole calculator forecast based on the outcomes of its 2019 timber pole RCM study
3. Simulated risk-based proactive interventions.

Figure 46: Powercor's proposed forecasting methodology[213]

[210] Which Powercor advises is 'very high' for poles

[211] Powercor, response to ESV IR WPM-007, Item 13, '*Clarification of language used on some slides.docx*'

[212] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019,* slide 5



Powercor also advises that its proposed forecasting methodology includes:[214]

- a sustainability test, for which it defines sustainable as 'delivering a volume to prevent continued unsustainable volumes into the future'
- a deliverability test, in which it takes into account material supply availability and workforce capability, and
- a 'recurrent test', defined as elevating intervention volumes to a new sustained baseline to prudently manage ongoing pole risks.

9.2.3. Planned improvements to the proposed forecasting methodology

Powercor has advised that, in addition to refinements to its serviceability assessment methodology (discussed in section 6), its continuous improvement of the proposed forecasting methodology will be driven from:[215]

- *'Design loading checks to determine actual and limits to pole utilisation as an input to the pole calculator*
- *Review of asset centric safety consequences*
- *Review of asset centric reliability consequences*
- *Implementation of RCM recommendations.'*

9.2.4. ESV assessment

The intent of Powercor's proposed forecasting methodology is aligned with regulatory requirements

ESV's focus is on whether Powercor's forecast intervention volume is likely to satisfy the requirements of the Electricity Safety Act to '*design, construct, operate, maintain and decommission its supply network to minimise as far as practicable'* hazards and risks. ESV also recognise that Powercor's forecast wood pole capital expenditure (per the volume of activity underpinning it) in its 2020 EDPR submission, will be subject to assessment by the AER.

[213] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019*, slide 7, modified by ESV

[214] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019*, slide 7

[215] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) – Wood pole forecast update, 28 October 2019*, slide 4

Powercor refers to key requirements of the Electricity Safety Act and the NER in claiming that:[216]

- *'Through implementing a RBAM approach, Powercor's pole interventions will minimise risk as far as practicable while maintaining acceptable performance levels…' and*
- *the volume of pole interventions has been tested as prudent and efficient' (by being deliverable, sustainable and recurrent).*

In the balance of this section 9, Powercor's approach to demonstrating the sustainable and recurrent features of its forecast are considered. The deliverability of the forecast volume of interventions is considered separately in section 10.

Powercor's superseded forecasting methodology was not consistent with good industry practice

If applied to the declining trend of pole defects and conversion rates (to Unserviceable), Powercor's historical trending approach would have resulted in a forecast of declining numbers of pole interventions. This is not consistent with its wood pole population characteristics and performance. A change was required.

Powercor's proposed forecasting methodology is based on two components that have not yet been approved nor implemented

ESV understands that Powercor's intention is to enhance its forecasting methodology because, based on the information provided, its current practices have not led to sustainable outcomes over the last four to five years and are unlikely to in the future.

However, Powercor's proposed forecasting methodology is still in draft form - it has not been approved by the CitiPower/Powercor Strategic Asset Management Committee - and it therefore must be regarded as subject to change. This creates uncertainty about what the forecast methodology will actually be when it's approved.

Additionally, in response to a finding from the 'Independent Review of Victoria's Electricity and Gas Network Safety Framework' chaired by Dr. Paul Grimes, ESV and the AER have ensured a strong working relationship exists between the safety and economic regulators. The existing MOU has been revised and published to ensure the communication process between the regulators (particularly during the EDPR process) is transparent. This is critical to achieving effective regulation that meets the dual objectives of promoting efficient prices for consumers, while achieving high safety standards.

Forecast interventions from the 'enhanced Pole Calculator' are based on simulations

The introduction of the Serviceability Index-based enhancement to the current Pole Calculator is likely to (i) increase volumes of poles being classified as Unserviceable and AC Serviceable, and (ii) over time, provide more accurate results. However, the enhanced Pole Calculator algorithms, input assumptions and other parameters have not yet been finalised, approved, implemented, or calibrated. Calibration with failure investigations and field results will take up to five years (i.e. one inspection cycle) unless accelerated through a special program (as discussed in section 6).

In the absence of actual results, Powercor has relied upon simulation studies to forecast intervention volumes from the enhanced pole calculator. This indicates that it is possible that the forecast interventions will vary considerably from the simulation volumes as the methodology is refined.

Risk-based proactive interventions (also referred to as RBAM interventions) are based on simulations

Powercor's proposed forecasting methodology more explicitly recognises the risk of failure of its wood poles, building on Powercor's intent to determine risk values for each pole. In practice, Powercor advises that individual pole failure risk will be determined using its Copperleaf C55 software, as discussed in section 7. If implemented, this will assist Powercor to target its interventions to the highest risk poles (in priority order).

[216] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019,* slides 6, 7

However, the method for deriving the risk-based proactive interventions is a work in progress. The methodology has not yet been finalised, approved, or implemented. Powercor does not have risk-values for its poles to enable it to forecast replacement volumes or to demonstrate that it will select the right pole at the right time for replacement or reinforcement.

Therefore, Powercor has relied upon simulation studies to forecast the volume of interventions from the 'risk-based proactive interventions' methodology, as discussed in section 7 (Pole Interventions). The results are not derived from a proven tool for forecasting future volumes. This also indicates that it is possible that the forecast interventions will vary considerably from the simulation volumes as the methodology is refined.

The reasonableness of the non-pole calculator forecast has not been demonstrated by Powercor

Powercor advises that the non-pole calculator volume is based on:

- defects 'such as fruiting body, repeat termite attack, etc. (as captured in Asset Inspection Manual and respective policy documents)' [217]
- the outcomes of the 2019 timber pole RCM study.[218]

Powercor's 2019 RCM study identified that:[219]

- 'An increasing number of poles are transitioning from the Serviceable state to lower states
- The previous inspection cycle for Added Controls –Serviceable poles is no longer optimal
- The number of poles bypassing the Added Controls –Serviceable state requires intervention and ongoing monitoring.'

These conclusions in turn led Powercor to increase its AC Serviceable pole inspection frequency and to enhance the Pole Calculator algorithms to include age-based strength loss. ESV assumes that the non-pole calculator forecast includes the poles classified as Unserviceable P2 from the Visual Assessment criterion[220] that Powercor introduced in 2019.

In response to ESV's request for an explanation about how the non-pole calculator volumes are forecast, Powercor advised that they were derived from '…*the transitions of poles through the managed state (S – ACS – US) as opposed to the poles that transitioned directly from S-US as observed during the 2019 RCM study. The transition rates identified from this RCM study were directly used to forecast the non-pole calculator driven interventions, and also the expected volumes for the 2026/27 to 2030/31 price review period.'* [221]

Even with this explanation by Powercor, ESV is unable to conclude with confidence that the forecast non-pole calculator volumes are likely to be reasonable.

As expressed in section 6 (Serviceability assessment), ESV does not consider that Powercor's Visual Assessment criterion is consistent with good asset management practice and therefore, ESV does not consider Powercor has demonstrated that it is a prudent basis for forecasting intervention volumes.

[217] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019,* slides 6

[218] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019,* slides 7

[219] Powercor, *Powercor wood pole management, ESV – Powercor workshop 19 September 2019*, slide 37

[220] This is ESV's label for Powercor's new visual assessment criterion to distinguish it from its current visual assessment criteria

[221] Powercor, response to ESV IR WPM-011, UPDATE - Wood pole management plan risk modelling dated 30 Oct.msg

9.3. Powercor's application of its proposed intervention forecasting methodology

In this section, Powercor's approach to identifying the number of poles expected to require reinforcement of replacement from the three sources.

9.3.1. Risk-based criticality view of Powercor's pole population

Powercor has presented a 'consequence mapping to fire classification' (which is reproduced as Table **27** to show its allocation of its entire wood pole population to bushfire area classifications and enhanced Pole Calculator (simulated) SI outcomes. Powercor's forecasting methodology is applied to determine the volume of poles to be replaced from each segment of the matrix in Table **27** in the 2021/22 – 2025/26 period. Powercor explains that it: '… *intends to treat poles with a serviceability index less than 0.7 with this fire classification as compliance interventions due to BCA (ELCA) areas being the highest consequence areas within the state.*'[222, 223] Another assumption that is consistent with its Pole intervention criteria is that Unserviceable poles will be replaced or reinforced regardless of fire classification location.

Table 27: Powercor's simulated pole calculator outcomes mapped to fire classification[224]

	Consequence mapping¹ to fire classification				
Pole Utilisation	80%	80%	90%	90%	100%
Pole condition	LBRA	HBRA	REFCL (non-SWER)	REFCL (SWER)	BCA (ELCA)
Unserviceable Serviceability Index < 0.65	[redacted]				
AC Serviceable 0.65 ≤ Serviceability Index < 0.70					
AC Serviceable 0.70 ≤ Serviceability Index < 0.75					
Serviceable 0.75 ≤ Serviceability Index < 1.0					
Serviceable Serviceability Index ≥ 1.0					

Unserviceable Interventions (Compliance Driven)	C1:	12,405	Highest Risk
	C2:	3,578	
RBAM Interventions	C3:	28,882	↓
	C4:	35,727	
Ongoing Monitoring and Inspection	C5:	280,310	Lowest Risk

9.3.2. Forecast volume of replacement and reinforcements

Powercor's forecast intervention volume for the next RCP (2021/22 to 2025/26) is 39,770 poles, as shown in Table 28. Powercor advises that it selected the three components of its forecast from Table 28 as follows:[225]

4. Simulation of pole calculator policy = 15,207 Unserviceable poles + 776 AC Serviceable poles in BCA
5. Non-pole calculator policy = 8,213 poles from the outcome of its 2019 timber pole RCM study
6. Risk-based asset management = 15,556 poles = 23,787 AC Serviceable poles (0.65 ≤ SI < 0.70) less Non-pole calculator policy volumes.

[222] Powercor, response to ESV IR WPM-011, UPDATE - Wood pole management plan risk modelling dated 30 Oct.msg

[223] BCA (ELCA) definition: Powercor bushfire mitigation plan version 6, p.25 and Electricity Safety (Bushfire Mitigation) Regulations 2013 version 4. p.10

[224] Powercor, *Powercor's Risk based Asset Management Approach (RBAM), Wood pole forecast update 28 October 2019*, slide 6

[225] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update*, 11 November 2019, slide 7

Table 28: Powercor's forecast pole replacement / reinforcement volume 2021/22 – 2025/26[226]

Forecasting component		Replacement volume 2021/22 – 2025/26	Reinforcement volume 2021/22 – 2025/26	Total
Compliance	1. Pole calculator policy	11,413	4,570	15,983
	2. Non-pole calculator policy[2]	5,877	2,354	8,231
	Sub-total	**17,290**	**6,294**	**24,214**
RBAM	3. Risk-based asset management	3,588	11,968	15,556
Total		**20,878**	**18,892**	**39,770**
Average p.a.		**4,176**	**3,778**	**7,954**

Table 29 shows that Powercor's forecast interventions for the following RCP (i.e. from 2026/27) is 2,700 poles (or 7 per cent) higher than for the next RCP. Proportionately more poles are expected to be identified as Unserviceable in the 2026/27 to 2030/31 period, which is consistent with the effect of ongoing fibre strength (and therefore pole strength) degradation with time, particularly of class 3 durability poles.

Table 29: Powercor's forecast pole replacement / reinforcement volume 2026/27 – 2030/31

Forecasting component		Replacement volume 2021/22 – 2025/26	Reinforcement volume 2021/22 – 2025/26	Total
Compliance	1. Pole calculator policy	18,752	7,509	26,261
	2. Non-pole calculator policy[2]	4,433	1,776	6,209
	Sub-total	**23,185**	**9,285**	**32,470**
RBAM	3. Risk-based asset management	2,307	7,693	10,000
Total		**25,492**	**16,978**	**42,470**
Average p.a.		**5,098**	**3,396**	**8,494**

Notes (to both tables):

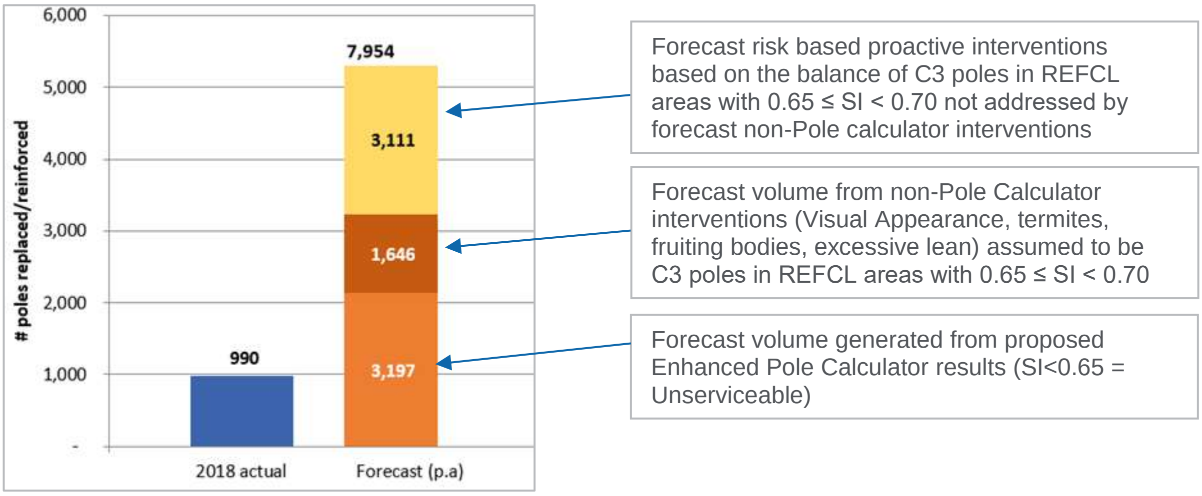
1. These are indicative volumes based on existing pole records estimating the impact of the enhanced pole calculator applied at next pole inspection
2. Interventions are driven by defects identified during pole inspection that are not inputs to the pole serviceability calculation, such as fungal fruiting body, repeated termite attack, etc. (as captured in Inspection Manual and respective policy documents)
3. The pole condition Serviceability Index criteria used on are taken from Table 1 in the draft Serviceability Assessment of Poles which includes the new pole residual strength calculation; this will identify poles in addition to the existing criteria currently being applied by the maintenance policy

Powercor's proposed forecasting methodology leads to a forecast of an average of 7,954 p.a. poles reinforced or replaced during the five-year period (refer to Figure 47). The simulated enhanced pole calculator results determined the serviceability classification, which in turn has enabled the RBAM (or 'proactive risk-based interventions) forecast.[227]

[226] ` Powercor, *Powercor's Risk based Asset Management Approach (RBAM), Wood pole forecast update 28 October 2019*, slide 6

[227] Powercor, response to ESV IR WPM-011, UPDATE - Wood pole management plan risk modelling dated 30 Oct.msg

Figure 47: Powercor's forecast average annual pole reinforcement and replacements (next RCP)



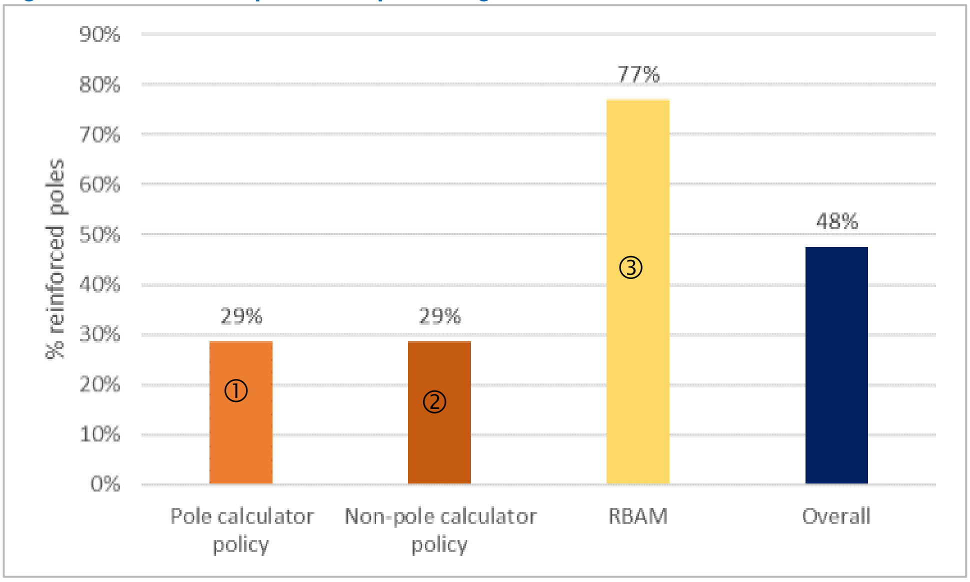
All poles in categories C1 and C2 in Table **27** are forecast to be replaced or reinforced. Poles classified as C3 will either be treated via non-Pole calculator interventions, by proactive risk-based intervention, or by increased inspection frequency.

Powercor advises that: '*For forecasting purposes the RBAM volume has been sized to enable sustainable management of the population and maintain acceptable asset performance.'*[228]

9.3.3. Powercor's forecast reinforcement to replacement ratio

Figure 48 shows Powercor's forecast percentage of total reinforcements from each of the three sources and the percentage of reinforcements compared to total interventions. Powercor advises that the target reinforcement rate of 48 per cent and that the Pole calculator policy and non-pole calculator policy values are based on historical results. Powercor advises that its forecast '*has considered which of these poles are already reinforced and then we have applied a 70 per cent reinforcement rate to the remainder of the poles as we expect to be intervening earlier in their life. An outcome of this will be to reach a 48 per cent reinforcement rate across the population which is in line with historical averages.'*

Figure 48: Reinforced poles as a percentage of total interventions[229]



[228] Powercor, response to ESV IR WPM-011, UPDATE - Wood pole management plan risk modelling dated 30 Oct.msg

[229] Powercor, *Powercor's Risk based Asset Management Approach (RBAM), Wood pole forecast update 28 October 2019*, slide 6

9.3.4. ESV Assessment

Using high pole strength utilisation factors for different bushfire zones is conservative

ESV considers that mapping simulated pole condition against fire classification areas (i.e. based on each pole's location) as a proxy for consequence, is a reasonable approach in the absence of better information.

The Serviceability Index results are very sensitive to the assumed pole strength utilisation, as discussed in section 6 (refer to Figure 29). Applying 100 per cent and 90 per cent utilisation factors to the BCA and REFCL fire classifications is a conservative forecasting approach. If applied in practice, this setting is likely to lead to a significant number of false positives (i.e. unnecessary investment) in the REFCL and BCA zones, but this may be a reasonable compromise given the potential consequences. Whilst the prudency of this risk-cost trade-off has not been demonstrated by Powercor quantitatively, ESV is supportive of a conservative approach in high consequence areas.

Powercor has not demonstrated that its forecast interventions will lead to sustainable outcomes

In addition to the preceding discussion, there are a lot of assumptions underpinning the 'mapping' shown in Table 27. It is not clear how Powercor assured itself that the proposed intervention volume over the next 10 years will satisfy either the relevant requirements of the Electricity Safety Act or of the NER, viz:

- minimise as far as practicable' hazards and risks
- enable sustainable management of the population and maintain acceptable asset performance.

ESV assumes that Powercor has satisfied itself that the forecast meets its three 'prudency and efficiency' tests (i.e. deliverable, sustainable, and recurrent) but the logic has not been explicitly represented. For example:

- Powercor does not define the sustainability criterion in a way that allows objective determination of the five-year or ten-year performance of its wood pole population
- Powercor does not explicitly explain why it is not prudent to target replacement/reinforcement of all the AC Serviceable C3 poles (i.e. an extra 1,000 poles p.a. on average) in Table **27** over the next RCP
- Powercor's forecast non pole calculator intervention volume has not been demonstrated as reasonable – it is much higher than its historical level and the impact of the new Visual Appearance criterion does not explain the difference
- The introduction of an extra AC Serviceable SI range implies a level of accuracy in determining the adequacy of residual pole strength that is not consistent with the actual predictive powers of the technique.

Comparison of Powercor's forecast with alternative forecasting methodologies shows Powercor's forecast is relatively high

To help test the reasonableness of Powercor's forecast, ESV has considered a number of alternative forecasting methodologies:

Replace at a rate commensurate with the assumed average pole life

Powercor's poles fail at an average age of 51 years. If this is assumed to be the average pole life expectancy, it implies that, on average 2.0 per cent of the Powercor's wood pole population should be replaced annually (i.e. approximately 7,160 poles p.a.) If the average pole life expectancy (including life extension) is assumed to be 60 years,[230] an average of 1.7 per cent (approx. 6,100 poles p.a.) would need to be replaced. This wood pole replacement forecasting approach is a very course measure and there are better age-based forecasting methodologies, as discussed below.

[230] Referring to the average service life expectancy in Figure 11 and adding 15 years life extension from pole staking (reinforcement)

Maintain average age

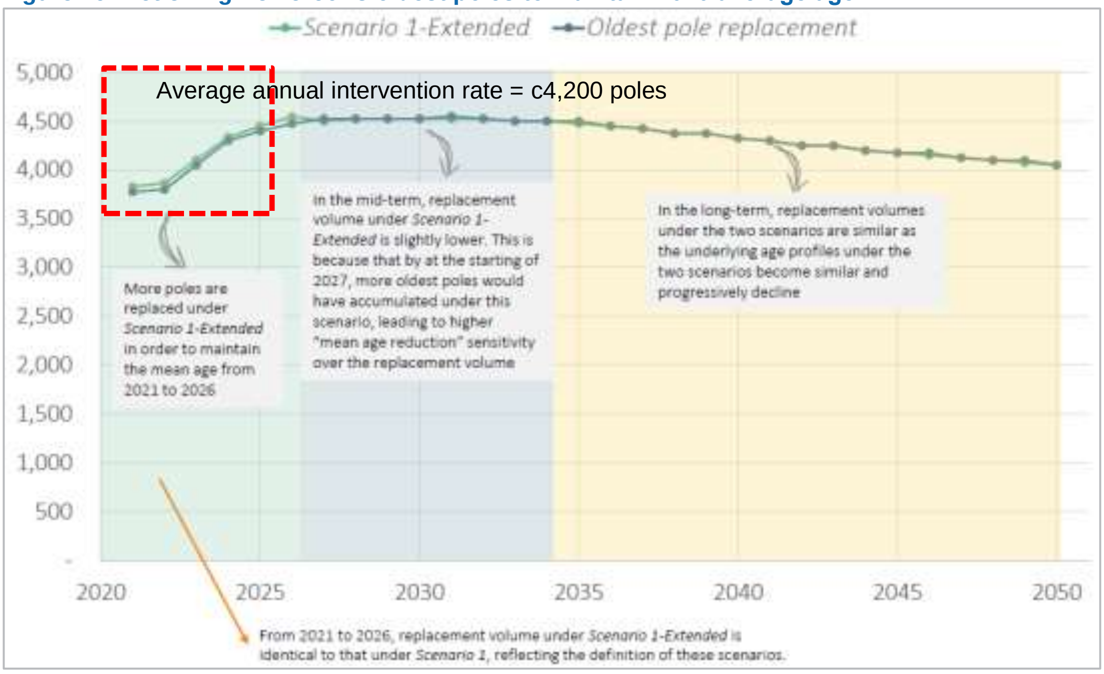
Powercor advises that its forecast over the next decade will enable sustainable lifecycle management of poles and that the average age of wood poles will be maintained at 44 years as a result of this approach. Whilst it is not an aspect of Powercor's wood pole management strategy nor one of its nominated performance measures, it is the outcome of its forecasting methodology.

Powercor has provided the results of a forecasting scenario analysis in which the oldest poles in its network are assumed to be replaced in priority order to maintain the mean wood pole population age at 44 years, as illustrated in Figure 49 below. The resulting average annual intervention volume of about 4,200 poles in the 2021 to 2026 period is:

- much higher than Powercor's average intervention levels over the period 2015-2018
- significantly lower than Powercor's proposed average intervention rates from its proposed forecasting methodology.

As Powercor points out,[231] the scenario is likely to represent a lower band of what will be required because it will not replace or reinforce poles based on their condition, which are likely to be other than the oldest poles. Nonetheless, ESV expects that the majority of the poles identified based on condition for intervention will be older poles (i.e. greater than 50 years of age).

Figure 49: Actioning Powercor's oldest poles to maintain 2020 average age[232]



[231] Powercor, *Powercor wood pole management, ESV-Powercor workshop, 19 September 2019*, slide 33

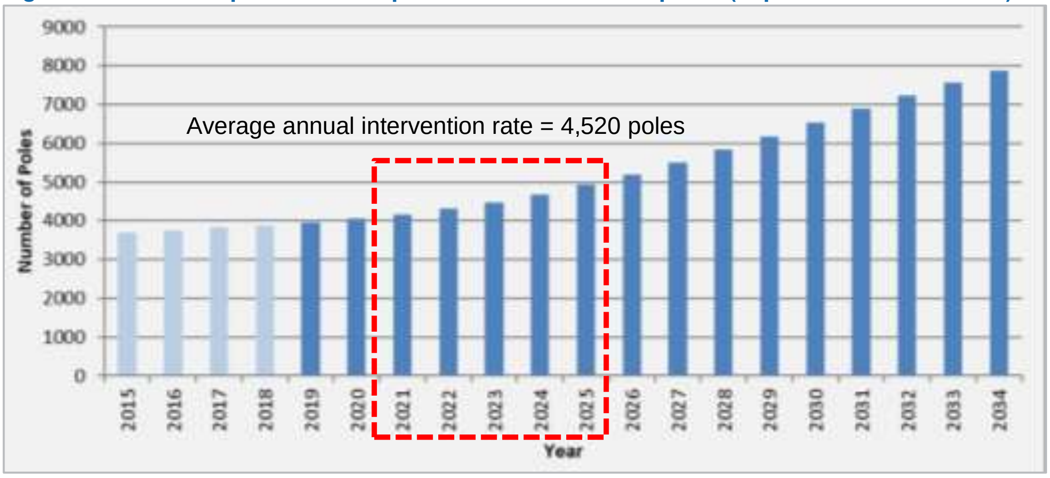
[232] Powercor, enea CONSULTING *Wood pole replacement to 2050,* slide 4

AER's Repex Model for maintaining the service level

The AER's Repex Model is a recognised means of identifying divergences of a utility's forecast from a calibrated age-based replacement forecast. The Repex Model is a more sophisticated methodology than maintaining average population age. Figure 50 is based on information provided by Powercor,[233] and shows that:

- there is a forecasted increase in pole interventions with time as the pole population ages as individual poles approach their expected end of life
- Powercor's proposed intervention volume is 76 per cent higher than the average annual volume of 4,520 interventions from the Repex Model scenario.
- Over 10 years, the Repex Model scenario identifies an average of 5,200 poles p.a., which is still much lower than Powercor's 10-year average of about 8,200 poles per annum.

Figure 50: AER's Repex Model output for Powercor wood poles (expected lives scenario)[234]



Maintaining service level using pole condition as the measure

A more sophisticated proxy for risk than age is pole condition – which, for Powercor, will be indicated by the Serviceability Index and could currently be determined using the Safety Factor result for each pole. Powercor could adopt the strategy of maintaining the aggregate health index constant by replacing those poles with the poorest condition (in priority order) to the extent necessary.

ESV has not attempted to model this approach, however Powercor's Safety Factor results would be available to do this, and its Sustainability Index simulation study may enable an estimate of the change in aggregate Serviceability Index over time with its forecast interventions.

Maintaining service level using risk-cost (value of risk) as the measure

A superior strategy to maintaining the average age of the wood pole population (as a proxy for maintaining risk) or an asset condition index approach is to maintain the risk by investing in wood pole interventions driven by risk value (or risk cost). Risk reduction per dollar spent would be targeted by replacing/reinforcing poles in priority order, starting with the highest risk poles each year to maintain the estimated risk profile at a constant level.

As stated in the AER's industry practice application note on asset replacement planning:[235]

'…the costs associated with an asset failing in service such as unserved energy costs, repair costs, the cost of losses due to fire or incidents of a safety or environmental nature will typically increase as the probability of the asset failure increases. All such relevant costs should be considered when demonstrating prudent and efficient asset management decisions including asset retirement decisions.'

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[233] Powercor response to ESV IR WPM-001,, 'DRAFT AER - Repex model - 2021-2025 - PAL Scenario 3 - Expected Lives.xls'

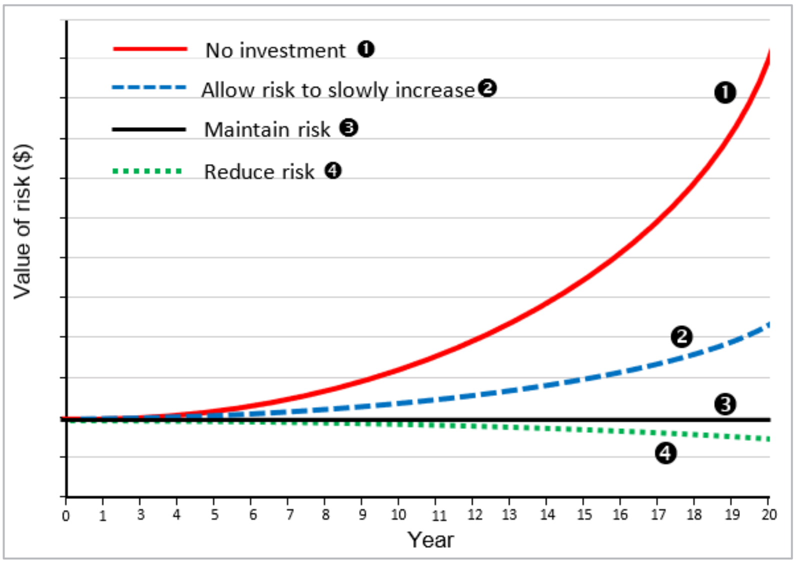
[234] Note that the volume of activity for the other Repex modelling scenarios is similar to the expected lives scenario shown in this figure

[235] AER, *Industry practice application note – Asset replacement planning*, Jan 2019, p. 10

The total wood pole population failure risk is the sum of the risk posed by all wood poles. As shown in Figure 51 below, pole failure risk would be expected to rise exponentially if poles are not replaced or reinforced in sufficient volume to maintain constant overall risk. Three other scenarios are also illustrated:

- resource constrained investment or investment at a level to deliberately allowed to slowly increase - this might be an appropriate strategy if the NSP determines that it has been overinvesting in wood pole intervention
- maintaining risk constant – this strategy aligns with the NER capex criteria
- reducing risk.[236]

Figure 51: Illustrative example of risk-based investment optimisation[237]



For Powercor to determine its wood pole intervention forecast applying risk value it would ideally have risk values, which incorporate safety, property damage, and reliability consequences of pole failure. Powercor has stated that it is working to develop achieve this.

In summary

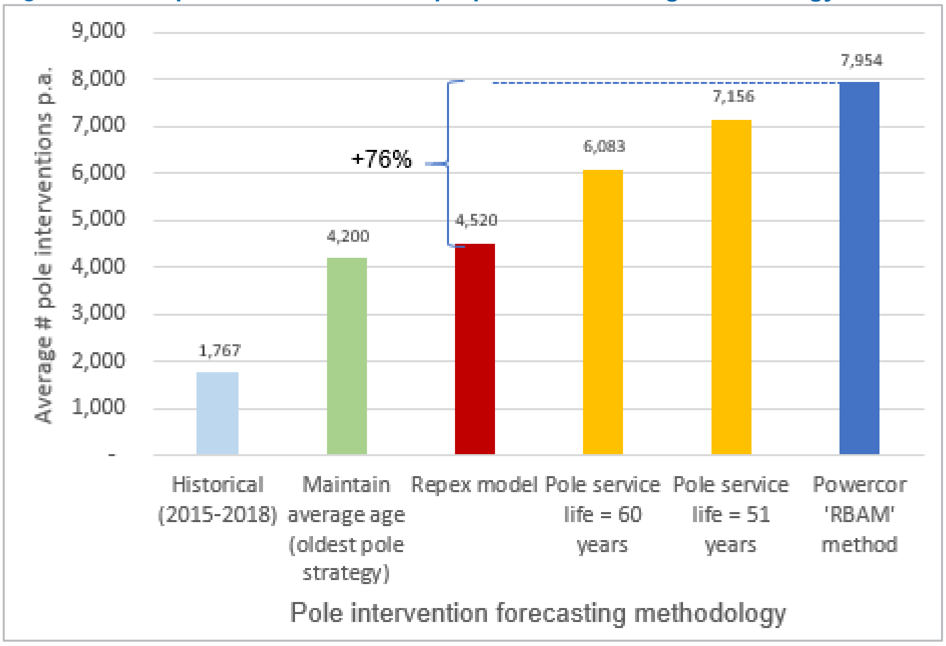
As shown in Figure 52, the outcome of Powercor's proposed intervention forecasting methodology is 76 per cent higher than the AER's Repex Model output and higher than other comparator forecasts

- Powercor has provided insufficient information to conclude that Powercor's proposed forecast will lead to sustainable outcomes
- Powercor has identified four improvement initiatives which, if implemented should help, over time, provide a more robust forecasting methodology.

[236] The NSP would need to convince the AER that this is the case, as this strategy typically results in a higher volume of interventions than the other scenarios, and therefore higher total investment

[237] Based on AER, *Industry practice application note – Asset replacement planning*, Jan 2019, Figure 7

Figure 52: Comparison of Powercor's proposed forecasting methodology with other approaches



Powercor's percentage of pole reinforcements is likely to increase from 2014-2018 levels

In principle it is reasonable to assume that because the poles replaced or reinforced under the RBAM criterion are likely to be AC Serviceable (i.e. with more good wood than Unserviceable poles), a higher proportion of poles will be suitable for reinforcement than current levels. On this basis, it is reasonable to assume that Powercor's reinforcement to replacement ratio will increase from current levels.

10.Wood Pole Intervention Deliverability

10.1. Introduction

Powercor's latest forecast is for 39,700 pole interventions in the five year period 2021/22 – 2025/26, more than four times the approximately 9,300 interventions over the last five years (2015-2019).[238] In this section the focus is whether there is likely to be any constraints on delivering the forecast volume of pole replacements and reinforcements efficiently.

Powercor has provided limited information on its capacity to efficiently deliver its forecast volume of interventions.[239] As a consequence, ESV's approach to the assessment is to:

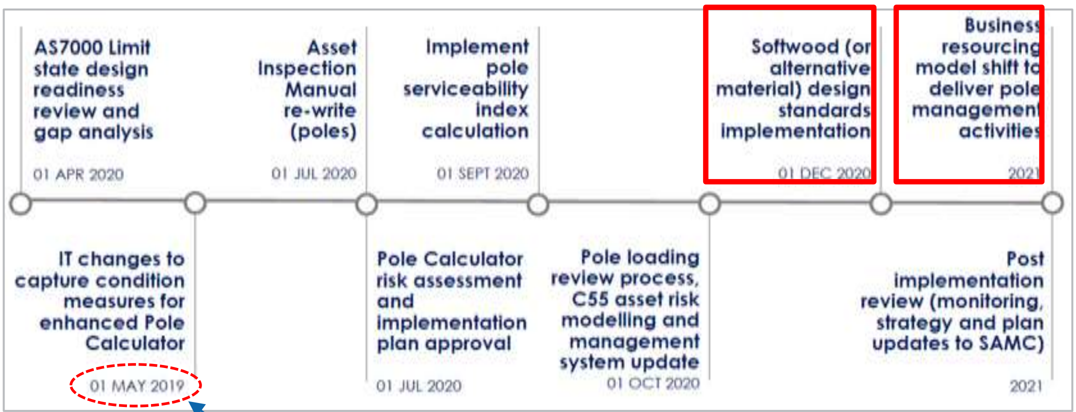
- understand Powercor's plans for managing the deliverability challenges
- identify the key areas of pole replacement and intervention delivery that will be impacted by the forecast increased volume of work
- assess whether deliverability risks are likely to constrain the delivery of the forecast volume of pole interventions.

10.2. Overview

10.2.1. Powercor's current plans

Powercor has recognised the future impact of the change to the selection of and volume of pole interventions in its latest improvement initiative timeline, shown in Figure 53. As discussed in subsequent sections below, Powercor needs to develop softwood design standards and a revised resourcing model to cope with the increased volumes of planning and delivery of interventions.

Figure 53: Pole interventions continuous improvement imitative timeline



ESV has been advised that this is a typographical error and should read 1 May 2020[240]

[238] Approximately 6000 replacements (65%); and 3,300 reinforcements (35%)

[239] This was a part of ESV's 19 September 2019 meeting agenda. Information provided has been referred too

[240] Powercor advised at Internal report draft review meeting dated 11 November 2019

10.3. Planning

10.3.1. Powercor's approach

The poles to be replaced or reinforced will be progressively identified from inspection results.[241] ESV's understanding is that Powercor's Network Services division is responsible for:

- scoping and issuing the work (i.e. replacements and reinforcements)
- resource scheduling and dispatch (cognisant of policy timeframes)
- job readiness (including material delivery and contractor coordination)
- field planning and construction (for pole replacements)
- monitoring and control (including reporting and change management)
- auditing replacement and reinforcement quality of work.

[redacted] is responsible for the design and installation of pole reinforcements.

No additional information to that in Figure 53 has been provided by Powercor to demonstrate its resourcing plan to accommodate the increased volume of work to be undertaken by Network Services division.

10.3.2. Quality assurance

Powercor advises that it utilises a number of business processes and their outputs to provide assurance of the quality of the design and installation of new and replacement wood poles:[242]

- 'Our Technical Standards team maintain a material specification for wood poles which governs the quality we expect from our suppliers. Technical Standards then set the criteria for use of wood poles which are applied in our design process.
- Our design teams conform to the technical standards in the design process. The distribution design process includes a quality assurance and a safety in design check.
- Our construction crews utilise the design outputs, Technical Standards and Standard Work Practices for the instillation of poles when completing construction works in the field. Construction Project Leaders (CPL's) sign off on the quality of the construction works completed.
- Construction quality audits are also undertaken under a sampling based regime to ensure that construction is completed to the requirements of the technical standards and the design provided.

No additional information to that in Figure 53 has been provided by Powercor to demonstrate its resourcing plan to accommodate the increased volume of work to be undertaken by Network Services division.

10.3.3. ESV Assessment

Planning risk is low provided Powercor acts now to build capability

The fourfold volume increase is likely to require extra skilled staff in Network Services division and possibly enhanced work management software to help with the efficient design, planning, dispatch, and control of work.

If Powercor brings in another pole reinforcement contractor,[243] there will be a significant amount of work to ratify the designs and alter internal procedures to manage planning, dispatch, monitoring, control, and auditing.

Whilst these changes are achievable, ESV expects that Powercor should have its new resourcing model in place by the end of 2020, not in 2021.

[241] Results entered into Pole Calculator and uploaded to SAP

[242] Powercor response to ESV IR WPM-017 Assurance of quality of replacement and new wood poles - design and installation.msg

[243] As discussed in section 7 (Pole intervention methodology)

10.4. Procurement

10.4.1. Procurement of replacement poles

Wood poles

A challenge for Powercor will be to procure sufficient hardwood poles with the ramp up in pole replacement activity. The challenge is mitigated by two factors:

- Powercor's strategy is to replace its wood poles located north of the Great Dividing range with concrete poles (because of termite risk)
- Powercor forecasts about 48 per cent (19,000) of the forecast 39,770 pole interventions will be reinforcements.

The proportion of replacement CCA treated wood poles required South of the Great Dividing Range is not known precisely, however Powercor advises that it has explored the availability of hardwood poles with its suppliers. Powercor's conclusion is that it is likely to need to satisfy 20-30 per cent of total demand with softwood poles and 12 month's-notice is required to allow suppliers to respond.[244] CCA treated softwood poles (typically *pinus radiata*) are widely and successfully used in Australia (and overseas). Powercor has over 4,000 CCA treated *pinus radiata* softwood poles durability class 1 (strongest classification) on its network that are between 40-60 years old with no performance issues.

Powercor has identified that using softwood poles requires different fittings and handling to hardwood poles, plus fire retardant coatings may be required to reduce the extent of fire damage.

Concrete poles

As a manufactured product with a number of potential suppliers in Australia (and, if necessary) overseas, Powercor has not identified significant procurement challenges through to 2026.

10.4.2. Procurement of pole reinforcements

Powercor currently uses [redacted] to design and install the RFD pole reinstatements. Powercor is also investigating using an alternative supplier, which would provide additional capacity to respond to the volume increase from an average of about 650 reinforcements p.a. to an average of about 3,800 p.a.

10.4.3. ESV assessment

Pole intervention activity is likely to ramp up over several years rather than 'step up'

Whilst an average of over 7,970 poles are forecast to be replaced or reinforced per year over the five year period, this is likely to be achieved by a progressive ramp-up of activity in 2021/22 through to 2025/26, which would provide some opportunity for progressive build-up of forward commitments to suppliers.

Procurement risk is low provided Powercor gives sufficient lead time to suppliers

Based on the information provided, ESV does not envisage significant issues with Powercor's procurement of replacement wood poles, concrete poles, or pole reinforcements provided that Powercor confirms its requirements to its suppliers 12 months in advance.

The possible introduction of alternative suppliers would reduce procurement risk further, although it would increase planning overhead (but as discussed above, in ESV's view, this is manageable within the lead time Powercor has).

[244] Powercor, *Powercor wood pole management ESV – Powercor workshop, 19 September 2019,* slide 45

The supply of reinforcement ‘nails’ or stakes’ is more scalable than wood poles. However, there are several pole suppliers around Australia and supplementing hardwood poles with softwood poles should ensure there are no significant poles shortages.

11.Summary Findings and conclusions

11.1. Wood Pole Management Objectives and Strategy

Powercor's current asset management principles, risk framework, and wood pole management objectives are adequate

ESV has no material concerns with these aspects of Powercor's asset management system, noting that they are aligned with Powercor's corporate strategic objectives and relevant regulations and standards.

Powercor's proposed wood pole management strategy is based on risk-based pole interventions which, when implemented, should support better wood pole management outcomes

Powercor has commenced transitioning from a RCM-based strategy to a risk-based asset management strategy. This introduces the opportunity for Powercor to extend pole intervention decisions to include pole failure consequence more explicitly. In time, this change should lead to better decision making about how many poles to replace/reinforce, and which poles to replace/reinforce, in risk-based priority order.

The current version of Powercor's 2019 wood pole strategy document is inadequate

Powercor's principal reference for its wood pole asset management strategy is its Asset Class Strategy – Poles and Towers document. Within this document, performance targets are incomplete, data is out of date, performance analysis is incomplete, and the strategic analysis is immature. However, Powercor demonstrated that in 2019 it undertook strategic analysis that has not yet been incorporated into its strategy document.

11.2. Inspection Practices

Powercor's current inspection practices align with documented procedures, and are consistent with general industry practice

Powercor's Inspection processes, generally align with their documented standards and procedures, with the service provider applying general industry standard pole inspection and condition assessment work practices.

An exception to this is 'sound' test referred separately below.

Like a number of utilities, Powercor also deploys a supplementary inspection technology (wood scanning) to provide an enhanced method of determining a pole's residual strength. Powercor uses wood scanning technology to complement and validate its current SDD practices for P2 unserviceable and double staked pole inspections, enhancing the accuracy of sound wood measurements at ground level, and at the top of double stakes on poles.

Powercor's sound test procedure is inadequately documented and inconsistently implemented

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.

Without a clear procedure for the sound test, the auditing process is also compromised.

The failure to clearly articulate the expectations of the 'sound' test may be a general Victorian industry issue.

Powercor's auditing of the quality of inspection practices is inadequate.

Powercor' primary asset inspection service provider has an auditing strategy and procedure in place that clearly articulates the overall framework and disciplines for the auditing of Asset Inspectors. The document adequately addresses auditing performance, accountabilities and responsibilities as well as guidelines for handling of non-conformances and actions.

However, the service provider's inspection audit and performance reporting does not ensure minimum frequency audit criteria are being met nor that the required breadth of pole class inspections is being consistently achieved.

Powercor Maintenance Service Officers and the service provider's Contract Managers undertake quality audits of inspectors. Powercor does not undertake any independent external audits of [redacted] full inspections to validate compliance with its inspection manual.

Compliance of the asset inspection training and competency modules has not been demonstrated

The asset inspection service provider's training program under the new competency based National Certificate II accreditation was initiated in August 2018 with the intake of trainee asset inspectors. ESV has not been provided with sufficient supporting training and competency material and documentation to confirm that the training program:

- complies with the National Certificate II accreditation requirements
- satisfies regulation 7(1)(j) of the "Electricity Safety (Bushfire Mitigation) regulations 2013
- complies with Powercor's asset inspection network training standards.

ESV endeavoured to source supporting inspection information from Powercor's asset inspection service provider, however due to impending legal action the service provider refused to provide this information to ESV. ESV may have used its powers under the Electricity Safety Act to compel the service provider to provide documents, but, due to uncertainty of the use of these powers in this case, and the potential to inhibit any other legal actions, chose not to enforce this requirement upon service provider.

The Powercor-asset inspection service provider contractual arrangement for inspection services is reasonable

The contractual arrangement between Powercor and the asset inspection service provider supports the objective of delivering safe, timely and quality inspection services. The contract is structured with a balanced approach to technical expectations and performance outcomes. It provides a framework to help incentivise delivery of quality asset inspection services, rewarding continuous improvement.

Powercor's pole inspection delivery performance is adequate

Although the impact of the changes in inspection frequency has been challenging, Powercor and the asset inspection service provider are managing the program and transition of works adequately.

As at the end of September 2019, there are no poles that have exceeded their inspection 'due policy date'. There are 26 poles in Powercor's area that were identified as 'outside policy risk assessed'. These poles have access issues and have been reassessed in accordance with Powercor's formal risk assessment procedure.

Powercor's asset inspection performance reporting can be improved

Overall Powercor's monthly inspection report is an adequate reporting tool, however ESV considers that it could be improved by including additional information to understand and monitor risk and trends, including a summary of progress against mandatory performance standards and key performance indicators.

Powercor need to pursue the implementation of SAP enhancements and processes to facilitate notification and reporting of inspection risk assessments, replacing the current manual process.

11.3. Serviceability Assessment

Powercor's serviceability classifications and definitions are reasonable

Whilst Powercor has replaced the 'Limited Life' label for poles which are assessed as requiring closer monitoring with the 'Added Controls – Serviceable' label, the definition hasn't changed, and the classifications and definitions are aligned with the historic industry definitions and practice.

With the exception of its Visual Appearance criterion, Powercor's methods of converting condition information to serviceability classifications is reasonable

The three most common methods of converting condition information to a serviceability classification are: age, health index (qualitative) and health index (quantitative). Powercor uses a combination of the quantitative (Safety Factor and R-Factor) and the qualitative (visual inspection) approaches to determine the serviceability classification for individual poles, relying on its own and industry-wide experience. This is a reasonable approach.

Powercor has recently introduced a Visual Appearance criterion for classifying poles as Unserviceable P2. However, this is not consistent with good industry practice, because the existence of holes and splits and loss of external wood is not a reliable indicator that the pole has a high risk of failure. The criterion is applied *after* the pole has been identified as AC Serviceable or Serviceable by the other condition assessment techniques and is designed to respond to public concern rather than Powercor's condition assessment results.

The other condition assessment criteria are consistent with common industry practices.

Powercor's superseded serviceability criteria were not identifying enough Unserviceable poles

Powercor's superseded serviceability criteria appeared to be fit-for-purpose as indicated by a relatively stable, unassisted pole failure level until about five years ago. Over the last five years, the number of poles classified as Unserviceable has reduced sharply whilst unassisted pole failure rates have been trending up. These trends are inconsistent with each other and do not align with the increasing aged wood pole population. While there are other contributing factors, including the introduction of the wood scanning inspection technique, this mismatch appears to be because the serviceability assessment criteria did not adequately recognise the cumulative effect of fibre strength degradation.

Powercor's serviceability assessment improvement initiatives have accelerated in 2019

The majority of Powercor's initiatives related to serviceability assessment have been undertaken in 2019, with more planned for 2020 and 2021.

Powercor's current serviceability criteria are not likely to support sustainable outcomes

Powercor has responded to the declining trend in poles being classified as Unserviceable by

- increasing the Unserviceable Safety Factor threshold to 1.4, up from 1.25
- introducing a new 'Visual Appearance' serviceability criterion and
- significantly increased the frequency of inspections of AC Serviceable poles from 2.5 years to annually.

These changes are expected to lead to about 2,250 poles annually being classified as Unserviceable, however this is unlikely to deliver sustainable wood pole safety performance.

Powercor's proposed introduction of Serviceability Index-based serviceability criteria is a positive initiative

Powercor is developing a new Serviceability Index-based criteria to improve its serviceability criteria. The combination of more explicit representation of fibre strength degradation and the capacity to incorporate actual LSD loadings should lead to more accurate representation of the likelihood of pole failure in time.

However, the input assumptions from the ENA research and the selected strength utilisation factors and pole degradation with age functions need to be further calibrated with results from actual pole residual strength data for the relevant species of wood poles in Powercor's network.

The current forecast of an Unserviceable poles find rate of about 3,200 poles annually based on the draft Serviceability Index settings is still likely to be less than a sustainable rate – this find rate is equivalent to an average pole service life of 114 years, which is credible.

Powercor's use of external expertise to improve its serviceability assessment is prudent

ESV considers it prudent for Powercor to continue to access relevant expert advice as it progresses its serviceability assessment improvement initiatives.

Powercor has participated in an inaugural Australian utility pole conference hosted by the University of the Sunshine Coast with the intention to create a national centre for timber durability and design life research at its campus. If it is established, the national centre may be a useful means for Powercor to cost-effectively participate in relevant research to accelerate improvements to its wood pole serviceability assessment.

Powercor's decision to not adopt wood scanning technology for inspection of all wood poles is prudent

Assessing the remaining life of a wood pole and how that changes over time as it approaches failure is difficult. The ground line inspection techniques have several drawbacks and asset managers have been seeking alternatives for at least 20 years.

Powercor's research has determined that, currently, there is no 'silver bullet' NDI technique or combination of NDI techniques to replace SDD. Cognisant of this, ESV considers that:

- Powercor's application of the currently available wood scanning techniques to supplement the ground line inspection techniques is prudent
- Powercor's rationale for not adopting currently available wood scanning technology for inspection of all wood poles is prudent
- Powercor's investigation of alternative NDI techniques is consistent with good practice.

A number of Victorian and interstate distribution businesses continue to conduct their own independent investigation of the various NDI technologies. There are cross business discussions occurring, but not a coordinated approach to research and development.

Powercor's serviceability assessment improvement initiatives are likely to result in a higher number of poles being classified as Unserviceable

From the information provided by Powercor, implementing the proposed new serviceability criteria in its proposed Enhanced Pole Calculator is likely to result in high numbers of poles being classified as Unserviceable and higher wood pole replacement/reinforcement volumes, which ESV supports.

Whilst ESV considers that Powercor is on the right track with its improvement initiatives, the serviceability settings in the proposed Enhanced Pole Calculator are preliminary, and will need to be calibrated over time with actual data from the field.

It should be possible to accelerate the calibration process, with a comprehensive pole investigation study to provide more data in a shorter timeframe.

11.4. Pole Interventions

Powercor's current wood pole intervention methodology is inconsistent with good practice and is unlikely to support sustainable safety outcomes

Powercor's current approach is largely based on the likelihood of failure as the criterion for pole interventions. Whilst this is likely to be adequate for poles classified as Unserviceable P1, for which the likelihood of failure is very high and should be replaced 'immediately', the lack of explicit consideration of the consequences of a pole failure means that Powercor is not adequately assessing the risk posed by each pole.

Because of the limitations of its risk assessment methodology, Powercor does not adequately account for the risk of pole failure in determining the appropriate intervention nor the appropriate timing of the interventions. Powercor's current intervention criteria are likely to mis-prioritise poles for replacement, particularly for AC Serviceable poles. ESV consider that it is likely that based on a risk-cost assessment, some AC Serviceable poles should be scheduled for replacement/reinforcement, rather than reinspection.

Powercor's planned risk asset based management (RBAM) intervention criteria are likely to improve its management of pole risk

Good industry practice is to deploy condition based risk assessment (CBRM) for assets, including poles. Powercor intends to use CBRM to assess the risk of each pole.

Powercor's proposed improvement of its intervention criteria to include risk ranking based on risk value is consistent with good industry practice. This approach will enable Powercor to prioritise the poles with the greatest risk for intervention (i.e. replacement or reinforcement) and appropriately apply other risk mitigation measures to suit the rest (i.e. increased inspection frequency and/or NDI).

If Powercor appropriately maps its proposed pole Serviceability Index scores into likelihood of failure and takes into account the cost of consequence to the community for credible events, it will have the means to prioritise its interventions based on risk. Powercor intends to populate its Copperleaf C55 software model with the relevant data by October 2020, and from the information provided, this tool is capable of producing the risk cost (or 'risk value') required for improved wood pole management.

Powercor's pole reinforcement/replacement ratio is likely to improve if it implements its new intervention criteria

Powercor 's strategy of replacing or reinforcing some AC Serviceable poles is likely to lead to increased number of reinforced poles over time. If Powercor adopts an alternative(s) to the RFD reinforcement system, this may also increase the number of poles deemed to be suitable for reinforcement.

Powercor is using a recognised pole reinforcement method

Powercor's current RFD reinforcement system is a widely used and successful technique that provides economic life extension of wood poles.

Nonetheless, drawbacks of the RFD system are (i) there are some instances where access to the pole is restricted when using the RFD system, and (ii) the need for bolt-holes through the pole to provide load transfer to the steel stakes (as it weakens the pole further).

Powercor's implementation of pole interventions is adequate

ESV is satisfied that there are no material issues with Powercor's well-established practice of replacing and reinforcing wood poles once they have been designated for such intervention.

Powercor's pole material selection is consistent with current industry practice

Powercor's current adoption of wood, concrete and steel as construction material for poles is consistent with other Victorian DNSP's. These materials have served the industry well and are broadly accepted as adequate and economical. Powercor's strategy to use concrete in termite areas seems logical and should continue to make material selections fit to the local pole operating environment and terrain.

Powercor's consideration of an alternative reinforcement methodology is positive

Despite the success of the RFD Reinforcement system, there are alternative reinforcement systems on the market which may prove technically and economically competitive to the current system. Powercor intends to continue evaluating alternative reinforcement systems in 2020, which ESV consider to be a positive initiative.

11.5. Performance Analysis

Powercor's assessment and reporting of unassisted pole failure statistics should be independently verified

Monitoring pole failure statistics is an important indicator of the condition and risk of the wood pole population. Currently the assessment and reporting of this data is left largely to the discretion of the asset inspection service provider and Powercor asset managers based, at least in part, on subjective criteria.

Powercor has experienced a decrease in find rates for poles in poor condition leading to a reduction in pole interventions, whilst observing an increasing number of failures

Powercor currently only identify 4.2 per cent of poles as AC serviceable (poles in the latter stage of their lifecycle). Given the current approach has achieved 53 years as the average age a pole is replaced and there is more than 120,000 poles greater than this age, it is intuitive to conclude that a greater number of poles are approaching end of life then has been identified.

Whilst Powercor's pole failure numbers have been increasing steadily since about 2015, the number of failures per year, when compared against its peers' performance) is above the median, but not excessively so.

Powercor's pole replacement and reinforcement volumes are declining while observing an increase in the number of pole failures

Powercor's current wood pole management system has led to reducing wood poles being replaced and reinforced over the last four years. This is not sustainable given that at the same time, Powercor's wood pole failures have been increasing and Powercor has more than 150,000 wood poles over 50 years of age.

Powercor's large wood pole population of unknown timber species are managed as Class 3 durability poles is a conservative approach

Powercor currently has more than 50,000 wood poles of unknown timber species. This is where there is no pole disc or distinguishing features to identify the species of timber. All poles of this type are being managed as durability class 3 poles and are assessed with under more conservative serviceability criteria. Where there is critical pole asset data missing, it is responsible practice that Powercor acts with a greater level of conservatism.

11.6. Forecasting and Modelling

The intent of Powercor's proposed forecasting methodology is aligned with regulatory requirements

Powercor refers to key requirements of the Electricity Safety Act and the NER in claiming that:[245]

- 'through implementing a RBAM approach, Powercor's pole interventions will minimise risk as far as practicable while maintaining acceptable performance levels…' and
- the volume of pole interventions has been tested as prudent and efficient' (by being deliverable, sustainable and recurrent).

Powercor's superseded forecasting methodology was not consistent with good industry practice

If applied to the declining trend of pole defects and conversion rates (to Unserviceable), Powercor's historical trending approach would have resulted in a forecast of declining numbers of pole interventions. This is not consistent with its wood pole population characteristics and performance.

Powercor's proposed forecasting methodology is based on three components, two of which have not yet been approved nor implemented

Forecast interventions from the 'Enhanced Pole Calculator' policy are based on simulations. The Enhanced Pole Calculator algorithms, input assumptions and other parameters have not yet been finalised, approved, implemented, or calibrated. Calibration with failure investigations and field results will take up to five years.

Risk-based proactive interventions (also referred to as RBAM interventions) are also based on simulations. The methodology has not yet been finalised, approved, or implemented. Powercor does not have risk-values for its poles to enable it to forecast replacement volumes or to demonstrate that it will select the right pole at the right time for replacement or reinforcement.

This indicates that it is possible that the forecast interventions will vary considerably from the simulation volumes as the methodology is refined.

The reasonableness of the third component of the forecast pole intervention volume, Non-pole calculator, has not been demonstrated by Powercor

Powercor's forecast Non-pole calculator policy intervention volume is based on defects (e.g. fruiting body, repeat termite attack, etc), and the outcomes of its 2019 timber pole RCM study. However, ESV is unable to conclude with confidence that the forecast non-pole calculator volumes are likely to be reasonable.

Powercor's forecast interventions for 2021/22 – 2025/26 is 39,770 poles, a four-fold increase from current levels

Powercor's wood pole intervention forecast represents a more than four-fold increase compared to the average over the last four years of actual interventions. If all forecast interventions are implemented, this will improve pole safety outcomes compared to remaining at the current intervention levels.

Powercor has forecast a further 42,470 interventions over the following five year period, a 7 per cent increase on the 39,770 forecast for the 2021/22 – 2025/26 period.

Using high pole strength utilisation factors for different bushfire zones is conservative

Powercor has mapped simulated pole condition against fire classification areas (i.e. based on each pole's location) as a proxy for consequence, which is a reasonable approach in the absence of better information. It has also assumed high pole strength utilisation factors in its simulation modelling, which have the effect of increasing the number of poles classified as Unserviceable. ESV considers that applying 100 per cent and

[245] Powercor, *Powercor's Risk Based Asset Management Approach (RBAM) Wood pole forecast update, 11 November 2019,* slides 6, 7

90 per cent utilisation factors to the BCA and REFCL fire classifications is a conservative forecasting approach. ESV is supportive of a conservative approach in high consequence areas.

Powercor has not demonstrated that its forecast interventions will lead to sustainable outcomes

Whilst the proposed 400 per cent increase in annual pole intervention volumes should have a beneficial impact on pole safety risk, it is not clear to ESV how Powercor assured itself that the proposed intervention volume over the next 10 years will satisfy Powercor's claims that:

- the pole interventions will minimise risk as far as practicable while maintaining acceptable performance levels
- the volume of pole interventions has been tested as prudent and efficient.

Powercor has advised that the proposed forecast increase of its pole interventions works will have the effect of maintaining the average age of the wood pole population at 44 years. Powercor has stated that this is not its strategy, nor one of its performance measures. Powercor infers that the pole failure rate will be within an acceptable range with the proposed investments, but this has not been demonstrated to ESV.

Comparison of Powercor's forecast with alternative forecasting methodologies shows Powercor's forecast is relatively high

The outcome of Powercor's proposed intervention forecasting methodology is 76 per cent higher than the AER's Repex Model output and higher than other comparator forecasts. Powercor has provided insufficient information to conclude that Powercor's proposed forecast will lead to sustainable outcomes.

Powercor has identified four improvement initiatives which, if implemented should help, over time, provide a more robust forecasting methodology.

11.7. Wood pole intervention delivery

ESV has no significant concerns with the deliverability of Powercor's forecast replacement and reinforcement volumes.

11.8. Conclusions

ESV concludes that:

- Powercor's previous wood pole management approach was unsustainable and its cumulative pole failure risk has been increasing, despite its historical performance over the last 10 years, as measured by unassisted pole failures, being commensurate with other utilities.
- Powercor's superseded forecasting methodology was not consistent with good industry practice.
- Powercor's proposed forecasting methodology is based on three improvements to its serviceability methodology including:
    - Serviceability Index – partially implemented
    - Risk-based asset management approach – yet to be implemented
    - Non-pole calculator, including fibre degradation – to be validated.
- The reasonableness of the non-pole calculator forecast has not been demonstrated by Powercor
- Powercor's forecast interventions for 2021/22 – 2025/26 is 39,770 poles, a significant increase from current levels, which need to be validated
- Powercor adopting and fully implementing a risk-based asset management methodologies with enhanced serviceability index criteria, should lead to delivery of sustainable safety outcomes for the community
- Powercor's sound test procedure is inadequately documented and inconsistently implemented
- Powercor's auditing process to support the quality of inspection practices is inadequate.
- Powercor's 2019 asset strategy document is inadequate, specifically the identified shortcomings in its Asset Class Strategy – Poles and Towers document.

12.Recommendations

A review of the Powercor wood pole management findings, reconciled against the overall objectives, has resulted in the following proposed recommendations:

12.1. Wood Pole Management Objectives and Strategy

Powercor is to develop a wood pole management improvement plan to address the recommendations and findings, by:

- establishing an implementation plan incorporating all recommendations and associated initiatives with clear and measurable milestones for ESV's acceptance by 5.00 pm. 28 February 2020
- incorporate the agreed plan into Powercor's updated Bushfire Mitigation Plan (BMP) for ESV to monitor and enforce compliance
- updating plan(s) to include forecasted volume of intervention works agreed through regulatory period.

ESV is to, in consultation with Powercor, establish a regulatory wood pole management improvement plan progress reporting protocol, by:

- establishing reporting protocol by 28 February 2020
- monitoring and reporting progress of plan (as referenced in the updated Powercor Bushfire Mitigation Plan) on a quarterly basis until all planned recommendations have been delivered.

Powercor is to update its wood pole management documentation by:

- incorporating revised wood pole objectives, strategies, performance measures, forecast, plans and improvement initiatives
- address the identified shortcomings in its *Asset Class Strategy – Poles and Towers* document.

12.2. Inspection Practices

Powercor is to review the 'Sound' Test procedure and practice as part of the inspection and condition assessment standard in the asset inspection and training manual by:

- clearly articulating the criteria required for a 'sound' test and clarify when a sound test is to be undertaken for types of inspections
- ensuring that all inspectors understand and are adequately trained to perform 'sound' test
- implementing an audit regime to ensure 'sound' tests are consistently applied.

Powercor is to review its inspection auditing process and performance reporting to improve the quality and consistency of inspections by:

- recording and reporting inspection audits performed against individual inspectors to ensure minimum frequency audit criteria are being met
- documenting and registering the current quality classification class of individual inspectors
- implementing steps in auditing process and reporting to ensure audits are being conducted on various pole classes'
- engaging an external inspection auditor to undertake periodic independent audits of the asset inspection service provider's full inspections process to validate compliance with inspection manual.

Powercor is to provide evidence to ESV confirming that asset inspector training and competency modules and assessment comply with National Certificate II accreditation and with Powercor's asset inspection standards by:

- reviewing the asset inspection service provider's inspection training package and process to ensure they adequately translate to Powercor's Inspection standards
- reviewing the asset inspection service provider's inspectors training and competency modules and competency comply with National Certificate II
- seeking written confirmation/approval from ESV of the course training material to ensure it is contextualised to Victorian Acts, Regulations, code of practice, safety rules and industry, as prescribed in regulation 7(1)(j) of the "Electricity Safety (Bushfire Mitigation) regulations 2013".

12.3. Serviceability Assessment

Powercor is to complete the development and implementation of its Serviceability Index (SI)-based serviceability assessment methodology, by:

- continuing to focus on improving its SI-based serviceability assessment methodology

Powercor is to proactively explore (if feasible with broader industry), the development of non-destructive instrument technology to its wood poles to improve accuracy of pole condition assessments.

12.4. Pole Interventions

Powercor is to continue its proposed improvements of its pole intervention methodology, by:

- implementing its proposed pole risk-based asset management (RBAM) intervention methodology.

ESV is to monitor the progress of Powercor's pole intervention improvement initiatives, by:

- auditing the unassisted pole failure reporting.

12.5. Performance Analysis

Powercor is to improve its asset performance monitoring to include pole asset performance metrics by:

- developing the targets for its asset performance measures
- including pole risk as a performance metric to account for asset condition and consequence of failure
- establishing a ceiling threshold for the five year average failure target
- developing asset health reporting dashboards to review performance levels at regular intervals.

ESV, in consultation with MECs, is to review and establish performance indicators relating to wood pole management, by:

- reviewing the ESV reporting guidelines to include a selection of leading and lagging indicators to allow ESV to monitor the underlying condition of wood poles
- clarifying the classification of assisted and unassisted pole failures to be reported
- updating the reporting guidelines for MECs to include information as part of quarterly and annual safety performance reporting.

12.6. Forecasting and Modelling

Powercor is to finalise its proposed forecasting methodology by:

- continuing to pursue a more robust forecasting methodology, implementing its risk-based forecasting component
- demonstrating that its forecast pole interventions will minimise risk as far as practicable while maintaining acceptable performance levels
- Powercor to include the agreed forecast pole interventions for the next regulatory period when the AER's final decision is available in its Bushfire Mitigation Plan.

ESV is to monitor quarterly the wood pole performance and delivery of Powercor's forecast intervention volumes by:

- requiring Powercor to provide its forecast interventions for 2019/20 and 2020/21 and review its performance against its forecast
- holding Powercor to account for the delivery of its forecast pole intervention activity for the next regulatory reset period when the AER's final decision is available
- Participating in the AER's assessment of Powercor's wood pole expenditure forecast, providing input on network safety considerations, and to ensure safety programs that are justified to the AER are transparently monitored (e.g. through making submissions in response to the AER's issues paper and Draft Determination)
- monitoring Powercor's progress with refining its pole forecasting methodology
- working with industry to facilitate joint work on wood pole management (including forecasting).

Appendices

Appendix 1: Information sources

The following is a list of information resources that have been referred to during the review.

Item	Document Name	Doc Number
1.	Enterprise Risk Management Policy	13-10-CP0006
2.	Enterprise Risk Management Framework	13-10-CP0006
3.	CitiPower and Powercor Asset Management Policy	A-001
4.	CitiPower and Powercor Asset Management System Framework	
5.	CitiPower and Powercor Strategic Asset Management Plan	JEQA4UJ443MT-150-27604
6.	Powercor Asset Class Strategy - Poles and Towers	
7.	Asset Management Plan	PAL-AMP-02
8.	Asset Inspection manual	05-M450
9.	Network Asset Maintenance Priority Policy	
10.	Network asset maintenance policy for inspection of poles	05-C001.D-390
11.	Network Asset Maintenance Policy for management of Leaning Poles	05-C001.D-393
12.	Network Asset Policy for management of Unserviceable Poles	
13.	Powercor wood pole management, Workshop Slide pack	
14.	Powercor's draft updated Network Asset Maintenance Policy for Serviceability Assessment of Poles (Pole Calculator_1st DRAFT)	
15.	CitiPower and Powercor Safety Case	
16.	CitiPower and Powercor Electricity Safety Management Scheme	
17.	[redacted], RFD Pole Reinstatement System™ Operational Manual	01-06
18.	Enea - Pole replacement strategy methodology	
19.	Enea - Wooden pole replacements to 2050 maintaining average age	
20.	ENA, Destructive test data on power poles, Draft Report, 2015	
21.	[redacted] - Supply of Asset Inspection Services (contract)	
22.	Garvoc Fire (The Sisters) Technical Report	
23.	National Electricity Rules	
24.	Australian Energy Regulator - Industry practice application note – Asset replacement planning	
25.	Australian Energy Regulator – Regulatory Information Notices	

Appendix 2: Summary of scope tasks and accountabilities

Assessment 1 – Inspection Work Practices

Objective	(i) Understand Powercor's inspection practices and identify any issues; (ii) Understand the application of Powercor's inspection practices and identify any issues, including with repeatability and accuracy; and (iii) Recommend actions (if any) to help achieve sustainable wood pole management.	
Task Description	**Lead**	**Responsible**
– Understand inspection general industry practice (GIP) focusing on sound, dig and drill (SDD)	[redacted]	[redacted]
– Understand GIP Inspection Cert II training and competency modules	[redacted]	[redacted]
– Review Powercor's pole inspection documentation, standards, practices and application (ref: Asset Inspection Manual – Issue 2.7), including: – Validate inspection practices align with documented standards and procedures; – Understanding how its practices and application have changed over time; – Identifying any apparent anomalies and opportunities, including differences with GIP; – Focusing on the sound, dig and drill (SDD) and wood scanning procedures.	[redacted]	[redacted]
– Review Powercor's approach to ensuring inspector competency, including by: – Review training process, competency evaluation and refreshers against Cert II requirements – Procuring from Powercor any relevant internal and external audit reports on its application of the SDD and wood scanning practices and review them (if such documents are available)	[redacted]	[redacted]
– Review documentation supporting Powercor's selection of its currently utilised wood scanning technology from alternatives, including: – Procuring from Powercor any relevant external reports and reviewing them; and – Testing whether there is evidence that the methodologies are effective for the different wood species in Powercor's pole population.	[redacted]	[redacted]
– Establish the consistency of results from Powercor's wood pole inspection processes for various species, including by: – Reviewing the degradation results; and – Checking that Powercor is collecting the appropriate data often enough in the context of serviceability/risk assessment. – How is accuracy established? Validate what external audits being undertaken.	[redacted]	[redacted]
– Assess alternatives to SDD and wood scanning methods	[redacted]	[redacted]
– Review Powercor Asset Inspection service provider Governance and Management process, including service agreement documentation (exclude commercial arrangements)	[redacted]	[redacted]
– Prepare Elements Assessment report - Identify remedies (or other actions) to any issues found.	[redacted]	[redacted]

Assessment 2 – Serviceability Criteria

Objective	(i) Understand how Powercor assesses the remaining life of its poles and the actions it takes as a result of those assessments; and (ii) Recommend actions (if any) to help achieve sustainable wood pole management.		
Task Description		**Lead**	**Responsible**
– Assess Powercor's serviceability criteria and application, identifying changes over time, and any opportunities or issues, including: – Review documented standards, procedures and work practices to ensure align with how being applied. – Reviewing its analysis to support the recent change in the good wood threshold from 30mm to 35mm – rationale and engineering analysis. – How is consistency in applying the criteria established		[redacted]	[redacted]
– Analyse the results of Powercor's inspection program to determine the 'find rate' and the 'degradation rate' for the different pole species and location. – What data is (or is not) required to be captured to inform degradation and approaching end of life management. – What data should be captured? – Implications of data quality.		[redacted]	[redacted]
– Understand the influence of Powercor's Bushfire Mitigation Plan (BMP) and Electrical Safety Management System (ESMS) on the serviceability criteria for HBRA, LBRA etc.		[redacted]	[redacted]
– Assess how Powercor applies its serviceability criteria, identifying any issues.		[redacted]	[redacted]
– Prepare Elements Assessment report - Identify remedies (or other actions) to any issues found.		[redacted]	[redacted]

Assessment 3 – Pole Treatment

Objective	(i) Understand the wood pole treatment (replacement/reinforcement) practices deployed by Powercor and how and when it deploys them; and (ii) Recommend actions (if any) to help achieve sustainable wood pole management.		
Task Description		**Lead**	**Responsible**
• Understand Powercor's wood pole treatment (replacement/reinforcement) strategies and practices, including: – How they have changed over time, opportunities or issues identified; – How they compare with GIP; and – The influence of BMP and ESMS on the application of the treatments to the wood pole population – HBRA, LBRA etc.		[redacted]	[redacted]
• Assess how Powercor applies its treatment practice, including: – The resultant number of treated poles per annum; and – The treatment types applied per annum.		[redacted]	[redacted]
• Identify any issues with Powercor's treatment strategies and practices and/or how Powercor applies them.		[redacted]	[redacted]
• Assess Powercor's reinforcement criteria and application identifying any changes, opportunities or issues.		[redacted]	[redacted]
• Prepare Elements Assessment report - Identify remedies (or other actions) to any issues found.		[redacted]	[redacted]

Assessment 4 – Pole characteristics and performance

Objective	(i) Develop a comprehensive picture of Powercor's pole population characteristics (i.e. standing data), and lagging and leading indicators of pole performance and condition – preferably 10 years of historical data for each metric (where applicable). (ii) Understand Powercor's wood pole performance targets and its rationale for the KPIs and the targets themselves, including its risk tolerance; (iii) Understand the performance of Powercor's wood pole assets over time. (iv) Identify any material issues.

Task Description	Lead	Responsible
• Document and assess Powercor's wood pole fleet characteristics and performance data.	[redacted]	[redacted]
• Understand from Powercor any changes to definitions or any other changes that have or will affect the trend and/or meaning of the information need to be identified.	[redacted]	[redacted]
• Check for data integrity issues and follow up Powercor as required	[redacted]	[redacted]

• Analyse, document and graph for each pole characteristic and performance metric, including:
– age profile of pole population
– Number of poles of each species
– Number of poles actually reinforced vs replaced p.a.
– Number of poles planned to be reinforced/replaced pa
– Number of inspections p.a.
– Number of overdue inspections p.a.
– Number of pole defects identified p.a.
– Mapped to classifications (e.g. Serviceable, Added Controls Serviceable, P1, P2)
– Number of unassisted pole failures p.a. identifying:
    – cause
    – reinforced or unreinforced
    – species
    – location
    – age
    – last inspected
    – inspection result/classification
	[redacted]	[redacted]

– Number of assisted pole failures p.a. identifying: – cause – reinforced or unreinforced – species – location – age – last inspected – inspection result/classification		
• Analyse the results of Powercor's inspection program to determine the 'find rate' and the 'degradation rate' for the different pole species and location.	[redacted]	[redacted]
• Understand what Powercor's wood pole management performance targets are and the basis for them, in the context of: – Powercor's risk tolerance; and – Powercor's BMP and ESMS	[redacted]	[redacted]
– Prepare Elements Assessment report - Identify remedies (or other actions) to any issues found	[redacted]	[redacted]

Summary of Tasks – Accountability

Assessment 5 – Performance analysis

Objective	(i) Understand the performance of Powercor's wood pole population and identify any issues; (ii) Understand how Powercor analyses its wood pole asset performance and how it has responded previously to the performance, identifying any issues. (iii) Recommend actions (if any) to help achieve sustainable wood pole management.	

Task Description	Lead	Responsible
• Assess the trends of leading and lagging indicators of the condition of Powercor's wood pole population.	[redacted]	[redacted]
• Identify material variances between performance and targets, including: – Inspections – e.g. is there or has there been inspection backlogs? – Treatments – e.g. is there or has there been backlogs of pole reinforcements and/or replacements? – Unassisted pole failures – including root cause failure analysis.	[redacted]	[redacted]
• Identify any systemic issues with Powercor's performance assessment and responses, including the extent of its root cause assessment of pole failures.	[redacted]	[redacted]
• Identify how Powercor has responded to actual performance historically, including the impact on risk tolerance (e.g. St Patrick Day fires and ESV's investigation).	[redacted]	[redacted]
• Determine Powercor's approach to undertaking failure modes and effects analysis (FMEA) studies on its wood poles. – Common mode issues identified considering characteristics of each failed pole – Any forensic analysis – Sampling of removed poles to improve/validate accuracy of inspection practices and prudency of serviceability criteria	[redacted]	[redacted]
• Prepare Elements Assessment report - Identify remedies (or other actions) to any issues found	[redacted]	[redacted]

Summary of Tasks – Accountability

Assessment 6 – Activity forecasting and modelling

Objective	(i) Identify a sustainable pole treatment profile for Powercor's wood pole population.		
Task Description		**Lead**	**Responsible**
• Acquire data and information from Powercor: – Powercor's repex model – Methodology, assumptions, and data for volume and expenditure forecasting (i.e. wood pole management) – The basis for its volume (replacement/reinforcement) of wood pole activity in the current RCP – A summary of forecast changes over time to include impact, reasons and any observations – any external advice used to support any of the above.		[redacted]	[redacted]
• Assess the remaining life for each wood pole to be established.		[redacted]	[redacted]
• ESV develop a wood pole treatment model to enable scenario analysis – Risk based (condition) – considering degradation rates among various species – Age-based (age as a proxy for condition) – i.e. the repex model.		[redacted]	[redacted]
• Understand Powercor's approach to End-of Life (EOL) modelling age/condition based only or more sophisticated probability of failure with age (using Weibull-curve approximations) models		[redacted]	[redacted]
• Compare end of life forecasts (age/condition) to current staking and replacement rates to understand any impact of Bow-wave on sustainable practice and probability of failures		[redacted]	[redacted]
• Based on future modelling forecasts, assess Powercor's Delivery strategy required to facilitate work program resourcing (labour, materials, equipment) to meet BPM and ESMS obligations		[redacted]	[redacted]
• Prepare Elements Assessment report - Identify remedies (or other actions) to any issues found		[redacted]	[redacted]

Summary of Tasks – Accountability

Findings 'Challenge' session

Findings 'Challenge' Session			
Objective	(i) Ensure that the findings are balanced and defensible before devoting effort to report writing.		
Task Description		**Lead**	**Responsible**
• Prepare and facilitate the challenge session – agenda, templates, and timing (with the latter via the Project Manager)		[redacted]	[redacted]
• Resolve any issues arising from the challenge session		[redacted]	[redacted]
• Review outcomes and incorporate in draft findings and recommendations		[redacted]	[redacted]

Reporting

Objective	(i) Produce a publishable report (Public Report) containing ESV's assessment of Powercor's wooden pole management, findings, and recommendations to sustainably achieve acceptable safety outcomes in the future.		
Task Description		**Lead**	**Responsible**
• Develop a draft internal technical, compiled from the results of the six stages of assessment, to include all findings and recommendations that are generated at each stage		[redacted]	[redacted]
• Develop a final version of the internal report: taking into account all stakeholder feedback		[redacted]	[redacted]
• Prepare preliminary conclusions report for presentation to minister's office		[redacted]	[redacted]
• Develop a draft publishable version of the public technical report		[redacted]	[redacted]
• Prepare final version of the publishable public technical report – taking into account feedback from ESV stakeholders, public consultation and DEWLP		[redacted]	[redacted]

Appendix 3: Transmittal Document Register

Transmittal document - South West pole extension: wood pole management approach

Doc #	Description	Request Date	Response Date	Comments
WPM-001	S134 Information Request #2 – response by 3rd Sept '19 1. The following documents no later than 4.00pm on 3 September 2019: – The latest copy of the CitiPower/Powercor: – Corporate Risk Management Policy – Enterprise Risk Management Framework – Investment management framework – Investment approval framework – Approved risk appetite statements – The latest copy of the Powercor: – Asset Inspection Procedure, 05-P450 – Wood pole asset management plan, PAL-AMP-02 – The latest copy of the following documents referred to by Powercor in its Network Asset Maintenance Policy for Inspection of Poles (05-C001.D-390): – Powercor Guideline Asset Maintenance Definition of Terms, 18-05-G0004 – Network Asset Maintenance Priority Policy, 05-C001.D-025 – Manage Network Faults Procedure, 07-20-P0013 – Inaccessible Asset Procedure, 18-20-P0004 – Asset Maintenance Policy for Management of Leaning Assets, 05-C001.D-393 – Asset Maintenance Policy for Management of Unserviceable Poles, 05-C001.D-392 – Asset Maintenance Policy for Realignment Inspections, 05-C001.D-395 – Network Asset Maintenance Policy for Termite Management, 05-C001.D-394	16 Aug 2019	3 Sept 2019	Refer to response on T drive link: > Request 1 - response 3 September 1. Refer to response on T drive link: > Item 1 Corporate Risk_Investment 2. Refer to response on T drive link: > Item 2 Asset Inspection_Wood pole mgt plan 3. Refer to response on T drive link: > Item 3 Asset maintenance policy documents 4. Refer to response on T drive link: > Item 4 External audits_reports wood pole mgt 5. Refer to response on T drive link: > Item 5 Analysis od failed pole investigations 6. Refer to response on T drive link: > Item 6 Wood pole volume forecasts repex model 2015_2025 7. Refer to response on T drive link: > Item 7 Wood pole volumes forecasts repes model 20 years 8. Refer to response on T drive link: > Item 8 wood scanning inspection methodology analysis

	– Network asset Maintenance policy for management of hazardous poles to traffic, 05-C001.D-399. – Copies of any external audits or other reports regarding Powercor's wood pole management commissioned by Powercor over the last five years. – Provide copies of forensic analysis investigations of failed poles undertaken in the last 5 years. 2. The following information no later than 4.00pm on 3 September 2019: – Provide a copy of the worksheets for wood pole volume forecast for 2015 to 2025 period extracted from Powercor's version of the AER's repex model. – Provide a copy of the worksheets for wood pole volume for 20-year future forecast extracted from Powercor's version of the AER's repex model or other model used. – Provide the analysis underpinning Powercor's addition of the wood scanning inspection methodology to its wood pole inspection process, including: – comparisons with other inspection practices – any assessment of its effectiveness when applied to the different wood species I Powercor's pole population.			
WPM-002	S134 Information Request #2 – response by 11th Sept '19 – Provide the spreadsheets / models used for derivation of the forecast volume of wood pole replacement versus reinforcement in HBRA and LBRA for the period 2015-2020. – The business case and/or asset management plan (or equivalent) showing the forecast volumes of wood pole management for the period 2015-2020, including details of: – the scope of the plan, – key drivers of the plan, – the asset condition, – risk information relied upon in developing the forecast, – the options considered, – the financial analysis undertaken, and – any relevant models – Provide the following data pertaining only to wood poles for the last	16 Aug 2019	11 Sep 2019	Refer to response on T drive link: > Request 2- response 11 September Data response clarification T drive link: > Overview of poles data collated Request 2.docx 1. Refer to response on T drive link: > Item 1 Wood pole repl_staking forecasts 2015_2020 2. Refer to response on T drive link: > Item 2 Wood pole mgt budgets 2015-2020 3. Refer to response on T drive link: > Item 3 Wood pole data last 10 years 4. Refer to response on T drive link: > Item 4 Asset Mgt Plan pole details 5. Refer to response on T drive link: > Item 5 Wood pole mgt performance targets 6. Refer to response on T drive link: > Item 6 Pole scanning analysis

	10 years split by HBRA and LBRA:
	– number of poles actually reinforced vs replaced per year.
	– number of poles planned to be reinforced, and the number planned to be replaced per year:
	  – approved in regulatory proposal, and
	  – approved in any updates in the poles Asset Management Plan (or equivalent)
	– number of pole inspections per year showing actual vs planned
	– number of overdue inspections by month
	– number of poles identified and reason to be classified limited life or Unserviceable per year by classification:
	  – Serviceable,
	  – Serviceable - Added Controls (limited life),
	  – Unserviceable P1,and
	  – Unserviceable P2
	– number of unassisted (unassisted is caused by rot, termites, decay, wind) vs assisted (caused by vehicle, lightning) pole failures per year identifying:
	  – cause of failure
	  – whether the pole was reinforced or not reinforced
	  – classification – Serviceable, Serviceable – Added Controls (limited life) or Unserviceable
	  – wood species
	  – GPS location of pole
	  – point of failure along pole (height above ground) – if known
	  – pole age
	  – last inspection date and the inspection results
	  – impact on SAIDI and SAIFI
	– Updated tables and figures in Powercor’s Asset Management Plan (PAL-AMP-02) i.e. including data from 1 January 2014 to present:
	– Table 3.4 – Pole numbers in each Category of Poles (2009)
	– Table 3.5 - Powercor – Poles Condition Movements from Asset Inspection			

	– Figure 3.4 - Pole fires – Powercor's current wood pole management performance targets and a description of any material changes from 1 January 2014 to present. – Provide results and analysis of Pole Scanning technologies stage 1 completed 31 May 2019.			
WPM-003	Information Request: Asset Inspection Service Agreement – [redacted] Provide the following information: – A copy of the Asset Inspection Service Agreement (excluding commercial arrangements) between Powercor and [redacted], including scope, standards, training/competency, auditing, reporting etc. expectations under the contract – Nominate Key contacts and introductions for Asset Inspection – Powercor representative – [redacted] representative – Asset Inspection Manual_document # 05-M450 – currently ESV has version 2.7 issue date 19/12/2017 can you please confirm this is latest version. If not can you please arrange for the latest version to be forwarded?	9 Sep '19	11 Sep '19 9 Sep '19 13 Sep '19 11 Sep '19	Contract with [redacted] provided in 11 Sep S134 response – Link: > [redacted] - Supply of Asset Inspection Services_commercials redacted Provided in email 9 and 13 Sep Provided in 11 Sep S134 response – Link: > Asset Inspection Manual version 3.2
WPM-004	[Clarification] S134 Request 2 Item 3.1 - Historic pole replacements/reinforcements • RIN data provided is highly aggregated and prevents the analysis of underlying trends. Please provide the full SAP equipment record (Age, Class, Species and location) with location data for these numbers?	16 Sep 2019	22 Sep 2019	Refer to response on T drive link: > IC-Project-Plan-Template-8538-V1 _RIN Poles replaced and Reinforced
WPM-005	[Clarification] S134 Request 1 Item 2 - ACS Poles and Towers • Current version of Asset Management Plan is 2015 – please provide updated version?	16 Sep 2019	17 Sep 2019	The 2015 version was the latest published version but it has now been archived. Currently developing new Asset Management Plans under our ISO55001 aligned system and these will be completed this year.
WPM-006	Information Request: [redacted] Asset Inspection Work Practices - Powercor's Wood Pole Management approach for future sustainability, please provide the following information: - • Review [redacted] Cert II training and competency documentation, including individual asset inspectors • Asset Inspectors training matrix and program, including training packages (modules) for UET20612.	17 Sep '18	4 Oct '19	[redacted] advised that they will be unable to provide any further documentation relating to this review. Refer email link: > DOC/19/13490

	• Audit quality plan and methodology as well individual copies of the last 12-months auditing results and identified corrective actions for non-compliance, • Documentation of Powercor Asset Inspection and wood scanning standards and work practices, and how applied in training modules • Worksite review Asset Inspection work practices (onsite) • Worksite review of wood scanning work practices (onsite)		20 Sep '19	Auditing Strategy procedure received filed on T drive: > DOC/19/12792
WPM-007	Information Request: ESV - Powercor - Wood Pole Management Workshop 1. RCM Analysis report recently completed – pole modelling not included in ACS paper. 2. Information regarding the Sunshine Coast university pole management studies and activities 3. Process undertaken by [redacted] – Staking criteria and loading assessment analysis to determine staking suitability. 4. Documentation explaining the noted trends and work practice changes to explain diminishing replacement and staking ratios 5. In ACS, clarify the 2016 results for unassisted failures (P.22, Section 3.2.2) which is not consistent with information provided. 6. Provide results of trial (500 poles) associated with wood scanning inspection of double staked poles. 7. Provide Sounding techniques and procedures as described under condition assessment. 8. Confirm Powercor's definition for unassisted pole failures and how interpreted. 9. Confirm details and results of # of poles determined to be replaced following initial 3-month visual assessment program. 10. Provide initial draft of [redacted] pole calculator analysis 11. Details of Koppers estimates (forecasts) and approach to support Powercor's increased pole replacement forecasts 12. Provide the following: – Asset Management Policy	19 Sep '19	20 Sep '19 and 23 Sep '19	Responses received 20 and 23 Sep '19 as outlined below: 1. Refer to response on T drive link: > PF Interval Analysis - Powercor population scenarios using KM CDF 09132019 v3 2. Refer to response on T drive link: > Item 02\Australian Utility Pole Network.docx 3. Refer to response on T drive link: > Item 03\MAN-UASG-OPS-GEN-Pole Reinstatement Manual-01-06 - V6.0 - Part AB.PDF 4. Refer to response on T drive link: > Item 04\Replacement vs Reinforcement ratios comments trends and work practice change.xlsx 5. Refer to response on T drive link: > Item 5 2016 Pole Failure information (1).docx 6. Refer to response on T drive link: > Item 06\FW_Final Update Double staked pole wood scanning assessment program.msg 7. Not Available – [redacted] not sending thru to Powercor due to legal aspects. Advice received 24/9 8. Refer to response on T drive link: > Item 8 Pole failure definition.docx 9. Refer to response on T drive link: > Item 09\Visual appearance defect volumes since SAP configuration 10. Response on T drive link: > 01403 Pole Calculator_1st DRAFT 11. Response on T drive link: > Item 11\Powercor_5 year supply plan_forJohnMifsud_090919 (1) 12. Response on T drive link: >

	– Strategic Asset Management Plan – Asset Management Strategy – Asset Management Plan (draft) 13. Forecasting section – confirm interpretation of Replacement. Does it include reinforcement? 14. Forecasting – describe the detail how determined volumes associated with: a) Policy driven changes (introduced in 2019) b) Incremental wood pole replacements to maintain age of all wood poles 15. Refer Slide 29 – provide actual detail for 2018 wood pole failures by condition and cause code 16. Breakdown of AC Serviceable poles (slide 8) by wood pole durability classification.			Item 12\ACS - Poles and Towers.pdf Item 12\CitiPower and Powercor Asset Management Policy.pdf Item 12\CPPAL Strategic Asset Management Plan.pdf 13. Response on T drive link: > Item 13\Clarification of language used on some slides.docx 14. Response on T drive link: > Item 14\Serviceability threshold change (2019 policy) forecast.pdf Item 14\Enea - Pole replacement strategy methodology.pdf 15. Response on T drive link: > Item 15\ESV Item 15 - 2018 wood pole failure breakdown.xlsx 16. Refer to response on T drive link: > Item 16\Breakdown of AC Serviceable poles by wood pole durability.xlsx
WPM-008	Clarification on forecast wood pole inspection volumes	24 Sep '19	30 Sep '19	Response on T drive link: > RE_Clarification on forecast wood pole inspection volumes.msg
WPM-009	Refer WPM-006 : request for additional information and documentation: Email dated 26 Sep '19 DOC/19/12881 and Email dated 30 Sep '19 DOC/19/12882	 26 Sep '19 30 Sep '19	4 Oct '19	[redacted] advised that they will be unable to provide any further documentation relating to this review. Refer email link: > DOC/19/13490
WPM-010	Information Request – further clarification ESV-Powercor workshop, per document WPM_010 ESV Information request Powercor tranche 1. Serviceability a) a copy of: [redacted]- Recommendations for Trial," [redacted], Newcastle, 2019 b) a copy of: ENA Power Poles and Crossarms Forum, Collective (industry) destructive test data on power poles to determine the influence of preservative treatment type and species on residual fibre strength (referred to in 01403 Pole Calculator_1st DRAFT). 2. Reinforcement vs replacement 1. How did/does Powercor satisfy itself that [redacted] nails are: i. Compliant with AS/NZS 7000 (e.g. engineering certification)	2 Oct '19	9 Oct '19	Response on T drive, refer email dated 9 Oct which has majority of written responses, link: > Powercor response_RE_WPM 010 - ESV Information Request follow up Workshop.msg 1b) Refer to response on T drive link: > Item 1b _ Australian Utility Pole Workshop - pole strengh excerpt 2019.pdf

	ii. Installed correctly e.g. auditing? 3. Forecasting (2020-25) a) Item 1 – please explain how the scenario analysis provided in response to question 1 arising from our on-site meeting has been used in Powercor's other documents that illustrate forecasts for the 2020-25 period (e.g. see the extract from Item 13 in part (b), below) b) Item 13 – please provide the spreadsheet containing the development of the forecast (i.e. in accordance with the described 'formula'): c) Item 11 – please provide the spreadsheet that is the basis of this forecast per graph provided. d) Item 14: i. (slide 1) please provide the spreadsheet ii. (slide 2) please provide the spreadsheet underpinning the forecast reclassification rates S to LL, and a description of the 'additional factors' increasing the rate that were also included e) Item 16 – please provide a copy of the underlying spreadsheet 4. Other a) Please provide the source of the NEM average failures per 1,000 poles as shown in the figure below (extracted from the response to Item 4) b) The response to Item 5 indicates 26 wood pole failures in 2016. Please provide a table/spreadsheet with the updated details of the wood pole failures from 2009 – 2019 (year to date), sorted by root cause (as has been done for 2018 in [redacted] response to Item 15) c) Item 8 – please describe the process and criteria applied in practice by Powercor to assesses whether a pole failure has been caused by weather/wind pressure in excess of the design ratings of the particular failed wood pole (per the table in s3.4.11). Please give worked examples			3b) Supporting file location: Shared with ESV>2019 08_S134 request on poles>Request 1 - due 3 September > Item 7 3c) Refer to response on T drive link: > Item 3c_NAM Monthly Dashboard - August 2019.pdf Supporting file location: Shared with ESV>2019 08_S134 request on poles>Request 1 - due 3 September > Item 7 3e) Refer to response on T drive link: > Item 3e_Copy of ACS poles data request.xlsx 4b) Not required – information previously provided

WPM-011	Information Request – further clarification ESV-Powercor workshop, per document WPM_011 ESV Information request Powercor.docx 1. Slide 13 of the 3 Oct briefing pack: Estimated pole conditions from different pole calculator options (over five years) – please explain: a) the derivation of the [redacted] (80% utilisation) forecast of 14,057 Unserviceable poles over 5 years, noting that the number is significantly different to the result in Table 9 (80% utilisation, 50th percentile) of the [redacted]; and b) the basis of the derivation of the Existing Calculator forecast of 12,206 Unserviceable poles. 2. Slide 14 of the 3 Oct briefing pack- please: a) ESV understanding - use of the term 'Compliance driven' for Unserviceable Interventions, includes P1 & P2 poles generated by the draft enhanced pole calculator requiring replacement under Powercor priority business rules; b) ESV understanding - the term 'Interventions' include either replacement or reinforcement of poles or inspections annually as ACS; c) ESV understanding - the basis for nominating RBAM Interventions on 22,778 poles (which are classified as AC Serviceable from the draft Enhanced Pole Calculator), is to maintain the average age of the wood poles to 44 years; d) explain the logic behind the strategy of maintaining the average age of the pole population at the current average age over the period 2020-2025; e) explain why Powercor has assigned the 80% utilisation to the poles in HBRA, which indicates the same 'risk tolerance' as poles in LBRA; and f) provide the forecast five year total pole interventions from other sources, such as visual condition assessment, in addition to the 37,953 identified from the combination of Unserviceable Interventions and RBAM Interventions. 3. Slide 16 of the 3 Oct briefing pack - please provide: a) the basis for the BAU reinforcement volume forecast; and b) the basis for the reinforcement volume forecast from Policy driven changes 4. If as proposed on slide 16 of the 3 Oct briefing pack, Powercor	4 Oct '19	9 Oct '19	Response on T drive, refer email dated 9 Oct which has majority of written responses, link: > Powercor response_ WPM 011.msg. Also refer to extract of email with table showing individual item response on T drive link:> Extract Powercor response IR WPM011_012.docx 2d) Shared with ESV\2019 09_Information Request ESV Powercor Wood Pole Management Workshop\Item 14\Enea - Pole replacement strategy methodology.pdf; Slide 40 3b) Shared with ESV\2019 09_Information Request ESV Powercor Wood Pole Management Workshop\Item 14\Serviceability threshold change (2019 policy) forecast.pdf

	replaces/reinforces approximately 38,600 poles from 2020-25, it will still have approximately 22,000 poles over 65 years of age in its network. Given that average age at failure of Powercor's wood poles over the last few years is 51 years: a) how does Powercor reconcile the risk posed by large number of 'very old poles' remaining in the network for at least another 5 years with its 'intervention' forecast? b) how does Powercor's wood pole management strategy respond to the looming Durability Class 3 'bow wave' of end-of-life poles indicated in the line diagram on slide 9 of the 3 Oct briefing pack(noting that even more conservative maximum age scenarios were applied)?			
	5. Slide 20 of the 3 Oct briefing pack - please update slide to reflect discussions to provide: a) more detail about what will be achieved (and not achieved) in all the steps from 30 December onwards (inclusive); and b) Powercor's current plan (timing and approach) for calculating actual pole limit state loadings.		14 Oct '19	Updated briefing pack 'UPDATE - Wood pole management plan risk modelling' dated 14 October 2019 received from Powercor. Refer to T drive, link: > T:\[redacted]\Powercor pole information\South West Wood Pole Review\WPM011\UPDATE - Wood pole management plan risk modelling.msg
			23 Oct '19	Updated briefing pack 'UPDATE - Wood pole management plan risk modelling' dated 23 October 2019 received from Powercor. Refer to T drive, link: > Powercor UPDATE - Wood pole management plan risk modelling dated 23 Oct.msg
			28 Oct '19	Updated briefing pack 'UPDATE - Wood pole management plan risk modelling' dated 28 October 2019 received from Powercor. Refer to T drive, link: > Powercor UPDATE - Wood pole management plan risk modelling dated 28 Oct.msg
	WPM-015 Request for information 'updated - Wood pole management plan risk modelling' dated 28 October, per email IR WPM015 RE UPDATE - Wood pole management plan risk modelling_29 Oct.msg 1. Please explain the rationale for classifying AC Serviceable poles in BCA (ELCA) locations as C2/Compliance Driven? 2. Please explain in detail the assumptions and method for deriving the pole reinforcement and pole replacement numbers on slide 5? 3. Please confirm whether the control measures (ie Unserviceable, ACS, Serviceability criteria) will change with the new proposed pole conditions referred to on slide 4?	28 Oct '19	30 Oct '19	Response on T drive, refer email dated 30 Oct which has majority of written responses, link: > Powercor response_RE IR WPM015 RE UPDATE - Wood pole management plan risk modelling dated 30 Oct.msg

			11 Nov '19	Additional updated information provided by Powercor during review of draft Internal report considering 'errors of fact' relating to wood pole management plan risk modelling. Response on T drive, refer email dated 11 Nov, link: > Powercor response_RE UPDATE - Wood pole management plan risk modelling dated 11 Nov.msg Attachment - Wood pole management plan risk modelling_11NOV.pdf
WPM-012	Request for Asset Inspection and other Information, per email WPM012 Information Request - Inspection and other Information.msg 1. Asset Inspection Powercor monthly report (most recent) as per Contract reporting requirements. 2. A copy of the plan and completed audits including detail of non-conformances undertaken by Powercor MSO's on Asset Inspection. 3. Information outlining the basis of Powercors decision to only undertake wood scanning on P2 Unserviceable poles. 4. Electronic copy of the Powercor wood pole management presentation dated 19 September.	7 Oct '19	9 Oct '19	Response on T drive, refer email dated 9 Oct which has majority of written responses, link: > Powercor response_RE_WPM012 Information Request - Inspection and other Information.msg Also refer to extract of email with table showing individual item response on T drive link:> Extract Powercor response IR WPM011_012.docx 1. Refer to response on T drive link: > Item 1_1909 PAL-CP Asset Inspection Monthly Report.pdf 2. Refer to response on T drive link: > Item 2_Copy of Audit docs_2019 GRAPH_MOD 1.xls; Item 2_Copy of Audit docs_2019 ANNUAL FIELD AUDITS Program.xls; Item 2_Copy of Audit docs_2019 AUDIT NC ACTION REGISTER.xls 3. Refer to response on T drive link: > Item 3_[redacted]use case.pdf 4. Refer to response on T drive link: > Item 4_Pole management workshop_19SEP.pdf
	Request for further information, per email Request further information Asset Inspection progress dated 23 Oct.msg 1. Please confirm difference between P1, P2 and HBRA above ground package type? 2. What is the breakdown of types of inspections (class 1, class 2 or ACS) making up the 19,490 poles identified as behind program? Please also include breakdown between LBRA and HBRA. 3. Please define what is difference between policy date and target date – what makes up 19,490 being 'behind program'? If these are 2 separately defined dates, please include split by these categories in question 1 table above. 4. Please confirm how many suitably qualified AI there are and approximately how many poles they would complete per day?	23 Oct '19	24 Oct '19 25 Oct '19	Response on T drive, refer email dated 24 Oct which has majority of written responses, link: > Powercor response_RE_Asset Inspection progress dated 24 Oct.msg Response on T drive, refer email dated 25 Oct which has majority of written responses, link: > Powercor response_RE_Asset Inspection progress dated 25 Oct.msg

	5. Please provide report that validates AI progress per Q1 and confirm compliance that there are no poles outside due policy date? 6. Please confirm impact of program being behind and plans to recover position and by when? Currently there are 19,490 pole behind program and based upon ytd total inspections (P1, P2 and HBRA) completed this equates to ~17,000 poles per month. Add to this to the normal planned monthly program ~19,700 poles. Request for further information, per email Request further information_RE Asset Inspection progress dated 28 Oct.msg Further to our telephone conversation, could you please send through the additional risk assessments that would have been done on Chomley 2 at/or around 30/3/19, 6/8/19 and 30/10/19 (If not done yet with 2-days remaining, can I get a copy of the Click PIN notification) as I expect it is still under water. Also, can you please confirm that the remaining poles that required a risk assessment have been completed (include the risk assessment) HOSK 2 Waiting for Risk Assessment HOSK 1 Waiting for Risk Assessment	28 Oct '19		
WPM-013	Request for Document " Policy No.05-C001.D-398-Permanent Reinforcement of Wood Poles, per email WPM013 - Document " Policy No 05-C001 D-398-Permanent Reinforcement of Wood Poles.msg	11 Oct '19	14 Oct '19	Response on T drive, refer email dated 14 Oct which has majority of written responses, link: > Powercor response_ Document " Policy No 05-C001 D-398-Permanent Reinforcement of Wood Poles.msg
WPM-014	Request for additional Staking Information, per email Information Request WPM014 - Additional Staking Information Staking Information.msg 1. Wood pole reinforcement a) When did Powercor begin using the [redacted] RFD system? b) What was used before the [redacted] RFD system? c) Please confirm if Power core is considering deploying [redacted] pole reinforcement system (and/or another alternative reinforcement system)* *Note - we recall [redacted] system being discussed at the on-site	22 Oct '19	24 Oct '19	Response on T drive, refer email dated 24 Oct which has majority of written responses, link: > RE_Information Request_WPM014 - Additional Staking Information Staking Information.msg

	meeting on 10 October 2019 but not the details d) If the answer to (c) is yes, please respond to the following questions: i. When did Powercor commence discussions with [redacted] (or other supplier)? ii. Why did Powercor commence discussions with [redacted] (or other supplier)? iii. What is the status of the possible deployment of [redacted] system (or other supplier's)? Is it likely that [redacted] system/service will be retained or replaced?			
WPM-015	Refer to WPM-011	28 Oct '19	30 Oct '19	Refer to WPM-011
WPM-016	Request for information: clarifying wood scanning Business rules – wood scanning values, per email Information request_WPM016 – wood scanning criteria SF-RS 1. Confirm or otherwise that the R Factor ranges for the condition classifications in the table on slide 11 of its Sep 19 PowerPoint slide deck represent Powercor's current settings, not the table on page 15 of Network Asset Maintenance Policy for Inspection of Poles (Document No. 05-C001.D-390) 2. Confirm that the R-factor is the Working strength/pole disc strength, as indicated in slide 11 and that this is equivalent to the % residual strength in the table in D-390 3. Explain how the R factor ranges align with the Safety Factor ranges in the table in slide 11, noting for example that for a pole to be rated Serviceable: – SF ≥ 1.875 indicates 25% loss of original strength is 'permitted' R factor ≥ 1.00 indicates that the residual strength needs to be at least equal to the original strength (i.e. no deterioration is permitted	29 Oct '19	30 Oct '19	Response on T drive, refer email dated 30 Oct which has majority of written responses, link: > 1. Clarifying [redacted] Business rules - [redacted] values_1_attachment.msg 2. Clarifying [redacted] Business rules - [redacted] values_2_detail.msg 3. Attachment 390 Pole Inspection policy v4.8, link: > 390 Pole Inspection Policy - Issue 4.8.pdf
WPM-017	Request for information : Assurance of quality of replacement and new wood poles - design and installation, per email Information Request WPM-017_Assurance of quality of replacement and new wood poles - design and installation.msg Could you confirm how Powercor assures itself of the quality of the design and installation of new and replacement wood poles?	30 Oct '19	1 Nov '19	Response on T drive, refer email dated 1 Nov which has majority of written responses, link: > Assurance of quality of replacement and new wood poles - design and installation.msg

WPM-018	Request for information: clarification on the treatment of unknown wood species, per email WPM018 - Clarification on the Treatment of unknown wood species.msg Can you confirm how wood poles of unknown species are being classified and why there is a mismatch?	15 Oct '19	17 Oct '19	Response on T drive, refer email dated 17 Oct, link: > Powercor response_RE_Clarification on the Treatment of unknown wood species.msg
WPM-019	Request for information: Class 1 pole replacements - Observation for comment, per email Class 1 pole replacements - Observation for comment .msg With regards to the dataset on replaced poles (2014-2018), the Average Age of a class 1 pole replacement appears to be fairly young at ~45 years old. We have noted that quite a few have been replaced between the 15-25 years of age. Is there any explanation that may help us understand these early replacements?	16 Oct '19	29 Oct '19	Response on T drive, refer email dated 17 Oct, link: > Powercor response_RE_Class 1 pole replacements - Observation for comment.msg
WPM-020	Draft Internal technical report forwarded to: 1. Powercor requesting feedback for 'errors of fact', per email RE_Draft Internal Technical Report.msg 2. DELWP requesting feedback, per email DELWP ESV Draft Internal Technical Report into SW Poles.msg	6 Nov '19 6 Nov '19	12 Nov '19 14 Nov '19	1. Powercor response on T drive, refer email providing feedback on 'errors of fact' dated 12 Nov, link: > Powercor response_ESV draft report feedback.msg DELWP response on T drive, refer email dated 14 Nov providing feedback, link: > DELWP_Feedback - draft internal SW power poles report.msg

Appendix 4: Powercor – ESV Wood Pole Management Workshop

Workshop Agenda

Powercor – wood pole management

19 September 2019: 9.00am to 4.30pm

Powercor Offices: Market Street, Melbourne

Purpose
The purpose of the workshop is to provide Powercor with the opportunity to inform and confirm ESV's understanding of Powercor's approach to managing its wood pole assets to deliver sustainable network safety outcomes. This interactive session will broadly focus on the following discussion topics: – Governance and management framework, including asset management strategy, and risk framework – Repex forecasting methodology – Wood pole asset management plan – Inspection practices – Serviceability criteria
Participants:
Energy Safe Victoria: [redacted] - Facilitator Powercor: [redacted] Apologies: [redacted] – technical expert)

Item	Agenda Item	Duration (Indicative)	Responsible
1	**Introductions and overview**		
1.1	Introduce participants; confirm the agenda for the day	9:00 - 9:05	[redacted]
1.2	ESV overview of workshop	9:05 - 9:15	[redacted]
2	**Background**	9:15 - 9:30	Powercor
3	**Pole Maintenance Process**		
3.1	Overview of wood pole management approach	9:30 – 11:30 (includes Morning tea ~ 11:00am)	Powercor
3.2	Pole Serviceability Criteria		Powercor
3.3	Inspection Process		Powercor
3.4	Wood pole plan – Performance and historical activity		Powercor
4	**Asset Management System**	11:30 –12:30	Powercor
5	Lunch	12:30 – 1:00	All
6	**Forecast replacement volumes 2021-2016**		
6.1	Repex forecasting methodology and governance	1.00 – 2:30	Powercor
6.2	Wood pole plan – Volume outlook (replacement and staking)		Powercor
7	**Maintenance System Enhancements**	2.30 – 3:15	Powercor
8	**Implementation**	3:15 – 4:00	Powercor
9	**General Business**		
9.1	Recap of the day and confirm actions arising	4:00 – 4:30	[redacted]

Proposed Approach

- Powercor's management/SME's present information with the emphasis on describing its approach to the areas set-out.
- Interactive session that fosters 2-way conversations and questions.
- Representation of appropriate management and SME's to support an informative and constructive conversation to address questions that arise.
- Powercor to present worked examples and/or work through the underlying models to support demonstration of the process and application approach taken, particularly associated with forecasting methodologies, RCM and analytical assessments.
- A log of follow up actions or requests for further information will be documented in the course of the workshop.
- ESV requires electronic and soft copies of all Powercor presentation material to be made available on the day.
- Provide flexibility in the agenda to ensure all information is able to be conveyed to effectively clarify Powercor's approach.

Summary of Aspects to be Covered (not limited to).
Governance Framework Scope: Explore Powercor's asset management governance framework with the emphasis on the objectives, policies, processes, procedures that it has in place to: 1. Develop its asset management strategy and plans (including investment drivers, risks and opportunities, and strategic responses) 2. Link to BMP and ESMS 3. Develop and approve the wood pole programs of work (opex and capex) in the context of Powercor's portfolio of work 4. Manage the delivery of approved wood pole activity (opex and capex) 5. Provide value assurance - processes, evidence of practice, key improvements implemented and quantification of benefits. **Repex Forecasting methodology and governance (as applied to the network capex forecast)** Scope: Understanding the process and application of the repex forecasting methodology and associated governance process, including: 1. Overview of wood pole repex forecasting methodology 2. Description of changes in response to AER, ESV and other stakeholders' feedback, if any 3. Risk assessment framework, methodology and tools to achieve ALARP/AFAP, including disproportionality multipliers 4. Cost-benefit analysis for establishing the wood pole investment program – Process – Probabilistic planning tools – Other tools – Input data and key assumptions – Evaluation of benefits, costs and risk, including sensitivity analysis – Timing
Wood pole plan - performance and historical activity (replacement and reinforcement) Scope: ESV seeks to understand how Powercor's plans have changed over the last 10 years, in response to historical wood pole performance (leading and lagging indicators) 1. Characteristics of the wood pole population 2. Overview of wood pole management performance (not limited to) – Pole failure – Condemnation rates by priority criteria – Degradation analysis by class/species 3. Historical investment volumes – actual vs planned and reasons for any material variances – Inspections – Pole treatments 4. Interaction of wood pole management with BMP and ESMS

Wood pole plan – volume (replacement and reinforcement) outlook - 5, 10, 20 years

Scope*:* Provide an overview of Powercor's wood pole forecast.

Explore the application of forecasting methodologies and inputs for determining the projects and programs of work for poles, namely:

1. Asset fleet / category objectives and strategies
2. Approach to asset risk assessments, condition assessment and data quality (including CBRM, probabilistic risk assessment, if applicable)
3. Development of repex work program – including planned, conditional, reactive and major project categories
4. Forward view of age profile and asset performance based on forecast repex program (replacement/reinforcement)

Inspection practices

Scope: Understand the basis for Powercor's inspection practices and any significant changes over the last 5-10 years.

1. Overview of inspection practices and related documentation
2. Changes over time, including rationale for recent change to inspection intervals for ACS (formally limited life) poles
3. Reason for introducing wood scanning and use of this technology
4. Other inspection practices considered or being considered by Powercor?
5. How is accuracy established?
   – Have any external audits been undertaken?
6. Findings from analysis of NDT technologies Stage 1 trials
7. Overview of governance and management of Asset Inspection service provider contract performance

Serviceability criteria

Scope: Understand the basis for Powercor's serviceability criteria, including any significant changes over the last 5-10 years.

1. Overview and rationale of serviceability criteria
2. Changes over time, including rationale and engineering analysis for recent change to 'sound wood' threshold
3. Other serviceability criteria considered (or being considered) by Powercor?
4. How is consistency in applying the criteria established?
   – Have any external audits been undertaken?

Appendix 5: [redacted] Inspection Quality Reports

1. Annual Field Inspection Audit Program

Item 2_2019
ANNUAL FIELD AUDI

2. Inspection Non-conformance Action Register

Item 2_2019 AUDIT
NC ACTION REGISTE

3. Field Inspection Audit Progress Graph

Item 2_2019
Results GRAPH MO