CitiPower / Powercor Poles replacement model Peer Review

SUMMARY REPORT

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Document History and Status

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About this report

The sole purpose of this report and the associated services provided by CutlerMerz is to perform a review of CitiPower and Powercor's consequence parameters and associated risk modelling for justifying pole replacements.

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

We derived the analysis in this report from information sourced from data and information available in the public domain and provided by network operators we engaged with during the course of the review. The passage of time, manifestation of latent conditions or impacts of future events may require re-examination, further data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report. We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report has been prepared on behalf of, and for the exclusive use of, CitiPower and Powercor, and is subject to, and issued in accordance with, the provisions of the contract between CutlerMerz and Powercor. We accept no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party. No responsibility is accepted by CutlerMerz for use of any part of this report in any other context.

1 Executive Summary

In their revenue proposals, CitiPower and Powercor proposed a significant uplift in pole replacement expenditure. In their draft decision, the AER materially reduced the forecasts, citing that whist the basis of the forecast was recognised, the assumptions were not tested and there was no quantification of the risk reduction against the expenditure proposed.

To address this, CitiPower and Powercor engaged EA Technologies to update the CBRM models used to forecast the pole replacements, and to build a model to quantify the risk reduction. The pole replacement forecast is comprised of three components:

1. Compliance – this is based on a pole assessment model (CBRM) that forecasts the degradation in the structural integrity of wooden poles. Several assumptions were used to develop the model output including the amount of sound wood required for a pole to be serviceable (35mm wall thickness) and the pole tip loading.

2. Visual defects – similar to the compliance component, this covered the replacement of wooden poles due to factors that are not captured through measured degradation (e.g. the presence of above-ground rot / decay, fungal fruiting, termite activity, leaning, and lightning / fire damage).

3. Risk driven – for poles where the quantified risk of a failure was sufficiently high to warrant intervention (such as staking or replacing), even if it was technically in a serviceable condition.

CitiPower and Powercor sought an independent peer review of the model that quantifies the risk reduction with a particular focus on:

1. the assumptions that underpin the risk quantification for all three components of the forecast (excluding a review of the health index assessment that is an input to the risk model); and

2. the robustness of the risk quantification model itself

This report has been prepared by CutlerMerz and presents our assessment of the assumptions and model used in the quantitative risk assessment to justify the pole replacement forecasts for each business.

The model quantifies risks across five categories (network performance, safety, bushfire, capex and environment) with the top three categories (network performance, safety and bushfire) accounting for almost all of the risk value.

The key findings from our review are summarised below.

The risk quantification model is appropriate given the forecasting requirement	The framework used by CitiPower and Powercor is consistent with contemporary asset management and risk management practices. The models were independently developed and follow a standard methodology that aligns with the risk monetisation justification approach proposed by the AER in the *Industry practice application note for asset replacement planning*. We did not identify any material concerns with the approach being applied that would lead us to believe that investment decisions that rely on the outputs of the model would be unreasonably biased.

Assumptions that underpin the risk quantification	**Network Performance risk** The risk value is based on VCR, customers impacted and outage duration. There is no observable bias towards under or over estimating risk based on the parameters being used. **Safety Risk** The risk value is based on the Federal Government value of statistical life (VSL), disproportionality factors, and likelihood of a safety incident. Whilst the VSL being used is appropriate, the valuation of lower consequence injuries tend to be underestimated. Furthermore, the weighted average of the disproportionality factors being applied are low compared to the AER's guidance. Whilst the likelihood of an incident is higher than expected, the weighting of incidents is heavily skewed to low consequence injuries and therefore in aggregate, the value of safety risk is likely to be a low estimate of the risk. **Bushfire risk** The risk value is based on investigations into the cost of bushfires and is moderated by bushfire zones using values from the Victorian F-Factor scheme. The values used within the model tend to be conservative and may result in an underestimate in the value of the bushfire risk. **Other risks** Capex and environment risks are minor contributors (<1%) to the total quantified risk and are not unreasonable.

In our opinion, the approach and logic used in the risk model developed by CitiPower and Powercor to quantify pole replacement risk is robust and can be relied upon. The cost of consequence and likelihood of consequence values used to parameterise the model are reasonable, unbiased and are not likely to overstate the risks associated with pole replacements. On the basis that the probability of failure parameter is also appropriate (not reviewed as part of the scope), the model output can be expected to be relied upon for the justification of risk driven pole replacements

2 Background

CitiPower and Powercor submitted their initial regulatory proposals to the AER on 31 January 2020 and the AER published its draft determination on these proposals on 30 September 2020. In its draft determination, the AER raised issues with the lack of quantitative economic analysis to support forecasts for pole expenditure.

In response, CitiPower and Powercor have updated the quantification tools used to support the initial submission and extended their use to the wooden poles category. The wooden poles replacement expenditure included in the AER's draft determination was significantly lower than the CitiPower and Powercor forecast.

CitiPower and Powercor engaged CutlerMerz to provide an independent review of the consequence parameters in the models used to justify portions of the planned wooden pole replacement programmes for the 2021-2026 regulatory period. This review provides an opinion on the reasonableness of the risk parameters with regard to how they are used and interpreted within the quantification model and the reasonableness of the approach taken to using the model results to justify a portion of the forecast wooden poles replacement and reinforcement programme.

Asset input parameters (such as existing pole condition inputs) and the probability of failure function are out of scope of this review except in cases where these inputs have a direct impact on the assessment of the in-scope items.

3 CBRM Model Overview

The CitiPower and Powercor Condition Based Risk Methodology (CBRM) models are economic models that can be used to justify asset interventions on the basis of risk reduction. The models are built by EA Technologies and follow a standard methodology that aligns with the risk monetisation justification approach proposed by the AER in the *Industry practice application note for asset replacement planning*[1].

The general structure of the models is:

Figure 1 - High Level Risk Value Framework

This PoF component is outside the scope of this review.

CBRM models are used by CitiPower and Powercor for many asset classes. This review only covers the Wooden Poles CBRM models for the two networks.

The CBRM models differentiate between the risk level of individual assets through the use of modifiers. The modifiers contain information about the unique circumstances of individual assets that may increase or decrease either the LoC or CoC of consequences that may occur if an asset fails.

This review covers:

- base values of LoC for all consequence types
- base values of CoC for all consequence types
- the appropriateness of the modifiers that are used
- calculations used to determine whether intervention is justified by the CBRM model outputs

[1] https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

4 Review of Intervention Justification

Under the methodology applied by CitiPower and Powercor, intervention is justified when the decrease in risk due to an intervention is greater than the annual financing cost of the intervention.

The reduction in risk due to the intervention is equal to the asset's risk in 2026 minus the risk of a brand-new asset. The use of 2026 risk corresponds to the end of the regulatory period the modelling is designed to cover. For the purposes of the modelling a reinforcement is assumed to have the same post-intervention risk as a replacement.

The financing cost represents the return on and return of capital that could be avoided if the intervention was deferred by one year. The methodology uses an amortisation type cashflow, which results in equal annual payments over the lifetime of the intervention. This differs from the actual regulatory return in the first year as the AER applies straight-line depreciation, which results in a declining return on capital over the life of the asset. However, an amortisation approach takes into account the decline in return on capital over the lifetime of the asset so is appropriate to use as a hurdle rate from a financial modelling perspective.

Table 1: Intervention Justification Parameters

	Discount rate	Time period	Cost	Required annual payment
Reinforcement	2.75%	10 years	$1,295	$149.88
Replacement		51 years	$10,012	$367.44

The time period used to calculate the annual payment for reinforcement is set at 10 years, which reflects a reasonable expectation for pole life extension following a reinforcement. A period of 51 years is used for pole replacements. This corresponds with the standard asset lifetime used by Powercor for distribution assets and also reflects the period over which regulatory depreciation is applied to the asset.

The pole replacement cost is the same for all poles and does not consider differences between pole cost based on factors such as voltage, line type, line capacity and pole attachments that may affect the cost of replacement.

CitiPower and Powercor assume that all poles that have not previously been reinforced will be reinforced rather than replaced, even if the target for replacement is met. Only poles that are already reinforced are eligible for replacement and are only justified if the higher hurdle for replacement is met.

5 Review of Failure Modes

The CBRM models contain three failure modes, Minor, Significant and Major. These correspond to the following definitions:

- Minor: pole conditionally fails an inspection and requires reinforcement
- Significant: pole conditionally fails an inspection and requires replacement
- Major: pole fails in service, resulting in a consequence

Although the first two failure modes do not result in any consequence, they require an intervention by the asset owner (i.e. reinforce or replace). As the CBRM model is used to calculate the quantity of interventions that are justified on an economic risk basis, it must produce a risk forecast for a no-intervention scenario. The likelihood of a pole failing will be heightened if a condition assessment identifies the need for intervention but that proposed intervention does not proceed. Therefore, a probability of a Major failure given no intervention, and the associated risk consequences of such a failure, is included in the risk model.

The Major failure mode is calibrated on the basis of existing asset management practices continuing, which requires reinforcement and replacement interventions to be undertaken as required following a conditional failure identified during an inspection. Therefore, the addition of risk (and Major failures) tied to the Minor and Significant failure modes does not introduce double counting of risk.

For example, for network performance, the CBRM model uses the following modifiers for risk consequences by failure mode:

Failure Mode	Risk modifier factor
Minor	0.01
Significant	0.05
Major	1.00

If a Major failure occurs, the normal level of risk is realised as this failure mode represents a pole functionally failing. If a Minor or Significant failure occurs and the asset is not reinforced or replaced, the CBRM model assumes that there is a 1% or 5% probability the pole will functionally fail within the model period (2021 to 2026).

The consequence parameters (discussed in Section 6) are based on a major failure. Therefore, the risk modifiers in the table above are required to lower the risk associated with the Minor and Significant failure modes.

Validating the reasonableness of the modifiers for the Minor and Significant failure modes is challenging as empirical data to support the values used is not readily available. Validation may be theoretically possible by collecting residual strength data on every pole replaced, such as by stressing the pole until it breaks or cutting it to measure actual remaining wood and then applying a model to determine actual probability of failure. Such invasive approaches are not possible for reinforcements as the pole must remain intact.

The assumptions used by CitiPower/Powercor appear conservative as they suggest that only 1 in 100 poles identified for reinforcement would fail and 1 in 20 poles identified for replacement would fail. Such low rates of avoided failures are typical of risk-averse utility operators that are required by legislation to keep risks as low as reasonably practicable.

In a real-world situation every pole identified for reinforcement or replacement would be expected to fail within a relatively short span of time and if a network stopped reinforcing or replacing poles the failure rate of the identified poles would rise to close to 100%. The CBRM model has to trade-off the medium term near certainty of failure with shorter-term horizons that may be used for determining interventions. The risk modifiers for the Minor and Significant failure modes need to sit somewhere between the probability the identified pole would fail in the next year and the probability it would fail in the long-run.

6 Review of Consequence Value Parameters

6.1 Overview of Consequences

The CBRM models contain six risk categories, of which five are used in the poles CBRM. The contribution to total risk in 2020 from each risk category for Powercor is shown in the table below:

Table 2: Modelled Risk (2020)

Consequence	Powercor Risk Contribution (2020)
Network Performance	49%
Safety	20%
Bushfire	31%
Capex	1%
Environment	<1%
Opex	N/A

The focus of our review has been on the top three consequence types as the remainder make only a negligible contribution to total risk. The following sections present the key assumptions used in the CBRM models for each risk category and our assessment of the reasonableness of the assumptions.

6.2 Network Performance Risk

Network performance risk covers the cost to customers of network outages. The CBRM models use an unserved energy approach to valuing this risk:

$$Network\ Performance\ Risk = Unserved\ Energy * VCR$$

Where:

*Unserved energy = Max demand per customer * Load factor * Outage duration * # customers affected*

VCR = Value of Customer Reliability ($/MWh)

The amount of unserved energy is based on an estimate of the amount of load that will be interrupted and the duration of the outage. As CitiPower and Powercor do not record these values for individual poles, data from other parts of the network are used to approximate the network performance risk for each pole.

Parameter	Description of source	Value
Max demand per customer	Annual max demand of the zone substation upstream of each pole divided by the number of customers supplied by the substation	Varies by location

Load factor	Weighted average load factor across all zone substations excluding customer owned zone substations	0.42
Outage duration	Estimate per network determined by SMEs to account for average response times, redundancy, etc.	CitiPower: 30 minutes Powercor: 60 minutes
# Customers affected	HV: number of customers supplied by HV feeder LV: known or default value of 100 customers	Varies by location and voltage
VCR	Consumption weighted average of AER 2019 VCR values for each network	CitiPower: $39,886/MWh Powercor: $41,691/MWh

The parameters are supported by data except for the outage duration assumptions. As the outage is for a pole failure, which is a reasonably significant repair task, the assumed durations appear conservative, especially for parts of the network without redundancy that will require a pole replacement before all load can be restored.

The CBRM models do not differentiate between the types of customers affected by outages in different parts of a network. By using a network average VCR, the model overstates risk in majority residential areas which would have a lower than average cost of consequence (i.e. lower VCR) while understating risk in industrial areas. This is likely to extend to overstating risk for most LV poles, which generally carry lower value residential loads as opposed to HV poles on which most industrial load is carried.

There is also no differentiator for the duration of outages where supply redundancy may exist. Where there is no redundancy, outage duration is based on the time to locate the fault and replace the failed asset, however if redundancy is present, outage duration should only cover the expected switching time. This is partly covered by the difference in average outage duration assumptions between CitiPower and Powercor, as CitiPower' s much denser network has more redundancy and therefore lower average outage durations.

These are not major issues as on average the VCR and outage duration is reasonable so there is no bias towards under or over estimating risk and the need for interventions, but it does reduce the quality of the results.

6.2.1 Consequence modifiers

The CBRM models use two consequence modifiers for network performance risk.

1. The number of HV protection devices on the feeder (HV poles only). More devices reduce the network performance risk as less customers are expected to be affected by an outage
2. If an HV protection device is attached to the pole. If a device is on the pole, it is unable to be used if the pole fails, which increases network performance risk

These modifiers provide an approximation of how switching may allow the extent of the outage to be limited. Without access to better data and a significant increase in model complexity, these modifiers are a reasonable way to incorporate switching into the model.

The values used for the first modifier assume 70% of feeder customers will experience an outage if one protection device is present, dropping to 60% for 2, 45% for 3 and 35% for four or more protection devices. The accuracy of these assumptions is highly sensitive to the feeder topology, including branching, the extent of n-1 segments and the distribution of customers along the feeder. If there is one device (by far the most common value in the models) positioned halfway along a feeder with customers equally dispersed along the feeder, a failure beyond the position of the switch would affect 50% of customers and a failure before the switch would affect 100% of customers. There is a 50% chance that a pole failure occurs in front of the switch or behind it, resulting in an average proportion of customers affected of 100%*50%+50%*50%=75%, which is similar to the value used in the CBRM models. Therefore, at a high level and without reviewing actual network structures, the modifiers are within the reasonable range.

The second modifier increases the outage extent by 70% if a protection device is attached to the failed pole. Considering the values used for a single protection device on a feeder, if the lone protection device is on the failed pole, the outage would increase from 75% to 100% of customers, an increase of 33%. Therefore, for the 70% increase to be reasonable, the duration of the outage must increase by 70%-33%=37% (equivalent to 11 minutes for CitiPower and 22 minutes for Powercor) to justify the value used as the modifier. This does not appear unreasonable for the additional complexity of restoring all load when a protection device is rendered inoperable.

6.3 Safety Risk

The CBRM models quantify safety risk for three possible severity levels, fatality, serious injury and minor injury, where each severity level has a different likelihood and cost. The models also apply a disproportionality factor in line with the requirements of AS5577.

6.3.1 Cost of Consequence

6.3.1.1 Fatality

The CBRM models value a fatality using the Value of Statistical Life approach. The models use $4.8m per fatality, which is based on the Value of Statistical Life (VSL) published by the Department of Prime Minister and Cabinet and escalated to 2020 dollars. This source is commonly used in the electricity industry.

6.3.1.2 Serious and minor

The CBRM models use a value for a Serious safety consequence of 15% of a fatality. This is a conservative estimate of the value of a serious injury. A common approach is to use disability weightings, which is also suggested in the VSL paper published by the Department of Prime Minister and Cabinet. This produces an estimate for serious injuries such as amputations of 30% of VSL, which is double the 15% used in the CBRM models.

The minor risk, valued at ~3% of VCR, is reasonable for a minor non-permanent injury when assessed against the same source for disability weights.

6.3.2 Disproportionality factors

The model uses a sliding scale of disproportionality factors as shown in the table below:

Table 3: CBRM Model Disproportionality Factors

Consequence Severity	Disproportionality Factor
Minor	1
Serious	2
Fatality	3

AER guidance is for a disproportionality factor of 3 for worker safety and 6 for public safety[2]. Many networks use a sliding

[2] https://www.aer.gov.au/system/files/Final%20decision%20-%20SA%20Power%20Networks%20distribution%20determination%202020-25%20-%20Attachment%205%20-%20Capital%20expenditure%20-%20June%202020.pdf Page 5-27 footnote 54

scale so that higher values, usually a disproportionality factor of 10, are applied to fatalities while the average value across all safety consequences falls within the AER guidance range.

The CBRM models use a disproportionality factor of 3 for fatal consequences. This value is typically used for worker safety consequences. As failed pole are most likely to present a risk to the public rather than workers, this disproportionality factor is lower than the typical values of between 6 and 10.

It is common for a disproportionality factor to be applied to even minor safety risks, so the use of a factor of 1 (equivalent to not having a factor) is also very conservative.

The weighted average disproportionality factor for safety risks (taking into account the relative probabilities of minor, serious and fatal consequences) is 1.3, which is very low by industry standards.

6.3.3 Consequence Modifiers

The CBRM model does not contain any consequence modifiers for safety risk.

As safety risk is typically due to members of the public being hit by falling objects and/or contacting downed conductors, population density is commonly used as a modifier for safety consequences. By not using such a factor, the CBRM models may overestimate risk in rural locations and underestimate risk in built up environments. While this has an effect on individual pole risk, this omission does not create a bias in aggregate risk calculated risk across the entire network.

6.3.4 Consequence Likelihood

The likelihood of a consequence occurring has been considered in two parts, the likelihood that any consequence occurs, and the relative likelihood that an observed consequence in each of the three severities included in the CBRM models.

6.3.4.1 Likelihood of any Safety Consequence

After a Major failure, there is a 2.5% probability of a safety consequence.

As the Powercor CBRM model is calibrated to 16 major failures per annum, this equates to a 40% annual probability of a safety consequence occurring if none of the 16 poles that will fail are proactively replaced (i.e. 2.5% x 16 = 40%). Given the 16 are presumed to be calibrated against observed failures, this implies that Powercor injures a person due to a pole failure approximately every two years.

This is high enough to be observable in historical data; however, we did not identify any recorded injuries related to pole failures. Accordingly, the Likelihood of Consequence appears to be on the high side relative to expectations. It is noted however, that safety consequences generally do not contribute significantly to the quantified risk and are not a primary driver for pole interventions.

6.3.4.2 Relative Consequence by Severity

Given a safety consequence has occurred, the CBRM models assume ~70% are minor, ~30% are serious and 0.2% are fatalities. This equates to approximately one fatality for every 500 safety incidents. Considering the likelihood of a safety consequence, this equates to one fatality for every 23,600 major pole failures.

Even though people may have some warning, such as a cracking sound, enabling them to escape the path of a falling pole, the relative likelihood of a fatality appears to be conservative. If a person is injured by a falling pole, the difference between an injury and a fatality (based on the position of the person) is likely to be on the order of centimetres, and the difference between an injury and being unscathed would be a few more centimetres. An injury due to being hit by a conductor bought down by the falling pole is expected to be fatal if energised and HV, potentially fatal if energised and LV and an injury if the line is deenergised by the time it makes contact.

Due to the above, it is reasonable to conclude that the safety consequence value is underestimated due to the underrepresentation of fatal consequences.

6.4 Bushfire Risk

The CBRM models quantify bushfire risk for two fire types, suppressed and not suppressed. Bushfire risk includes property damage and safety components and is adjusted for geographical factors.

Suppressed fires contribute only 0.6% of total bushfire risk. Due to the low contribution, this review has focused exclusively on the model parameters for not suppressed fires.

Bushfire risk is only relevant for the Powercor CBRM model. Although the CitiPower model does include fire risk, the aggregate risk is less than $1,000.

6.4.1 Bushfire Consequence Value

6.4.1.1 Base value

The bushfire risk consequence (not suppressed) has a base value of $50m. This is made up of property damage equal to $27.5m and safety risk of $22.4m.

The property damage value is the average of recent fires related to Powercor's network. The safety risk is based on the Black Saturday bushfires, which provided a safety risk starting point of $52m. As these fires occurred in a high-risk bushfire area, the $52m is divided by the BCA modifier (discussed below) of 6.95 to produce a value of $7.5m. As the bushfire royal commission figures did not include disproportionality factors, Powercor's fatality disproportionality factor of 3 was used to produce a value of $22.4m of safety risk per bushfire.

6.4.1.2 Bushfire risk zone modifier

The CBRM models adjust the bushfire risk based on the bushfire zone a pole is located in. The modifiers are derived from the parameters used in the Victorian Government's F-Factor scheme. The F-Factor scheme has two components, a geographic factor and a bushfire danger factor. Using average days at each bushfire danger level the annual average factor is 0.35. The total modifier for each zone is the zone modifier multiplied by the annual average factor.

Region	Zone modifier	Total Modifier	Value per fire
LBRA	0.2	0.07	$3.5m
HBRA	1.0	0.35	$17.5m
HBRA + REFCL	4.6	1.61	$80.7m
BCA	19.8	6.95	$347.1m

There is not a sufficient level of historical bushfire data to fully validate whether the relative risk values used by the F-Factor scheme reflect the actual difference in bushfire risk values in Powercor's network area. For example, Powercor has never had a bushfire in a BCA area, which covers only 3% of poles. The values were calculated by the Victorian Government using fire loss consequence (property damage) modelling so should be a reasonable approximation of the true risk.

The CBRM model upper estimate for risk from a bushfire, the BCA risk value, is consistent with the findings of the Black Saturday royal commission, which stated a value of $330m per bushfire. The Black Saturday value is in 2009 dollars and excludes a disproportionality factor on safety risk, so an equivalent value in 2020 would be considerably higher than the $347.1m used for assets in a BCA zone. Therefore, the BCA value appears reasonable and is within the expected range.

6.4.2 Likelihood of Consequence

The likelihood of consequence for a bushfire is dependent on the fire zone of the asset. This determines both the likelihood of a fire start and the likelihood that a fire start is suppressed.

6.4.2.1 Likelihood of a fire start

The probability of a fire start after a pole failure is set in the CBRM models to 0.25% in LBRA zones and to 5.0% in HBRA, HBRA+REFCL and BCA zones.

The probability of a fire start is dependent on the probability the failed pole causes a conductor fall or otherwise come into contact with a surface, the conductor comes into contact with a flammable object and the object is dry enough to ignite.

The likelihood of the pole failure causing a conductor failure is largely independent of location and is expected to have a reasonably high probability.

The chance to come into contact with a flammable surface will differ by area and is expected to be the main reason for the difference in the likelihood of a fire start. LBRA areas are mostly urban and therefore the conductor is more likely to land on a hard surface than in vegetation.

The probability that a flammable surface is dry enough for a fire to start may be weakly related to location. During the driest months of the year it is expected that most regions of Powercor's network will be sufficiently dry to cause a fire to start if the other conditions are met. In shoulder seasons there may be a slightly higher probability of dryness in high risk areas but the effect is not expected to be large.

Based on the above, probability of a conductor coming into contact with a flammable surface is expected to be the main justification for the difference in probability for LBRA zones. As these are mostly urban, a very low rate, such as 0.25% is reasonable and corresponds with other networks that apply no bushfire risk to urban assets.

The HBRA/BCA fire start rate of 5% is not out of line with fire start rates used in the electricity industry. Additionally, the probabilities across all fire zones imply a total of only 4 fire starts caused by poles per annum. This is in line with Powercor observing fires over recent years.

6.4.3 Suppression Chance Modifier

The CBRM models include a modifier, based on the fire region, that influences the suppression probability for a bushfire. The modifier is calculated from a bottom-up perspective based on the suppression probability in each fire zone at different fire danger levels.

The average suppression chance in LRBA zones is 99%, and 94.28% in HBRA, HBRA+REFCL and BCA zones. The difference is mostly due to Severe, Extreme and Code Red fire danger warning days, where the suppression chance drops to 5%-15%. The suppression probability is high across all zones, indicating that Powercor is only counting the most significant bushfires in the model and leaving the remainder as part of the suppressed fire risk. As noted earlier, the contribution of suppressed fires to total risk is negligible.

6.4.4 Summary

The reasonableness of the combined parameters for bushfire risk can be checked by reviewing the overall number of bushfires predicted by the model. This results in a per annum probability of at least one bushfire caused by a pole failure of 22%, or approximately one bushfire every five years. This calculation assumes no pole replacements or reinforcements.

A more practical comparison is the probability associated with the Major failure mode (which represents a pole failure that would not be detected early in an inspection), which forecasts only a 3% probability of a pole failure causing a bushfire.

This appears to be very conservative given Powercor has observed such an event in the past few years and that similar consequences have been observed multiple times across Australia in recent years.

6.5 Other Risks

6.5.1 Capex

The CBRM model includes the capital cost of a pole replacement as a risk. This is only included for the Major failure mode and does not include a cost premium for emergency repair and replace.

The replacement cost is the same for all poles regardless of voltage level and is the same value used in the intervention justification for replacement (see Section 4).

As covered in Section 5, there is an assumed probability of failure (if no intervention is made) for the Minor and Significant failure modes. Based on this and the approach used for assigning safety and bushfire risk to these failure modes, a capex risk could be included, equal to 1% and 5% respectively, of the pole replacement cost as per the definitions used for those failure model. However, as the capex risk only makes a minor contribution to total risk the exclusion of this risk for Minor and Significant failure modes is reasonable.

6.5.2 Environmental

The CBRM model includes a small cost for disposal of waste (being the broken pole) and repairing ground disturbances caused by a pole failure. This cost is not unreasonable.

6.5.3 Opex

The opex risk parameters in the CBRM models for poles are not used.