Audit of ElectraNet Service Standards Performance Reporting

PERFORMANCE RESULTS FOR 2006

- Final Report
- 9 March 2007

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1. Executive Summary

Sinclair Knight Merz (SKM) was engaged by the Australian Energy Regulator (AER) to conduct an audit of the performance report of ElectraNet for 2006 under the AER Performance Incentive (PI) Scheme.

The audit reviewed the performance results submitted by ElectraNet, in particular:

- any refinements or additions to the recording system used to measure performance;
- the accuracy of the calculations of the final performance; and
- the force majeure and other exclusions to accord with the service standards guidelines.

SKM and representatives from the AER met with ElectraNet staff in Adelaide on Tuesday 13 February 2007, to review their data systems and procedures for gathering and processing outage information, and to investigate specific events proposed for exclusion. As a result of audit activities undertaken, Sinclair Knight Merz has formed an opinion that:

- the performance reporting by ElectraNet was free from material errors and was in accordance with the requirements of the AER service standards guidelines;
- the recording system used by ElectraNet to capture outage data is accurate and reliable;
- the categorisation of assets was consistent with the historical categorisation; and
- the application of exclusions was in accordance with defined exclusions and historical calculation of performance.

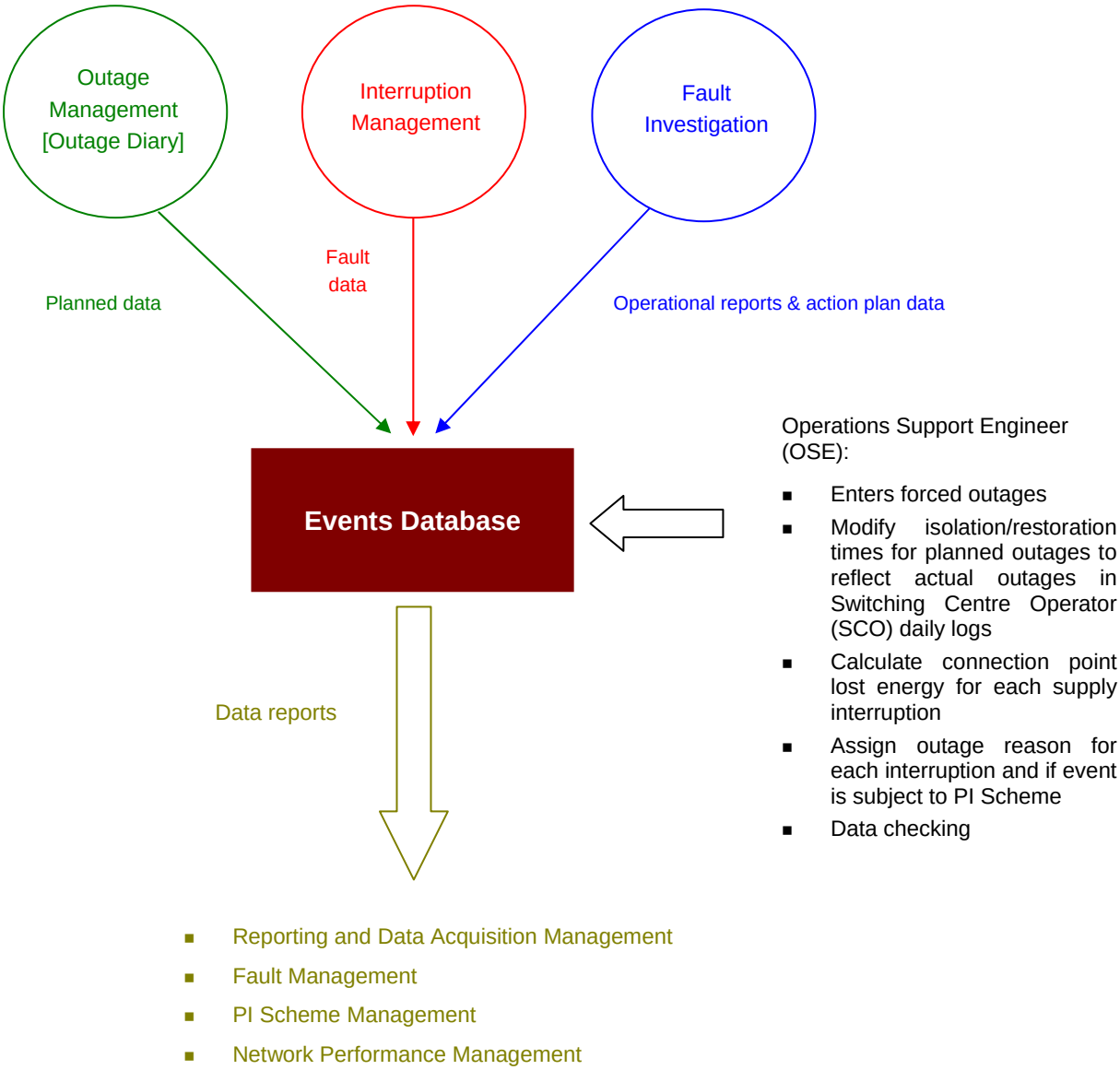
SKM recommends that:

- ElectraNet's calculation of its S-factor be accepted as free from material errors;
- the proposed exclusion of the Yorke Peninsula and Kanmantoo outages are considered to be third party inter-trips and should be accepted as satisfying defined exclusion provisions;
- the inclusion of major capital works capped to 14 days is consistent with the transmission line availability calculations applied in previous reviews; and
- based on the acceptance of the proposed exclusions being consistent with standard performance measures in the AER ElectraNet determination, the bonus recommended under the AER PI Scheme for 2006 is **0.592245% of the Annual Revenue for 2006.**

2. Recording System

An overview of the ElectraNet transmission performance data management process is shown in Figure 2-1.

- **Figure 2-1 Transmission Performance Data Management Process**



2.1 Events Database

The Events Database was developed in-house using Oracle. Data entry was originally based on a series of manual inputs, although the system has being developed over the past 12 to 18 months and some more direct data input methods are currently being employed, with further development planned in the future.

Operators in the Switching Operation Centre maintain an electronic log using a database system, which the Operations Support Engineer (OSE) subsequently uses to review events and cross check the start and finish times for outages entered by the operators with the SCADA records.

Certain defined events, such as fault outages, automatically generate preliminary advice via SMS and a confirmation email from the operator in the Switching Operation Centre to a defined list of staff, advising of the details of the incident.

Planned work is recorded in the Outage Diary, which is entered into the Events Database. The OSE reviews each planned outage against the daily logs and SCADA records to modify the isolation and/or restoration times to reflect actual times. Each planned outage is part of the System Switching Program and carries a SSP number for easy identification. The operators log the actual start and finish times for this work, and it is these times that are used in calculating performance results.

In late January 2006, ElectraNet introduced a custom system to tighten the control of and accountability for planned outages. The Switching Writer and Outage Booking System (SWOBS) allows any authorised person either internal to ElectraNet or a third party to enter the requirements for an outage, including the proposed time and the particular pieces of plant (selected from equipment lists) to be effected. Based on these requests, ElectraNet schedule the outages and make the results available to third parties with external viewing access rights. Once an outage has been planned, an authorised person[1] will develop the initial switching sheet, which will be subsequently checked and amended as required. A complete history and audit trail of the switching sheet is maintained within SWOBS. The stage 2 phase of SWOBS is scheduled for May 2007, and will replace the existing Outage Diary by integrating planned work records into SWOBS. Stage 3 is planned for 2008 and will include a B2B interface with the NEMMCO outage scheduler. These modifications will eventually result in a single point of data entry for the Events Database rather than the existing two.

[1] Clause 4.10.3(d) of the National Electricity Rules states registered market participants registered by NEMMCO as network service providers " *...must ensure that transmission network operations performed on their behalf are undertaken by authorised persons ...*".

All relevant events from the logs, interruption reports, and the Outage Diary are entered into the Events Database. Fault investigation reports are used in some cases to establish the cause of outages, and to assign the appropriate classification (eg included/excluded).

For each outage, the Operation Support Engineer calculates the unserved energy using actual load data from revenue metering, reviews the cause for the outage and codes the event for calculation of performance under the PI Scheme. This coding is checked by others as part of the operational report for each event, and modified if the original categorisation is deemed inappropriate. It was noted that the original coding is not overwritten, but updated, so that there is a history maintained for this coding phase.

2.2 Categorisation and Exclusions

The reasons for each event are considered at the time events are entered into the Events Database, and excluded events are "tagged" in the database.

2.3 Processing of Outage Data

ElectraNet have developed database queries and reports that extract relevant data from the Events Database for further analysis in a spreadsheet for PI Scheme analysis and reporting.

The Events Database acts as a single information source for PI Scheme reporting, with all relevant events exported to spreadsheets for summation and analysis. There is a separate sheet for each performance indicator, listing total events for that indicator. A cover sheet summarises the results for each performance indicator, and calculates the S-factors and revenue bonus/penalty.

2.4 Calculation of Performance Measure Results

The performance measure results are calculated using the S-factor equations defined in the South Australian Transmission Network Revenue Cap decision (2002). The AER has previously written to ElectraNet clarifying the discrepancies between Appendices 6 and 7 of the original decision document, and confirming that the equations in Appendix 7 prevail over the figures in Appendix 6. ElectraNet have applied the equations and coefficients from Appendix 7.

2.5 System Audit Findings

SKM has previously conducted extensive testing of the recording system in previous reviews which found no errors in the processing of event data. The tests confirmed that each of the events had been correctly transferred, with the date, time and other details intact. SKM was satisfied the reasons and classification for each event was reasonable and in accordance with historical reporting protocols.

3. Exclusions

The AER service standard guidelines noted that the PI Scheme adopted standard definitions for performance measures to ensure that TNSPs have similar incentives, whilst recognising that these definitions needed to be flexible. It was highlighted that the definitions should align with appropriate information that the TNSP has been collecting historically to ensure that performance is measured consistently over time to preserve the incentive to improve. The audit identified the events that have been excluded in the past.

3.1 Excluded Events

For each of the performance measures applicable to ElectraNet, there are different exclusions specified for each. These exclusions are shown in Table 1 for each of the performance indicators.

Shaded areas represent exclusions applied by ElectraNet in line with historical practice that are not explicitly listed in the AER PI Scheme (as per the South Australian Transmission Network Revenue Cap decision (2002)).

Table 1 Exclusions for ElectraNet performance indicators

Circuit Availability	Loss of Supply Event Frequency Index	Average Outage Duration
Unregulated transmission assets;	Unregulated transmission assets	Unregulated transmission assets
3rd party initiated events (TNSPs, generators, customers, NEMMCO)	3rd party initiated events (TNSPs, generators, customers, NEMMCO)	3rd party initiated events (TNSPs, generators, customers, NEMMCO, faults causing correct operation of ElectraNet protection)
Extended outages for major line rebuilding involving substantial multi structure replacements, restringing and reinsulation	Planned outages	Planned outages
	Successful reclose within one (1) minute	Momentary interruptions (<1 minute)
Force majeure	Force majeure	Force majeure
Voltage control [2] where circuit is available for immediate restoration	Outages resulting from an interconnector outage are capped to thirty (30) minutes	Outages resulting from an interconnector outage are capped to thirty (30) minutes
Opening of only one end of a transmission line ie. where the transmission line remains energised and available	SA Water pumping station supply outages (refer section 3.2)	

[2] Circuit switched out to provide actual or contingency voltage control.

3.2 SA Water

Interruptions involving SA Water pumping stations are included in Average Outage Duration performance calculations but excluded from the Loss of Supply Event Frequency Index. This is due to two main considerations:

- These interruptions were excluded from historical data used in setting performance targets under the AER PI Scheme, as pumping station loads are highly irregular, which makes any accurate estimation of load profiles and therefore projected energy lost very unreliable; and
- SA Water pumping stations are classified as Category 1 loads under the South Australia Transmission Code, and were historically interruptible by ElectraNet and therefore excluded from any calculations of lost system minutes.

The Transmission Code defines a Category 1 load as

"A transmission entity shall not contract for an amount of agreed maximum demand greater than 100% of installed line capacity. A transmission entity shall have no obligation to provide N-1 line capacity [3] beyond that necessary to maintain power system performance and quality of supply standards under the National Electricity Code. A transmission entity shall use its best endeavours to restore the contracted line capacity within 2 days of an interruption."[4]

[3] N-1 means the ability of the transmission system to continue to supply loads connected to the system in the event of a "worst case" outage of any single element (line, transformer, busbar, circuit breaker…)

[4] Essential Services Commission of South Australia, *Electricity Transmission Code*, 1 July 2003, section 2.2.2

3.3 Audit Findings

During 2006, there were 284 events recorded for transmission line circuit outages, and 69 customer interruption events[5]. The number of exclusions, and primary cause for exclusion, are shown in Table 2 and Table 3.

Table 2 Transmission line circuit availability outages

Outage type	No. of events	Hours	Notes
Included events	254	5,476.94	Includes Angas Creek - Mannum project work each capped to 14 days[6]
Excluded events	15	352.17	Contingency switching
	11	1,477.25	Customer requested work initiated from Northern PS and others
	2	646.00	Voltage control work
	2	3.57	Third party outage on Yorke Peninsula
Subtotal	*30*	*2,478.99*	
Total	**284**	**4,252.85**	

Consistent with previous reviews relating to major capital works, ElectraNet have included the extended transmission line outages resulting from the Angas Creek - Mannum 132 kV transmission line rebuild. The time associated with each of these extended outages has been capped to 14 days in aggregate in calculating the 2006 transmission circuit availability figure.

Table 3 Customer interruption events

Outage type	No. of events	Minutes	System minutes[7]	Notes
Included events	13	1,150	1.585	
Excluded events	40	0	0.000	Trips caused by generators
	10	0	0.000	Trips caused by wind farms
	2	0	0.000	Trips caused by ETSA Utilities protection
	2	223	0.189	ETSA Utilities protection trip on Yorke Peninsula
	1	81	0.008	Kanmantoo outage caused by ETSA Utilities inter-trip
	1	0	0.000	Trip caused by SA Water
Subtotal	*56*	*304*	*0.197*	
Total	**69**	**1,454**	**1.782**	

[5] A single customer interruption event may affect a number of separate connection points.

[6] The uncapped result for inclusions in 2006 was 5,695.57 hours.

[7] System Minutes are calculated for each individual connection point affected by an event. It is calculated as *System Minutes = Average Load Lost (MW) * Outage Duration (minutes) / System Maximum Demand*

Table 4 summarises the overall results by included and excluded events.

Table 4 Summary of inclusions and exclusions

Category	Total no. of events		Total Duration	
	Included	Excluded	Included	Excluded
Transmission line circuit outages	254 (89%)	30 (11%)	5,477 (69%)	2,479 (31%)
Customer interruption events	13 (19%)	56 (81%)	1,150 (79%)	304 (21%)

3.4 Significant Events

There were three significant events reported by ElectraNet affecting the performance calculations:

- Kanmantoo substation outage of 12 November 2006;
- Ardrossan West substation bus zone trip of 26 November 2006; and
- Multiple voltage or contingency switching events.

3.4.1 Kanmantoo Substation outage

A fault occurred on the low voltage side of a transformer supplying a copper mine at Kanmantoo substation on Sunday 12 November 2006, with an outage duration of 81 minutes. The design of the installation is such that any fault on the ETSA Utilities 11kV distribution side will result in the operation of the protection scheme of the ElectraNet circuit breaker CB6102 on the 132kV side.

SKM has reviewed the electrical connection diagrams for Kanmantoo substation, and is satisfied that the outage was the result of a third party inter-trip from the distribution side of the substation. It is therefore recommended that this exclusion is accepted.

3.4.2 Ardrossan West Substation outage

On Sunday 26 November 2006, an electrical storm moving across the Upper Yorke Peninsula caused a fault near the distribution substation in Ardrossan, a town on the Yorke Peninsula. Following a reported lightning strike, the protection on two 33kV circuit breakers operated due to serious and permanent damage to distribution line insulators and conductors. Both of these circuit breakers reclosed automatically approximately 8½ seconds later. The protection on these 33kV circuit breakers appeared to fail to respond to the re-established fault, resulting in the protection operating in the ElectraNet Adrossan West substation to backup the ETSA Utilities protection.

This protection correctly tripped several 33kV and 132kV circuit breakers in the Adrossan West substation, together with providing an inter-trip signal to circuit breakers in Dalrymple and Hummocks transmission substations. Supply was restored to all areas at 7:12am, approximately 2 hours after the initial event occurred.

ElectraNet has investigated the incident, and concluded that there was a deficiency with the protection system in the Ardrossan distribution substation, which resulted in the protection at Ardrossan West transmission substation acting to clear the sustained fault.

Following a review of this incident, SKM is of the view that:

- Independent weather reports for Sunday 26 November 2006 detailed electrical storms on the Upper Yorke Peninsula, with multiple lightning strikes recorded in the vicinity of Ardrossan;
- A lightning strike was recorded at 5:09am approximately 2½ kilometres from Ardrossan distribution substation[8];
- The investigation identified permanent damage on the distribution network, consistent with a lightning strike; and
- The power system performance monitor output at Hummocks recorded two events - the original trip of the distribution circuit breakers, and the subsequent automatic reclose 8.62 seconds later. The second event resulted in a two phase fault which persisted for 1.70 seconds before the ElectraNet circuit breakers at Ardrossan West substation operated to clear the fault.

Following a review of the network configuration and power system monitoring data, SKM is satisfied that the evidence supports the conclusion that the outage was a result of a third party. The lightning strike on the distribution network was initially correctly cleared by protection on the distribution network, but the subsequent automatic reclose of the distribution circuit breakers lead to a failure in the second instance to again operate the distribution network protection. Instead, the re-established fault was ultimately cleared by protection at Ardrossan West substation.

Consistent with the findings of previous audits, SKM would make the following recommendations:

- The event should be excluded from Circuit Availability (Measure 1) and Loss of Supply Event Frequency (Measure 2) in line with the definition of acceptable exclusions including " … *any outage caused by a fault or other event on a 3rd party system.*"[9]
- Whilst the definition for Average Outage Duration (Measure 3) in the South Australia Decision of 2002 does not explicitly exclude third party trips, ElectraNet historical data for this measure has been based on the exclusion of third party outages. The Force Majeure definition for ElectraNet excludes " … *third party and natural events for which the TNSP can not be*

[8] www.hillsrain.com.au lightning tracker records of 26 November 2006. Website provided details, including the latitude and longitude, of each individual strike as storm passed over Yorke Peninsula

[9] ACCC, *South Australia Transmission Network Revenue Cap: Decision*, 11 December 2002, Appendix 5, pp 116 and 117

reasonably expected to cater for."[10] SKM is of the view this event should be accepted as an exclusion for Measure 3 as it satisfies the Force Majeure provision.

3.4.3 Voltage or Contingency Switching

ElectraNet has proposed exclusion of 15 contingency switching events and 2 voltage control events totalling 998 minutes from the performance calculation of Circuit Availability (Measure 1) in accordance with the following defined[11] exclusions:

- Exclusion 1.4 Switching to control fault levels - outages to control voltages within required limits, both as directed by NEMMCO and where NEMMCO does not have direct oversight of the network (in both cases only where the element is available for immediate energisation if required); and
- Exclusion 1.5 Circuit opening for operational purposes - the opening of only one end of a transmission circuit (eg. where the transmission circuit remains energised and available to carry power with immediate manual or automatic return to service).

These contingency and voltage switching exclusions are consistent with the operating requirements for a Transmission Network Service Provider detailed in Chapters 4 and 5 of the National Electricity Rules for power system security and network connection.

SKM would recommend that these exclusions are accepted.

3.5 Recommendations

The audit identified that the categories used for designating exclusions are generally in accordance with the exclusions defined with the ElectraNet determination. The exception is system minutes[12] associated with SA Water outages which has been excluded in accordance with historical reporting protocols and previous reviews.

[10] Appendix 5, pp 121

[11] Definitions provided in the AER template for performance reporting dated January 2007

[12] System minutes are used in the calculation of the Loss of Supply Event Frequency indices.

4. Force Majeure

In the Service Standards Guidelines published by the AER[13], there are four (4) considerations listed for determining what force majeure events should be "excluded force majeure events". These are:

- Was the event unforeseeable and its impact extraordinary, uncontrollable and not manageable;
- Does the event occur frequently – if so, how did the impact of the particular event differ;
- Could the TNSP, in practice, have prevented the impact (not necessarily the event itself); and
- Could the TNSP have effectively reduced the impact of the event by adopting better practices?

4.1 Definition

The definition used by ElectraNet in the determination of performance under the AER PI Scheme reflects the definition outlined in the AER service standards guidelines and which was used historically in processing performance data (see Appendix B for details).

4.2 Event

There were no events during 2006 for which ElectraNet sought exclusion as a Force Majeure event.

[13] AER, *Statement of principles for the regulation of transmission revenues – Service standards guidelines*, 12 November 2003, Appendix E, Schedule 2

5. Assessment of S-factors

Table 6 shows the results of S-factor calculation proposed by ElectraNet and recommended by SKM following its audit of the ElectraNet service performance report.

SKM confirmed that the ElectraNet has used the S-factor equations contained in the revenue cap decision and correctly applied the formulas and coefficients to calculate the S-factors in their submission. In addition, SKM has audited and confirmed the results generated from the supporting files detailing the outages included and claimed for exclusion from the performance calculations.

- **Table 5 Performance Results**

No	Performance Measure	Target	ElectraNet without exclusions	ElectraNet with all proposed exclusions	SKM without exclusions	SKM assessment
1	Circuit Availability (total)	99.25%	99.2921%	99.4211%	99.2921%	99.4211%
2a	Loss of Supply Event Frequency Index > 0.2 mins	5	4	4	4	4
2b	Loss of Supply Event Frequency Index > 1.0 mins	2	0	0	0	0
3	Average Outage Duration (mins)	100	90.88	88.46	90.88	88.46

- **Table 6 Calculated S-factors**

No	Performance Measure	ElectraNet without exclusions	ElectraNet with proposed exclusions	SKM without exclusions	SKM assessment
1	Circuit Availability (total)	0.042099%	0.171091%	0.042099%	0.171091%
2a	Loss of Supply Event Frequency Index > 0.2 mins	0.025000%	0.025000%	0.025000%	0.025000%
2b	Loss of Supply Event Frequency Index > 1.0 mins	0.300000%	0.300000%	0.300000%	0.300000%
3	Average Outage Duration (mins)	0.076042%	0.096154%	0.076042%	0.096154%
	TOTAL	**0.443141%**	**0.592245%**	**0.443141%**	**0.592245%**

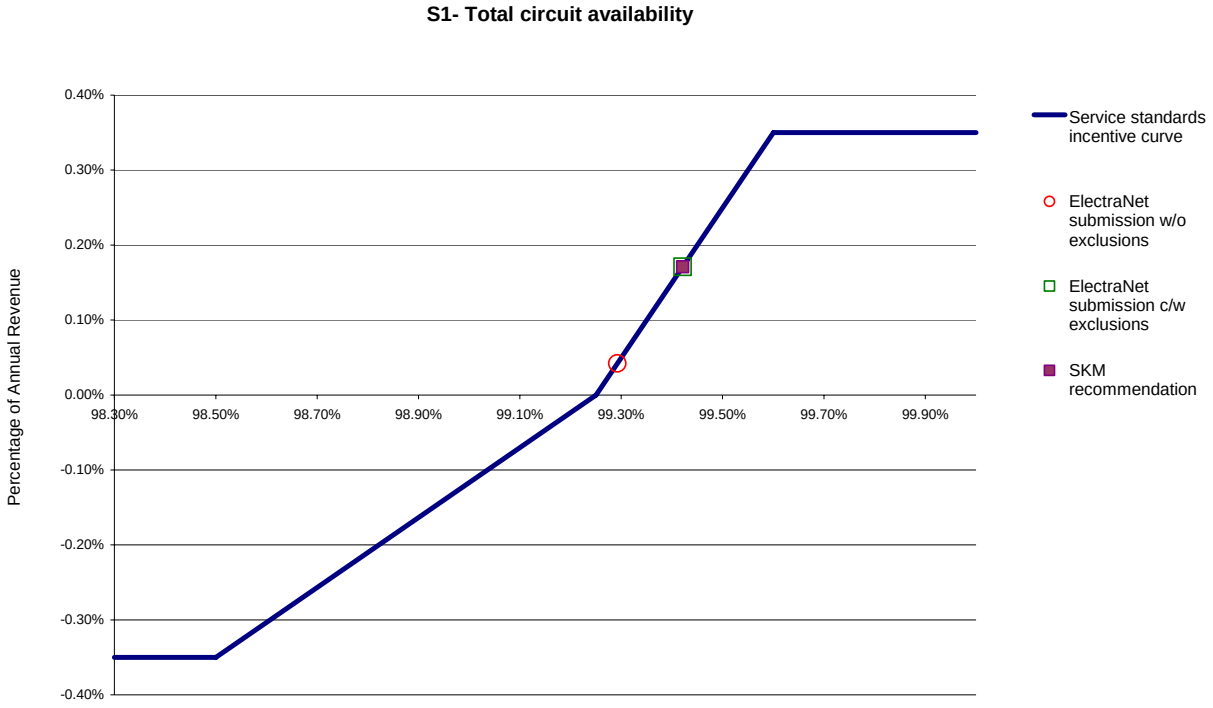
The profiles for each of the applicable measures are shown in Appendix A to illustrate the performance in graphical terms. Based on these results, SKM recommends the bonus for ElectraNet should be **0.592245% of the Annual Revenue for 2006**.

Appendix A Performance Measure Profiles

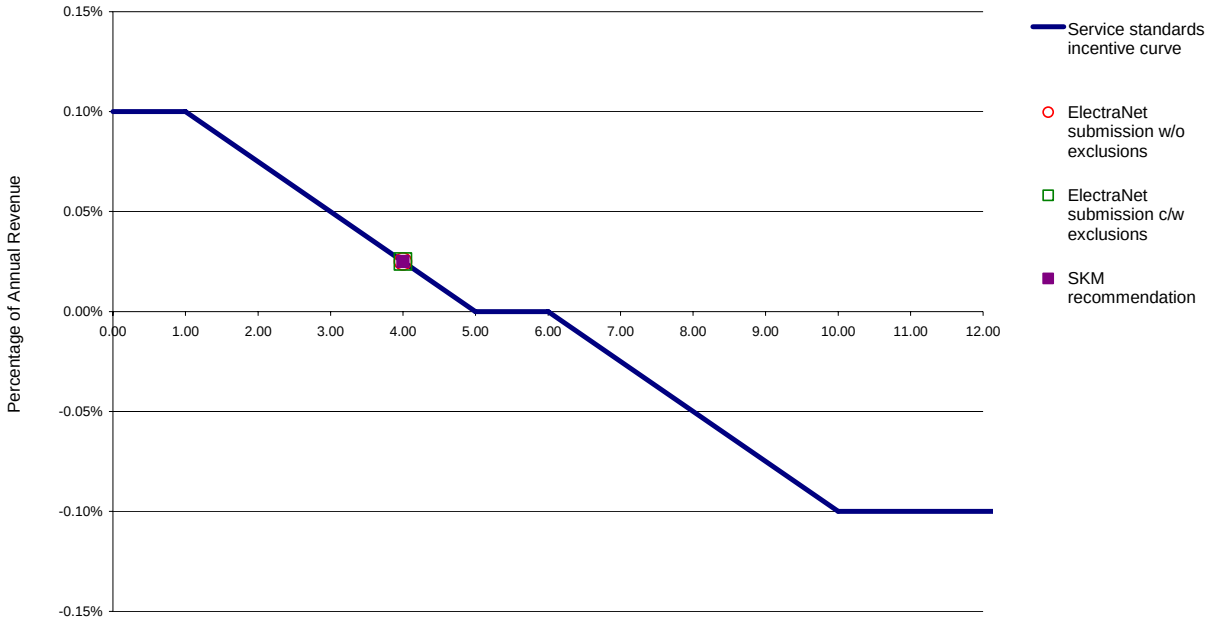
The Performance Measure profiles graphically illustrate the 2006 performance against the targets for Circuit Availability and Average Outage Duration.

The profiles shown are:

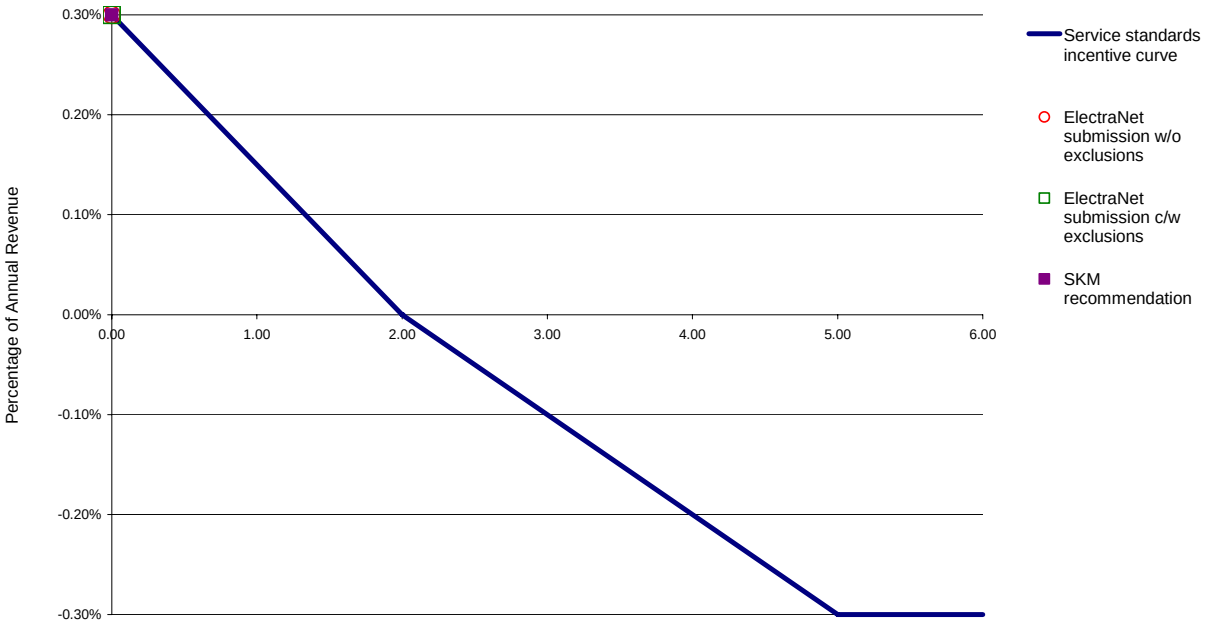
- Measure 1 Circuit Availability (total)
- Measure 2a Loss of Supply Event Frequency Index > 0.2 mins pa
- Measure 2b Loss of Supply Event Frequency Index > 1.0 mins pa
- Measure 3 Average Outage Duration

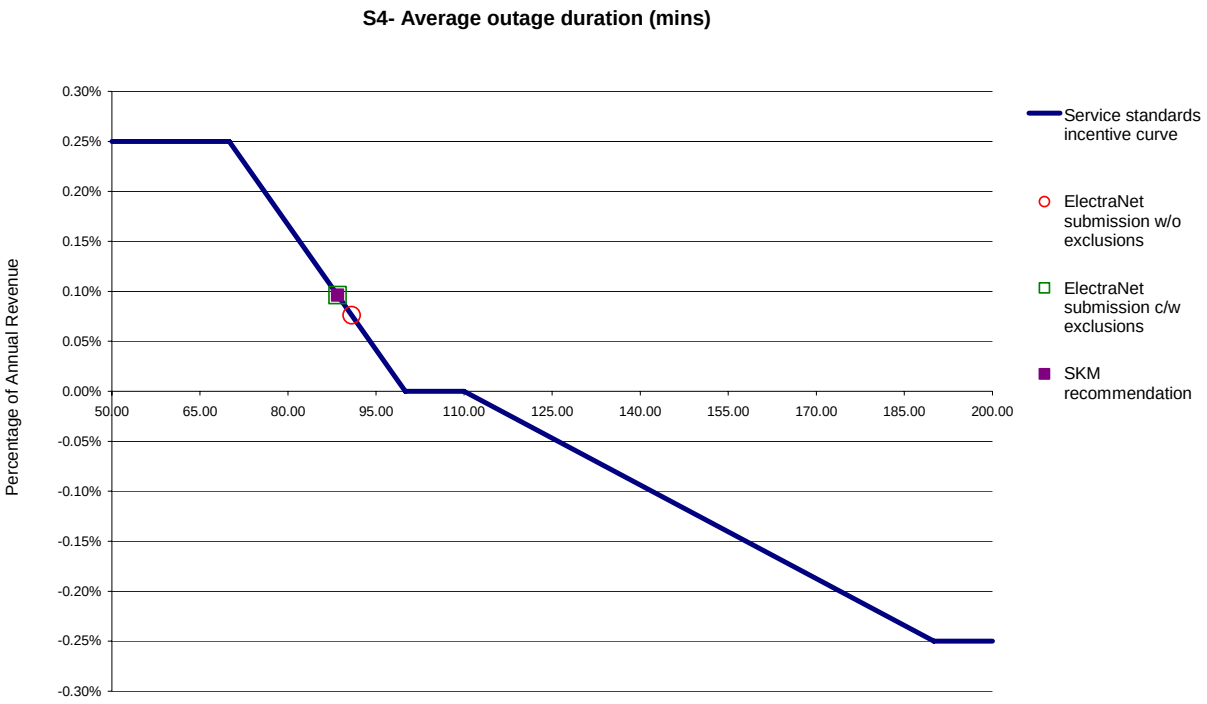


S2- Loss of supply frequency (>0.2 system minute)



S3- Loss of supply frequency (>1.0 system minute)




S4- Average outage duration (mins)
Percentage of Annual Revenue
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
-0.05%
-0.10%
-0.15%
-0.20%
-0.25%
-0.30%
50.00
65.00
80.00
95.00
110.00
125.00
140.00
155.00
170.00
185.00
200.00
Service standards incentive curve
ElectraNet submission w/o exclusions
ElectraNet submission c/w exclusions
SKM recommendation

Appendix B Definition of Force Majeure

The AER Revenue Cap decision does not contain a formal definition for force majeure.

On 6 February 2003 the AER wrote to ElectraNet clarifying discrepancies between the coefficients in Appendix 6 and Equations in Appendix 7 of the decision. At this time the AER included the following definition of force majeure:

"*… third party and natural events for which the TNSP can not be reasonably expected to cater for*"