# 2023-27
# POWERLINK QUEENSLAND REVENUE PROPOSAL

## Appendix 15.01 – PUBLIC

## Setting STPIS Values

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# 1. Setting STPIS Values

## 1.1 Purpose

This appendix outlines the approach Powerlink has taken to determine performance targets, caps and floors for the Service Component (SC) and Market Impact Component (MIC) of the Australian Energy Regulator's (AER's) Service Target Performance Incentive Scheme (STPIS). The information in this appendix supports Chapter 15 Service Target Performance Incentive Scheme of our Revenue Proposal.

## 1.2 Regulatory requirements

The Australian Energy Regulator's (AER's) 2015 STPIS (Version 5)[1] requires us to propose, in our Revenue Proposal, the following values:

- performance target, cap and floor for each of the SC parameters and sub-parameters; and
- performance target, unplanned outage event limit and dollar per dispatch interval (DI) incentive for the MIC.

We have complied with the AER's requirement to set our targets for the 2023-27 regulatory period, and have used the historical data range specified by the AER[2]. The AER's stipulated date ranges are:

- for the SC: 2015-19 (Revenue Proposal) and 2016-20 (Revised Revenue Proposal); and
- for the MIC: 2013-19 (Revenue Proposal) and 2014-20 (Revised Revenue Proposal).

We have urged the AER to reconsider these historical ranges as they do not reflect the latest historical year data i.e. it does not include the 2020 calendar year data, which is the most recent data available for our Revenue Proposal, or the 2021 calendar year data for consideration as part of the Final Decision in April 2022.

We have therefore included targets set based on our most recent historical data (up to 2020 for the Revenue Proposal) for consideration by the AER. Our reasons for this are discussed further in Section 15.5.1 of our Revenue Proposal and not repeated here.

## 1.3 Appendix structure

The approach and methodology used to derive the proposed values is divided into four sections:

- Section 2 outlines the approach used to establish and develop a sound methodology.
- Section 3 contains STPIS values based on the historical data ranges specified by the AER[3]. For the SC – 2015 to 2019 and for the MIC – 2013 to 2019.
- Section 4 contains STPIS values based on our alternative proposed to use the most recent historical data. For the SC – 2016 to 2020 and for the MIC – 2014 to 2020.
- Section 5 compares the values calculated in sections 3 and 4.

[1] Final STPIS Version 5 (corrected), Australian Energy Regulator, October 2015.
[2] Reset Regulatory Information Notice (RIN) clauses 11.1 and 11.2, Australian Energy Regulator, October 2020.
[3] *Ibid.*

# 2. Approach

Section 15.5 of our Revenue Proposal provides an overview of the approach used to set our proposed STPIS targets for the 2023-27 regulatory period. This appendix complements the information in our Revenue Proposal and focuses on more detailed elements of the target setting arrangements.

The approach we used to set our STPIS targets and values for each component is detailed in the sections below. Our approach is consistent with the Rules[4], the AER's 2015 STPIS and the AER's Final Framework and Approach for Powerlink[5].

## 2.1 Service Component

We are required to propose values for the performance targets, caps and floors for the SC based on section 3.2 of the AER's 2015 STPIS[6]. The proper operation of equipment parameter requires that we 'report only' and therefore no values are required.

In our Revenue Proposal for the current 2018-22 regulatory period[7], we undertook a principled approach in calculating the performance target, cap and floor values using a sound methodology that was established by the AER in its regulatory determinations for other transmission network service providers (TNSPs)[8].

Our proposed values were accepted by the AER who determined that it was consistent with the methodology outlined in The AER's 2015 STPIS[9].

We have applied the same approach for determining targets, caps and floors for the SC parameters for the 2023-27 regulatory period:

- To calculate this performance target, we averaged the previous five years' historic performance data, consistent with clause 3.2 (f) of the AER's 2015 STPIS. When selecting suitable distributions to calculate caps and floors, we applied the following set of principles that the AER previously noted[10].
- The chosen distribution should reflect any inherent skewness of the performance data.
- The distribution should not imply that impossible values are reasonably likely. For example, the distribution for an average circuit outage rate sub-parameter should not imply that values below zero per cent are reasonably likely.
- Discrete distributions should be used to represent discrete data. For example, a discrete distribution such as the Poisson distribution should be used when calculating caps and collars for loss of supply sub-parameters. Continuous distributions should not be used.
- It is appropriate to use standard deviations to set caps and collars when a normal distribution is selected.
- When asymmetric distributions are selected, the better measure to use are percentiles. The 5th and 95th percentiles of an asymmetric distribution are the equivalent of being two standard deviations from the mean in a normal distribution.

The caps and floors have been calculated by first fitting a statistical distribution to the previous five years' performance data and then calculated as the 5th and 95th percentiles of the chosen statistical distribution.

[4] National Electricity Rules, schedule S6A.1, clause S6A.1.3(2).
[5] Final Framework and Approach Paper for Powerlink, Australian Energy Regulator, July 2020.
[6] Final STPIS Version 5 (corrected), Australian Energy Regulator, October 2015, Section 3.2.
[7] 2018-22 Revenue Proposal, Powerlink, January 2016, Appendix 15.01 - Setting STPIS Values.
[8] Draft Decision SP AusNet 2014-15 to 2016-17 STPIS, Australian Energy Regulator, August 2013, pp.184-185.
[9] Draft Decision Powerlink 2017-18 to 2021-22 STPIS, Australian Energy Regulator, September 2016, Attachment 11, p11-11.
[10] Draft Decision SP AusNet 2014-15 to 2016-17 STPIS, Australian Energy Regulator, August 2013, pp.184-185.

We acknowledge the AER's principles above, and considered a number of criteria in our process of the best fit statistical distribution selection. They must:

- reflect the inherent skewness of the data;
- be bound by the logical limits of the parameter type;
- be discrete when fitting discrete data;
- be continuous when fitting continuous data;
- preference distributions with fewer parameters rather than more; and
- be a good fit for the performance data.

We used '@RISK' software to assist in selecting the best fit statistical distribution for each set of historic performance data, except for the 'large' loss of supply (greater than 0.4 system minutes) sub-parameter, as discussed below. The software provides 'goodness of fit' data outcomes for each distribution. These 'goodness of fit' statistics are calculated using standard statistical fit tests.

Overall, we had regard to the below inputs to determine the appropriate distribution fits, and therefore the caps and floors for each performance measure:

- the results from the @RISK software;
- the AER's principles and methodology; and
- the AER's previous distribution selection preferences.

Our proposed targets, caps and floors are summarised in Table 5.1. Details of the selected statistical distribution for each SC parameter and sub-parameter are provided in sections 3 and 4.

*Alternative target proposal for 'large' loss of supply event frequency (y) sub-parameter*

We have proposed an alternative target setting approach for the 'large' loss of supply (greater than 0.4 system minutes) sub-parameter, consistent with section 3.2(i) of the AER's 2015 STPIS. Our reasons for this and consideration of why our proposed alternative target meets the requirements of the 2015 STPIS is outlined in Section 15.5.4 of our Revenue Proposal.

## 2.2 Market Impact Component

The AER's 2015 STPIS[11] requires that we propose values for the performance target, unplanned outage event limit and dollar per dispatch interval incentive for the MIC.

While the use of historical performance data to set our MIC target remains a concern for us, we have calculated our target for the 2023-27 regulatory period consistent with the methodology in Appendices C and F of the 2015 STPIS[12].

We calculated values consistent with the methodology established by the AER in Appendices C and F of the AER's 2015 STPIS[13]. The proposed performance target has been calculated in the following steps:

- Calculate a raw performance target, as the mean of five of the previous seven years of data, with the largest and smallest DI counts removed.
- Determine 17% of the raw performance target.

[11] Final STPIS Version 5 (corrected), Australian Energy Regulator, October 2015, Section 4.2.
[12] Final STPIS Version 5 (corrected), Australian Energy Regulator, October 2015, Appendix C Market Impact Component – Definition, Appendix F Market Impact Component - Application.
[13] Final STPIS Version 5 (corrected), Australian Energy Regulator, October 2015, Appendix C Market Impact Component - Definition, Appendix F Market Impact Component - Application.

- Review the previous seven years data, applying the 17% cap value to unplanned outage events and limiting them to 17% of the performance target.
- Recalculate the adjusted performance target as the mean of five of the previous seven years of adjusted data, with the largest and smallest DI counts removed.
- Compare the adjusted performance target to a minimum requirement of 100 DIs to determine the proposed performance target.

The unplanned outage event limit is calculated as 17% of the final performance target.

The dollar per dispatch interval incentive calculation is based on 1% of the maximum allowed revenue (MAR) for the first year of the 2023-27 regulatory period divided by the proposed performance target.

Our proposed performance target, unplanned outage event limit and dollar per dispatch interval incentive for the MIC are summarised in Table 5.2 in section 5. Details of the methodology for the MIC are provided in sections 3 and 4 in this document.

# 3. STPIS Values – Data Range to 2019

This section contains our proposed STPIS values based on the historical data range specified by the AER[14]:

- for the SC – 2015 to 2019; and
- for the MIC – 2013 to 2019.

## 3.1 Service Component – unplanned outage circuit event rate

The Unplanned Outage Circuit Event Rate parameter measures network reliability by using the aggregate number of fault or forced outages per annum for each of the element transmission types - lines, transformers and reactive plant. The best statistically possible performance rate for this parameter is zero. Therefore, a higher performance rate represents a less reliable network.

For each sub-parameter we have provided the following information to demonstrate how the best fit statistical distribution is selected:

- relevant historic performance data;
- fit distribution chart; and
- fit result table.

### 3.1.1 Lines event rate – fault

Our Lines Fault Event Rate performance history is shown in Table 3.1. Average of the 5 year performance is 18.92.

Table 3.1: Lines event rate – fault – historic performance 2015-2019

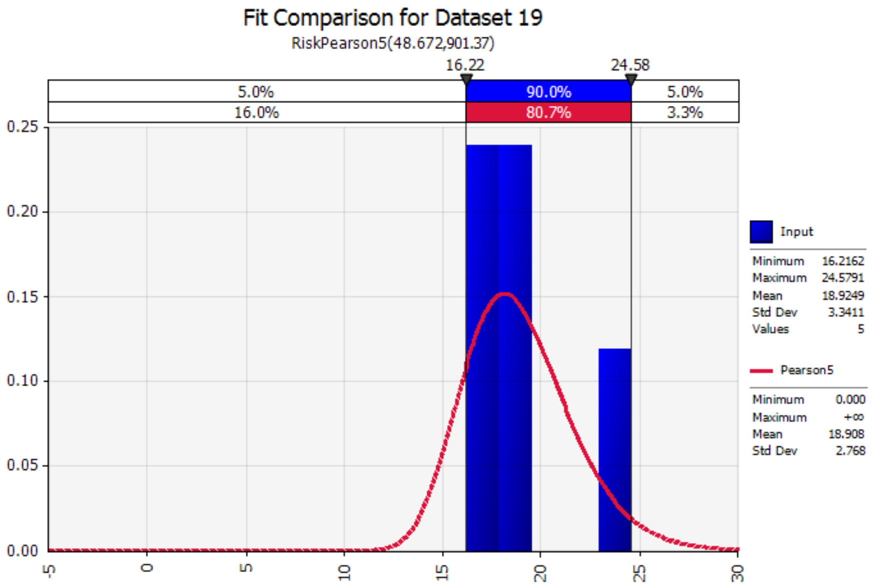
| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Lines event rate – fault | 18.52 | 16.22 | 18.64 | 24.58 | 16.67 |

We have selected the Pearson5 distribution as the best fit distribution for this parameter, as it scores the highest on both Kolmogorov-Smirnov and Anderson-Darling tests.

[14] Reset Regulatory Information Notice clauses 11.1 and 11.2, Australian Energy Regulator, October 2020.

See Figure 3.1 and Table 3.2 for the detail.

Figure 3.1: Lines event rate – fault – fit distribution




Source @RISK

Table 3.2: Lines event rate – fault – distribution percentiles

| Percentiles | Pearson5 |
|---|---|
| 5% | 14.85 |
| 95% | 23.85 |

Our proposed values for lines fault event rate is shown in Table 3.3.

Table 3.3: Lines event rate – fault –proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Lines Event Rate – Fault | 23.85 | 18.92 | 14.85 | Pearson5 |

### 3.1.2 Transformer event rate – fault

Our transformer fault event rate performance history is shown in Table 3.4. Average of the 5 year performance is 18.07.

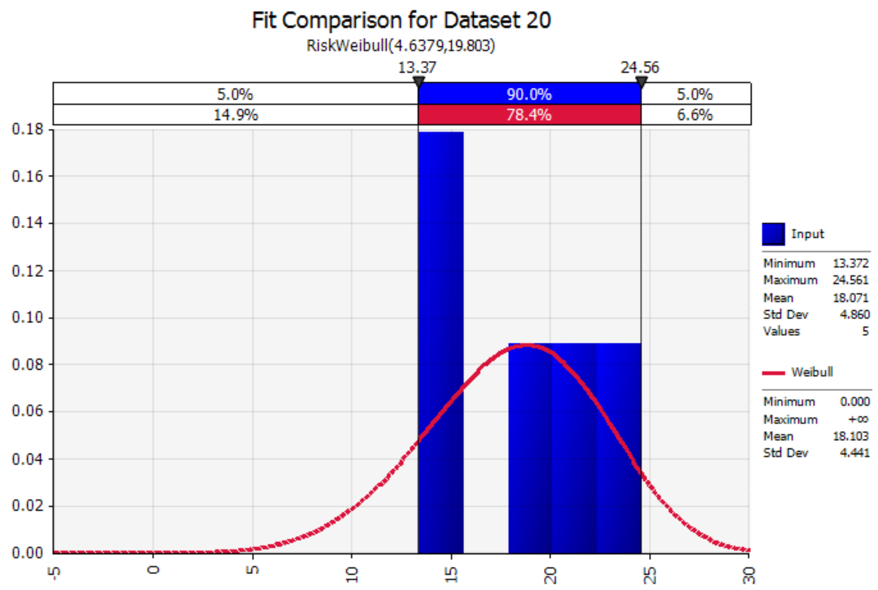
Table 3.4: SC transformer event rate – fault – historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Transformer event rate – fault | 17.92 | 13.37 | 21.05 | 24.56 | 13.45 |

We have selected the Weibull distribution as it has the best score from both Kolmogorov-Smirnov and Anderson-Darling tests.

See Figure 3.2 and Table 3.5 for the detail.

Figure 3.2: Transformer event rate – fault - distribution




Source @RISK

Table 3.5: Transformer event rate – fault – distribution percentiles

| Percentiles | Weibull |
|---|---|
| 5% | 10.44 |
| 95% | 25.09 |

Our proposed values for transformer fault event rate is shown in Table 3.6.

Table 3.6: Transformer event rate – fault – proposed values for 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Transformer event rate – fault | 25.09 | 18.07 | 10.44 | Weibull |

### 3.1.3 Reactive plant event rate – fault

Our reactive plant fault event rate performance history is shown in Table 3.7. Average of the 5 year performance is 25.60.

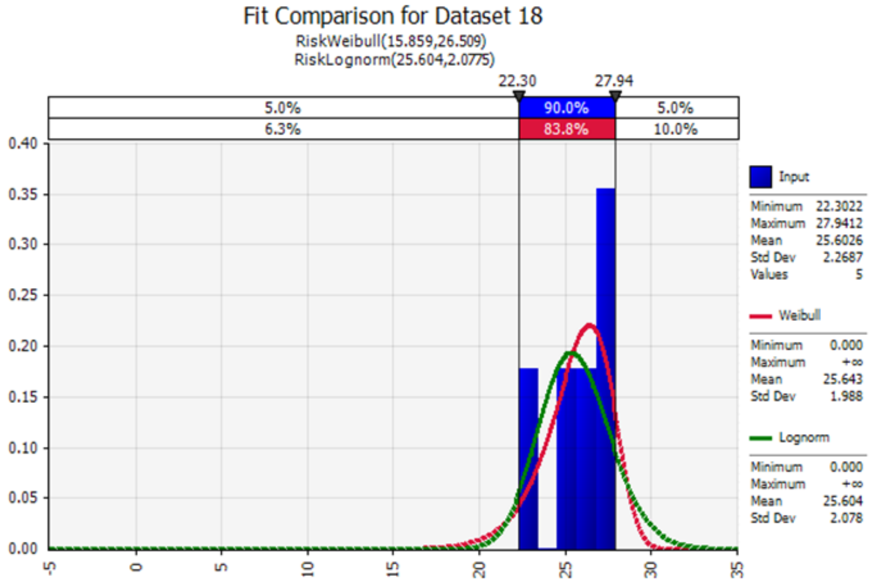
Table 3.7: SC reactive plant event rate – fault – historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Reactive plant event rate – fault | 22.30 | 25.74 | 27.94 | 27.41 | 24.63 |

We have selected the LogNormal distribution for this parameter, as it has the best fit score from the Kolmogorov-Smirnov test. While the Weibull distribution has the best fit score from the Anderson-Darling test, it scores fourth in the Kolmogorov-Smirnov test.

See Figure 3.3 and Table 3.8 for the detail.

Figure 3.3: Reactive plant event rate – fault – fit distribution




Source @RISK

Table 3.8: Reactive plant event rate – fault – distribution percentiles

| Percentiles | LogNormal |
|---|---|
| 5% | 22.34 |
| 95% | 29.16 |

Our proposed values for reactive plant fault event rate is shown in Table 3.9.

Table 3.9: Reactive plant event rate – fault – proposed values from the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Reactive plant event rate – fault | 29.16 | 25.60 | 22.34 | LogNormal |

### 3.1.4 Lines event rate – forced

Our lines forced event rate performance history is shown in Table 3.10. Average of the 5 year performance is 16.83.

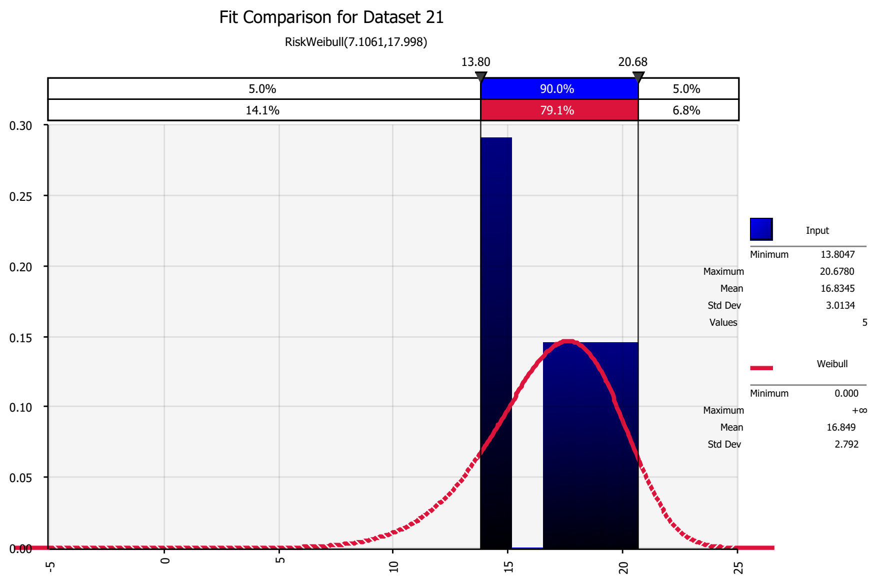
Table 3.10: SC line event rate – forced – historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Lines event rate – forced | 17.17 | 13.85 | 20.68 | 13.80 | 18.67 |

We have selected the Weibull distribution as the best fit distribution for this parameter, as it has the best fit scores from the Kolmogorov-Smirnov and Anderson-Darling tests.

See Figure 3.4 and Table 3.11 for the detail.

Figure 3.4: Lines event rate – forced – fit distribution




Source@RISK

Table 3.11: Lines event rate – forced – distribution percentiles

| Percentiles | Weibull |
|---|---|
| 5% | 11.85 |
| 95% | 21.00 |

Our proposed values for lines forced event rate is shown in Table 3.12.

Table 3.12: Lines event rate – forced – proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Lines event rate – forced | 21.00 | 16.83 | 11.85 | Weibull |

### 3.1.5 Transformer event rate – forced

Our Transformer forced event rate performance history is shown in Table 3.13. Average of the 5 year performance is 14.10.

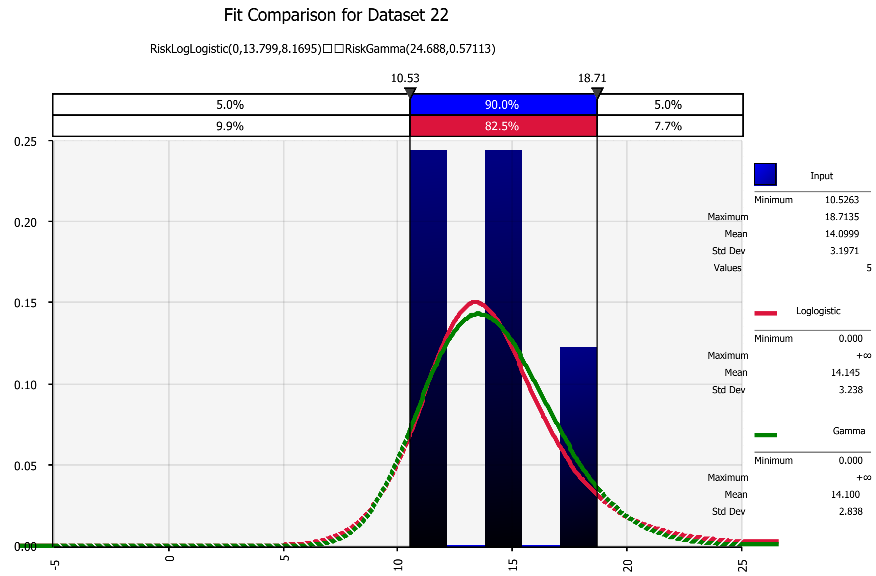
Table 3.13: SC transformer event rate - forced - historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Transformer event rate – forced | 15.03 | 14.53 | 18.71 | 10.53 | 11.70 |

We have selected the Gamma distribution as the best fit distribution for this parameter, as it has the best fit score from the Kolmogorov-Smirnov test. The LogLogistic distribution has the best fit score from the Anderson-Darling test, it scores fifth in the Kolmogorov-Smirnov test.

See Figure 3.5 and Table 3.14 for the detail.

Figure 3.5: Transformer event rate - forced - fit distribution




Source@RISK

Table 3.14: Transformer event rate - forced – distribution percentiles

| Percentiles | Gamma |
|---|---|
| 5% | 9.78 |
| 95% | 19.07 |

Our proposed values for transformer forced event rate is shown in Table 3.15.

Table 3.15: Transformer event rate - forced - proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Transformer event rate – forced | 19.07 | 14.10 | 9.78 | Gamma |

### 3.1.6 Reactive plant event rate – forced

Our reactive plant forced event rate performance history is shown in Table 3.16. Average of the 5 year performance is 21.18.

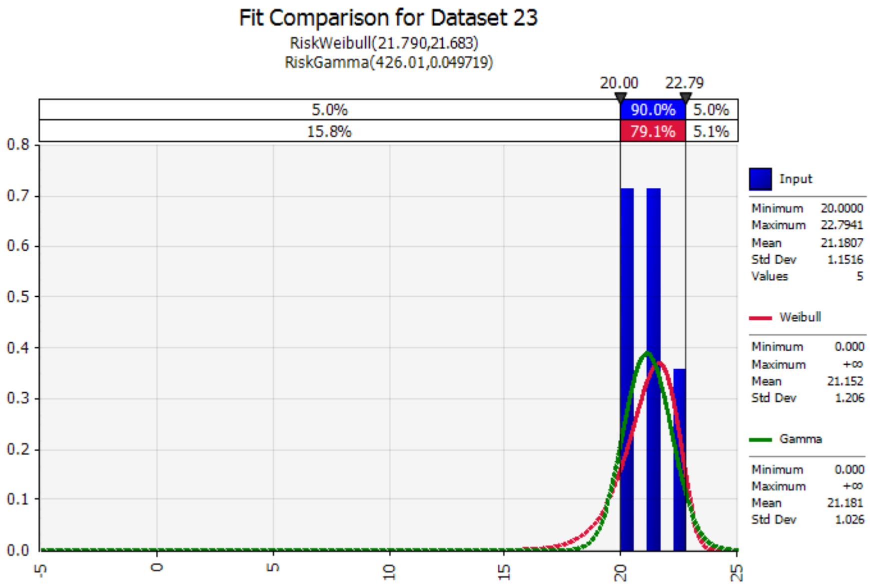
Table 3.16: SC reactive plant event rate - forced - historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Reactive plant event rate – forced | 20.14 | 21.32 | 22.79 | 20.00 | 21.64 |

We have selected the Weibull distribution as the best fit distribution for this parameter, as it has the best fit score from the Kolmogorov-Smirnov test. While the Gamma distribution has the best fit score from the Anderson-Darling test, it scores second in the Kolmogorov-Smirnov test.

See Figure 3.6 and Table 3.17 for the detail.

Figure 3.6: Reactive plant event rate - forced - fit distribution




Source@RISK

Table 3.17: Reactive plant event rate - forced - fit comparison

| Percentiles | Weibull |
|---|---|
| 5% | 18.92 |
| 95% | 22.80 |

Our proposed values for reactive plant forced event rate is shown in Table 3.18.

Table 3.18: Reactive plant event rate - forced - proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Reactive plant event rate – forced | 22.80 | 21.18 | 18.92 | Weibull |

## 3.2 Service Component – loss of supply event frequency

The loss of supply event frequency parameter measures network reliability by counting the number of loss of supply events on our network that impact our customers. Performance is measured in system minutes which are calculated using the energy not supplied for each supply interruption, divided by our peak demand value. The number of events where system minutes exceed each threshold is summed per annum. The best statistically possible performance for this parameter is zero. Therefore, a higher number of event counts represents a less reliable network.

As the Loss of Supply event frequency parameter represents discrete data, the calculated target is rounded to the nearest whole number.

### 3.2.1 Frequency of moderate loss of supply events greater than 0.05 system minutes (X Threshold)

Our loss of supply event frequency greater than 0.05 system minutes performance history is shown in Table 3.19. Average of the 5 year performance is 2.20 and the nearest integer is therefore 2.

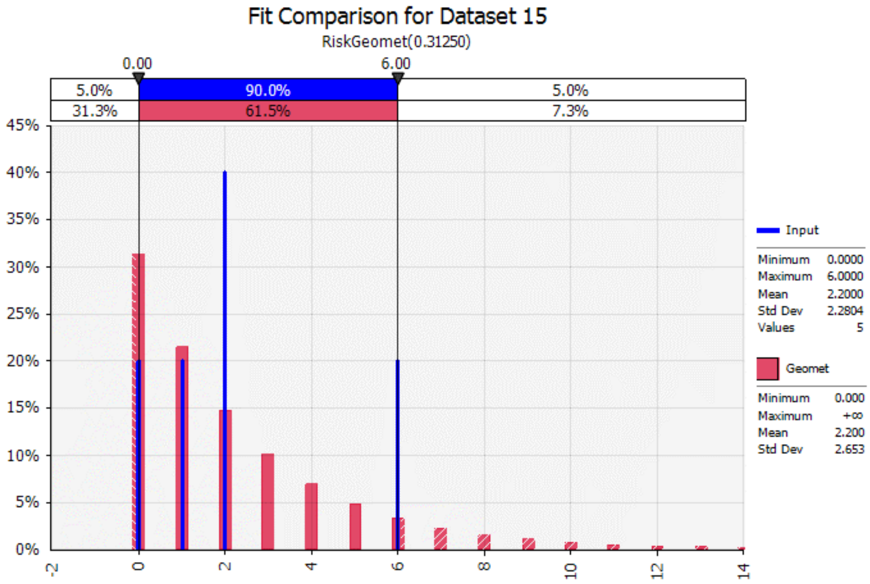
Table 3.19: SC loss of supply event frequency > 0.05 system minutes - historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Loss of Supply event > 0.05 system minutes | 2 | 1 | 6 | 2 | 0 |

We have selected the Geometric distribution as the best fit distribution for this parameter, as it has the best fit scores from all of the tests including the Akaike Information Criterion (AIC).

See Figure 3.7 and Table 3.20 for the detail.

Figure 3.7: Loss of supply X threshold - fit distribution




Source@RISK

Table 3.20: Loss of supply X threshold – distribution percentiles

| Percentiles | Geometric |
|---|---|
| 5% | 0 |
| 95% | 7 |

Our proposed values for loss of supply event frequency greater than 0.05 system minutes is shown in Table 3.21.

Table 3.21: Loss of supply X threshold - proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Loss of supply X threshold greater than 0.05 system minutes | 7 | 2 | 0 | Geometric |

### 3.2.2 Frequency of large loss of supply events greater than 0.40 system minutes (Y threshold)

Our loss of supply event frequency greater than 0.40 system minutes performance history is shown in Table 3.22.

Table 3.22: SC loss of supply event frequency > 0.40 system minutes - historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Loss of supply event > 0.4 system minutes | 1 | 0 | 0 | 1 | 0 |

The average of the 5 year performance is 0.4. The AER's 2015 STPIS[15] requires that targets are rounded to the nearest integer. This would result in a target of zero. This means that as a consequence of the improvements we have made over the 2018-22 regulatory period, there is potential for the threshold target for the large loss of supply event frequency measure to be set at zero events for the 2023-27 regulatory period.

One of the principles for the design of the STPIS is that it should provide incentives to maintain and improve the reliability of transmission network elements. We consider that a target of zero events does not support this principle.

We initially raised this issue with the AER in October 2019 as part of our request that it reviews and amends our Framework and Approach for the STPIS (SC and MIC)[16].

In its November 2019 response to this request, the AER stated that a target of zero is reasonable to incentivise a TNSP. It provided an example where a TNSP experienced 3 events in 5 years, which derives an average of 0.6 and the target that is calculated in accordance with the scheme is 1.

The AER argued that the rounding of numbers would have provided an easier target by 0.4 for the TNSP in this example. The AER concluded that due to this "benefit" from the rounding that we may have received in the past, the application of zero target to Powerlink, which would represent a "loss" or a harder target to balance out the impact of the rounding over time, is reasonable[17].

While it requires the targets be rounded, the scheme is silent in its understanding or expectation of any impact of the benefit and loss which may arise from the approach. As the "rounding" of the five year average goes both ways – up or down, we consider that the impact of the rounding has no relevance in a decision of whether or not a target of zero is appropriate for an incentive scheme.

In addition, Table 3.23 shows our event counts between 2011 and 2015, which was used to derive the target for this measure for the current 2018-22 regulatory period. The five year average was calculated as 1 exactly, with no rounding. This means that the number did not provide any easier or harder target for us to respond.

Table 3.23: SC loss of supply event frequency > 0.40 system minutes - 2011-2015

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Loss of supply event > 0.4 system minutes | 2 | 0 | 0 | 2 | 1 |

While the AER considers a target of zero is reasonable for this measure, it invited us to submit an alternative target[18]. As permitted under the AER's 2015 STPIS, we have therefore proposed an alternative target that we consider will better reflect the intent and design principles of the scheme. Our reasons for proposing an alternative target and assessment against section 3.2(i)(1) to (5) of

[15] Clause 3.2(k).
[16] Framework and Approach initiation letter, Powerlink, October 2019.
[17] Australian Energy Regulator email "Powerlink request for review of the STPIS", Australian Energy Regulator, 14 November 2019.
[18] Australian Energy Regulator email "Powerlink request for review of the STPIS", Australian Energy Regulator, 14 November 2019.

the 2015 STPIS is included in Section 15.5.4 of our Revenue Proposal and we have not sought to repeat it here.

We propose that the performance target for the large loss of supply event frequency parameter be the average performance over the relevant five year period rounded to the nearest non-zero integer. Our alternative proposed values for loss of supply event frequency greater than 0.40 system minutes is shown in Table 3.24.

Table 3.24: Loss of supply Y threshold – alternative proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Loss of supply Y threshold greater than 0.40 system minutes | 2 | 1 | 0 | N/A |

## 3.3 Service Component – average outage duration

The average outage duration parameter measures network reliability by measuring the average time it takes for a TNSP to restore loss of supply events. The average outage duration (in minutes) is calculated by dividing the annual cumulative summation of the loss of supply event duration time by the number of loss of supply events. The best statistically possible performance for this parameter is zero minutes. Therefore longer average outage duration minutes represents a less reliable network.

Our average outage duration performance history is shown in Table 3.25. Average of the 5 year performance is 69.00 minutes.

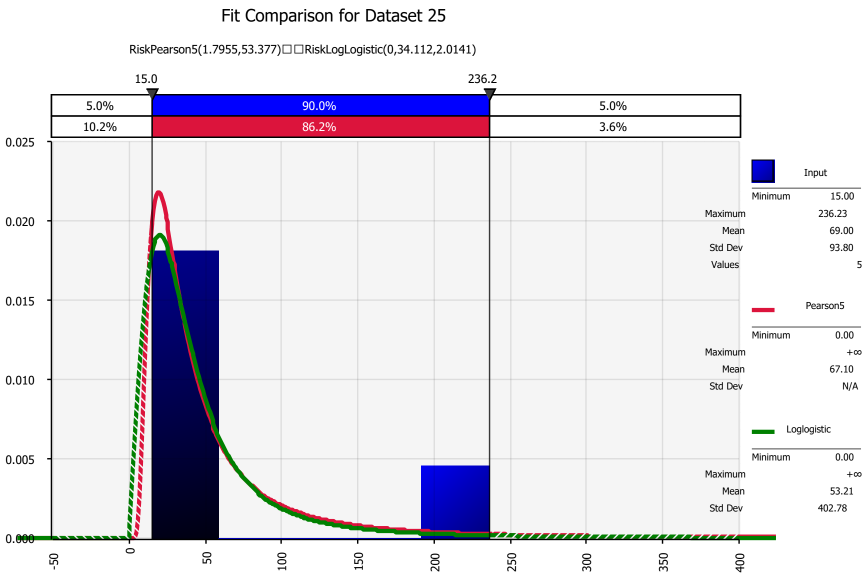
Table 3.25: SC average outage duration - historic performance 2015-2019

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Average outage duration (mins) | 236.23 | 30.06 | 27.45 | 36.24 | 15.00 |

We have selected LogLogistic distribution as the best fit distribution for this parameter, as it scores the highest on the Kolmogorov-Smirnov test. The Pearson5 distribution has the best fit score from the Anderson-Darling test, however, it scores second in the Kolmogorov-Smirnov test.

See Figure 3.8 and Table 3.26 for the detail.

Figure 3.8: Average outage duration - fit distribution




Source @RISK

Table 3.26: Average outage duration - fit comparison

| Percentiles | LogLogistic |
|---|---|
| 5% | 7.91 |
| 95% | 147.17 |

Our proposed values for average outage duration is shown in Table 3.27.

Table 3.27: Average outage duration - proposed values for the 2015-2019 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Average outage duration | 147.17 | 69.00 | 7.91 | LogLogistic |

## 3.4 Market impact component

The AER's 2015 STPIS[19] also requires that we propose values for the performance target, unplanned outage event limit and dollar per dispatch interval incentive for the MIC.

We have taken an approach consistent with the methodology that has been established by the AER in Appendices C and F of The AER's 2015 STPIS[20] to calculate these values. As we are applying the AER's 2015 STPIS for the second time, our approach is consistent with example 2 of Appendix F.

Our historic performance data is shown in Table 3.28.

Table 3.28: MIC - historic performance without unplanned outages capped 2013-2019

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|
| Planned outage events | 81 | 3936 | 64 | 7 | 62 | 160 | 13095 |
| Unplanned outage events | 16 | 5 | 1 | 35 | 11 | 286 | 838 |
| Total DIs for the year | 97 | 3941 | 65 | 42 (1) | 73 | 446 | 13933 (1) |

(1) The largest and smallest DI counts.

### 3.4.1 Applying the unplanned outage cap

We reviewed the unplanned outage events for all seven years and capped any unplanned outage event by the unplanned outage event limit that was derived and set for the 2018-22 regulatory period. This unplanned outage event cap was 57 events. The MIC historic performance data with unplanned outages capped is shown in Table 3.29.

Table 3.29: MIC - historic performance with unplanned outages capped 2013-2019

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|
| Planned outage events | 81 | 3936 | 64 | 7 | 62 | 160 | 13095 |
| Unplanned outage events (17% cap applied) | 16 | 5 | 1 | 35 | 11 | 57 (1) | 57 (1) |
| Total DIs for the year | 97 | 3941 | 65 | 42 (2) | 73 | 217 | 13152 (2) |

(1) Cap of unplanned outage events.
(2) The largest and smallest DI counts.

[19] *Final STPIS Version 5* (corrected), Australian Energy Regulator, October 2015, Section 4.2.
[20] *Final STPIS Version 5* (corrected), Australian Energy Regulator, October 2015, Appendix C Market Impact Component – Definition, Appendix F Market Impact Component - Application.

To calculate the performance target, we removed the largest and smallest counts of bound DIs from the most recent seven years' of historic data with unplanned outages capped and averaged the remaining five years. This calculated number was rounded to the nearest whole number.

We then calculated the adjusted unplanned outage event limit by applying the cap of 17% to the adjusted performance target.

As our adjusted performance target exceeded the minimum of 100 DIs, no further adjustment was necessary.

Our proposed performance target and unplanned outage event limit values for the MIC are shown in Table 3.30 and also are summarised in Table 5.2 in section 5.

Table 3.30: MIC - adjusted performance target and unplanned outage event limit

| Adjusted Performance Target | Adjusted Unplanned Outage Event Limit |
|---|---|
| 879 | 149 |

### 3.4.2 Dollar per dispatch interval incentive

We calculated the dollar per dispatch interval incentive by taking 1% of the MAR for the first year of the regulatory period, divided by the performance target as follows:

$$\frac{1\% \text{ x } \$674.5 \text{ million (MAR)}}{879} = \$7,673$$

Our proposed dollar per dispatch interval incentive for the MIC is shown in Table 3.31 and also is summarised in Table 5.2 in section 5, assuming a MAR of $674.5 million.

Table 3.31: MIC - dollar per dispatch interval incentive

| Dollar per Dispatch Interval Incentive |
|---|
| 7,673 |

# 4. STPIS Values – Data Range to 2020

This section contains our proposal based on the most recent historical data range that is specified below, for consideration for the AER's Draft Decision:

- for the SC – 2016 to 2020; and
- for the MIC – 2013 to 2020.

## 4.1 Service Component - unplanned outage circuit event rate

The Unplanned Outage Circuit Event Rate parameter measures network reliability by using the aggregate number of fault or forced outages per annum for each of the element transmission types - lines, transformers and reactive plant. The best statistically possible performance rate for this parameter is zero. Therefore, a higher performance rate represents a less reliable network.

For each sub-parameter we have provided the following information to demonstrate how it selected the best fit statistical distribution:

- relevant historic performance data;
- fit distribution chart; and
- fit result table.

### 4.1.1 Lines event rate – fault

Our Lines Fault Event Rate performance history is shown in Table 4.1. Average of the 5 year performance is 17.03.

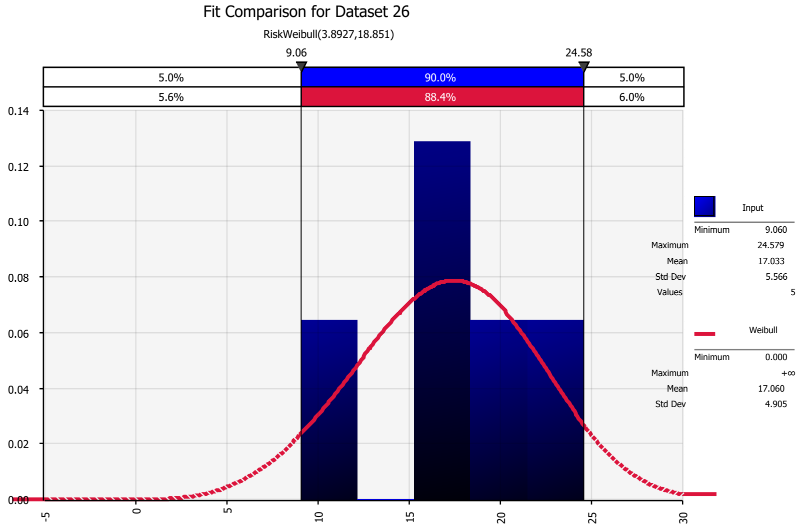
Table 4.1: SC line event rate - fault - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Lines event rate – fault | 16.22 | 18.64 | 24.58 | 16.67 | 9.06 |

We have selected the Weibull distribution as the best fit distribution for this parameter, as it scores the highest on both Kolmogorov-Smirnov and Anderson-Darling tests.

See Figure 4.1 and Table 4.2 for the detail.

Figure 4.1: Line event rate - fault - fit distribution




Source @RISK

Table 4.2: Line event rate - fault - distribution percentiles

| Percentiles | Weibull |
|---|---|
| 5% | 8.79 |
| 95% | 24.99 |

Our proposed values for lines fault event rate is shown in Table 4.3.

Table 4.3: Line event rate - fault - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Lines event rate – fault | 24.99 | 17.03 | 8.79 | Weibull |

### 4.1.2 Transformer event rate – fault

Our transformer fault event rate performance history is shown in Table 4.4. Average of the 5 year performance is 16.81.

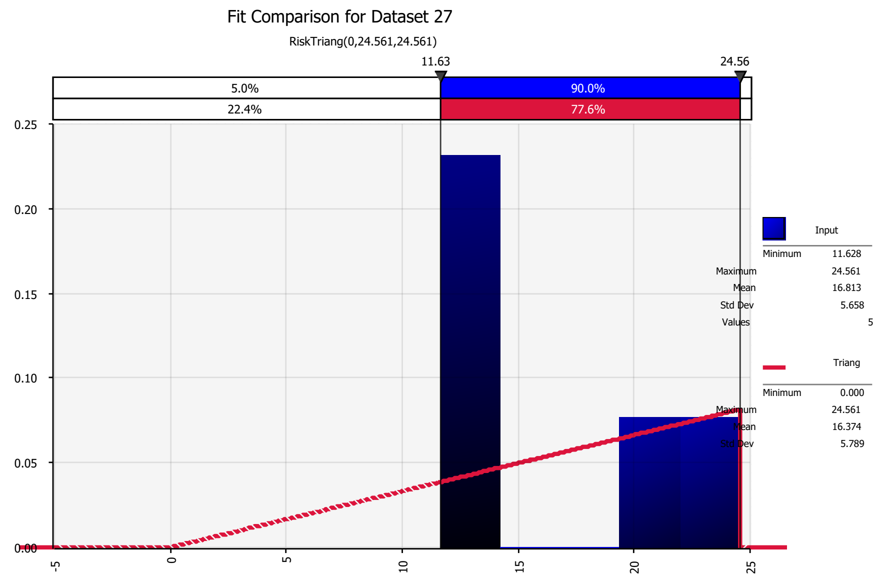
Table 4.4: SC transformer event rate - fault - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Transformer event rate – fault | 13.37 | 21.05 | 24.56 | 13.45 | 11.63 |

We have selected the Triangular distribution as it has the best Kolmogorov-Smirnov score.

See Figure 4.2 and Table 4.5 for the detail.

Figure 4.2: Transformer event rate - fault - fit distribution




Source @RISK

Table 4.5: Transformer event rate - fault - distribution percentiles

| 3 | Triangular |
|---|---|
| 5% | 5.49 |
| 95% | 23.94 |

Our proposed values for transformer fault event rate is shown in Table 4.6.

Table 4.6: Transformer event rate - fault - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Transformer event rate – fault | 23.94 | 16.81 | 5.49 | Triangular |

### 4.1.3 Reactive plant event rate – fault

Our reactive plant fault event rate performance history is shown in Table 4.7. Average of the 5 year performance is 25.65.

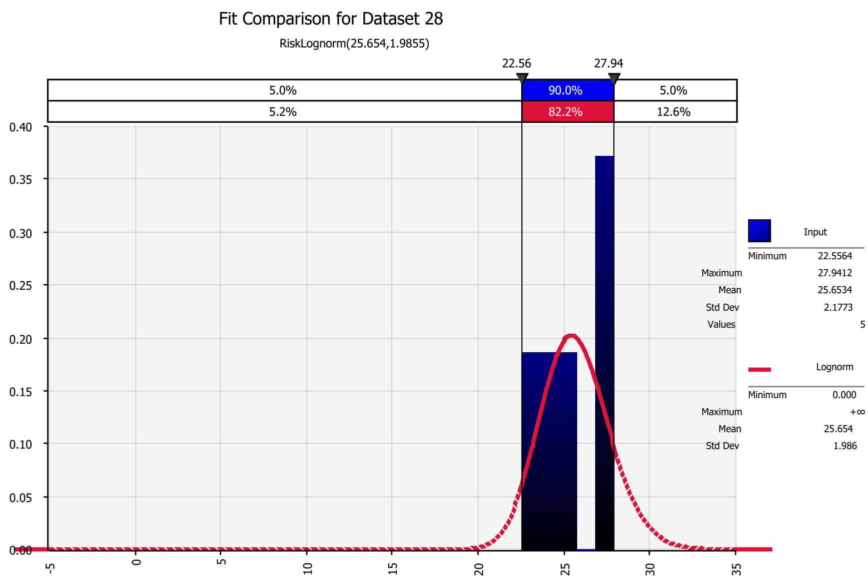
Table 4.7: SC Reactive plant event rate - fault - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Reactive plant event rate – fault | 25.74 | 27.94 | 27.41 | 24.63 | 22.56 |

We have selected the LogNormal distribution as the best fit distribution for this parameter, as it has the best fit score from the Kolmogorov-Smirnov test.

See Figure 4.3 and Table 4.8 for the detail.

Figure 4.3 Reactive plant event rate - fault - fit distribution




Source @RISK

Table 4.8: Reactive plant event rate - fault - distribution percentiles

| Percentiles | LogNormal |
|---|---|
| 5% | 22.52 |
| 95% | 29.04 |

Our proposed values for reactive plant fault event rate is shown in Table 4.9.

Table 4.9: Reactive plant event rate - fault - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Reactive plant event rate – fault | 29.04 | 25.65 | 22.52 | LogNormal |

### 4.1.4 Lines event rate – forced

Our lines forced event rate performance history is shown in Table 4.10. Average of the 5 year performance is 17.02.

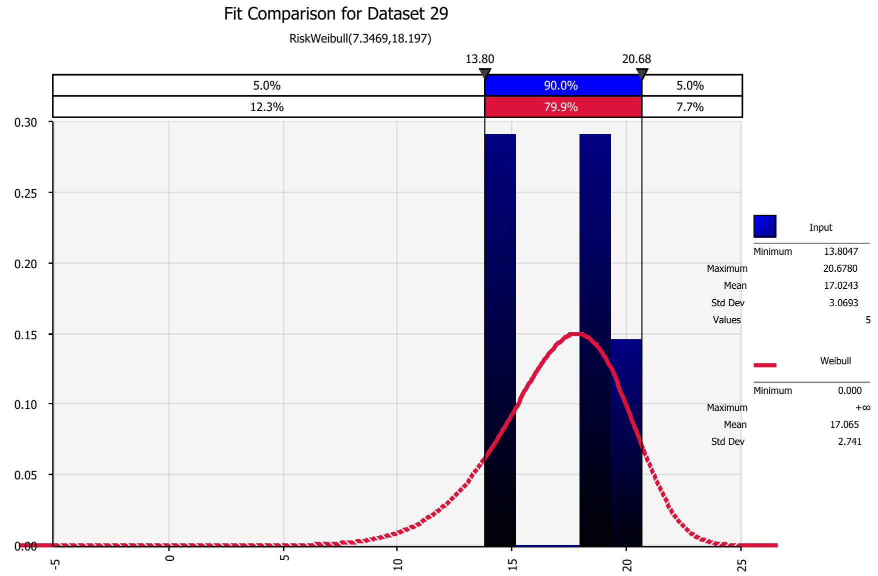
Table 4.10: SC line event rate - forced - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Lines event rate - forced | 13.85 | 20.68 | 13.80 | 18.67 | 18.12 |

We have selected the Weibull distribution as the best fit distribution for this parameter, as it has the best fit scores from the Kolmogorov-Smirnov and Anderson-Darling tests.

See Figure 4.4 and Table 4.11 for the detail.

Figure 4.4: Line event rate - forced - fit distribution




Source @RISK

Table 4.11: Line event rate - forced – distribution percentiles

| Percentiles | Weibull |
|---|---|
| 5% | 12.15 |
| 95% | 21.13 |

Our proposed values for lines forced event rate is shown in Table 4.12.

Table 4.12: Line event rate - forced - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Lines event rate – forced | 21.13 | 17.02 | 12.15 | Weibull |

### 4.1.5 Transformer event rate – forced

Our transformer forced event rate performance history is shown in Table 4.13. Average of the 5 year performance is 14.82.

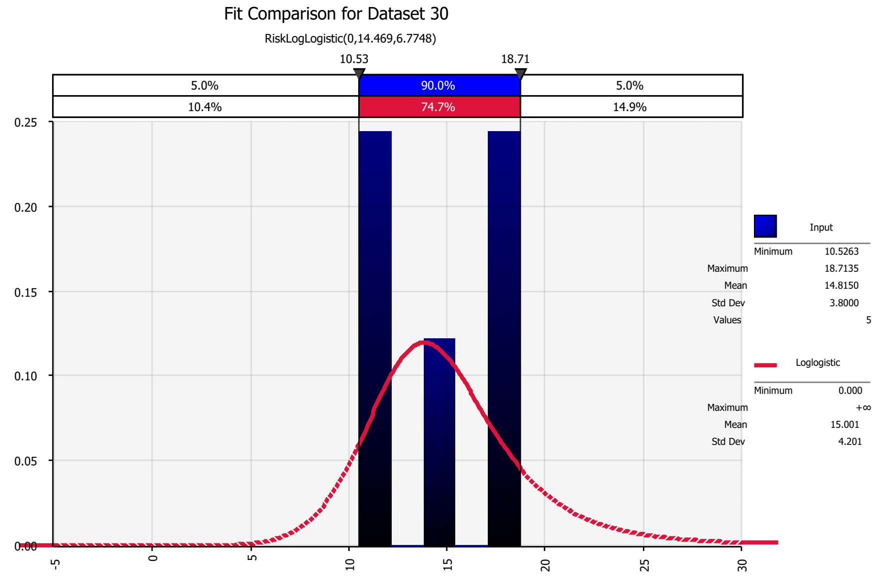
Table 4.13 SC transformer event rate - forced - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Transformer event rate – Forced | 14.53 | 18.71 | 10.53 | 11.70 | 18.60 |

We have selected the LogLogistic distribution as the best fit distribution for this parameter, as it has the best fit scores from the Kolmogorov-Smirnov and Anderson-Darling tests.

See Figure 4.5 and Table 4.14 for the detail.

Figure 4.5: Transformer event rate - forced - fit distribution




Source @RISK

Table 4.14: Transformer event rate - forced – Distribution Percentiles

| Percentiles | LogLogistic |
|---|---|
| 5% | 9.37 |
| 95% | 22.34 |

Our proposed values for transformer forced event rate is shown in Table 4.15.

Table 4.15: Transformer event rate - forced - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Transformer event rate – forced | 22.34 | 14.82 | 9.37 | LogLogistic |

### 4.1.6 Reactive plant event rate – forced

Our reactive plant forced event rate performance history is shown in Table 4.16. Average of the 5 year performance is 21.21.

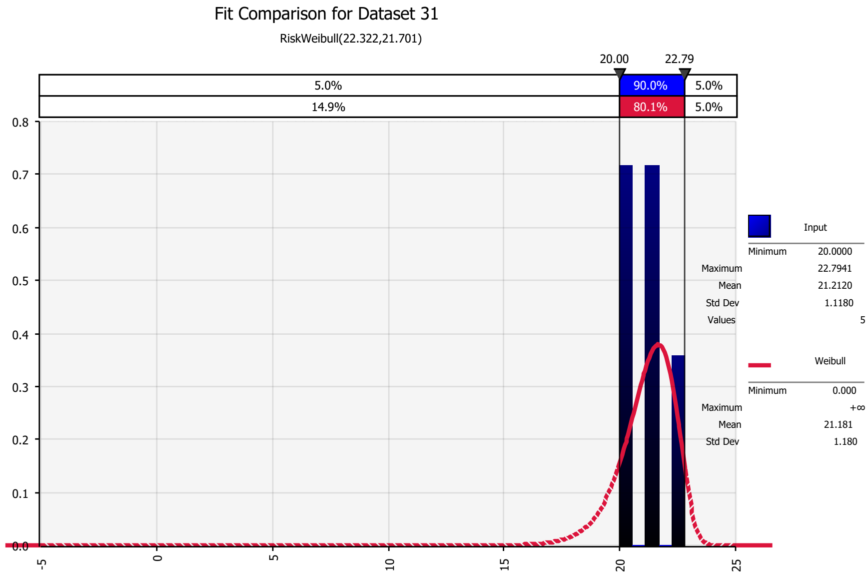
Table 4.16: SC reactive plant event rate - forced - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Reactive plant event rate - forced | 21.32 | 22.79 | 20.00 | 21.64 | 20.30 |

We have selected the Weibull distribution as the best fit distribution for this parameter, as it has the best fit score from the Kolmogorov-Smirnov test.

See Figure 4.6 and Table 4.17 for the detail.

Figure 4.6: Reactive plant event rate - forced - fit distribution




Source @RISK

Table 4.17: Reactive plant event rate - forced - fit comparison

| Percentiles | Weibull |
|---|---|
| 5% | 19.00 |
| 95% | 22.79 |

Our proposed values for Reactive Plant Forced Event Rate is shown in Table 4.18.

Table 4.18: Reactive plant event rate - forced - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Reactive plant event rate – forced | 22.79 | 21.21 | 19.00 | Weibull |

## 4.2 Service Component – loss of supply event frequency

The Loss of Supply Event Frequency parameter measures network reliability by counting the number of loss of supply events on our network that impact our customers. Performance is measured in system minutes which are calculated using the energy not supplied for each supply interruption, divided by our peak demand value. The number of events where system minutes exceed each threshold is summed per annum. The best statistically possible performance for this parameter is zero. Therefore, a higher number of event counts represents a less reliable network.

As the Loss of Supply Event Frequency parameter represents discrete data, the calculated target is rounded to the nearest whole number.

### 4.2.1 Frequency of moderate loss of supply events greater than 0.05 system minutes (X Threshold)

Our loss of supply event frequency greater than 0.05 system minutes performance history is shown in Table 4.19. Average of the 5 year performance is 2.

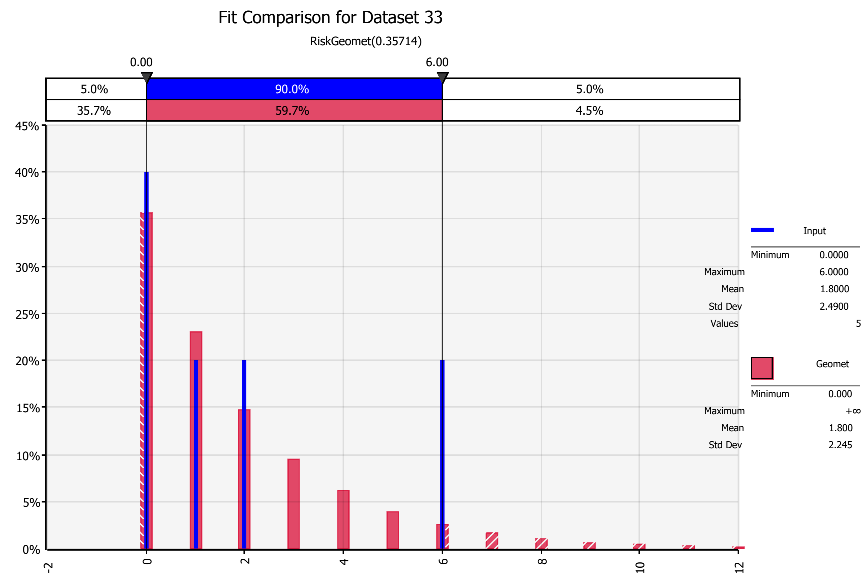
Table 4.19: SC loss of supply event frequency > 0.05 system minutes - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Loss of supply event > 0.05 system minutes | 1 | 6 | 2 | 0 | 0 |

We have selected the Geometric distribution as the best fit distribution for this parameter, as it has the best fit scores from all of the tests including the Akaike Information Criterion (AIC).

See Figure 4.7 and Table 4.20 for the detail.

Figure 4.7: Loss of supply X threshold - fit distribution




Source @RISK

Table 4.20: Loss of supply X threshold – distribution percentiles

| Percentiles | Geometric |
|---|---|
| 5% | 0 |
| 95% | 6 |

Our proposed values for loss of supply event frequency greater than 0.05 system minutes is shown in Table 4.21.

Table 4.21: Loss of supply X threshold - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Loss of supply X threshold greater than 0.05 system minutes | 6 | 2 | 0 | Geometric |

### 4.2.2 Frequency of large loss of supply events greater than 0.40 system minutes (Y Threshold)

Our loss of supply event frequency greater than 0.40 system minutes performance history is shown in Table 4.22.

Table 4.22: SC loss of supply event frequency > 0.40 system minutes - historic performance 2016-2020

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Loss of supply event > 0.4 system minutes | 0 | 0 | 1 | 0 | 0 |

Average of the 5 year performance is 0.2. The AER's 2015 STPIS[21] requires that targets are rounded to the nearest integer. This would result in a target of zero. This means that as a consequence of the improvements we have made over the 2018-22 regulatory period, there is potential for the threshold target for the large loss of supply event frequency measure to be set at zero events for the 2023-27 regulatory period.

Our reason for an alternative target for this parameter is discussed in section 3 of this appendix and Section 15.5.4 of our Revenue Proposal. Our alternative proposal is summarised in Table 4.23.

Table 4.23: Loss of supply Y threshold - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Loss of supply Y threshold greater than 0.40 system minutes | 2 | 1 | 0 | N/A |

## 4.3 Service Component – average outage duration

The average outage duration parameter measures network reliability by measuring the average time it takes for a TNSP to restore loss of supply events. The average outage duration (in minutes) is calculated by dividing the annual cumulative summation of the loss of supply event duration time by the number of loss of supply events. The best statistically possible performance for this parameter is zero minutes. Therefore longer average outage duration minutes represents a less reliable network.

Our average outage duration performance history is shown in Table 4.24. Average of the 5 year performance is 33.23 minutes.

Table 4.24: SC average outage duration - historic performance 2016-2020

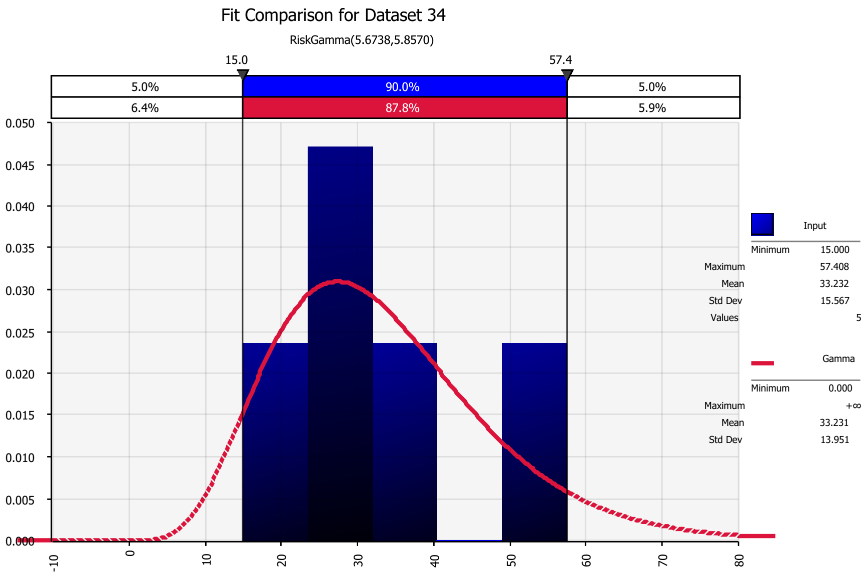
| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Average outage duration (mins) | 30.06 | 27.45 | 36.24 | 15.00 | 57.41 |

We have selected Gamma distribution as the best fit distribution for this parameter, as it has the best fit score from the Kolmogorov-Smirnov test.

[21] Clause 3.2(k).

See Figure 4.8 and Table 4.25 for the detail.

Figure 4.8: Average outage duration - fit distribution




Source @RISK

Table 4.25: Average outage duration - fit comparison

| Percentiles | Gamma |
|---|---|
| 5% | 14.06 |
| 95% | 59.00 |

Our proposed values for average outage duration is shown in Table 4.26.

Table 4.26: Average outage duration - proposed values for the most recent 2016-2020 year range

| SC Parameter | Floor | Target | Cap | Distribution |
|---|---|---|---|---|
| Average outage duration | 59.00 | 33.23 | 14.06 | Gamma |

## 4.4 Market Impact Component

The AER's 2015 STPIS[22] also requires that we propose values for the performance target, unplanned outage event limit and dollar per dispatch interval incentive for the MIC.

We have taken an approach consistent with the methodology that has been established by the AER in Appendices C and F of the AER's 2015 STPIS[23] to calculate these values. As we are applying the AER's 2015 STPIS for the second time, our approach is consistent with example 2 of Appendix F.

Our historic performance data is shown in Table 4.27.

Table 4.27: MIC - historic performance without unplanned outages capped 2014-2020

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| Planned outage events | 3936 | 64 | 7 | 62 | 160 | 13095 | 23852 |
| Unplanned outage events | 5 | 1 | 35 | 11 | 286 | 838 | 1048 |
| Total DIs for the year | 3941 | 65 | 42 (1) | 73 | 446 | 13933 | 24900 (1) |

(1) The largest and smallest DI counts.

### 4.4.1 Applying the unplanned outage cap

We reviewed its unplanned outage events for all seven years and capped any unplanned outage event by the unplanned outage event limit that was derived and set for the 2018-22 regulatory period. This unplanned outage event cap was 57 events. The MIC historic performance data with unplanned outages capped is shown in Table 4.28.

Table 4.28: MIC - historic performance with unplanned outages capped 2014-2020

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| Planned outage events | 3936 | 64 | 7 | 62 | 160 | 13095 | 23852(2) |
| Unplanned outage events (17% cap applied) | 5 | 1 | 35 | 11 | 57 (1) | 57(1) | 57(1) |
| Total DIs for the year | 3941 | 65 | 42(2) | 73 | 217 | 13152 | 23909(2) |

(1) Cap of unplanned outage events.
(2) The largest and smallest DI counts.

To calculate the performance target, we removed the largest and smallest counts of bound DIs from the most recent seven years' of historic data with unplanned outages capped and averaged the remaining five years. This calculated number was rounded to the nearest whole number.

We then calculated the adjusted unplanned outage event limit by applying the cap of 17% to the adjusted performance target.

As our adjusted performance target exceeded the minimum of 100 DIs, no further adjustment was necessary.

[22] *Final STPIS Version 5 (*corrected), Australian Energy Regulator, October 2015, Section 4.2.
[23] *Final STPIS Version 5 (*corrected), Australian Energy Regulator, October 2015, Appendix C Market Impact Component – Definition, Appendix F Market Impact Component - Application.

Our proposed performance target and unplanned outage event limit values for the MIC are shown in Table 4.29 and also are summarised in Table 5.1 in section 5.

Table 4.29: MIC - adjusted performance target and unplanned outage event limit

| Adjusted Performance Target | Adjusted Unplanned Outage Event Limit |
| --- | --- |
| 3490 | 593 |

### 4.4.2 Dollar per dispatch interval incentive

We calculated the dollar per dispatch interval incentive by taking 1% of the MAR for the first year of the regulatory period, divided by the performance target as follows:

$$\frac{1\% \text{ x } \$674.5\text{million (MAR)}}{3490} = \$1,933$$

Our proposed dollar per dispatch interval incentive for the MIC is shown in Table 4.30 and also is summarised in Table 5.2 in section 5, assuming a MAR of $674.5 million.

Table 4.30: MIC - dollar per dispatch interval incentive

| Dollar per Dispatch Interval Incentive |
| --- |
| 1,933 |

# 5. STPIS Values – Comparison

Tables 5.1 and 5.2 provide a summary of our proposed STPIS values for both the SC and MIC of the STPIS. The tables compare the targets in Section 3 (2015-19) to the targets in Section 4 (2016-20) of this appendix.

Table 5.1: Powerlink's proposed STPIS SC values

| | 2015-2019 Year Range | | | | 2016-2020 Year Range | | | |
|---|---|---|---|---|---|---|---|---|
| SC Parameter | Floor | Target | Cap | Distribution | Floor | Target | Cap | Distribution |
| Unplanned outage circuit event rate | | | | | | | | |
| Lines event rate - fault | 23.85 | 18.92 | 14.85 | Pearson5 | 24.99 | 17.03 | 8.79 | Weibull |
| Transformer event rate – fault | 25.09 | 18.07 | 10.44 | Weibull | 23.94 | 16.81 | 5.49 | Triangular |
| Reactive plant event rate – fault | 29.16 | 25.60 | 22.34 | LogNormal | 29.04 | 25.65 | 22.52 | LogNormal |
| Lines event rate – forced | 21.00 | 16.83 | 11.85 | Weibull | 21.13 | 17.02 | 12.15 | Weibull |
| Transformer event rate – forced | 19.07 | 14.10 | 9.78 | Gamma | 22.34 | 14.82 | 9.37 | LogLogistic |
| Reactive plant event rate – forced | 22.80 | 21.18 | 18.92 | Weibull | 22.79 | 21.21 | 19.00 | Weibull |
| Loss of supply event frequency | | | | | | | | |
| Greater than 0.05 system minutes | 7 | 2 | 0 | Geometric | 6 | 2 | 0 | Geometric |
| Greater than 0.40 system minutes | 2 | 1 | 0 | N/A | 2 | 1 | 0 | N/A |
| Average outage duration | 147.17 | 69.00 | 7.91 | LogLogistic | 59.00 | 33.23 | 14.06 | Gamma |

Table 5.2: Powerlink's proposed STPIS MIC values

| | 2013-20 Year Range | | | 2014-2020 Year Range | | |
|---|---|---|---|---|---|---|
| MIC Parameter | Performance Target | Unplanned Outage Event Limit | Dollar per Dispatch Interval Incentive | Performance Target | Unplanned Outage Event Limit | Dollar per Dispatch Interval Incentive |
| MIC | 879 | 149 | $7,673 | 3490 | 593 | $1,933 |