2023-27 POWERLINK QUEENSLAND REVISED 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 Revised Revenue Proposal.

1.2 Regulatory requirements

The 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 for our Revised Revenue Proposal are:

- for the SC: 2016-20; and
- for the MIC: 2014-20.

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 – 2016 to 2020 and for the MIC – 2014 to 2020.
- Section 4 summarises the values calculated in section 3.

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 the detailed elements of the target setting arrangements for our Revised Revenue Proposal.

The approach we used to set our STPIS targets and values for each component is included in the sections below. Our approach is consistent with the Rules[4], the AER's 2015 STPIS, the AER's Final Framework and Approach for Powerlink[5] and adjustments made by the AER in its Draft Decision[6].

[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.
[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] Powerlink transmission draft determination 2022-27, Attachment 10 Service Target Performance Incentive Scheme, Australian Energy Regulator, September 2021.

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[7]. The proper operation of equipment parameter requires that we 'report only' and therefore no values are required.

In our Revenue Proposal for the 2023-27 regulatory period[8], 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)[9].

In its Draft Decision, the AER:

- calculated targets, caps and floors for the SC parameters consistent with those in our Revenue Proposal[10]; and
- did not accept our proposed alternative target of one (in lieu of zero) for the large loss of supply threshold element of the SC and adjusted our target for this sub-parameter to zero[11].

We have aligned with the AER's Draft Decision in respect to the large loss of supply threshold element of the SC and applied the same approach for determining targets, caps and floors for the SC parameters in our Revised Revenue Proposal:

- 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[12].
- 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.

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;

[7] Final STPIS Version 5 (corrected), Australian Energy Regulator, October 2015, Section 3.2.
[8] 2023-27 Revenue Proposal, Powerlink, January 2021, Appendix 15.01 - Setting STPIS Values.
[9] Draft Decision SP AusNet 2014-15 to 2016-17 STPIS, Australian Energy Regulator, August 2013, pages 184-185.
[10] Powerlink transmission draft determination 2022-27, Attachment 10 Service Target Performance Incentive Scheme, AER, page 5.
[11] *Ibid*, page 14.
[12] Draft Decision SP AusNet 2014-15 to 2016-17 STPIS, Australian Energy Regulator, August 2013, pages 184-185.

- 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. 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 4.1. Details of the selected statistical distribution for each SC parameter and sub-parameter are provided in sections 3 and 4.

2.2 Market Impact Component

The AER's 2015 STPIS[13] requires that we propose values for the performance target, unplanned outage event limit and dollar per dispatch interval incentive for the MIC.

We have calculated our targets and values for the 2023-27 regulatory period consistent with the methodology in Appendices C and F of the 2015 STPIS[14]. Our proposed performance target has been calculated using 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.
- 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 4.2 in section 4. Details of the methodology for the MIC are provided in sections 3 in this document.

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

3. STPIS Values – Data Range to 2020

This section contains our proposal based on the historical data range that is specified below, for consideration by the AER in its Final Decision:

- for the SC – 2016 to 2020; and
- for the MIC – 2014 to 2020.

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 it selected the best fit statistical distribution:

- 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 17.03.

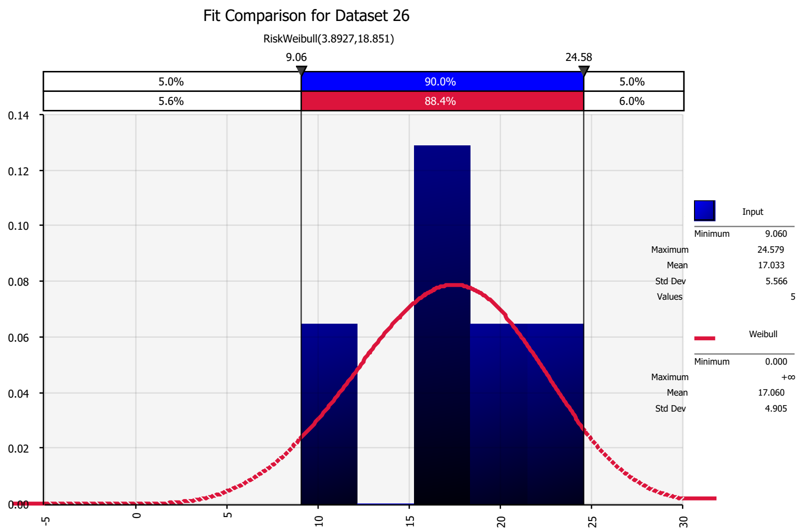
Table 3.1: SC line event rate - fault - historic performance 2016-2020

	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 3.1 and Table 3.2 for the detail.

Figure 3.1: Line event rate - fault - fit distribution



Source @RISK

Table 3.2: 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 3.3.

Table 3.3: Line event rate - fault - proposed values for 2016-2020 year range

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

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 16.81.

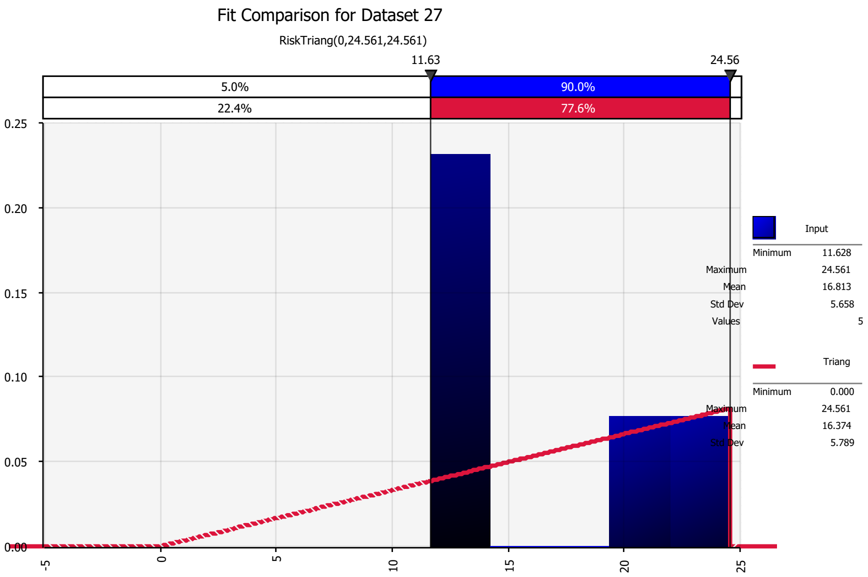
Table 3.4: SC transformer event rate - fault - historic performance 2016-2020

	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 3.2 and Table 3.5 for the detail.

Figure 3.2: Transformer event rate - fault - fit distribution



Source @RISK

Table 3.5: Transformer event rate - fault - distribution percentiles

Percentiles	Triangular
5%	5.49
95%	23.94

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

Table 3.6: Transformer event rate - fault - proposed values for 2016-2020 year range

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

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 25.65.

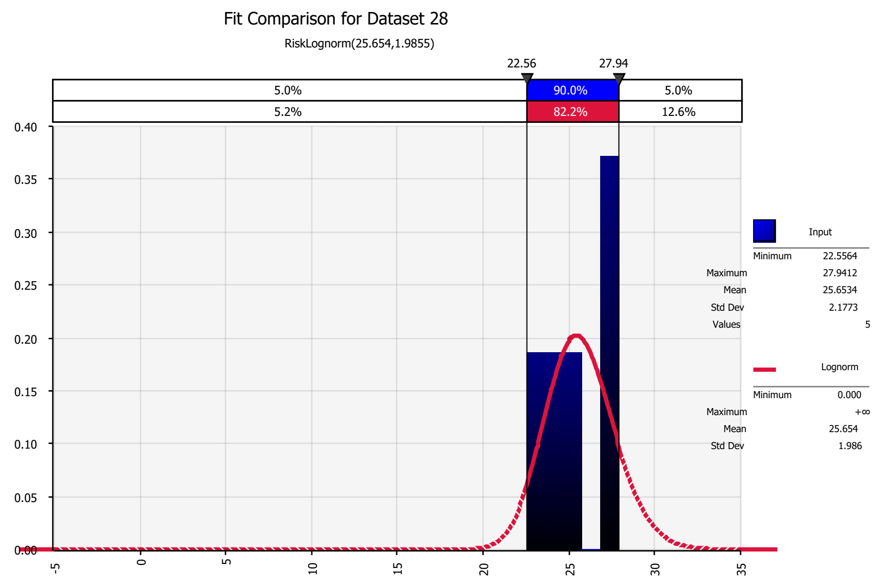
Table 3.7: SC Reactive plant event rate - fault - historic performance 2016-2020

	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 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%	22.52
95%	29.04

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 for 2016-2020 year range

SC Parameter	Floor	Target	Cap	Distribution
Reactive plant event rate – fault	29.04	25.65	22.52	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 17.02.

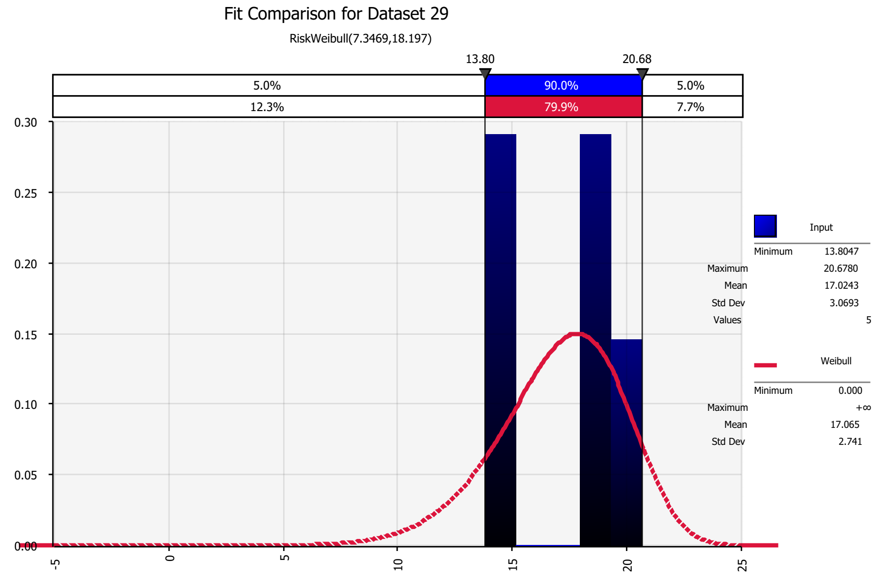
Table 3.10: SC line event rate - forced - historic performance 2016-2020

	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 3.4 and Table 3.11 for the detail.

Figure 3.4: Line event rate - forced - fit distribution



Source @RISK

Table 3.11: 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 3.12.

Table 3.12: Line event rate - forced - proposed values for 2016-2020 year range

SC Parameter	Floor	Target	Cap	Distribution
Lines event rate – forced	21.13	17.02	12.15	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 14.82.

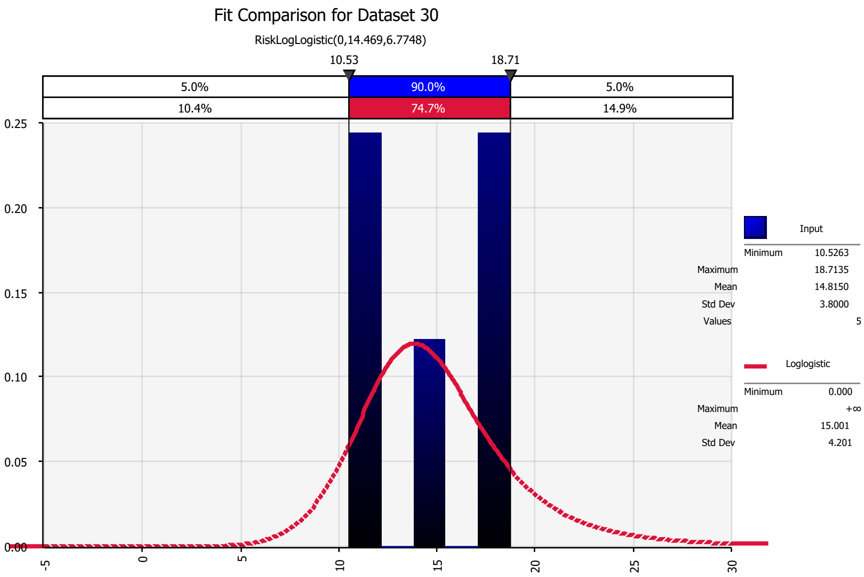
Table 3.13 SC transformer event rate - forced - historic performance 2016-2020

	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 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	LogLogistic
5%	9.37
95%	22.34

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

Table 3.15: Transformer event rate - forced - proposed values for 2016-2020 year range

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

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 21.21.

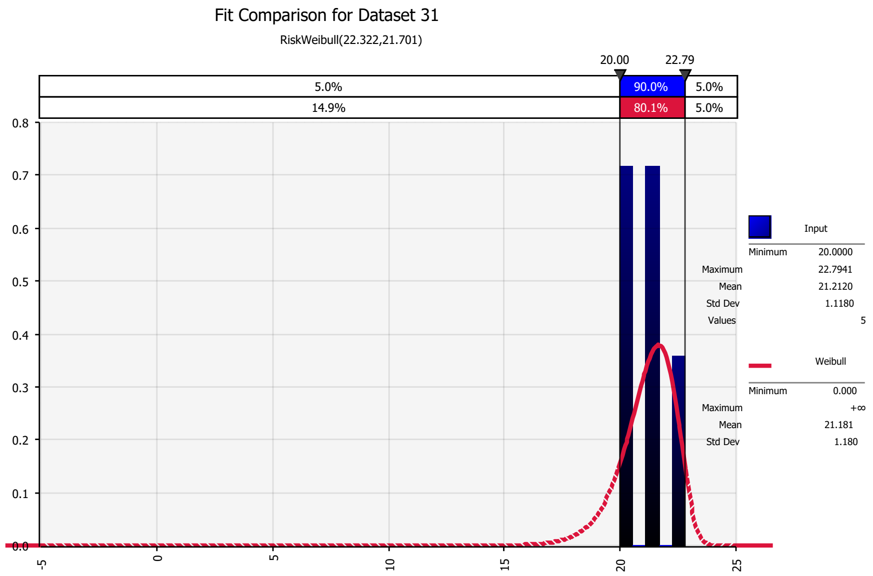
Table 3.16: SC reactive plant event rate - forced - historic performance 2016-2020

	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 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%	19.00
95%	22.79

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 2016-2020 year range

SC Parameter	Floor	Target	Cap	Distribution
Reactive plant event rate – forced	22.79	21.21	19.00	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.

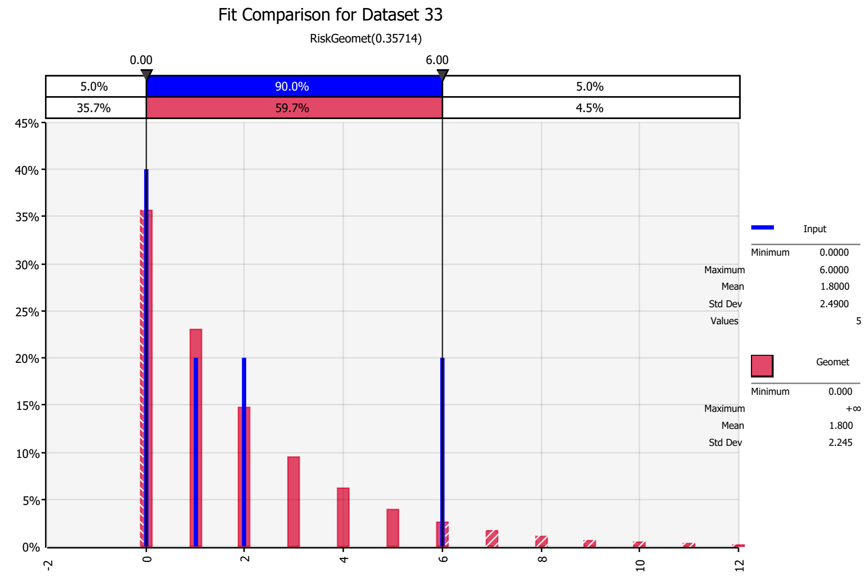
Table 3.19: SC loss of supply event frequency > 0.05 system minutes - historic performance 2016-2020

	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 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%	6

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 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

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

We have revised our proposed target for the large loss of supply event sub-parameter to be a zero target, consistent with the AER's Draft Decision[15].

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

[15] Powerlink transmission draft determination 2022-27, Attachment 10 Service Target Performance Incentive Scheme, AER, page 14.

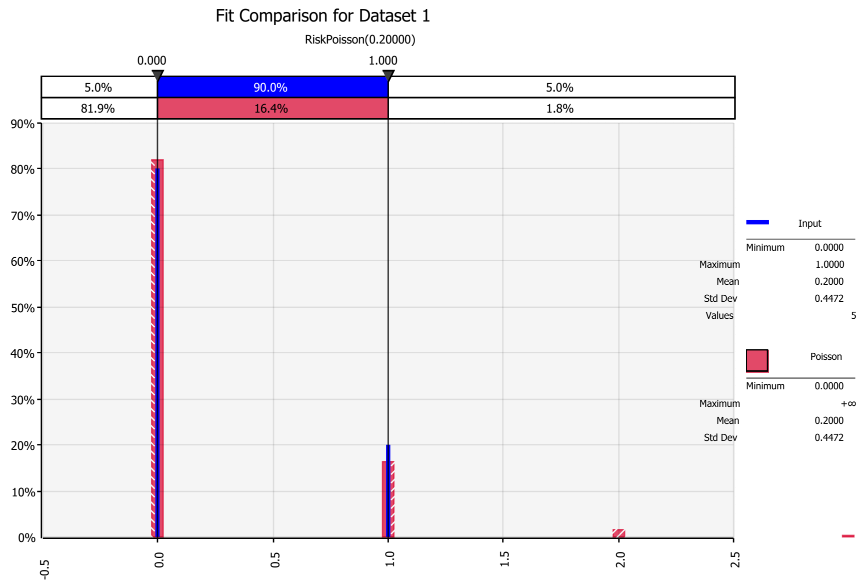
Table 3.22: SC loss of supply event frequency > 0.40 system minutes - historic performance 2016-2020

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

We have selected the Poisson 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 3.8 and Table 3.23 for the detail.

Figure 3.8: Loss of supply Y threshold - fit distribution



Source @RISK

Table 3.23: Loss of supply Y threshold – distribution percentiles

Percentiles	Poisson
5%	0
95%	1

Our proposed values for loss of supply event frequency greater than 0.4 system minutes is shown in Table 3.24.

Table 3.24: Loss of supply Y threshold - proposed values for 2016-2020 year range

SC Parameter	Floor	Target	Cap	Distribution
Loss of supply Y threshold greater than 0.40 system minutes	1	0	0	Poisson

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 33.23 minutes.

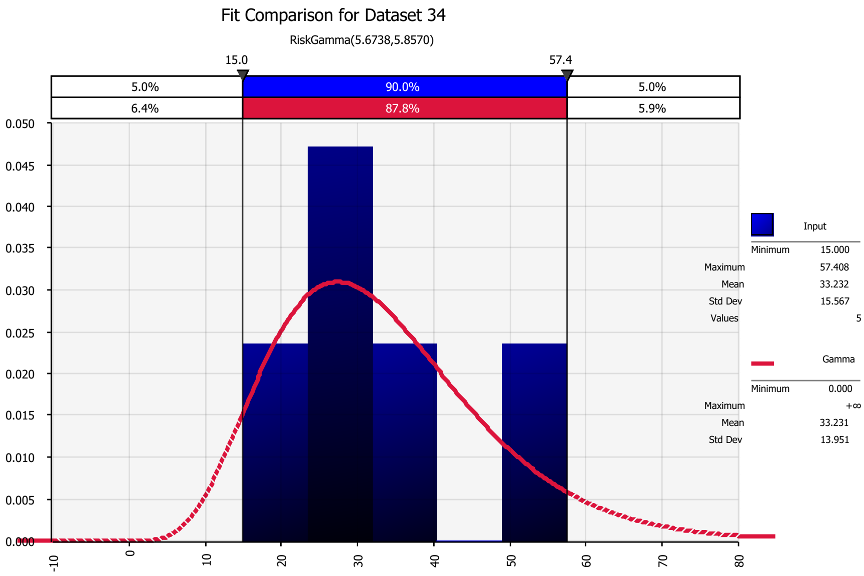
Table 3.25: SC average outage duration - historic performance 2016-2020

	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.

See Figure 3.9 and Table 3.26 for the detail.

Figure 3.9: Average outage duration - fit distribution



Source @RISK

Table 3.26: Average outage duration - fit comparison

Percentiles	Gamma
5%	14.06
95%	59.00

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

Table 3.27: Average outage duration - proposed values for 2016-2020 year range

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

3.4 Market Impact Component

The AER's 2015 STPIS[16] 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 established by the AER in Appendices C and F of the AER's 2015 STPIS[17] and used by the AER in its Draft Decision[18] to calculate these values. We applied two revisions to our historical data for 2015 and 2019 to align

[16] *Final STPIS Version 5* (corrected), Australian Energy Regulator, October 2015, Section 4.2.
[17] *Final STPIS Version 5* (corrected), Australian Energy Regulator, October 2015, Appendix C Market Impact Component – Definition, Appendix F Market Impact Component - Application.
[18] Powerlink transmission draft determination 2022-27, Attachment 10 Service Target Performance Incentive Scheme, AER, pages 15-19.

with the AER's Draft Decision[19]. The detail of the revisions is outlined further in section 15.3 of our Revised Revenue Proposal. 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 2014-2020

	2014	2015	2016	2017	2018	2019	2020
Planned outage events	3,936	26	7	62	160	12,492	23,115
Unplanned outage events	5	1	35	11	286	786	1,048
Total DIs for the year	3,941	27(1)	42	73	446	13,278	24,163(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 2014-2020

	2014	2015	2016	2017	2018	2019	2020
Planned outage events	3,936	26	7	62	160	12,492	23,115(2)
Unplanned outage events (17% cap applied)	5	1	35	11	57 (1)	57(1)	57(1)
Total DIs for the year	3,941	27(2)	42	73	217	12,549	23,172(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.

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 4.1 in section 4.

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

Adjusted Performance Target	Adjusted Unplanned Outage Event Limit
3,364	572

[19] *Ibid*, page 16.

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:

$$\frac{1\% \times \$690.3\text{million (MAR)}}{3,364} = \$2,052$$

Our proposed dollar per dispatch interval incentive for the MIC is shown in Table 3.31 and also is summarised in Table 4.2 in section 4, assuming a MAR of $690.3 million.

Table 3.31: MIC - dollar per dispatch interval incentive

Dollar per Dispatch Interval Incentive
2,052

4. STPIS Values – Summary

Tables 4.1 and 4.2 provide a summary of our proposed STPIS values for the SC and MIC of the STPIS.

Table 4.1: Powerlink's proposed STPIS SC values

	2016-2020 Year Range			
SC Parameter	Floor	Target	Cap	Distribution
Unplanned outage circuit event rate				
Lines event rate - fault	24.99	17.03	8.79	Weibull
Transformer event rate – fault	23.94	16.81	5.49	Triangular
Reactive plant event rate – fault	29.04	25.65	22.52	LogNormal
Lines event rate – forced	21.13	17.02	12.15	Weibull
Transformer event rate – forced	22.34	14.82	9.37	LogLogistic
Reactive plant event rate – forced	22.79	21.21	19.00	Weibull
Loss of supply event frequency				
Greater than 0.05 system minutes	6	2	0	Geometric
Greater than 0.40 system minutes	1	0	0	Poisson
Average outage duration	59.00	33.23	14.06	Gamma

Table 4.2: Powerlink's proposed STPIS MIC values

	2014-2020 Year Range		
MIC Parameter	Performance Target	Unplanned Outage Event Limit	Dollar per Dispatch Interval Incentive
MIC	3,364	572	$2,052