Appendix W

Service Target Incentive Scheme Review

SAHA INTERNATIONAL

ElectraNet

Service Target Incentive Scheme Review

May 07

Final Report

SAHA INTERNATIONAL

CONTACT PERSON
Kumar Padisetti
Partner
Mob: 0412 199 065
kpadisetti@sahainternational.com.au
Melbourne Office

MELBOURNE
Level 4, 190 Queen Street
Melbourne
VIC 3000
Australia
Ph: +61 3 9934 0600
Fax: +61 3 9602 4825

SYDNEY
Level 15, 45 Clarence Street
Sydney
NSW 2000
Australia
Ph: +61 2 8299 4200
Fax: +61 2 9279 2066

BRISBANE
Level 30, 10 Eagle Street
Brisbane
QLD 4000
Australia
Ph: +61 7 3303 0213
Fax: +61 7 3303 0111

WELLINGTON
Level 4, Clayton Ford House
128 – 132 The Terrace
PO Box 5350
Wellington
New Zealand
Ph: +64 4 499 7007
Fax: +64 4 499 7009

JOHANNESBURG
Level 7, JHI House
11 Cradock Avenue
Rosebank 2196
PO Box 521591
Saxonwold 2132
South Africa
Ph: +27 11 268 8800
Fax: +27 11 327 7344

CAPE TOWN
Canal Walk West Office Tower
1st Floor Premises
Century Boulevard
Century City
Cape Town
South Africa
Ph: +27 21 552 0029
Fax: +27 21 552 0040

NAMIBIA
Level 7, Metje Behnsen Building
Independence Avenue
Windhoek
Namibia
Ph: +264 812 924 133

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1. INTRODUCTION

1.1 Background

Under the AER's Service Target Performance Incentive Scheme (including the explanatory statement and issues paper), ElectraNet's new revenue cap will incorporate a performance incentive scheme that would allow ElectraNet to gain up to an additional 1% of revenue each year for above target performance, or lose up to 1% of revenue each year for below target performance.

The scheme sets out three key performance parameters for all of the Transmission Network Service Providers (TNSP's) and identifies the items that each of the individual TNSP's need to provide as part of the determination process. For ElectraNet's determination the following items need to be included:

- Identifying the source of the data for analysing the performance against the three parameters;

- Definitions for Critical Circuits and Plant, Peak and Non-Peak period for Parameter 1 – Transmission circuit availability;

- Parameter 2 – Loss of supply event frequency, definitions for the magnitudes of the events that constitute a loss of supply event (x system minutes per annum and y system minutes per annum);

- Proposed targets, caps and collars for the three performance parameters (including Parameter 3 – Average Outage Duration); and

- Weightings for the three performance parameters, and how these weightings are in accordance with the objectives of the Service Target Incentive Scheme.

The targets need to be based on the performance history over the previous 5 years (a greater period is allowed subject to section 2.5 h of the AER Service Target Incentive Scheme document) but may be adjusted for statistical outliers, changes to Capital Expenditure/Operational Expenditure (capex/opex) work and material changes to regulatory obligations. The service targets need to take into account the regulatory obligations set out by the NER but material changes to these obligations may require adjustment to the targets being set by ElectraNet.

The caps and collars could be symmetric or asymmetric incentives but need to be calculated by a sound methodology in relation to the performance targets. This will be based on the information available to ElectraNet and the analysis of the historical information.

To recognise natural variation in performance outcomes around a target, ElectraNet may propose a "deadband" around the target within which the transmission provider is neither rewarded nor penalised for their performance outcome. Appropriate specification of the upper and lower bounds for the deadband is an issue that needs to be addressed.

Against this background, ElectraNet has asked Saha International to provide statistical advice in relation to the targets, caps and collars proposed for submission to the AER.

1.2 Scope of the Consultancy

As set out in our proposal of 19 April 2007, the Service Target Incentive Scheme Review conducted by Saha International was to have the following deliverables:

- A strictly sound analysis of the historical data;
- Technical Review of ElectraNet models;
- Recommend a methodology for setting performance targets, caps and collars; and
- Assess the impact of statistical outliers, changes in the capex and opex work programs and material changes to regulatory obligations on the targets, caps and collars set, using a monte carlo modelling exercise or another appropriate statistical method.

In delivering on this Consultancy scope, our working assumption is that ElectraNet intends for its performance incentive proposal to comply with the First Draft Proposed Service Target Performance Incentive Scheme. Consequently, our scope of work does not involve developing a completely new approach to the design of a performance incentive scheme but, rather, ensuring that the application of the AER's scheme to ElectraNet is statistically robust and does not lead to ElectraNet being unreasonably exposed to performance risk.

1.3 Process for Project

Our process for this project has involved:

- Receiving models and historic performance data from ElectraNet, including an understanding of the reliability of the data sources, and briefings from ElectraNet on issues with historical data for some of the parameters;
- Provision of a summary forecast of the Capex work scheduled in the next regulatory period and a summary of the capex program conducted over the previous regulatory period;
- Review of documents and data provided by ElectraNet;
- Analysis of the historic performance data and determining a statistically sound methodology for setting targets, caps and collars based on this information;
- Consultation with our statistical expert, Professor Piet de Jong, to ensure methodologies are statistically sound; and
- Development of our report for ElectraNet.

2. FRAMEWORK

Under the Service Target Performance Incentive Scheme (STPIS), there are five key aspects that need to be defined:

- the parameters;
- the targets associated with each parameter;
- the deadbands around each target;
- the cap and collar values for each parameter; and
- the weightings between parameters.

Although the STPIS appendices provide definitions of parameters, there are no published figures in relation to targets, weightings, deadbands or cap and collar values. Nonetheless, as noted in the previous section, it is up to ElectraNet to propose the values to be set for these parameters to be applied by the AER as part of the new revenue cap. The statistical framework or approach relevant to each aspect is discussed below in general terms and then more detail on the framework applied for each of the individual parameters is discussed in the sections on those parameters.

2.1 Parameters

While the three groups of parameters that will form part of the STPIS for ElectraNet are defined by the AER, the precise definition of each parameter is defined in Appendix B of the STPIS. From a statistical perspective and for ElectraNet's purposes, we believe that each parameter should be defined in such a way that it is capable of providing a strong read on how performance is changing over time even though observed performance is subject to random factors. This is often characterised in terms of having a high signal to noise ratio.

2.2 Parameter Targets

For any given parameter, the associated target for a given year should be set as the expected value of that parameter in that year. Note that while the parameter itself may be defined as a median, a mean, a trimmed mean, a count or any other summary statistic, the appropriate target is still the expected value of the relevant summary statistic in the relevant future year. For example, when using a mean as a parameter, then the expected value of the mean would have to be forecast and that value would then be used as the target value.

Set in this way, we should point out that the "target" value is not a minimum acceptable value. Indeed due to the influence of random factors, even if underlying performance is kept constant over time, we would observe that actual outcomes would be distributed both above and below the target.

2.3 Deadbands

While appropriate definition of each parameter should provide for a high signal to noise ratio and (hopefully) a strong read on performance changes, it is not possible to completely eliminate the effects of random factors. In view of this, standard statistical techniques for inference testing have to be applied before drawing any conclusions regarding whether underlying performance has changed. The deadbands allowed by the STPIS provide for this, by not penalising or rewarding outcomes that are within the natural variation of the parameter around the target.

2.4 Cap and collar values

When an outcome is outside the deadbands or targets set, the STPIS automatically assumes that a change in underlying performance has occurred and ElectraNet will incur a penalty or bonus as appropriate. As the scheme is capped at 1% of annual revenue overall, the maximum penalty/bonus for a parameter is subject to the cap/collar proposed by ElectraNet. However the STPIS does not provide a rationale for how to set these values, but asks that ElectraNet use a sound statistical methodology for setting these values. A discussion on the rationale behind the caps and collars set by Saha International will be provided for each of the performance parameters.

2.5 Weightings between parameters

The STPIS provide little or no insight into how the weightings between parameters should be established. Nonetheless, we surmise that the purpose of the weightings between parameters is twofold:

- to ensure that the 1% of annual revenue at risk under the scheme is divided between parameters in proportion to the value that customers place on the various aspects of service captured by each parameter, or group of parameters; and
- to recognise the fact that many parameters, and their associated sub-parameters, often overlap, either explicitly or implicitly.

In our view, setting the STPIS weights should be done in a manner that takes into account the customer value on the activity, the historical variability of the parameter and the potential of the future capex/opex programs impacting on the parameters.

2.6 Penalties and incentives

The limits of the parameters (Caps & Collars) relate to reasonable statistical limits in the original distribution of the data. However, the mean of the yearly data set has a less variable distribution and hence the penalty or incentive schemes based on the mean should recognise that the mean is less variable than the original observations. Therefore penalties or incentives should be investigated to determine whether a sculpted gradient or linear gradient is appropriate depending on the parameter and the historical data available for each of the parameters.

3. PARAMETER 1 – TRANSMISSION CIRCUIT AVAILABILITY

There are three transmission circuit availability sub-parameters identified in the STPIS for ElectraNet. These three sub-parameters are:

- Total circuit availability;
- Critical circuit peak period availability (peak period has been identified by ElectraNet as between 8am and 8pm weekdays); and
- Critical circuit non-peak period availability.

These sub-parameters are calculated as the average availability across the relevant elements (critical or total) for the relevant time period (peak times in a year, non-peak times in a year or all times in a year).

The information provided by ElectraNet covered the period 2002-2006, and this information was considered very reliable; ElectraNet said that this period was representative of current practice. The period for averaging for target setting is five years under guideline 2.5(g) of the AER STPIS therefore the data provided by ElectraNet is sufficient to the level required under the AER guidelines for the analysis of this parameter.

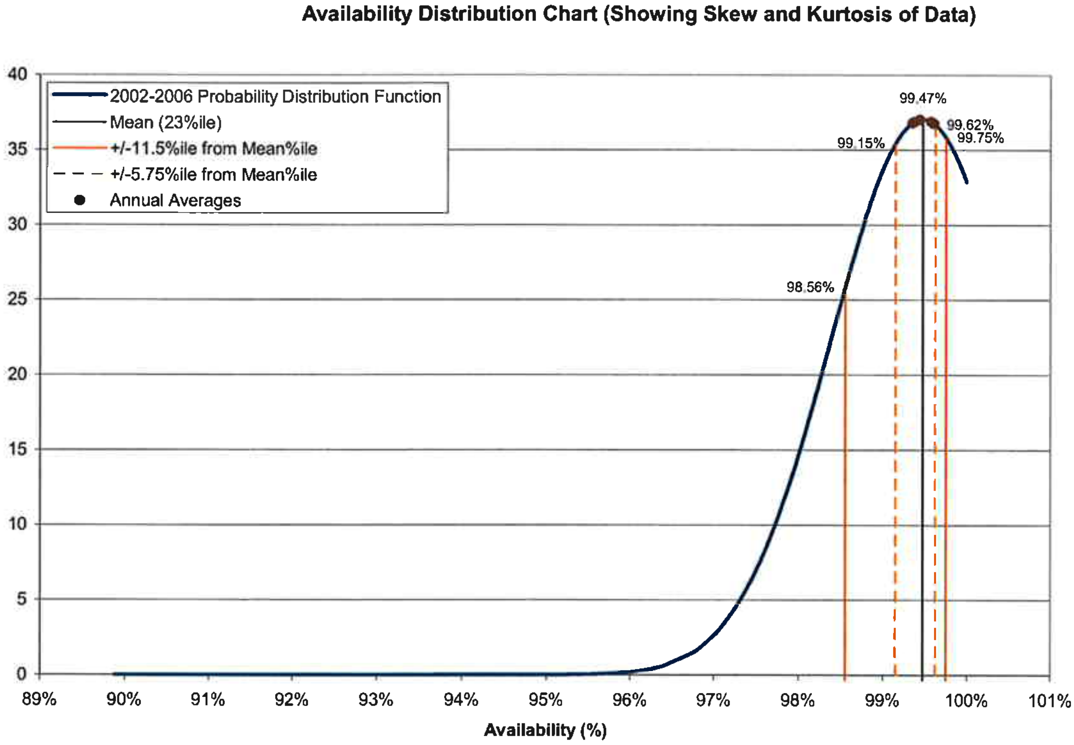
3.1 Definition of the parameters

As noted above, the availability parameters are calculated as the average availability across the relevant elements (critical or total) for the relevant time period (peak times, non-peak times or all times in a year). All causes of unavailability (construction, maintenance and forced outages) contribute to the parameters, provided that the fault does not lie with a third party or is due to a Force Majeure event. In view of this definition, we have two concerns with the availability parameters.

First, the average element availability observed may vary materially from year to year due simply to random factors. This is because the probability distribution of element availability is (intuitively) heavily skewed towards 100% availability, with a long tail that extends all the way down to 0% availability (for the year). The probability distribution for the availability data provided by ElectraNet is shown in Figure 3-1, and also shown is the percentile that the mean occurs at, the annual averages for 2002-2006, and the recommended bands, caps and collars based on percentile around the mean.

Figure 3-1 shows the level of skew and kurtosis of the availability data for ElectraNet. A distribution is skewed if one tail is longer than the other, representing an asymmetrical range of data around the mean; in this case the "Availability" data is negatively skewed as the median is greater than the mean and has a longer tail to the left of the mean. The kurtosis of a distribution is a measure of whether the data is peaked and is also represented by the length of the tails of the distribution. Distributions that have longer tails tend to have a peaked data set, concentrated around a set of values (near the mean) with smaller data sets away from the mean, which is the case for the "Availability" data provided by ElectraNet. The percentiles are a representation of the sorted data set and the percentage that the value falls within the data set, for example the mean occurs at the 23rd percentile for the "Availability" data which has 537 data points, this would suggest that when the data is sorted the mean falls at the 123.5 (between the 123rd and 124th) value in the data series (99.47%).

Figure 3-1: Probability distribution of availability data showing the skew and kurtosis of data



Second, the current parameters of availability are unlikely to generate stable outcomes from year to year because the three main components that drive availability (construction outages, maintenance outages and forced outages) are themselves unstable from year to year.

The key problem with the availability parameters is that the factors influencing each of the components are different. While forced outages are inherently stochastic (caused by random factors), most of the variation in construction across years is determined by ElectraNet's decisions on how much capex to undertake in one year as opposed to another. This is also the case with a significant part of maintenance (related to routine maintenance and refurbishment). Furthermore, ElectraNet can choose whether to take planned outages at peak times or at non-peak times.

This heterogeneity in the component parts of the availability parameters complicates the application of statistical techniques because it cannot be assumed that the observed distribution of availability across elements reflects random factors. This needs to be factored into the statistical analysis of the availability parameters, and will be an issue for setting the targets, caps, collars and if recommended, deadbands.

3.2 Methodology for target, cap and collar setting

Given that there are three main components driving the availability parameters, and the factors influencing each of these are different, this needs to be taken into account in setting the targets for the new regulatory period. This involves a number of challenges.

Firstly, targets, caps and collars for normally distributed data may be created by setting the target as the mean and the cap and collar at n standard deviations from the mean. However, ElectraNet's performance parameter data exhibits both skewness and kurtosis (Figure 3-1), and as a result the standard deviation of the data around the mean is not appropriate to set the cap and collar.

To take into account the skewness and kurtosis of data, we recommend using the percentiles instead of standard deviations. Our recommendation is to use the mean as the target, determine the percentile that the mean occurs at and then developing a cap and collar around the mean percentile. The nth percentile above the mean percentile will be set as the cap and the nth percentile below the mean percentile as the collar. Under this methodology the probability of being rewarded equals the probability of being penalised. Hence, using the nth percentile above and below the mean percentile to set the cap and collar takes into account both the skewness and the kurtosis of the performance parameter data.

Each performance parameter has a unique level of skewness and kurtosis. Kurtosis is a parameter of how peaked a distribution is. The value of n that minimises exposure to performance risks depends on the kurtosis of the distribution of the underlying variable. We recommend using a unique cap and collar for each type of performance parameter to account for the fact that its distribution may be more peaked or less peaked.

In developing a methodology for setting n, we have looked to the standard normal distribution and how one would arrive at the value of n given a cap at quartile three and a collar at quartile one.

Multiplying the percentile rank of the mean of a standard normal distribution by a factor of 0.5 would result in the desired n value of 25 based on the following

- For a variable that follows a standard normal distribution we know that the third and first quartile occur at the 25th percentile above and below the mean respectively.
- In addition we know that by definition, the mean of a standard normal distribution occurs at the 50th Percentile.

The same methodology may be applied to calculate n for the Availability parameters:

$n = 0.5 * (\text{percentile rank of } \mu)$ where

- μ = mean of performance parameter over the time period under consideration e.g. mean of Availability parameter during the period 2002–2006.

- Percentile rank of μ = the percentage of data that has values lower than the value of μ.

In using this percentile based methodology to set caps and collars, as compared with a standard deviation based methodology. We are taking into account the skewness and kurtosis of the distribution of the Availability parameters.

Secondly, given the significant effect that construction can have on circuit availability, a methodology is required for incorporating the effect of the capex program on the availability parameters. The proportions of Low, Medium, and High impact Capital Expenditure in ElectraNet's forecast, as compared to the historic numbers, indicate that the impact on overall line availability may not be significant. However, we note that South East, which has connections to critical circuits, is listed as one of the forecast Capex locations and has not had capex in the previous regulatory period.

Using the data provided by ElectraNet we are unable to determine the impact this capital expenditure will have on the critical circuit peak and non peak availability parameters and therefore if ElectraNet expects that construction at South East will impact the critical circuit availability performance parameters, a reduction in the annual target and/or a reduction in the weighting of the performance parameters may be required.

As there are only six identified critical circuits an outage duration on any one of the circuits due to capital expenditure programs will impact on the performance parameters for the critical circuits. Therefore if it is known that this work will impact on the line availability of a critical circuit it would be recommended to reduce the weighting attributed to this parameter.

3.3 Results of analysis of historical availability data

Examining the historic data provided by ElectraNet and then applying the above methodologies for target, cap, collar and deadband setting the following charts and tables summarise the expected targets, caps, collars and deadbands that Saha International recommend ElectraNet use in their submission to the regulator, based on statistically sound methodologies.

3.3.1 Total circuit availability

Based on the historical information provided by ElectraNet the mean circuit availability for the period 2002-2006 across all circuits was 99.47%, this forms the basis of Saha International's targets, caps and collars for this parameter. The mean was determined by taking the recorded availability for each of the circuits (107 circuits between 2002 and 2004, 108 circuits for 2005 and 2006), across each of the years and then averaging the entire sample size (537 points).

The percentile of the mean was taken by sorting the data into order and determining at what percentile the mean fell, in this case the 23rd percentile.

As described in the methodology above the cap and collar are set at the mean percentile +/- 0.5 x mean percentile = 23% + 11.5% = 34.5% and 23% - 11.5% = 11.5%.

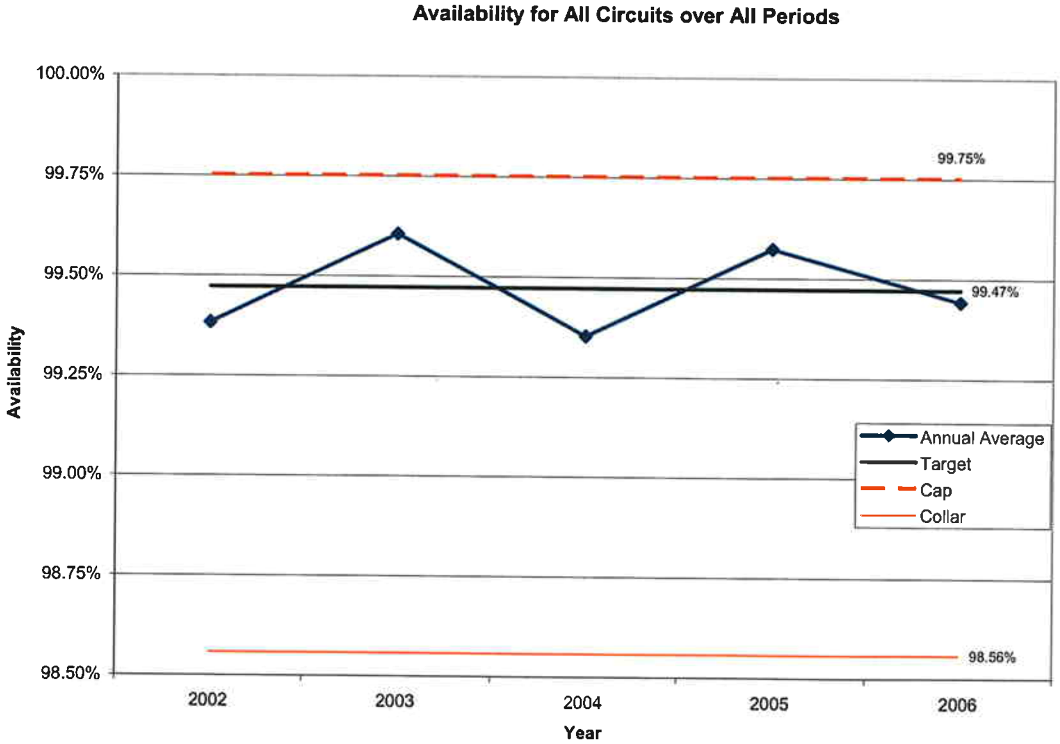
The resultant availability is found by matching the percentile against the sorted availability data and is shown in Table 3-1 below.

Table 3-1: Total circuit availability performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Total circuit availability	**99.25%**	99.47%	99.75%	98.56%	**2002 to 2006**
Percentile		23%	34.5%	11.5%	

Figure 3-2 shows the annual average circuit availability, the 107 circuits average over each year for 2002, 2003 and 2004 and the 108 circuits average over 2005 and 2006 in comparison to the overall five year average which constitutes the targets, caps and collars presented in Table 3-1 above.

Figure 3-2: Total circuit availability



3.3.2 Availability of critical circuits for peak periods

The availability of critical circuits for peak periods is determined by ElectraNet defining the critical circuits and peak period. The data presented to Saha International identified six critical circuits and the peak period as being between 8am and 8pm on weekdays. Analysing the data for these six critical circuits over the five year period taking into account the identified peak period resulted in a mean critical circuit peak period availability of 99.75%, this mean is then used by Saha International as the target for this parameter going forward. The mean was determined by taking the recorded availability for each of the critical circuits (6 circuits for 2002 to 2006), across each of the years and then averaging the entire sample size (30 points).

The percentile of the mean was taken by sorting the data into order and determining at what percentile the mean fell, in this case the 36.4th percentile.

As described in the methodology above the cap and collar are set at the mean percentile +/- 0.5 x mean percentile = 36.4% + 18.2% = 54.6% and 36.4% - 18.2% = 18.2%.

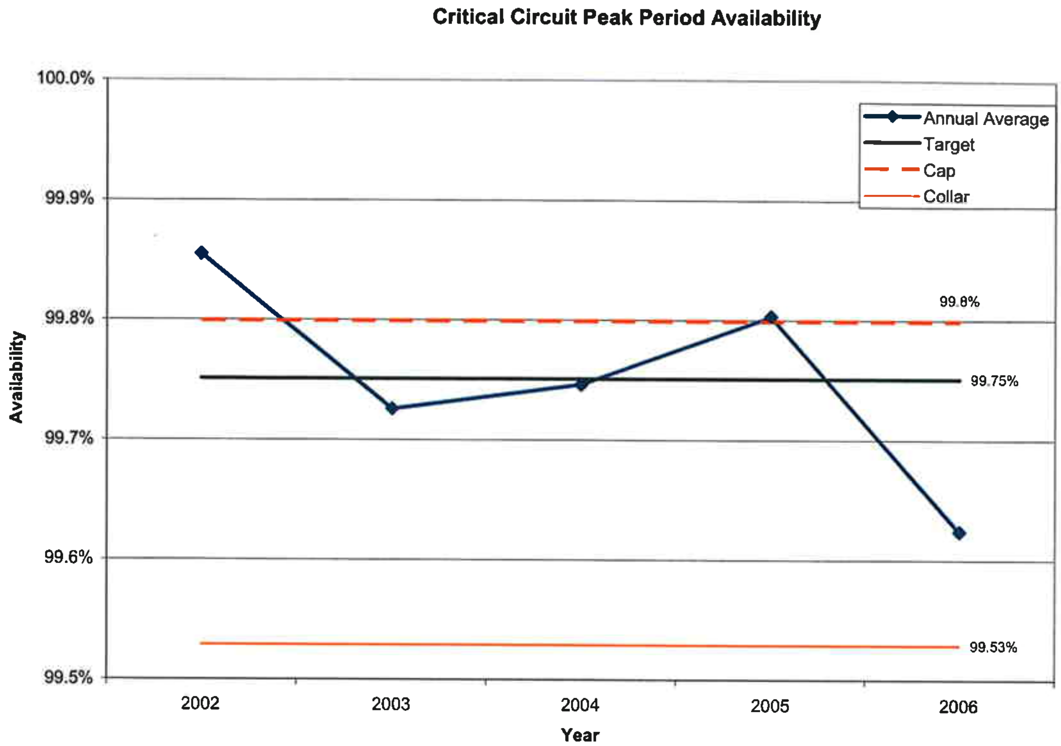
The resultant availability is found by matching the percentile against the sorted availability data and is shown in Table 3-2 below.

Table 3-2: Availability of critical circuits peak period performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Critical circuit availability peak	n/a	99.75%	99.80%	99.53%	**2002 to 2006**
Percentile		36.4%	54.6%	18.2%	

Figure 3-3 shows the annual average critical circuit peak period availability, the 6 circuits average over each year for 2002 to 2006 in comparison to the overall five year average which constitutes the targets, caps and collars presented in Table 3-2 above.

Figure 3-3: Availability of critical circuits peak period



Based on the historical data provided by ElectraNet and the targets, caps and collars established by Saha International, caution needs to be taken in setting the weightings as the Critical Circuits parameters rely on only 6 data points for each year, therefore the risk of one bad incident on one of these circuits will significantly impact on the achievability of the targets for these parameters.

3.3.3 Availability of critical circuits for non-peak periods

The availability of critical circuits for non-peak periods is also determined by the critical circuits and non-peak period defined by ElectraNet. Again, there are six critical circuits and the non-peak period is everything but the peak period (between 8am and 8pm on weekdays). Analysing the data for these six critical circuits over the five year period taking into account the identified peak period resulted in a mean critical circuit non-peak period availability of 99.94%, this mean is then used by Saha International as the target for this parameter going forward. The mean was determined by taking the recorded availability for each of the critical circuits (6 circuits for 2002 to 2006), across each of the years and then averaging the entire sample size (30 points).

The percentile of the mean was taken by sorting the data into order and determining at what percentile the mean fell, in this case the 29^{th} percentile.

As described in the methodology above the cap and collar are set at the mean percentile +/- 0.5 x mean percentile = 29% + 14.5% = 43.5% and 29% - 14.5% = 14.5%.

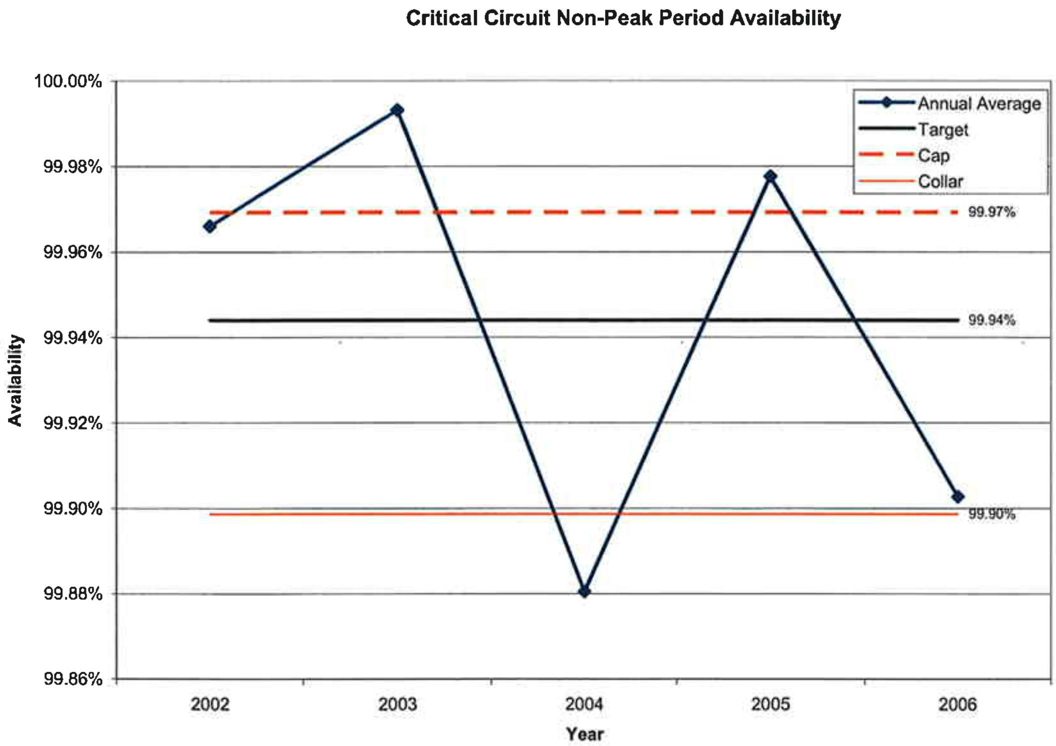
The resultant availability is found by matching the percentile against the sorted availability data and is shown in Table 3-3 below.

Table 3-3: Availability of critical circuits non-peak period performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Critical circuit availability non peak	n/a	99.94%	99.97%	99.90%	2002 to 2006
Percentile		29%	43.5%	14.5%	

Figure 3-4 shows the annual average critical circuit non-peak period availability, the 6 circuits average over each year for 2002 to 2006 in comparison to the overall five year average which constitutes the targets, caps and collars presented in Table 3-3 above. As ElectraNet has not had a significant amount of interconnector related work programmed during the off-peak hours, a very low weighting for this sub-parameter is appropriate.

Figure 3-4: Availability of critical circuits non-peak period



4. PARAMETER 2 – LOSS OF SUPPLY EVENT FREQUENCY INDEX

There are two sub-parameters included for the loss of supply event frequency index: the number of events greater than x system minutes; and the number of events greater than y system minutes. Where y is required to be greater than x and ElectraNet is required, as part of its submission to the AER, to define the values of x and y (ElectraNet determined x=0.2 system minutes, y=1 system minutes).

The information provided by ElectraNet covered the period from 1996 to 2006, and this information was considered very reliable. The period for averaging for target setting is five years under guideline 2.5(g) of the AER STPIS, there is however provision for greater than 5 years under 2.5(h) of the guideline where the AER may approve a performance target based on a different period if it is satisfied that the use of a different period is consistent with the objectives in clause 1.4 of this scheme. The data provided by ElectraNet is sufficient to the level required under the AER guidelines. For the analysis of this parameter the historical information provided beyond the 5 year period is also important as the data is limited to a single value for each year and five data points is not statistically significant, therefore it is important to increase the sample size to the maximum available historical data that contains reliable data.

4.1 Methodology for target, cap and collar setting

Once we have determined the applicable thresholds, the appropriate target for each parameter would be calculated using historical analysis, with some adjustment for the increase in the size of the network over time.

As noted by ElectraNet over several years, the number of loss of supply events would be random, which from a statistical stand-point would be expected to follow a Poisson distribution, where the mean is equal to the target value. This is the standard distribution to use in situations where there are a large number of trials but with a relatively small probability of success.

As the variance of a Poisson distribution is equal to the square root of its mean, it is a relatively straightforward exercise to set limits based on a given probability of exceedance being due to random factors.

For this purpose the cap and collars set for this parameter are found based on determining the probability of achieving the mean and then taking a 50% band around the mean based on the Poisson distribution probabilities for that mean.

4.2 Results of analysis of historical system event frequency data

Examining the historic data provided by ElectraNet and then applying the above methodologies for target, cap and collar setting the following charts and tables summarise the expected targets, caps and collars that Saha International recommend ElectraNet use in their submission to the regulator, based on statistically sound methodologies.

Saha International has for this parameter done an analysis based on the initial unadjusted data and the adjusted data taking into account the network growth over the period.

4.2.1 Loss of supply events > 0.2 system minutes non-adjusted data

The loss of supply events > 0.2 system minutes parameter is determined by ElectraNet first defining the x value as 0.2 system minutes and then analysing the historical data over the period of 1996 to 2006 to count the number of events that had system minutes off supply of greater than 0.2 system minutes. Analysing the data over the eleven year period resulted in a mean loss of supply events > 0.2 system minutes of 4, this mean is then used by Saha International as the target for this parameter going forward.

As described in the methodology above the cap and collar are set based on taking a 50% probability band around the mean. The cap and collar was set at the nearest whole number as the results each year will only be a whole number and therefore taking a value in between does not affect the bonus or penalty position.

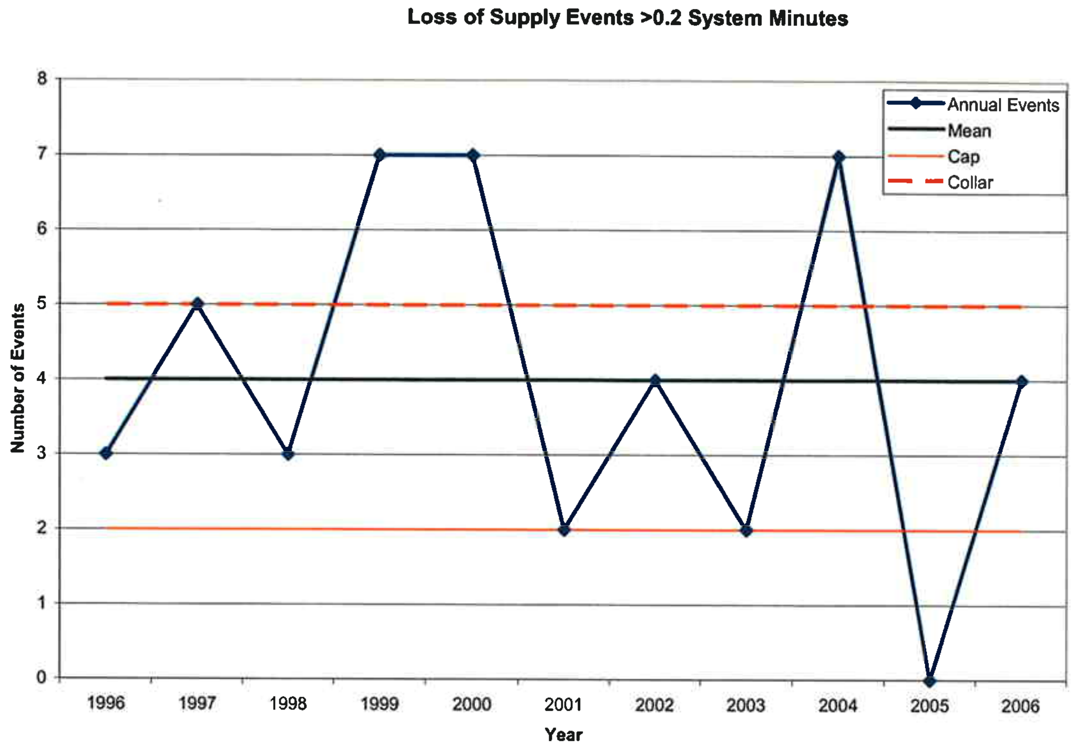
The resultant event frequency for the non-adjusted data is found by matching the nearest whole number against the cumulative Poisson distribution function for the mean and determining the nearest 50% band. The results are shown in Table 4-1 below.

Table 4-1: Loss of supply events > 0.2 system minutes non-adjusted performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Events > x system minutes (x=0.2)	5-6	4	2	5	1996 to 2006
Cumulative Poisson Probability		62.88%	23.81%	78.51%	

Figure 4-1 shows the loss of supply event frequency > 0.2 system minutes non-adjusted data, the number of events over each year from 1996 to 2006 in comparison to the overall eleven year average which constitutes the targets, caps and collars presented in Table 4-1 above.

Figure 4-1: Loss of supply event frequency > 0.2 system minutes non-adjusted data



4.2.2 Loss of supply events > 1 system minutes non-adjusted data

The loss of supply events > 1 system minutes parameter is determined by ElectraNet first defining the y value as 1 system minute and then analysing the historical data over the period of 1996 to 2006 to count the number of events that had system minutes off supply of greater than 1 system minutes. Analysing the data over the eleven year period resulted in a mean loss of supply events > 1 system minutes of 0.91, this mean is then used by Saha International as the target for this parameter going forward. As the mean is not a whole number and the only results achievable in a given year are whole numbers we suggest the mean is rounded to the nearest whole number as the target for a given year, in this case 1, but use the actual mean (0.91) to determine the Poisson distribution and relevant caps and collars.

As described in the methodology above the cap and collar are set based on taking a 50% probability band around the mean. The cap and collar was set at the nearest whole number as the results each year will only be a whole number and therefore taking a value in between does not affect the bonus or penalty position.

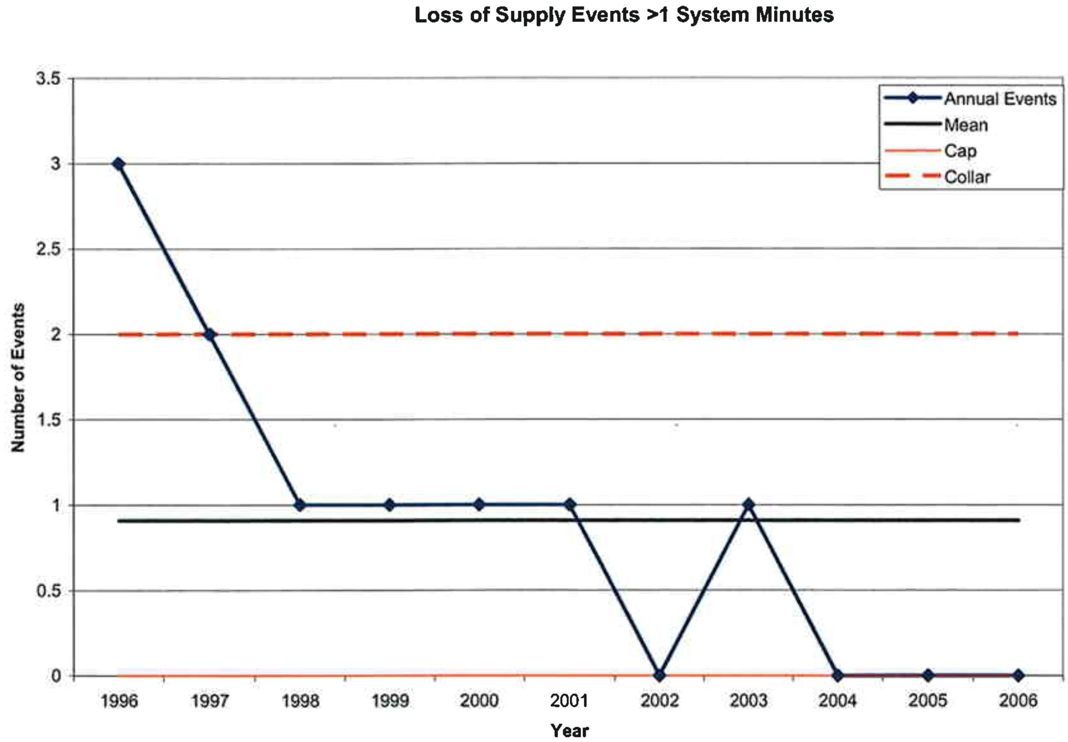
The resultant event frequency for the non-adjusted data is found by matching the nearest whole number against the cumulative Poisson distribution function for the mean and determining the nearest 50% band. The results are shown in Table 4-2 below.

Table 4-2: Loss of supply events > 1 system minutes non-adjusted performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Events > y system minutes (y=1)	2	1 (0.91)	0	2	1996 to 2006
Cumulative Poisson Probability		76.92%	40.29%	93.56%	

Figure 4-2 shows the loss of supply event frequency > 1 system minutes non-adjusted data, the number of events over each year from 1996 to 2006 in comparison to the overall eleven year average which constitutes the targets, caps and collars presented in Table 4-2 above.

Figure 4-2: Loss of supply event frequency events > 1.0 system minutes non-adjusted data



4.2.3 Loss of supply events > 0.2 system minutes adjusted data

Adjustment of the historical data was undertaken to account for the material changes in network configuration, bringing the historical information in line with the current operating configuration of the network. The adjustment took into account the known load increases which impact the system minutes calculations for three connection points, Woomera Kanmantoo and Middleback, the load increases were advised by ElectraNet and the calculation adjusted accordingly to incorporate the new load arrangements on the historical data. The loss of supply events > 0.2 system minutes adjusted data parameter is determined by ElectraNet first defining the x value as 0.2 system minutes and then adjusting and analysing the historical data over the period of 1996 to 2006 to count the number of events that had system minutes off supply of greater than 0.2 system minutes and taking into account the changes to the network during the period of the new revenue determination. Analysing the data over the eleven year period resulted in a mean loss of supply events > 0.2 system minutes of 4.55, this mean is then used by Saha International as the target for this parameter going forward. Again, as the mean is not a whole number it would be recommended to set the target at the nearest whole number, in this case rounded up to 5, however still using the mean (4.55) to determine the Poisson distribution and the resultant caps and collars.

As described in the methodology above the cap and collar are set based on taking a 50% probability band around the mean. The cap and collar was set at the nearest whole number as the results each year will only be a whole number and therefore taking a value in between does not affect the bonus or penalty position.

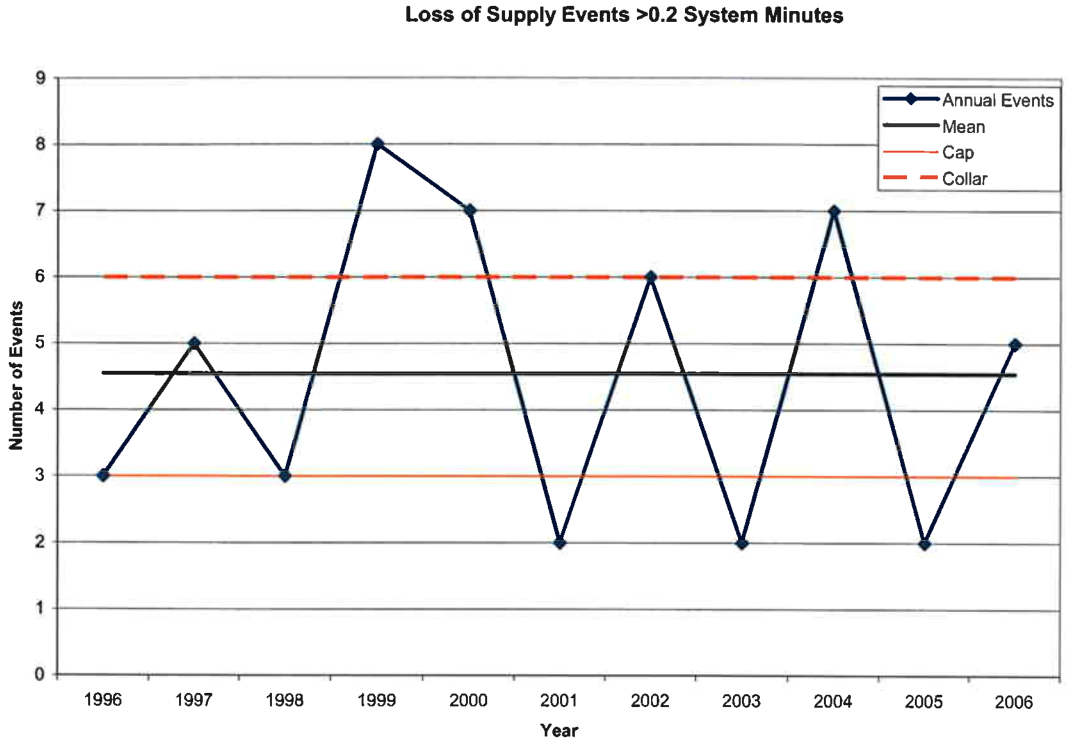
The resultant event frequency for the non-adjusted data is found by matching the nearest whole number against the cumulative Poisson distribution function for the mean and determining the nearest 50% band. The results are shown in Table 4-3 below.

Table 4-3: Loss of supply events > 0.2 system minutes adjusted performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Events > x system minutes (x=0.2)	5-6	5 (4.55)	3	6	1996 to 2006
Cumulative Poisson Probability		69.52%	33.48%	82.52%	

Figure 4-3 shows the loss of supply event frequency > 0.2 system minutes adjusted data, the number of events over each year from 1996 to 2006 in comparison to the overall eleven year average which constitutes the targets, caps and collars presented in Table 4-3 above.

Figure 4-3: Loss of supply event frequency > 0.2 system minutes adjusted data



4.2.4 Loss of supply events > 1 system minutes adjusted data

The loss of supply events > 1 system minute adjusted data parameter is determined by ElectraNet first defining the y value as 1 system minute and then adjusting and analysing the historical data over the period of 1996 to 2006 to count the number of events that had system minutes off supply of greater than 1 system minute and taking into account the changes to the network during the period of the new revenue determination. Again, the adjustment related to the known load increases for the Woomera, Kanmantoo and Middleback connection points provided by ElectraNet. Analysing the data over the eleven year period resulted in a mean loss of supply events > 1 system minutes of 1.27, this mean is then used by Saha International as the target for this parameter going forward. Again, as the mean is not a whole number we would suggest setting the target at the nearest whole number, in this case the mean would be rounded down to 1, and the caps and collars will be set on the Poisson distribution about the actual mean (1.27).

As described in the methodology above the cap and collar are set based on taking a 50% probability band around the mean. The cap and collar was set at the nearest whole number as the results each year will only be a whole number and therefore taking a value in between does not affect the bonus or penalty position.

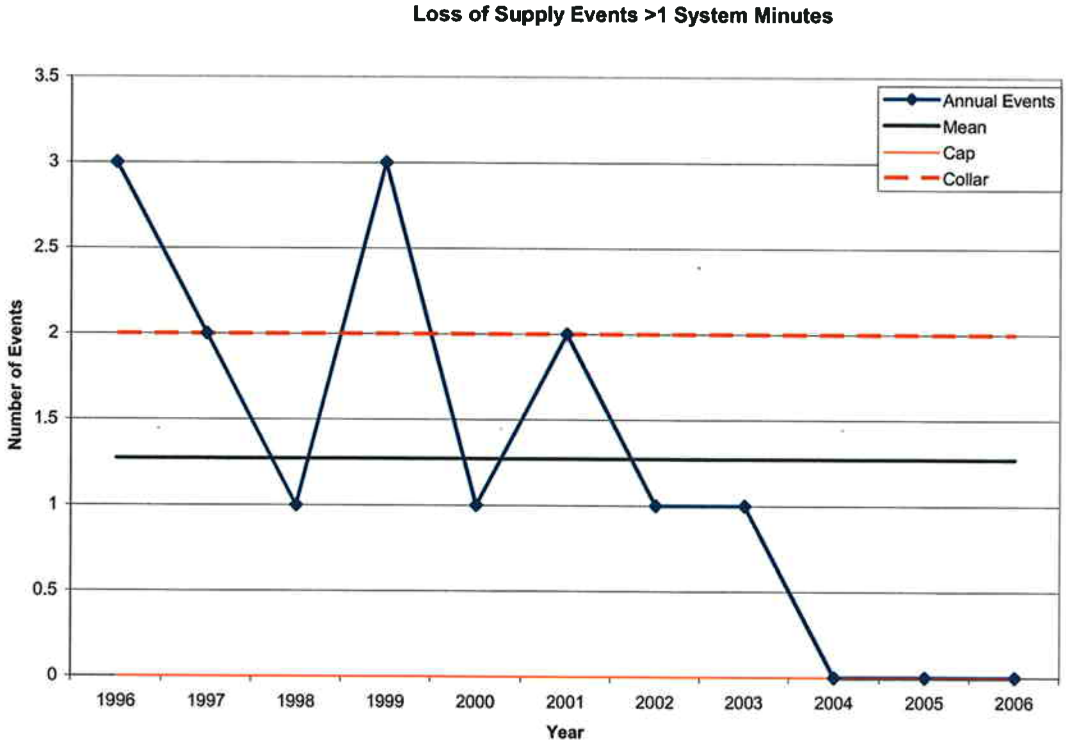
The resultant event frequency for the non-adjusted data is found by matching the nearest whole number against the cumulative Poisson distribution function for the mean and determining the nearest 50% band. The results are shown in Table 4-4 below.

Table 4-4: Loss of supply events > 1 system minutes adjusted performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Events > y system minutes (y=1)	**2**	1 (1.27)	0	2	**1996 to 2006**
Cumulative Poisson Probability		63.65%	28.01%	86.33%	

Figure 4-4 shows the loss of supply event frequency > 1 system minutes adjusted data, the number of events over each year from 1996 to 2006 in comparison to the overall eleven year average which constitutes the targets, caps and collars presented in Table 4-4 above.

Figure 4-4: Loss of supply event frequency events > 1.0 system minutes adjusted data



5. PARAMETER 3 – AVERAGE OUTAGE DURATION

The average outage duration parameter includes only forced outage events and is defined so as to measure the duration of the event rather than the duration of the individual element outages caused by that event. This is achieved by ascribing the longest element outage as the event outage duration.

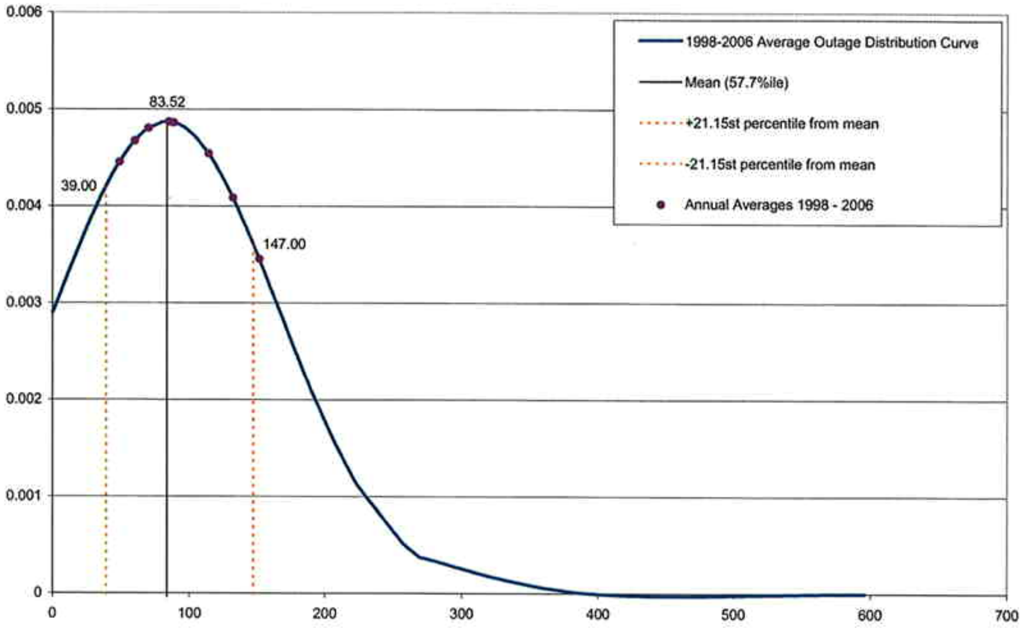
The information provided by ElectraNet covered the period from 1996 to 2006, and the information from 1998 to 2006 was considered very reliable and relevant to the current system for this parameter. The data was truncated due to the exclusion of the exceptional high outage that occurred in 1997, as this is considered an outlier year for this parameter. The period for averaging for target setting is five years under guideline 2.5(g) of the AER STPIS, there is however provision for greater than 5 years under 2.5(h) of the guideline where the AER may approve a performance target based on a different period if it is satisfied that the use of a different period is consistent with the objectives in clause 1.4 of this scheme. The data provided by ElectraNet is sufficient to the level required under the AER guidelines. For the analysis of this parameter the historical information provided beyond the 5 year period is also important, therefore it is important to increase the sample size to the maximum available historical data that contains reliable data, as the data for the period 1996-1997 is not considered as consistent and reliable, for this parameter, as the information from 1998 onwards, the analysis has been limited to the 1998-2006 period.

5.1 Definition of the parameters

The average outage duration parameter is calculated as the average of the outage duration for each event across the year. The average outage duration observed may vary materially from year to year due simply to random factors. This is because the probability distribution of outage duration is (intuitively) heavily skewed towards the shorter durations, with a long tail that extends all the way to the maximum outage duration recorded in this period (596 minutes).

The probability distribution for the outage duration data provided by ElectraNet is shown in Figure 5-1, and also shown is the percentile that the mean occurs at, the annual averages for 1998-2006, and the recommended bands, caps and collars based on percentile around the mean.

Figure 5-1: Probability distribution of average outage duration data showing the skew and kurtosis of data



5.2 Methodology for target, cap and collar setting

The target for average outage duration would be set largely on the basis of historical data, unless ElectraNet believes that there are systematic changes expected over the next five years that would affect the underlying distribution of forced outage event duration, our view is that the recent data will provide an adequate estimating base.

Targets, caps and collars for normally distributed data may be created by setting the target as the mean and the cap and collar at n standard deviations from the mean. However, ElectraNet's performance parameter data exhibits both skewness and kurtosis (Figure 5-1), and as a result the standard deviation of the data around the mean is not appropriate to set the cap and collar.

As with the availability parameters a similar approach is taken for the average outage duration parameter, to take into account the skewness and kurtosis of data, we recommend using the percentiles instead of standard deviations. Our recommendation is to use the mean as the target, determine the percentile that the mean occurs and then developing a cap and collar around the mean percentile. The nth percentile above the mean percentile will be set as the cap and the nth percentile below the mean percentile as the collar. Under this methodology the probability of being rewarded equals the probability of being penalised. Hence, using the nth percentile above and below the mean percentile to set the cap and collar takes into account both the skewness and the kurtosis of the performance parameter data.

Each performance parameter has a unique level of skewness and kurtosis. Kurtosis is a parameter of how peaked a distribution is. The value of n that minimises exposure to performance risks depends on the kurtosis of the distribution of the underlying variable. We recommend using a unique cap and collar for each type of performance parameter to account for the fact that its distribution may be more peaked or less peaked.

In developing a methodology for setting n, we have looked to the standard normal distribution and how one would arrive at the value of n given a cap at quartile three and a collar at quartile one.

Multiplying the percentile rank of the mean of a standard normal distribution by a factor of 0.5 would result in the desired n value of 25 based on the following

- For a variable that follows a standard normal distribution we know that the third and first quartile occur at the 25th percentile above and below the mean respectively.
- In addition we know that by definition, the mean of a standard normal distribution occurs at the 50th Percentile.

The same methodology may be applied to calculate n for the average outage duration parameter:

n = 0.5 * (1 - percentile rank of μ) where

- μ = mean of performance parameter over the time period under consideration e.g. mean of average outage duration parameter during the period 1998–2006.
- Percentile rank of μ = the percentage of data that has values lower than the value of μ.

In using this percentile based methodology to set caps and collars, as compared with a standard deviation based methodology. We are taking into account the skewness and kurtosis of the distribution of the average outage duration parameters.

5.3 Results of analysis of historical average outage duration data

Examining the historic data provided by ElectraNet and then applying the above methodologies for target, cap, and collar setting the following charts and tables summarise the expected targets, caps, and collars that Saha International recommend ElectraNet use in their submission to the regulator, based on statistically sound methodologies.

Based on the historical information provided by ElectraNet the mean average outage duration for the period 1998-2006 was 83.52 minutes, this forms the basis of Saha International's targets, caps and collars for this parameter. The mean was determined by taking the recorded outage duration for each event across each of the years and then sorting and averaging the entire sample size (total number of events in the period).

The percentile of the mean was taken by sorting the data into order and determining at what percentile the mean fell, in this case the 57.7th percentile.

As described in the methodology above the cap and collar are set at 1 - mean percentile +/- 0.5 x mean percentile = 57.7% + 21.15% = 78.85% and 57.7% - 21.15% = 36.55%.

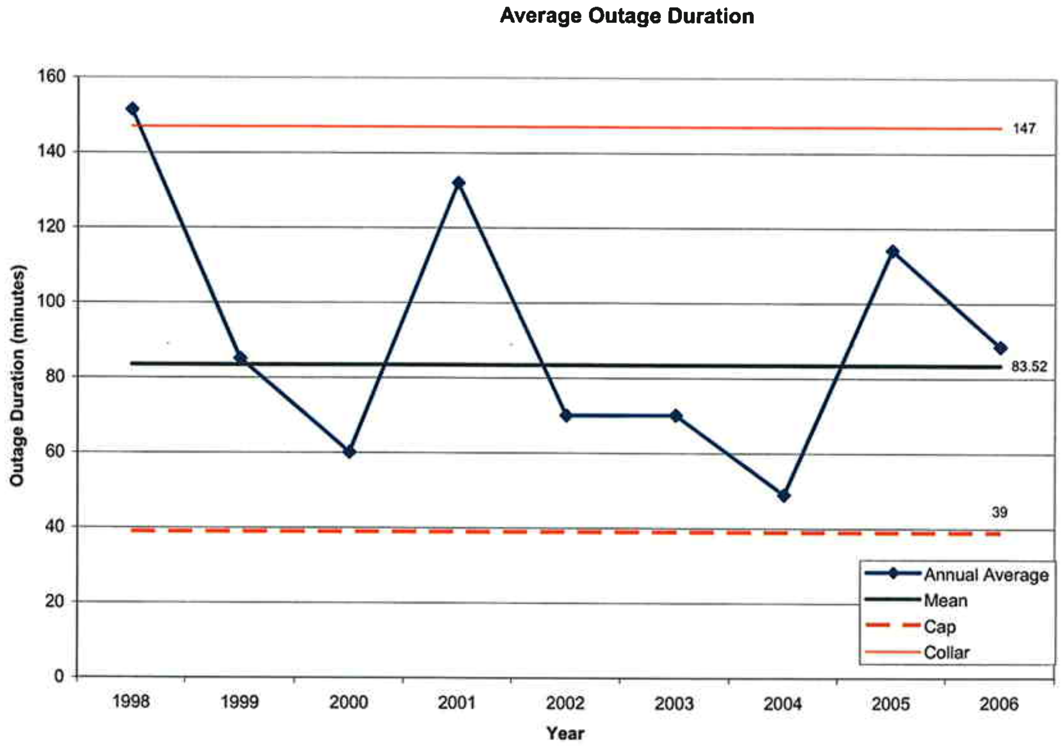
The resultant average outage duration is found by matching the percentile against the sorted data and is shown in Table 5-1 below.

Table 5-1: Average outage duration performance targets

	Target 2003-2008	Target	Bonus/ Cap Limit	Penalty/ Collar Limit	Period for Average
Average Outage Duration (Minutes)	**100-110**	83.52	39	147	**1998 to 2006**
Percentile		57.7%	36.55%	78.85%	

Figure 5-2 shows the annual average outage duration, in comparison to the overall eight year average which constitutes the targets, caps and collars presented in Table 5-1 above.

Figure 5-2: Average outage duration data



APPENDIX A - SUMMARY OF HISTORICAL DATA USED FOR ANALYSIS

	Year													
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Avg 02-06	Avg 96-06	Avg 98-06
Availability														
Transmision Circuit Availability (%) - Each Circuit Calendar Year	99.23%	99.25%	98.82%	99.29%	99.32%	99.30%	99.38%	99.59%	99.35%	99.57%	99.42%	99.47%	n/a	n/a
Average Transmission Circuit Availability (%) - Average of Annual Averages												99.47%	99.32%	99.34%
Transmision Critical Circuit Peak Period Availability (%)	n/a	n/a	n/a	n/a	n/a	n/a	99.85%	99.73%	99.75%	99.80%	99.62%	99.75%	n/a	n/a
Average Transmision Critical Circuit Peak Period (Between 8am and 8pm, Monday to Friday) Availability (%) - Average of Annual Averages												99.75%	99.75%	99.75%
Transmision Critical Circuit Non-Peak Period Availability (%)	n/a	n/a	n/a	n/a	n/a	n/a	99.97%	99.99%	99.88%	99.98%	99.90%	99.94%	n/a	n/a
Average Transmision Critical Circuit Non-Peak Period (All other times than 8am to 8pm, Monday to Friday) Availability (%) - Average of Annual Averages												99.94%	99.94%	99.94%
Loss of Event Frequency														
Number of Events > 0.2 System Minutes	3	5	3	7	7	2	4	2	7	0	4	3.40	4.00	4.00
Number of Events > 1.0 System Minutes	3	2	1	1	1	1	0	1	0	0	0	0.20	0.91	0.56
Number of Events > 0.2 System Minutes (Adjusted)	3	5	3	8	7	2	6	2	7	2	5	4.40	4.55	4.67
Number of Events > 1.0 System Minutes (Adjusted)	3	2	1	3	1	2	1	1	0	0	0	0.40	1.27	1.00
Average Outage Duration														
Average Outage Duration (minutes) - Each Event Calendar Year	88.28	360.94	151.40	85.11	60.09	132.00	70.03	70.13	48.92	114.11	88.46	72.63	102.55	78.81
Average Outage Duration (minutes) - Average of Annual Averages												78.33	115.41	91.14

Historical Data Used for Analysis by Saha International.

Availability data was provided in more detail for the past 5 year regulatory period and therefore a detailed analysis of the data could be undertaken and the critical circuit availability measures could be analysed.

Loss of Supply Events, the entire historical data supplied was used for analysis by Saha International as only a total annual figure can be used and therefore the data sample size would be limited to 5 points if we are to only use the last regulatory period, therefore the historical data doubles the sample size and allows for more accurate statistical analysis, however 11 data points is still not a significant data set.

Average outage duration was taken over the period of 1998 to 2006, the data was truncated due to the exclusion of the exceptional high outage that occurred in 1997, as this is considered an outlier year for this parameter. As the level of events that occur in each year is variable, having a larger number of years provides a greater sample size and a more reliable data set.

Averages Used by Saha International to Set Targets for Performance Incentives

ElectraNet's methodology for adjusting the historic data to be consistent with the expected future connection point loads included the following steps:

- Establishing the expected step load increases at existing or new connection points which are not represented in the historic data.
- For new connection points identifying the appropriate existing connection points with similar characteristics including transmission line and location.
- Determine the agreed maximum demand (AMD) prevailing during the historic period for the selected connection points
- Determine the adjusted AMD for the connection points by adding the new load to the existing AMD
- Multiplying the system minutes for events at the connection points by the ratio of the adjusted AMD to prevailing AMD.