Audit of Powerlink Service Standards Performance Reporting

PERFORMANCE RESULTS FOR PERIOD 1 JULY - 31 DECEMBER 2007

- Final Report
- 10 April 2008

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Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
A	12.03.2008	A Lambe	J Butler	12.03.2008	For comment
B	28.03.2008	A Lambe	J Butler	28.03.2008	For review
1.0	10.04.2008	A Lambe	J Butler	10.04.2008	For issue

Distribution of copies

Revision	Copy no	Quantity	Issued to
A	Electronic	1	AER
B	Electronic	1	Powerlink
1.0	Electronic	1	AER, SKM Library

Printed:	29 April 2008
Last saved:	24 April 2008 11:36 AM
File name:	I:\QHIN\Projects\QH43508\Deliverables\Powerlink\QH43508R023.doc
Author:	Alex Lambe/Jeff Butler
Project manager:	Jeff Butler
Name of organisation:	Australian Energy Regulator (AER)
Name of project:	Audit of Powerlink Service Standards Performance Reporting
Name of document:	Report
Document version:	Final
Project number:	QH43508

1. Executive Summary

Sinclair Knight Merz (SKM) was engaged by the Australian Energy Regulator (AER) to conduct an audit of the 2007 performance report of Powerlink (Queensland transmission) based on the service standards defined in the AER's Final Decision on Powerlink's 2007/08-2011/12 Revenue Cap[1], and in accordance with the general provisions of the 2003 ACCC service standards guidelines.

The audit concentrated on a review of the performance results submitted by Powerlink, in particular:

- the adequacy and accuracy of the recording system used to measure performance;
- the accuracy of the calculations of the final performance; and
- any and all exclusions to ensure compliance with the AER's Decision and AER Service Standards Guidelines.

As the auditor, SKM met with Powerlink staff in Brisbane on Tuesday 19th February 2008 to review the accuracy and integrity of the system established by Powerlink for retrieving data from the performance data maintenance system for reporting under the AER Service Standards Guidelines. In addition, the supporting information for specific events was reviewed to examine any particular issues associated with any claims for exclusion.

As a result of the audit activities undertaken, Sinclair Knight Merz has formed an opinion that:

- the performance reporting by Powerlink was free from errors and was in accordance with the requirements of the AER Service Standards Guidelines[2];
- Powerlink has correctly applied the AER performance incentive model that contain the S-factor equations and coefficients defined in the revenue cap decision to calculate the S-factors;
- the data recording system used by Powerlink to capture the relevant details for outages is considered to be accurate and reliable for the intended use as a performance reporting mechanism;

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[1] AER, *Powerlink Queensland Transmission Network Revenue Caps 2007/08-2011/12: Decision*, 14 June 2007

[2] The STPIS that was relevant at the time of the 2007/08-2011/12 Determination was an ACCC guideline *Decision – Statement of principles for the regulation of transmission revenues – service standards guidelines*. This guideline was subsequently revised and reissued as the Service Target Performance Incentive Scheme, with the latest version published November 2007. Section 5 of the November 2007 document defines the general requirements of the data recording and reporting systems.

- the report submitted by Powerlink, using the spreadsheet template provided by AER, included details of four exclusions.

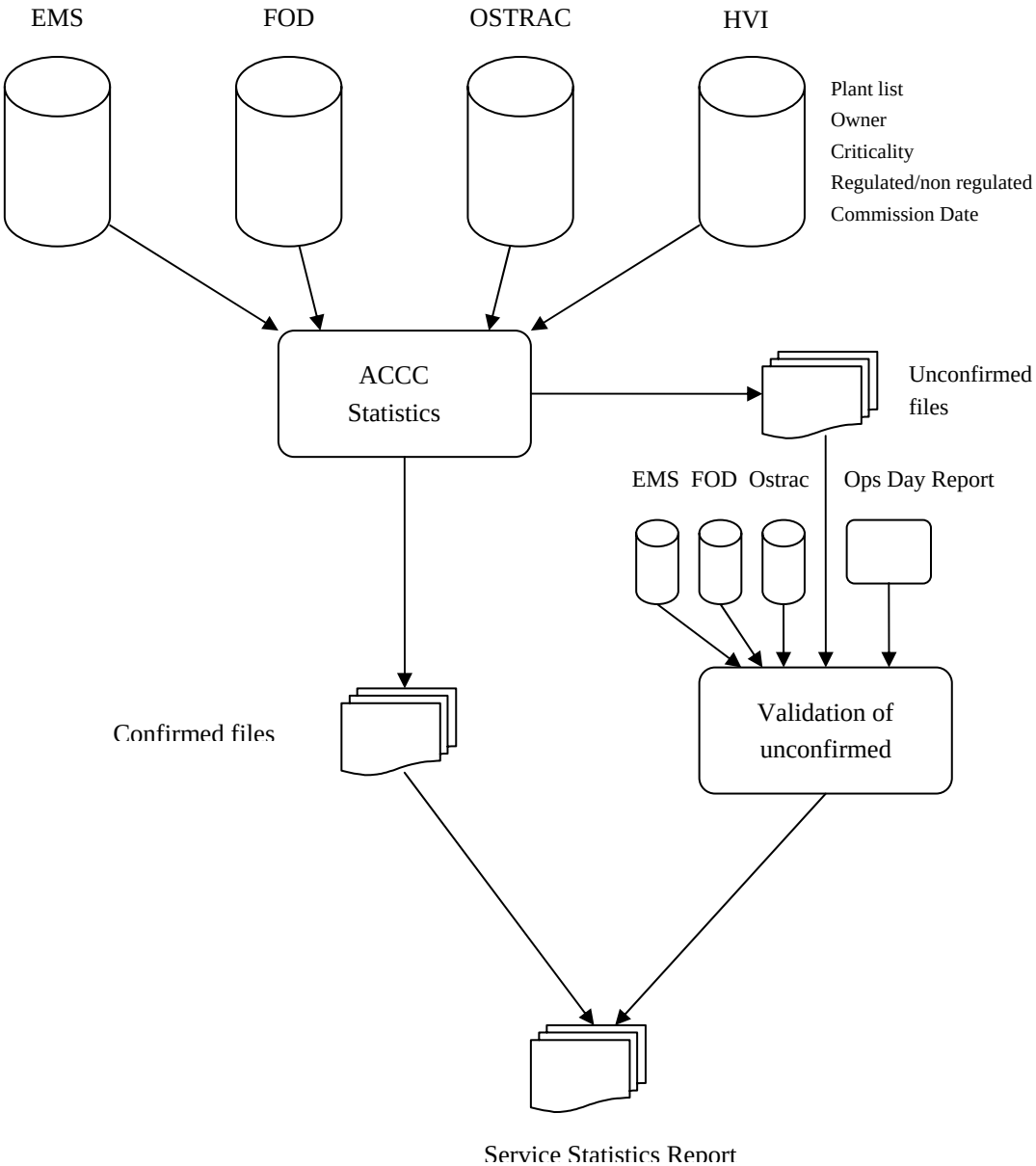
SKM recommends:

- Powerlink's calculation of its S-factor be accepted as free from errors, subject to the AER's acceptance of the exclusions recommended by SKM; and
- The S-factor for Powerlink under the AER Service Standards Scheme for 2007 to be **0.818619% of Powerlink's MAR for the 2007/08 revenue period**, being 1 July 2007 – 31 December 2007.

2. Recording System

An overview of the Powerlink data reporting system is illustrated in Figure 1.

- **Figure 1 Powerlink Data Recording System**



The focal point of this performance recording system is an Oracle forms based program referred to by Powerlink as the "ACCC Statistics Generator".[3]

Data is fed into the ACCC Statistics Generator through four sources:

- Energy Management System EMS;
- Forced Outage Database FOD;
- Planned Outage System OSTRAC; and
- High Voltage Index asset list HVI.

SKM noted that Powerlink have employed a consistent performance data capture and processing system over the previous 5 years.

2.1 Energy Management System (EMS)

The Energy Management System (EMS) is an event capture database where all outage events are recorded either from direct SCADA input or from system operators. All data is automatically tagged with date and time information.

The system operators have the ability to tag an event with a comment to describe an outage in more detail if it is considered appropriate.

2.2 Forced Outage Database (FOD)

The Forced Outage Database (FOD) consists of data files that provide details of all unplanned plant outages that occurred during a specific month. Line outages will be recorded if they satisfy two criteria:

a) the transmission line is owned by Powerlink; and
b) the outage is attributable to Powerlink.

The FOD also lists all plant outages that are attributable to Powerlink.

The raw data in the FOD provides details pertaining to each unplanned event. These details include:

- respective transmission plant identification depending on the outage type;

[3] It was noted that this database application was created prior to the AER emerging as a separate constituent, and the program title was not updated to reflect this change.

- cause category (including various categories such as fire, storm, equipment malfunction or failure, etc);
- outage start/end date and time (including peak/off-peak periods);
- FOD comments (providing a brief written report regarding what occurred and was observed during the incident); and
- organisation responsible for the outage (eg. Powerlink, distributor, customer or generator).

2.3 Planned Outage Database (OSTRAC)

The Planning Outage database OSTRAC contains data related to all planned outages for a specific month. To be included in this database, an outage must have been started or finished in the month in question, must relate to work undertaken on Powerlink assets, and must involve switching of High Voltage (HV) plant.

The raw data in OSTRAC provides details including:

- substation or feeder which the Application For Work (AFW) was raised against;
- item of plant the AFW was raised against;
- description of the item of plant (e.g. capacitor, feeder, reactor SVC and transformer);
- work code and work code description, (e.g. line and substation work, line/underground (UG), live line work, live substation work, maintenance/repairs of HV infrastructure, protection work, etc);
- Start/end date and time ((including peak/off-peak periods);
- effect on system; and
- organisation that the outage is assigned to (e.g. Powerlink, distributor, customer or generator)

2.4 High Voltage Index asset list (HVI)

The High Voltage Index (HVI) asset list is a plant register that contains data on each asset, including:

- critical / non-critical categorisation;
- regulated / non-regulated status; and
- commissioning date.

2.5 ACCC Statistics Generator

Data from the four source databases - EMS, FOD, OSTRAC, and HVI - is compiled within the ACCC Statistics Generator, which enables the analysis of Powerlink's performance through the generation of the following files[4]:

- Matching Data files where operation times entered into FOD or OSTRAC match the times that elements within EMS are unavailable or de-energised (within a tolerance);
- Summary Data file for Loss of supply frequency index, which is used for summarising customer outages;
- Plant Data file which provides a count of critical, non-critical and total plant availability for the month; and
- Exception Data files where operation times entered into FOD or OSTRAC do not match the times that the elements within EMS are unavailable or de-energised (within a tolerance), together with an EMS exception file for elements that have become unavailable and do not have corresponding references to OSTRAC or FOD.

SKM noted that the "tolerance" referred to above has been set by Powerlink as a five (5) minute window; that is, Powerlink have found through experience to be an appropriate concession to allow for potential differences between the actual operation time registered by SCADA devices within the EMS and those manually entered times in FOD or OSTRAC.

SKM would agree that this timing allowance is reasonable given the nature of the data recording system.

2.6 Summary Data File

The raw data included in this file will provide details related to:

- Bulk Supply point or customer affected;
- cause category (including failure, storm and unknown);
- event date;
- customer outage duration (in seconds);
- MW shed;
- MW minutes;
- system Maximum demand;
- system minutes duration;

[4] Powerlink, *AER Statistics Preparation and Maintenance*, 15 February 2008

- customer outage and FOD Event comments; and
- entity assigned responsibility (eg. Powerlink, distributor, generator, customer etc)

During the auditing process, SKM analysed Powerlink's calculation of Loss of Supply system minutes, and found it to be correct.

2.7 Exception Files

In instances where the ACCC Statistics Generator cannot find a match for an outage between EMS, FOD, and OSTRAC, the event is placed into an unconfirmed file, which requires manual checking.

The types of circumstances that may arise that would result in an exception include:

- operational switching of assets;
- a planned outage that never proceeded; or
- a situation where, for example, a circuit breaker has an outage which is captured, but an associated capacitor bank which has become unavailable as a result is not.

Exception data is corrected for each of the source databases - EMS, FOD and OSTRAC - and each of these unconfirmed files requires manual checking to ensure all events have been accounted for.

2.7.1 FOD exception data

Whilst being fed by data from the FOD, the ACCC Statistics Generator assumes that plant has become unavailable when it is de-energised or open-ended in the case of feeders. Powerlink noted that this assumption may not always prove sufficient for the purposes of reporting to the AER, with the example given where a transformer becomes unavailable due to the circuit breaker being open on the high voltage side, but which has not become de-energised as it is being back-fed from the low voltage side.

Due to the unavailability of the plant, this situation would still require reporting under the AER Service Standards Guidelines.

2.7.2 OSTRAC exception data

Powerlink reported that the most common cause for entries sourced from the OSTRAC files to appear in the ACCC Statistics Generator exception file is due to misalignment with start and end times falling outside of the 5 minute tolerance setting. The ACCC Statistics Generator applies the same assumption per the FOD matching process. In the case of OSTRAC data, it was noted that reactive plant may also be unavailable for operational reasons, which requires reporting. All SVC outages were noted to be automatically placed in this file, in order to allow for the determination of

whether the SVC was already out of service, which would therefore still require reporting, or it was taken out of service for maintenance.

SKM noted that manual sorting of events occurs according to whether the plant falls under the critical or non-critical definition during this validation process. SKM also observed that Powerlink have a installed a suitable procedure to ensure that double counting of an event is eliminated.

Time that had elapsed during an outage event spanning more than a single month, was observed to be assigned proportionately according to when it actually occurred.

2.8 AER Service Standards Report

Having thus provided validation for events that have arisen in the unconfirmed files, and compiled an AER Statistics Report spreadsheet, the next phase in the reporting system is to compile the AER Service Standards report, which is generated internally on a monthly basis. This report is then circulated to relevant management personnel for comment and further scrutiny.

The AER Service Standards Report is an Excel file, into which confirmed data from the Matching files are copied and pasted into worksheets for each month, together with data related to outages that have been separately investigated in the exception data files. The compiled data is analysed using standard Visual Basic macros to generate results for each of the parameters, both with and without proposed excluded events.

2.9 System Maintenance

SKM noted that Powerlink were found to have in place, a three-tier process of maintaining the performance reporting system. The individual components of the system maintenance procedure are:

- ACCC Statistics Generator maintenance - including the annual updating of relevant dates on which public holidays occur, and continuous updating the network element table (which identifies all EMS nodes and elements, along with an indication of its critical/non-critical status).
- AER Statistics Report Spreadsheet maintenance - Annual updating of all related information (critical/non-critical/commissioning dates etc) and monthly inclusion of data from the various sources.
- Updating of related documentation - SKM understood that this component of system maintenance, involved the ongoing maintenance of all documentation used in the preparation of Powerlink's AER report; including the AER documentation revisions register, the AER plant listings (a count of monthly critical and non-critical elements of the transmission system), and two internally published procedural documents entitled *Powerlink: Guiding*

Principles for AER Service Standards Reporting and *Powerlink: Asset Monitoring Procedure – AER Statistics Preparation and Maintenance*.

SKM considered that the system maintenance procedures were sufficient to ensure the system remained both accurate and current.

3. System Audit Findings

SKM noted and appreciated the full co-operation and assistance provided by Powerlink management and personnel during this audit of its performance reporting procedures.

SKM established that between 1 July and 31 December 2007, 1,044 line entries relating to system events appeared in the OSTRAC planned outage file, and 98 in the FOD forced outage database.

As part of its audit process, SKM conducted random sampling of thirty (30) individual events to ensure they had been captured and appropriately categorised. In each instance, SKM was satisfied that the information had been correctly recorded and processed. The assignment of the various descriptors was found to be appropriate and accurate, and the data entry arrangements provided sufficient support to the system operators in order to allow for appropriate categorisation of events.

SKM noted that Powerlink has a number of internal checks, including those automatically generated, through Excel spreadsheet cell formatting operations, and procedurally required. These internal checks were deemed to assist in ensuring that such categorisation is in line with the requirements of the AER Service Standards Scheme.

SKM observed the real-time operation of Powerlink's performance data outage monitoring system during its site visit, and was satisfied that the system appeared to function as designed. The arithmetic functions on the Excel spreadsheets provided were also checked, and all were found to have been correctly constructed and applied.

In summary, SKM is satisfied that the recording and data processing systems that have been put in place by Powerlink appear to accurately log and calculate performance.

4. Exclusions

The AER's Decision established a set of provisions for certain defined events to be excluded from Powerlink's calculated outage figures. These provisions are provided in section 4.1.

4.1 Defined Exclusions

The exclusions defined under the AER Powerlink Decision are as follows:

Transmission Circuit Availability parameters	▪ unregulated transmission assets (e.g. some connection assets) ▪ any outages shown to be caused by a fault or other event on a 'third party system' (e.g. intertrip signal, generator outage, customer installation) ▪ Force Majeure events ▪ any outage not affecting Powerlink's primary transmission equipment ▪ faults originating from Powerlink owned equipment that affect primary plant or equipment owned by a distributor, connected customer or a generator
Loss of Supply Event Frequency Index parameters	▪ unregulated transmission assets (e.g. some connection assets) ▪ any outages shown to be caused by a fault or other event on a 'third party system' (e.g. intertrip signal, generator outage, customer installation) ▪ planned outages ▪ Force Majeure events
Average Outage Duration parameter	▪ planned outages ▪ momentary interruptions (duration of less than one minute) ▪ Force Majeure events

4.2 Event Based Exclusions Sought by Powerlink

Powerlink made an application for exclusion relating to a total of four (4) events arising during the period 1 July – 31 December 2007 from the transmission circuit availability parameters, and the Average Outage Duration parameter:

- Calvale substation outage of 19 July 2007;
- Feeder 8828 line trip of 13 September 2007;
- Kamerunga substation outage of 2 October 2007; and
- Kareeya transformer trip of 3 December 2007.

4.2.1 Calvale Substation Outage

On Thursday 19 July 2007, feeder 851, which runs between the Callide B Power Station and Calvale substation, tripped at the same time as Callide B Power Station unit 1 generator tripped off line, due to a generation issue. The outage extended for 1.30 hours.

An investigation into the incident identified that there had been a failure of a protection scheme relay module associated with 1 Generator, which had sent an inter-trip signal to the Powerlink plant at Calvale substation. The Powerlink plant, equipment and protection schemes were found to have operated as designed.

SKM is satisfied that the cause of this outage was a third party inter-trip initiated at the Callide B Power Station. It is therefore recommended that this exclusion is accepted.

4.2.2 Feeder 8828 Line Trip

Whilst Powerlink were undertaking planned work at Calvale substation on Thursday 13 September 2007, Tarong North Power Station was conducting tests on a generator unit that was out of service for an overhaul. During these tests, an inter-trip signal was sent to Tarong substation, which tripped a 275kV feeder between Tarong and Tarong North, and de-loaded a 275kV feeder between Tarong and Calvale. The event lasted approximately 44 minutes.

Following a review of the planned and forced outage data base records, SKM is of the view that:

- Powerlink was conducting planned project work at Calvale substation under switching program number Q07S/1728, which began on Sunday 9 September 2007. This work required some reconfiguration of the feeder 8810 on to another circuit breaker and was completed on Sunday 16 September 2007;
- On Thursday 13 September, at approximately 3:07pm, an inter-trip signal was received at Tarong substation from Tarong North Power Station, which tripped feeder 8828 which is a 275kV feeder between Tarong and Tarong North;
- As a result of this trip, feeder 8810, which is a 275kV feeder between Tarong and Calvale, was de-loaded due to an excessively high voltage level on the system;
- All of the Powerlink equipment and protection schemes were found to have operated correctly; and
- All of the hours associated with the construction work under project Q07S/1728 have been included in the performance calculations by Powerlink.

SKM is satisfied that the evidence suggests the outage of feeder 8828 and the associated de-loading of feeder 8810 were caused by an inter-trip signal from Tarong North Power Station. It is recommended that this outage event is excluded from the performance calculations as it satisfies the provision for exclusion of an outage due to a third party inter-trip signal.

4.2.3 Kamerunga Substation Outage

At 8:11 am on Tuesday 2 October 2007, feeder 7184 was tripped due to an inter-trip signal received from Barron Gorge Power Station. The outage lasted approximately 38 minutes. An investigation of the Powerlink equipment and protection schemes found that it had operated correctly and as designed.

During the audit, SKM found that the configuration of the network requires the operation of a Powerlink circuit breaker to isolate the feeder between Kamerunga substation and Barron Gorge Power Station. This outage is considered to satisfy the provisions for exclusion as a third party inter-trip, and SKM would recommend for this event to be excluded from the performance calculations.

4.2.4 Kareeya Transformer Outage

On Monday 3 December 2007, a circuit breaker supply a 132kV transformer at Kareeya substation was tripped. The event lasted for approximately 5¼ hours.

An investigation into the incident identified that the circuit breaker protection operation was due to a fault with an auxiliary transformer on the Stanwell hydroelectric power station side. All of the Powerlink protection schemes were found to have operated correctly and as designed.

SKM considers that this outage was due to a third party inter-trip signal from the generator, and would therefore recommend that this outage is excluded from the performance calculations.

5. Force Majeure

5.1 Definition

Under the service standards scheme guidelines, Force Majeure is defined as:

For the purpose of applying the service standards performance-incentive scheme, 'force majeure events' means any event, act or circumstance or combination of events, acts and circumstances which (despite the observance of good electricity industry practice) is beyond the reasonable control of the party affected by any such event, which may include, without limitation, the following:

- *fire, lightning, explosion, flood, earthquake, storm, cyclone, action of the elements, riots, civil commotion, malicious damage, natural disaster, sabotage, act of a public enemy, act of God, war (declared or undeclared), blockage, revolution, radioactive contamination, toxic or dangerous chemical contamination or force of nature*
- *action or inaction by a court, government agency (including denial, refusal or failure to grant any authorisation, despite timely best endeavour to obtain same)*
- *strikes, lockouts, industrial and/or labour disputes and/or difficulties, work bans, blockades or picketing*
- *acts or omissions (other than a failure to pay money) of a party other than the TNSP which party either is connected to or uses the high voltage grid or is directly connected to or uses a system for the supply of electricity which in turn is connected to the high voltage grid*
- *where those acts or omissions affect the ability of the TNSP to perform its obligations under the service standard by virtue of that direct or indirect connection to or use of the high voltage grid.*

In determining what force majeure events should be 'Excluded force majeure events', the ACCC will consider the following:

- *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)?*
- *Could the TNSP have effectively reduced the impact of the event by adopting better practices?*

5.2 Event

There were no events during the July - December 2007 period for which Powerlink has sought exclusion as a Force Majeure event.

6. Calculation of S-factors

Table 1 shows the service performance results proposed by Powerlink with and without the events under consideration for exclusion, as well as the figures recommended by SKM following its audit of Powerlink service performance report.

Table 2 provides the S-factor calculation results proposed by Powerlink with and without the exclusions being applied for, as well as the figures recommended by SKM following its audit of Powerlink service performance report.

SKM confirmed that Powerlink has used the AER performance incentive model that contains S-factor equations and coefficients in the Decision to correctly calculate the S-factors.

- **Table 1 Performance Results**

No	Performance Measure	Target	Powerlink without exclusions	Powerlink with all proposed exclusions	SKM assessment
S1	Transmission circuit availability (critical circuit elements)	99.07%	99.438281%	99.438281%	99.438281%
S2	Transmission circuit availability (non-critical circuit elements)	98.40%	98.701377%	98.701793%	98.701793%
S3	Transmission circuit availability (peak periods)	98.16%	98.597368%	98.598182%	98.598182%
S4	LOS number of events greater than 0.2 system minutes per annum	2.5	1	1	1
S5	LOS number of events greater than 1.0 system minutes per annum	0.5	0	0	0
S6	Average outage duration	1033	583	612	612

Table 2 Calculated S-factors

No	Performance Measure	Powerlink without exclusions	Powerlink with proposed exclusions	SKM assessment
S1	Transmission circuit availability (critical circuit elements)	0.107705%	0.107705%	0.107705%
S2	Transmission circuit availability (non-critical circuit elements)	0.043419%	0.043479%	0.043479%
S3	Transmission circuit availability (peak periods)	0.105925%	0.106122%	0.106122%
S4	LOS number of events greater than 0.2 system minutes per annum	0.155000%	0.155000%	0.155000%
S5	LOS number of events greater than 1.0 system minutes per annum	0.300000%	0.300000%	0.300000%
S6	Average outage duration	0.113636%	0.106313%	0.106313%
	TOTAL	**0.825685%**	**0.818619%**	**0.818619%**

The profiles for each of the applicable measures are shown in Appendix A to illustrate the performance in graphical terms.

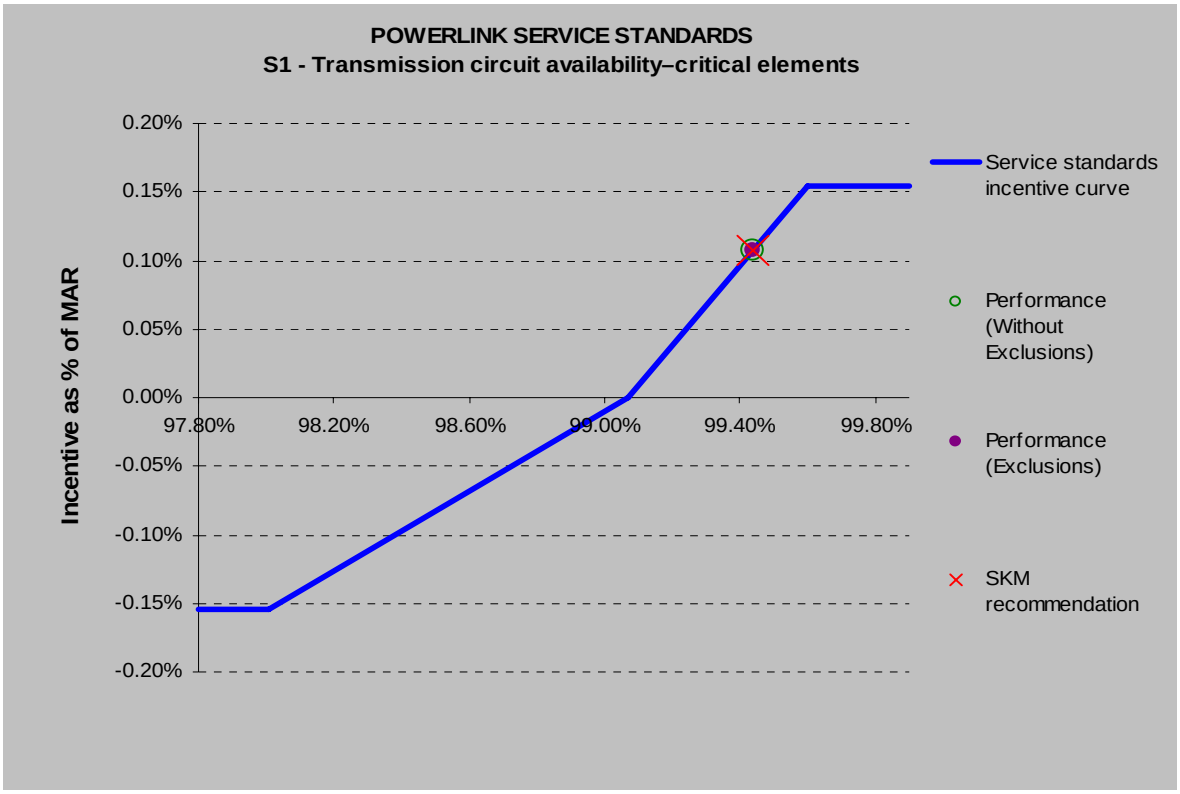
Based on these results, SKM considers Powerlink's calculation of its S-factor to be free of errors, and recommends that the financial bonus for Powerlink under the AER Service Standards Scheme for 2007 is **0.818619% of the Annual Revenue for the 2007/08 revenue period, being 1 July - 31 December 2007.**

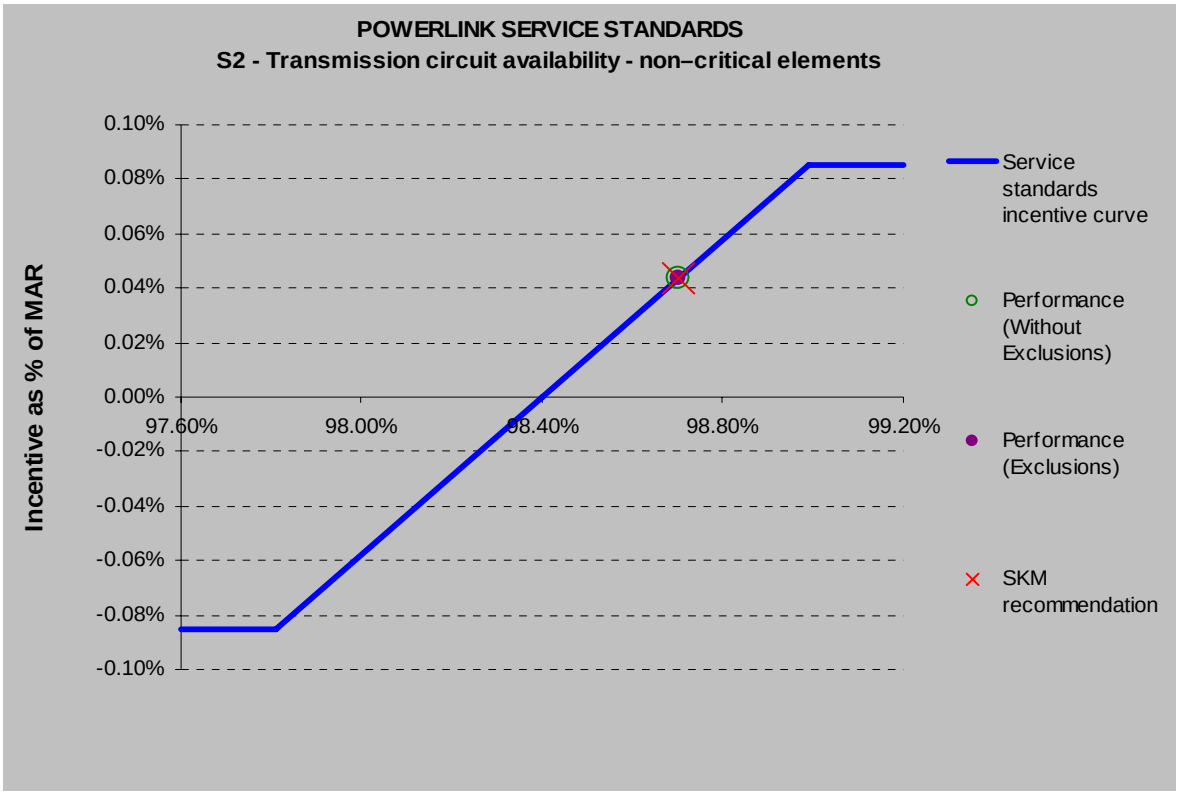
Appendix A Performance Measure Profiles

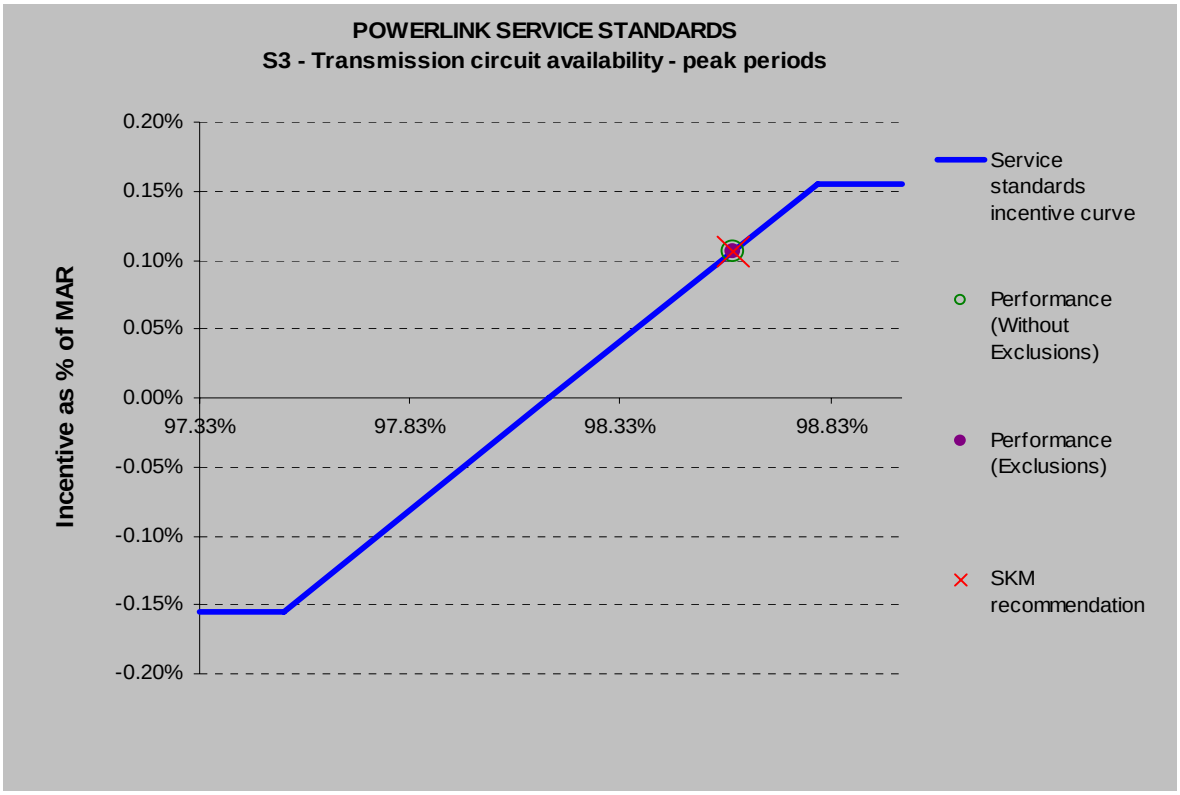
The Performance Measure profiles graphically illustrate the 2007 performance against the targets for Circuit Availability and Average Outage Duration.

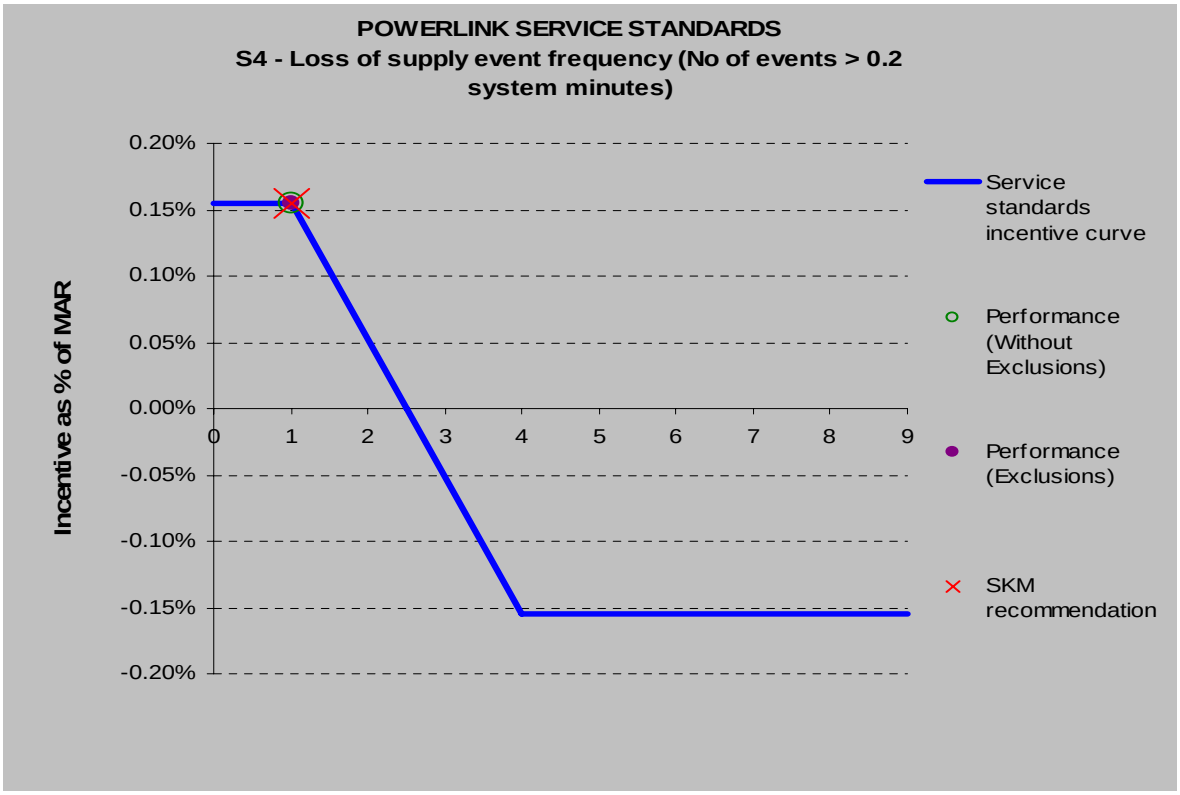
The profiles shown are:

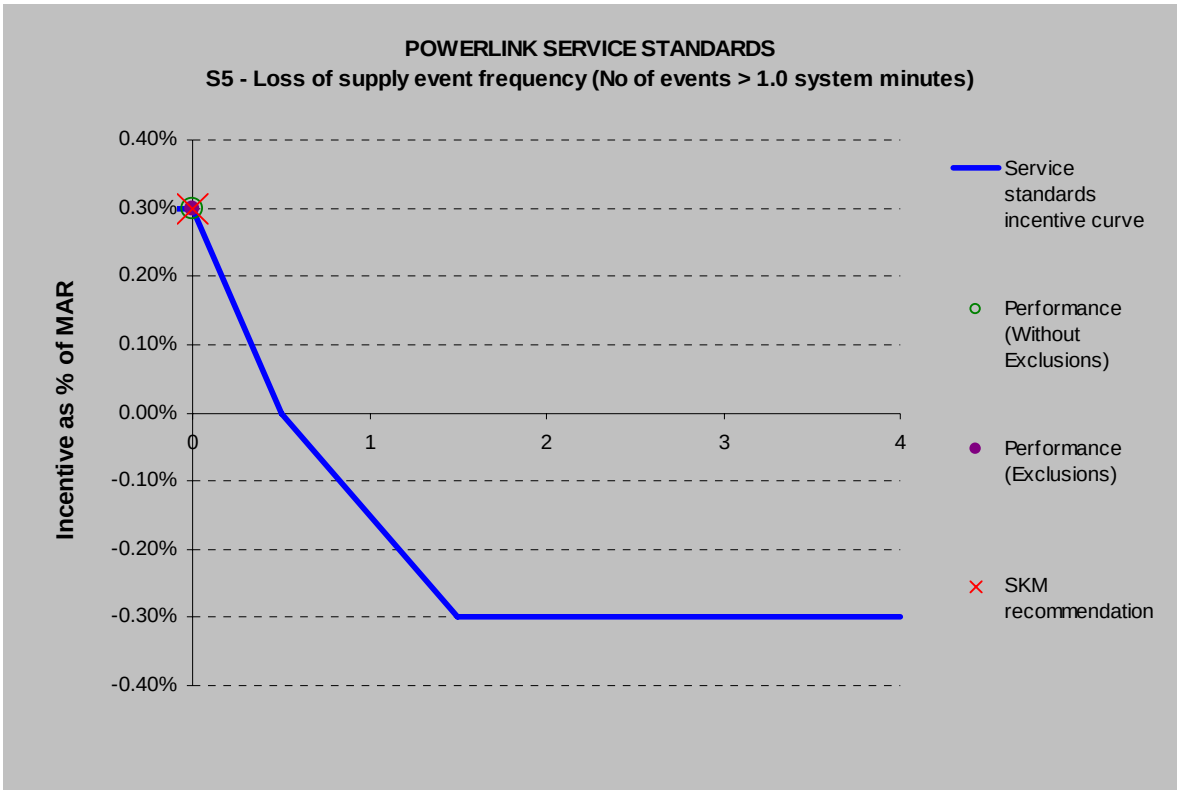
- S1 -Transmission circuit availability (critical circuit elements)
- S2 -Transmission circuit availability (non-critical circuit elements)
- S3 -Transmission circuit availability (peak periods)
- S4 -LOS number of events greater than 0.2 system minutes per annum
- S5 -LOS number of events greater than 1.0 system minutes per annum
- S6 -Average outage duration

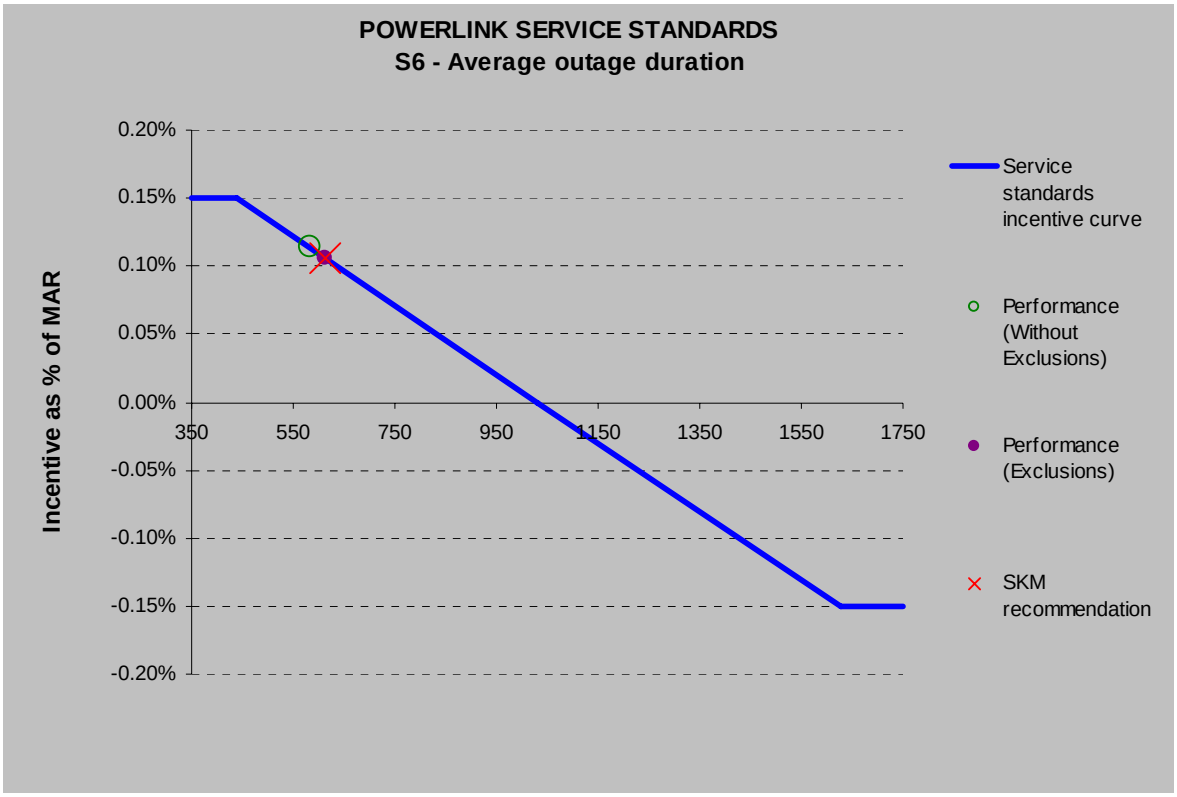



POWERLINK SERVICE STANDARDS
S2 - Transmission circuit availability - non–critical elements
Incentive as % of MAR
0.10%
0.08%
0.06%
0.04%
0.02%
0.00%
-0.02%
-0.04%
-0.06%
-0.08%
-0.10%
97.60%
98.00%
98.40%
98.80%
99.20%
Service standards incentive curve
Performance (Without Exclusions)
Performance (Exclusions)
SKM recommendation


POWERLINK SERVICE STANDARDS
S3 - Transmission circuit availability - peak periods
Incentive as % of MAR
0.20%
0.15%
0.10%
0.05%
0.00%
-0.05%
-0.10%
-0.15%
-0.20%
97.33%
97.83%
98.33%
98.83%
Service standards incentive curve
Performance (Without Exclusions)
Performance (Exclusions)
SKM recommendation


POWERLINK SERVICE STANDARDS
S4 - Loss of supply event frequency (No of events > 0.2 system minutes)
Incentive as % of MAR
0.20%
0.15%
0.10%
0.05%
0.00%
-0.05%
-0.10%
-0.15%
-0.20%
0
1
2
3
4
5
6
7
8
9
Service standards incentive curve
Performance (Without Exclusions)
Performance (Exclusions)
SKM recommendation


POWERLINK SERVICE STANDARDS
S5 - Loss of supply event frequency (No of events > 1.0 system minutes)
Incentive as % of MAR
0.40%
0.30%
0.20%
0.10%
0.00%
-0.10%
-0.20%
-0.30%
-0.40%
0
1
2
3
4
Service standards incentive curve
Performance (Without Exclusions)
Performance (Exclusions)
SKM recommendation


POWERLINK SERVICE STANDARDS
S6 - Average outage duration
Incentive as % of MAR
0.20%
0.15%
0.10%
0.05%
0.00%
-0.05%
-0.10%
-0.15%
-0.20%
350
550
750
950
1150
1350
1550
1750
Service standards incentive curve
Performance (Without Exclusions)
Performance (Exclusions)
SKM recommendation