Audit of TransGrid Service Standards Performance Reporting for 2009

PERFORMANCE RESULTS FOR 2009

- Final Report
- 30 April 2010

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1. Executive Summary

Sinclair Knight Merz (SKM) has been appointed by the Australian Energy Regulator (AER) to conduct an audit of the January to December 2009 performance report of TransGrid under the AER Service Target Performance Incentives Scheme (STPIS) dated March 2008.

SKM's scope of work comprises of auditing TransGrid's 2009 *Service Component* performance reporting under the STPIS. This involves reporting of six performance parameters from Jan to Jun 2009 and from Jul to Dec 2009 under the 2004/05 – 2008/09 and the 2009/10 – 2013/14 AER Transmission Determinations respectively.

This audit includes the following:

- an examination of the accuracy and adequacy of TransGrid's recording system;
- a review of any changes in the recording system since previous audits;
- an assessment of the application of exclusions and force majeure;
- whether the reporting complies with the requirements of TransGrid's revenue cap and service target decisions from the AER Transmission Determinations for 2004/05 – 2008/09 and 2009/10 – 2013/14, the STPIS and the Service Standards Guidelines;
- comparison of the actual results achieved relative to the targets set in the Transmission Determinations of the respective periods; and
- an independent validation, or otherwise, of the calculations and the s-factors.

As a result of audit activities undertaken, SKM has formed an opinion that:

- TransGrid's 2009 *Service Component* performance reporting to be free from material errors[1] and in accordance with the STPIS;
- The recording system used by TransGrid to capture, process and report the outage detail is accurate and adequate;
- With the exception of one exclusion, which SKM has referred to the AER for consideration, the application of all other exclusion and force majeure events are in accordance with the STPIS and historical calculation of performance;
- TransGrid's calculation of its s-factors be accepted as free from material errors;

[1] Some minor errors were found during the audit process. These minor errors are mostly non-systematic and discussed in greater detail in Section 3.5 of this report. SKM confirms that these errors produce no effect or negligible effect to the calculation of s-factors.

- Based on the acceptance of the proposed exclusions, the overall s-factor calculated for Jan to Jun 2009 period is 0.220799% of the portion of annual revenue for the same period (i.e. $628,015 bonus); and
- Based on the acceptance of the proposed exclusions (note that exclusion of the Bayswater CT failure is allowed for in this calculation and the values contained in this report), the overall s-factor calculated for Jul to Dec 2009 period is 0.068131% of the portion of annual revenue for the same period (i.e. $231,099 bonus).

2. Introduction

Sinclair Knight Merz (SKM) has been appointed by the Australian Energy Regulator (AER) to conduct an audit of the January to December 2009 performance report of TransGrid under the AER Service Target Performance Incentives Scheme (STPIS) dated March 2008.

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- comparison of the actual results achieved relative to the targets set in the Transmission Determinations of the respective periods; and
- an independent validation, or otherwise, of the calculations and the s-factors.

2.1 Methodology

SKM reviewed the results provided by TransGrid to the AER for their 2009 *Service Component* performance reporting. This included verifying the underlying data and application of formulas to calculate the performance results. It involved reviewing TransGrid's 2009 outage data, proposed exclusions and their justifications. SKM also verified the annual revenue, performance targets, collars, caps and weightings against the values prescribed in the AER Transmission Determinations for the respective regulatory periods. SKM verified that these annual values were scaled down to 6 month periods for each reporting halves of 2009.

SKM met with TransGrid staff in their Wallgrove office on Monday 15th Feb 2010 to undertake the audit of TransGrid's recording system for the purpose of performance reporting to the AER and to investigate specific events that TransGrid had proposed for exclusion. This involved gaining an overview of the TransGrid outage recording, processing and reporting system. SKM carried out random spot checks on the recorded outages data and verified if the reported time, affected transmission circuit and other relevant information were accurate. SKM reviewed the justification and the supporting evidence provided by TransGrid for events proposed for exclusion. SKM also

reviewed randomly selected outage data that are capped to a prescribed duration limit since TransGrid manually intervenes in reporting the performance for such events.

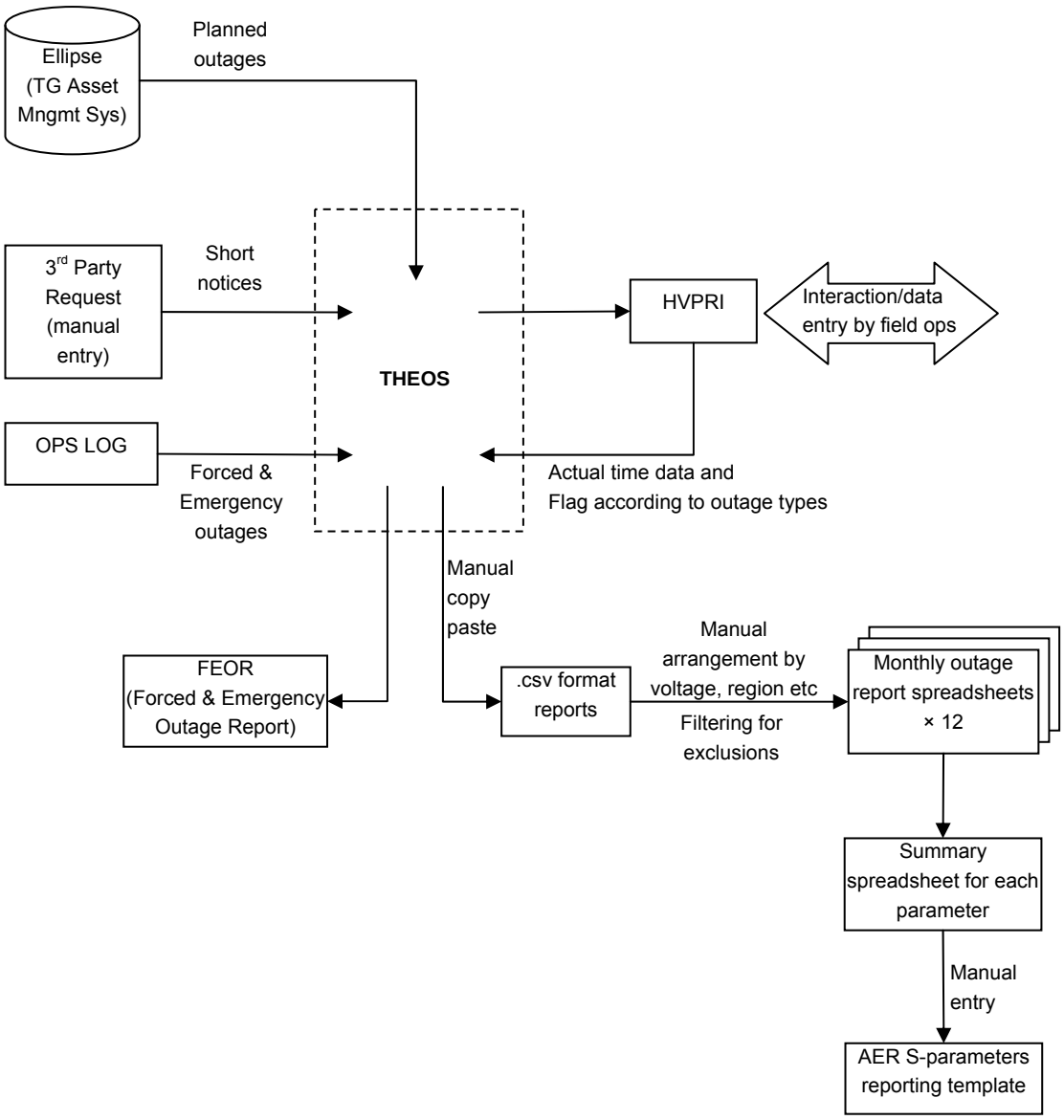
Following the audit meeting, further evidence pertaining to TransGrid's recording system, reported performance results and proposed exclusions was provided by TransGrid. This evidence was reviewed and verified by SKM.

3. Recording System

3.1 Service Component Performance Reporting Process

TransGrid has developed and implemented a new outage recording system "THEOS" since the last audit by SKM for the 2006 *Service Component* performance report. TransGrid's 2009 *Service Component* performance report is based on THEOS. An overview of this performance reporting process is shown in Figure 1.

Figure 1 – TransGrid's Service Component Performance Reporting Process



TransGrid's *Service Component* performance reporting process is comprised of a number of components. These are:

- TransGrid's Asset Management System – Ellipse (Electronic);
- The Outage System – THEOS (Electronic);
- High Voltage Preparation and Restoration Instructions – HVPRI (Electronics);
- Operators Log – Ops Log (Paper and Electronic); and
- Excel Spreadsheets for performance parameters calculation (Electronic)

3.2 Outage Type

The process for recording an outage depends on whether the outage is planned, requested, forced or emergency.

Planned Outage

A planned outage occurs when an outage for an item of equipment is requested by Ellipse according to TransGrid's asset maintenance schedule via THEOS. This involves creation of work order in Ellipse which is sent to THEOS along with the indicative date and time of the planned outage. THEOS then creates an ID number for each work order and generates a Request for Access (RFA) form that is sent to System Control. System Control prepares a HVPRI for the planned outage which is used to control the process of removing the equipment from service and returning it to service. The HVPRI is an electronic form and is used by the field operator to record the actual date and times of equipment switching. This information from the HVPRI form is then automatically transferred into the THEOS database.

3rd Party Request Outage

A 3rd party outage occurs following the request from a 3rd party (i.e. other market participants, customers etc) to TransGrid. The operations group will record such requests in THEOS manually. Similarly to the Planned Outage process, the RFA is generated and a HVPRI is prepared. The actual switching date and times are then recorded by the system operator in HVPRI and then transferred into the THEOS database. Such outages are flagged in THEOS as 3rd Party Requested Outages.

Forced Outage

A forced outage occurs when a line, transformer or another piece of plant is removed from service due to a protection operation. The control room operator will record the details of the event in the Operators Log from the SCADA output and manually enter it into THEOS. Such outages are flagged as Forced Outages. This automatically generates a Forced and Emergency Outage Report (FEOR).

Emergency Outage

An emergency outage occurs following a request from emergency services or others to de-energise the system due to an emergency arising on or near items of equipment. The event is recorded by the control room operator in the Operators Log and manually entered into THEOS. Such outages are flagged in THEOS as Emergency Outages. This automatically generates a Forced and Emergency Outage Report (FEOR).

The outage statistics in THEOS are recorded in three TransGrid control rooms at Newcastle, Wallgrove and Yass. The data captured in these control rooms are in direct oversight of the Australian Energy Market Operator (AEMO). TransGrid's Network Control Manager also oversees the operations of these control centres and ensures the reliability of the captured data.

All recorded outages are manually flagged with different pre-defined codes according to the type and nature of the outages in THEOS by the control room operators. All recorded outage details are copied from THEOS as .csv files each month for reporting. These files are checked for coding anomalies by the Performance & Compliance section staff before analysing the outage statistics further. Corrections are made in the THEOS if required.

The data from the .csv files is copied into Excel spreadsheets each month and manually organised according to voltage levels, regions, equipment types, outages types etc based on the code flagged for each outage. Filtering of excluded events also takes place at this step by identifying code flagged for each outage. Excluded events are marked and then omitted from the monthly outage report spreadsheet from which performance parameters are derived.

The annual *Service Component* performance parameters reporting to the AER are derived from the summary spreadsheet linked to the 12 monthly outage report spreadsheets. These are mostly automatic with manual adjustments for capping outages at 168 hours in accordance with the STPIS.

3.3 Outage Duration

The planned and 3rd party request outage times captured by the HVPRI are based on the inputs by the system operators recorded during switching.

The timings for the Forced and Emergency[2] outages are recorded in THEOS as they occur and the operation times are taken from the operators SCADA interface.

The time recorded in the HVPRI (and therefore THEOS) can be different from the time captured by SCADA. The operators manually enter the times from their system into HVPRI following the

[2] TransGrid defines a forced outage as an automatic protection operation, and emergency outages as forced switching under control of operators.

operation of equipment. Depending on the level of activity in the field and control room, this may take some time. The magnitude of the difference between the time recorded in HVPRI and SCADA is typically only a minute or two and the net effect of this is immaterial to the outage duration.

The times can also differ due to the settings an operator has configured (i.e. Day Light Saving / Eastern Standard Time setup) in the THEOS. TransGrid identified this issue early in the implementation of THEOS and all operators have been trained to configure their version of THEOS to EST.

3.4 Categorisation and Exclusions Details

Monthly analysis of the recorded outages involves categorising the outages based on the pre-defined code flagged for each outage. The exclusion determining codes are based on the list of exclusions defined by the STPIS for each performance parameters.

Outages on TransGrid's equipment not covered by the performance reporting under the STPIS (for e.g. circuit breaker) are excluded. Outages on equipment not owned by TransGrid are also excluded.

3.5 Audit walk-through of the existing system

3.5.1 Spot checks on the recorded outages timings

As TransGrid's *Service Component* performance recording process involves manual intervention, SKM carried out number of spot checks on the recorded outage timings. This process consisted of checking randomly selected outage data recorded in THEOS against the SCADA output for the same outages. The results are shown in Table 1 in the next page.

Table 1 Spot Checks on the TransGrid Reporting system

ID	Asset Type	Description	Data from THEOS				Data from SCADA				Outage Duration (hours)		Difference in recorded outage duration (hours)		Comments
			Start Date	Start Time	End Date	End Time	Start Date	Start Time	End Date	End Time	THEOS	SCADA			
1	330kV line	T/L 66 Non-routine oil sample - CT's	21/10/2009	9:01	21/10/2009	11:45	21/10/2009	9:02	21/10/2009	10:43	2.73	1.68	1.05	over	DLS issue in end time
2	330kV line	Replace OHEW with OPGW from LTSS to T3 PS	24/10/2009	6:14	25/10/2009	16:27	24/10/2009	5:12	25/10/2009	16:18	34.22	35.10	0.88	less	DLS issue in start time
3	330kV line	T/L 8 disconnector replacement	1/06/2009	7:06	6/06/2009	15:26	1/06/2009	7:05	6/06/2009	15:25	128.33	128.33	0.00	equal	
4	132kV line	945 Orange - Wellington 132kV Feeder (outage 1)	12/10/2009	8:14	16/10/2009	15:56	12/10/2009	7:14	16/10/2009	14:56	103.70	103.70	0.00	equal	
5	132kV line	945 Orange - Wellington 132kV Feeder (outage 2)	19/10/2009	8:37	23/10/2009	15:05	19/10/2009	7:35	23/10/2009	14:05	102.47	102.50	0.03	less	DLS issue - nullify
6	132kV line	945 Orange - Wellington 132kV Feeder (outage 3)	26/10/2009	8:24	30/10/2009	17:11	26/10/2009	7:25	30/10/2009	16:11	104.78	104.77	0.02	over	DLS issue – nullify
7	Transformer 132kV	No. 1 132/66/11 transformer Narabri	5/05/2009	7:43	5/05/2009	15:03	5/05/2009	7:42	5/05/2009	15:02	7.33	7.33	0.00	equal	
8	Transformer 132kV	No. 1 132/66/11 transformer Narabri	6/05/2009	7:39	6/05/2009	15:38	6/05/2009	7:50	6/05/2009	15:36	7.98	7.77	0.22	over	
9	Transformer 132kV	No. 1 132/66/11 transformer Narabri	7/05/2009	7:00	7/05/2009	13:53	7/05/2009	7:24	7/05/2009	13:50	6.88	6.44	0.44	over	
10	Transformer 330kV	No. 3 Transformer Canberra	29/04/2009	8:12	29/04/2009	14:32	29/04/2009	8:23	29/04/2009	14:16	6.33	5.88	0.45	over	
11	Transformer 330kV	No. 3 Transformer Dapto	28/04/2009	7:06	28/04/2009	15:24	28/04/2009	7:14	28/04/2009	15:15	8.30	8.02	0.28	over	
12	Transformer 330kV	No. 3 Transformer Dapto	29/04/2009	6:22	29/04/2009	14:18	29/04/2009	6:39	29/04/2009	14:16	7.93	7.62	0.32	over	
13	Transformer 330kV	No. 3 Transformer Dapto	30/04/2009	6:27	30/04/2009	14:12	30/04/2009	6:41	30/04/2009	14:10	7.75	7.48	0.27	over	
14	Transformer 330kV	No. 3 Transformer Dapto	1/05/2009	6:33	1/05/2009	16:02	1/05/2009	6:33	1/05/2009	15:53	9.48	9.33	0.15	over	
15	Capacitor 132kV	Armidale No. 1 Capacitor	4/02/2009	8:10	4/02/2009	11:02	4/02/2009	7:16	4/02/2009	9:57	2.87	2.69	0.17	over	DLS issue - nullify
16	SVC	SYW SVC	29/05/2009	6:35	29/05/2009	14:57	29/05/2009	6:36	29/05/2009	14:56	8.37	8.33	0.03	over	
17	Reactor	X5/3	10/12/2009	9:13	10/12/2009	14:08	10/12/2009	8:13	10/12/2009	13:08	4.92	4.92	0.00	equal	
											554.38	**551.90**	**2.49**	**over**	

It can be seen from Table 1 that there are discrepancies between the times recorded in THEOS and that captured by SCADA for the same outages. SKM noted two patterns of discrepancies. The recorded outage times in HVPRI often differ by a few minutes to the SCADA times and in some cases the recorded outage times in HVPRI differ by approximately 1 hour to SCADA times.

As noted previously, the difference of a few minutes between HVPRI and SCADA is most likely due to the level of activities in the field and the control rooms and the time when the outage is recorded in the system as compared to when the equipment actually operated. Based on the spot checks presented in Table 1, SKM considers that the error created by this issue causes an immaterial over reporting of the outage duration for the 2009 reporting.

The difference of approximately 1 hour is due to the operator's time setting in THEOS (i.e. Day Light Saving / Eastern Standard Time) and occurs when transferring time data from the HVPRI to THEOS. TransGrid indicated that this issue had been discovered during the implementation of THEOS and corrective action had been taken.

This issue was first discovered by TransGrid in October 2009 (start of Day Light Saving period for 2009/10 summer season) and is caused when the recorded time data from HVPRI is automatically transferred to THEOS[3]. During the first half of 2009, the time data from HVPRI was manually copied to THEOS and no such issues were observed. Therefore, for the period of Jan to Mar 2009 (during the Day Light Saving period for 2008/09 summer season), no such issues are known and the use of Eastern Standard Time settings appears consistent throughout the system.

In order to determine the magnitude of error in the reported performance caused by this issue, TransGrid ran a query on outage time data recorded in their system to narrow down the outages that were possibly affected. Of the 108 outages examined, the following are the details:

- 31 outages duration were correctly recorded;
- 60 outages were recorded with 1 hour extra duration; and
- 17 outages were recorded with 1 hour short duration;

A further examination of 47 out of the 108 outages[4] revealed the following affect on the performance reporting:

- Transmission lines availability performance report (S1 parameter):
    - 24 outages over reported by approximately 1 hour
    - 5 outages under reported by approximately 1 hour

[3] TransGrid implemented automatic transfer of time data from HVPRI to THEOS from July 2009. Prior to this the operators transcribed time data from HVPRI to THEOS.

[4] The remaining 61 outages are in-service works, a circuit breaker in a double bus configuration etc. that are not counted under the STPIS.

This resulted in net over reporting of approximately 19 hours (i.e. 0.09% error over the total hours from Jul to Dec 2009). The correction of this error does not change the s-factor as the transmission line availability performance result is on the collar.

- Transformers availability performance report (S2 parameter):
  - 10 outages over reported by approximately 1 hour
  - 2 outages under reported by approximately 1 hour

  This resulted in net over reporting of approximately 8 hours (i.e. 0.06% error over the total hours from Jul to Dec 2009). The correction of this error yields negligible change to s-factor.

- Reactive Plants availability performance report (S3 parameter):
  - 5 outages over reported by approximately 1 hour
  - 1 outages under reported by approximately 1 hour

  This resulted in net over reporting of approximately 4 hours (i.e. 0.02% error over the total hours from Jul to Dec 2009). The correction of this error does not change the s-factor as the reactive plants performance availability result is on the collar.

Based on this analysis, TransGrid elected not to re-submit the corrected performance report.

3.5.2 Review of Transfer of Outage Data to THEOS from HVPRI

While responding to SKM's queries, TransGrid found one transmission line outage for which start and end times had not propagated to THEOS from HVPRI. This was most likely due to a glitch in transfer between the two applications and was a one-off event. This glitch created a blank entry in the outage start and end time fields in THEOS and resulted in over reporting of the outage duration by a whole year rather than its actual duration (4 hours). This lowered the transmission line availability performance result; however there is no impact on TransGrid's incentive payment as the s-factor for this parameter remains on the collar for both first and second half of 2009. TransGrid's checked that times recorded in HVPRI are present in THEOS each month; however this single outage was not picked up in their monthly review process. A subsequent review of all outages for 2009 confirmed that this was the only outage for which actual times were missing.

Following this discovery, TransGrid has elected to correct the reported 2009 transmission line availability result (S1) as the reported performance results in the present regulatory period will affect their performance target in the next regulatory period. Not opting for correction will artificially lower TransGrid's transmission line availability target in the future. SKM considers this to be appropriate.

3.5.3 Review of Outage Coding

Outages recorded in THEOS are tagged with a pre-defined code so they can be categorised and filtered. To avoid any anomalies due to human error, TransGrid's Performance & Compliance

section carries out review of all outage data each month. SKM sighted the documentary evidence of this review process for the 2009 reporting period during the audit. SKM consider the coding process of the outages to be free from material errors.

3.5.4 Evidence of 3rd Party's Request for Outages

During the audit, SKM carried out number of random spot checks of the outages that were excluded for being 3rd party outages. SKM sighted the documentary evidence of correspondence from 3rd parties requesting outages from TransGrid. Electronic copies of all such correspondence are stored in THEOS along with the outages record.

3.5.5 Review of Adjustment for Capping Outage Durations

In order to report the average outage restoration duration (i.e. S6 parameter), the outages recorded in THEOS are manually adjusted to cap it at 7 days as per the STPIS. During the audit, SKM reviewed the adjustments made the capped events and is satisfied with the manual adjustment made for the reporting purpose.

4. Performance Measures

Since calendar year 2009 fell under two regulatory periods, TransGrid has reported on the following *Service Component* parameters from Jan to Jun 2009 and from Jul to Dec 2009 periods as shown in the following Table 2 and Table 3 respectively:

- **Table 2 TransGrid performance measures from Jan to Jun 2009**

Parameters	As set out in Table 9.8.1 of the 2004/05 – 2008/09 ACCC's Determinations and scaled down to 6 months period			
	Collar	Target	Cap	Weighting
Transmission circuit availability (%)	99.00	99.50	99.70	20%
Transformer availability (%)	98.20	99.00	99.50	15%
Reactive plant availability (%)	97.00	98.60	99.30	10%
Reliability (Events > 0.05 and ≤0.4 system minutes)	4	3	2	25%
Reliability (Events > 0.4 system minutes)	2	1	0	20%
Average outage restoration time (minutes)[5]	1800	1500	800	10%

- **Table 3 TransGrid performance measures from Jul to Dec 2009**

Parameters	As set out in Table 8.4 of the 2009/10 – 2013/14 AER's Determinations and scaled down to 6 months period			
	Collar	Target	Cap	Weighting
Transmission circuit availability (%)	99.05	99.26	99.36	20%
Transformer availability (%)	97.33	98.61	99.89	15%
Reactive plant availability (%)	98.65	99.12	99.33	10%
Loss of supply event frequency (Events > 0.05 system minutes)	4	2	1	25%
Loss of supply event frequency (Events > 0.25 system minutes)	2	1	0	10%
Average outage restoration time (minutes)	999	824	649	20%

4.1 Inclusions

SKM has considered the inclusions discussed in TransGrid's submission and can confirm that the inclusions are in line with those stated for TransGrid in the STPIS.

4.2 Exclusions

The STPIS contain provisions for certain defined events to be excluded from the calculated outage figures, on the basis that they are beyond the control of Transmission Network Service Providers

[5] From Jan to Jun 2009: Dead Band Knee 1 = 1600 minutes and Dead band Knee 2 = 1400 minutes (there are no such measures for Jul to Dec 2009 period).

(TNSPs) or consistent with historical reporting of outages. SKM's findings from the review of exclusions are contained in the following section.

5. TransGrid Specific Exclusions and Caps

TransGrid has highlighted the following events as exclusions or capped events.

5.1 Transmission Line Availability Parameter (S1)

TransGrid has a total of 107 outages marked for exclusion from the transmission line availability performance reporting in 2009. Of 107 events, 10 outages are due to 3rd parties (customers and other networks) equipment failure; 96 outages are due to request from 3rd parties, and; 1 outage is due to TransGrid's protection operating correctly caused by a fault on a 3rd party system.

SKM randomly chose the following outages to review the exclusion reasons provided by TransGrid during the audit process:

- Event ID 36056 (Request for outage from Snowy Hydro)
- Event ID 30300 (Request for outage from Snowy Hydro)
- Event ID 5498 (caused by Country Energy's system)
- Event ID 42533 (caused by EnergyAustralia's system)

SKM sighted the documentary evidence of an outage request from Snowy Hydro for Event ID 36056. SKM noted that the outage started at Snowy Hydro's requested start time and ended 2 days before the Snowy Hydro's requested end time. SKM is satisfied with the evidence provided by TransGrid for this event.

SKM also sighted the documentary evidence of an outage request from Snowy Hydro for Event ID 30300. SKM noted that the outage started at Snowy Hydro's requested start time and ended at Snowy Hydro's requested end time. SKM is satisfied with the evidence provided by TransGrid for this event.

Event ID 5498 involved Country Energy commissioning two transformers at Boambee South. Both transformers were energised in quick succession resulting in higher inrush current than normal. This tripped the temporary distance protection (9W82 Circuit Breaker) at the Coffs Harbour end which was suitable for inrush of one transformer only (the normal case). This caused TransGrid's 9W8 line to be out of service. SKM is satisfied that this exclusion is reasonable.

Event ID 42533 caused an outage in TransGrid's 96X line which is in close vicinity of EnergyAustralia's 33kV line. Upon inspection by EnergyAustralia's field staff, a dead swan was found near EnergyAustralia's line. TransGrid suspects that the bird struck EnergyAustralia's line thus initiating a fault protection trip and creating an outage in TransGrid's 96X line. SKM believes that the presence of a dead swan under EnergyAustralia's line may not be a plausible reason for the

exclusion due to lack of certainty in determining the actual cause of this event. SKM is unable to confirm if the fault on EnergyAustralia's line initiated TransGrid's protection trip or vice versa.

It is noted that the omission (or non-omission) of all the 107 outages marked for exclusion by TransGrid has no impact on the s-factor calculation for the transmission line availability performance result. In either case, TransGrid's performance result for this parameter is in the collar for 2009.

Overall, SKM is satisfied with the justification provided by TransGrid and confirm that they are in accordance to the STPIS. Therefore, SKM accepts the proposed exclusions. It is noted that the performance results for both without and with exclusions shall be corrected based on the discussion provided in Section 3.5.2.

5.2 Transformer Availability Parameter (S2)

TransGrid has a total of 11 outages marked for exclusion from the transformer availability performance reporting in 2009. Of the 11 events, 4 outages are due to 3rd parties (customers) operations and 7 outages are due to request from 3rd parties.

SKM sighted documentary evidence justifying the exclusion of the following outage that was randomly chosen during the audit process:

- Event ID 28319 (Request for outage from Integral Energy)

SKM is satisfied with the evidence provided by TransGrid for the above event.

SKM notes that the omission (or non-omission) for all the 11 outages marked for exclusion by TransGrid has a very small impact on the s-factor calculation for the transformer availability performance result. The omission of these 11 outages results in a small decrement in the penalty to TransGrid.

Overall, SKM is satisfied with the justification provided by TransGrid and confirm that they are in accordance to the STPIS. Therefore, SKM accepts the proposed exclusions and the reported performance result for this parameter.

5.3 Reactive Plant Availability Parameter (S3)

TransGrid has only 1 outage (Event ID 37041) marked for exclusion from the reactive plant availability performance reporting in 2009. This outage was requested by EnergyAustralia to work on their line which also has TransGrid's reactor connected to it. SKM sighted evidence of correspondence from EnergyAustralia that was logged in the TransGrid's control room logbook as this was a short notice request. SKM is satisfied with the evidence provided by TransGrid for this event.

Overall, SKM is satisfied with the justification provided by TransGrid and confirm that they are in accordance to the STPIS. Therefore, SKM accepts the proposed exclusions and the reported performance result for this parameter.

5.4 Reliability / Loss of Supply Event Frequency Parameters (S4 & S5)

TransGrid has no outages marked for exclusion in the first half of 2009 for these performance parameters reporting.

Since July 2009 any outage with more than 0.05 system minutes needs to be reported under S4 parameter (> 0.05 system minutes) as well as under S5 parameters (> 0.25 system minutes). TransGrid has 1 outage (Event ID 31603) marked for exclusion in the second half of 2009. Therefore this single outage is reported and marked for exclusion in both S4 and S5 parameters. It is noted that the omission of this single event from TransGrid's performance parameters S4 and S5 reporting is worth $1.18 million in financial incentives.

Event ID 31603 occurred due to an explosion of TransGrid's circuit breaker (CB5042) blue phase current transformer at Bayswater substation. The fire and smoke from this explosion was then blown across the adjacent switchbays by strong westerly wind. This incident then tripped TransGrid's 31, 32, 33 and 34 lines; all four generator units at Bayswater; and, four additional generators in the National Electricity Market (NEM). This resulted in Under Frequency Load Shedding (UFLS) of 565MW in NSW and 1131MW across the NEM.

Bayswater Units 4, 3 and 2 tripped due to the operation of interzone protection and Unit 1 tripped as a result of the reverse power opening of the circuit breaker following trips of the boiler and turbine. All four Bayswater units complied with their performance standards for the duration of the fault event. The performance standard specifies that the generating units at Bayswater must remain in continuous uninterrupted operation for a credible contingency event in the transmission system. As this event was a multiple contingency in the Bayswater switchyard it falls outside of the requirements of the performance standard.

Among the four additional generators, Mount Piper Unit 2 tripped due to negative phase sequence protection mechanism; Gladstone Unit 5 tripped due to over-excitation protection mechanism; Yallourn West Unit 3 tripped due to overload situation caused by falling frequency, and; Tarong Unit 4 tripped due to faulty phase voltage imbalance protection relay of the water pump motor. An AEMO report into the incident, *Power System Incident Report – Multiple Generator Disconnection and Under Frequency Load Shedding Event – 02 July 2009 Volume I and Volume II – Ancillary Service Provision,*[6] suggests that with the exception of Gladstone Unit 5, the additional generators

[6] These reports are electronically available in the AEMO website.

may not have conformed with their performance standards as they did not ride through the low frequency event.

Consequently, TransGrid has excluded this event from its S4 and S5 performance parameters reporting on the basis that the Under Frequency Load Shedding (UFLS) was not only caused by the disconnection of the Bayswater units, but the possible failure of other generators to meet their performance standards (3rd party outages).

In determining the reasonableness of TransGrid's position, SKM reviewed the details of the AEMO report, *Power System Incident Report – Multiple Generator Disconnection and Under Frequency Load Shedding Event – 02 July 2009*, (dated 27 October 2009).

The first load shedding event occurred in Tasmania as a result of a frequency change over time ($\Delta f/\Delta t$) UFLS relay setting (i.e. a rapid decline in frequency triggered the operation of the relay before the UFLS limit was reached). According to the AEMO report, this resulted in the disconnection of 93MW of Rio Tinto load and 83MW of Nyrstar load. The operation of the relay was correct. Table 2 and Figure 7 from the AEMO report (included below) show the sequence of events. The first UFLS occurred due to the rate of frequency decline caused by the disconnection of the Bayswater units and Mt Piper Unit 2.

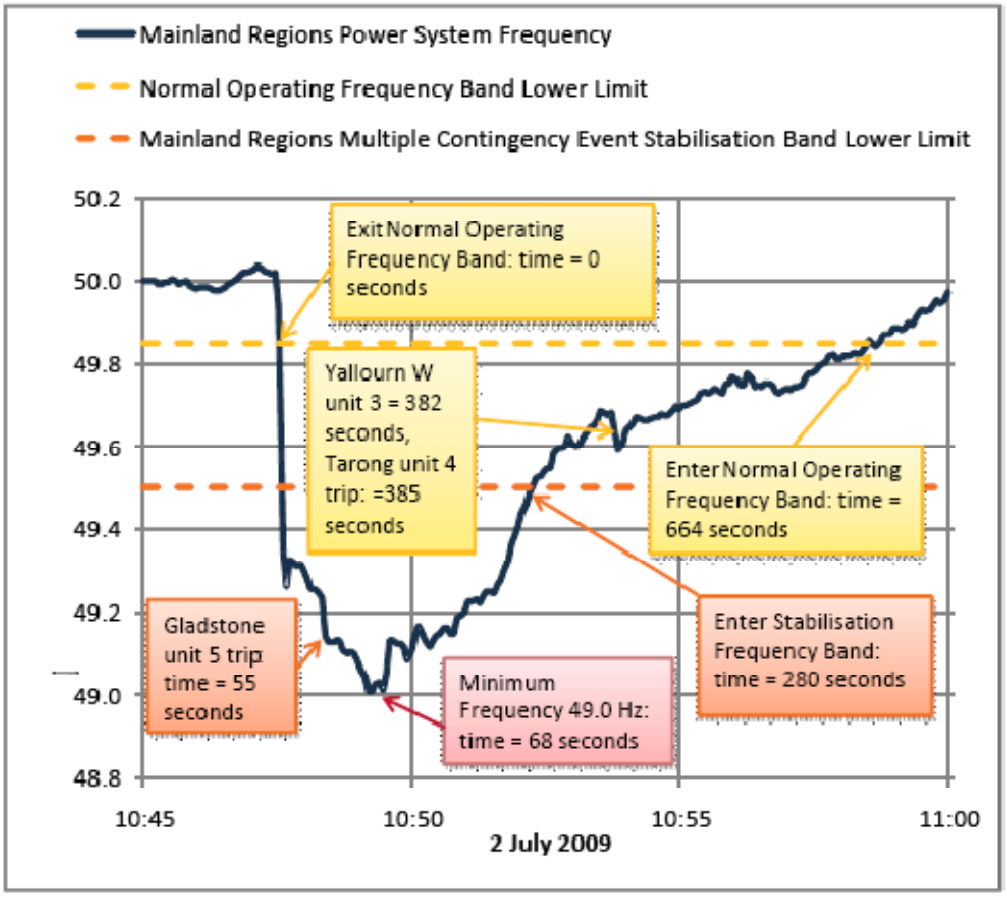
GENERATION	DELTA MW	TIMES		LOAD	DELTA MW	TIMES
Bayswater Unit 1	474	10:47-14:57		Rio Tinto	100	10:47-11:23
Bayswater Unit 2	480	10:47-20:34		Nyrstar	83	10:48-11:36
Bayswater Unit 3	477	10:47-19:26		Tomago 2	287	10:49-11:21
Bayswater Unit 4	617	10:47-22:58		Kurri 2	97	10:49-11:50
Mt Piper Unit 2	234	10:47-17:14		QLD other[3] load	60	Approx 10:49-11:00
Gladstone Unit 5	190	10:48-13:40		SA other load	30	Approx 10:49-11:00
Yallourn Unit 3	387	10:53-13:03		VIC other load	150	Approx 10:49-11:08
Tarong Unit 4	346	10:53-12:48		NSW other load	324	Approx 10:49-11:03
Total	3205			Total	1131	

- **Source: Table 2 of AEMO Report**

The next block of load to trip was 287MW in NSW, being the Tomago No.2 potline. This load tripped due to the correct operation of an instantaneous UFLS relay and occurred after the disconnection of Gladstone Unit 5. The AEMO report indicates that the Gladstone Unit 5 trip did not cause a breach of its performance standards.

The remaining UFLS of 661MW occurred at approximately 10:49am, 4 minutes before the disconnection of the final two generators. As the disconnection of Yallourn Unit 3 and Tarong Unit 4 did not precipitate any UFLS, it is not appropriate that they be considered with respect to a contribution to the UFLS (it is worth noting that their disconnection did result in the frequency remaining under the Normal Operating Frequency Band for a longer period of time).

In order for TransGrid's exclusion of the event to be substantiated, SKM considers the Mt Piper Unit 2 trip needs to be investigated. In the event that Mt Piper Unit 2 was non-compliant with the Registered Performance Standards a determination needs to be made as to whether the Δf/Δt UFLS relay operation in Tasmania and the UFLS operation in the mainland would have occurred without the loss of Mt Piper Unit 2.



- **Source: Figure 7 of AEMO Report**

The AEMO report states that "*Delta Electricity advised AEMO in accordance with clause 4.15(f) of the NER that the plant appeared to have been non-compliant with the Registered Performance*

Standard as it did not ride through the low frequency event." AEMO required Delta Electricity, the operator of Mt Piper Unit 2, to inform AEMO of the outcome of the investigation into the trip by 30/11/2009. As such, the determination of whether the plant was non-compliant should be straightforward. In the event that Mt Piper Unit 2 did meet its performance standards, it is not appropriate for TransGrid to exclude the event.

In the event that Mt Piper Unit 2 did not meet its performance standards, it is challenging to determine whether the Δf/Δt UFLS in Tasmania and the mainland frequency decline to 49.0 Hz and subsequent load shedding would have occurred had Mt Piper Unit 2 not tripped. The AEMO report suggests that the mainland UFLS was marginal in the sense that the frequency was within relay setting tolerances.

> *"A number of UFLS relays set to be operated at 49.0 Hz did not operate. In most cases this was due to the fact that minimum frequencies observed at some substations on the mainland where UFLS is implemented were slightly above 49.0Hz*." *(AEMO report page 34)*
>
> *"Investigations so far indicate that uneven sharing of load shedding among regions was largely due to the marginal nature of the situation and that, except for a limited number of cases where there were incorrect settings, failure of blocks to trip can be explained on the basis of normal relay setting tolerances." (AEMO report page 34)*

It could be argued that the "*marginal nature"* of the event suggests that had Mt Piper Unit 2 not tripped, the UFLS events may not have occurred. Countering this argument, it is likely that given the magnitude of generation lost at Bayswater compared to Mt Piper (2048MW against 234MW), the Δf/Δt UFLS in Tasmania would have occurred despite the loss of Mt Piper Unit 2.

Leaving the loss of the Tasmanian load to one side, the Tomago 2 load loss in NSW more than accounted for the loss of generation from Mt Piper Unit 2 (287MW load loss against 234MW generation loss). This is a difficult argument to substantiate however, as the loss of load does not necessarily translate to an equivalent amount of generation and in the event of cascading frequency, further load shedding may still be required. It is worth noting that despite the UFLS of Tomago 2, there was further load shedding of 661MW in NSW, QLD, SA and VIC, all of which occurred before the loss of the generators that many not have complied with their performance standards (i.e. Yallourn Unit 3 and Tarong Unit 4).

Complicating this line of argument further is that while the disconnection of Gladstone Unit 5 did not breach its performance standards, it may be possible that the Mt Piper Unit 2 disconnection contributed to the conditions that allowed the Gladstone Unit to trip correctly. As the Gladstone trip occurred before the Tomago 2 and Kurri 2 load shedding, it is possible that the Mt Piper Unit 2

trip contributed to the situation that allowed Gladstone to trip and as such led to the UFLS. A connection can therefore be made between the UFLS and the possible breach by Mt Piper Unit 2 of its performance standards.

Given that there is a degree of uncertainty as to whether the UFLS would have occurred had Mt Piper Unit 2 not tripped, SKM is unable to determine whether the event should be excluded from the S4 and S5 performance parameters. As the determination of this exclusion may set precedent for future events in the NEM, and the value of the exclusion is worth $1.18 million in financial incentives, SKM recommends that the AER determine the appropriateness of TransGrid's exclusion in light of the investigations undertaken to date and their own analysis of the situation.

It is noted that TransGrid acknowledges its asset failure as the cause for tripping the lines and the four generator units at Bayswater and therefore, this event is accounted for in performance parameters S1 (transmission line availability) and S6 (outage duration).

5.5 Average Outage Restoration Duration Parameter

TransGrid has a total of 17 outages marked either for exclusion or capping from the average outage restoration duration performance reporting in 2009. Of the 17 events, 10 outages are due to 3rd party faults, 1 outage is due to request from 3rd parties, and 6 outages are to be capped to 7 days period. SKM noted that the omission (or non-omission) of all the 11 outages marked for exclusion and the capping of 6 outages by TransGrid has approximate incentive value of $350k.

TransGrid manually adjust its recorded time data from THEOS in order to report the result of this performance parameter with the 7 days cap for outages with longer duration. During the audit, SKM review the adjustment made to the following outages in reporting spreadsheets:

- Event ID 42871 (under investigation)

SKM reviewed the manual adjustment made for the reporting purpose and is satisfied with the capping of this event at 7 days (168 hours). SKM also ensured that this event is only capped at 168 hours and not excluded from the reporting purpose altogether.

Overall, SKM is satisfied with the justification provided by TransGrid and confirm that they are in accordance to the STPIS. Therefore, SKM accepts the proposed exclusions and the reported performance result for this parameter.

6. Calculation of S-Factors

SKM reviewed the pre-entered data and formulas for calculating s-factors in the AER spreadsheet template provided to TransGrid against the biannual revenues, performance targets, collars, caps and weightings prescribed in the AER Transmission Determinations for the respective regulatory periods. SKM found one instance where the pre-entered performance target, collar and cap were not scaled down to six months period for S4 reporting parameter in the Jan to Jun 2009 AER spreadsheet template. This error however did not affect TransGrid's s-factor result because the S4 performance was on the cap. The correction to the AER spreadsheet template was made in consultation with the AER staff.

SKM has audited TransGrid's *Service Component* performance results and the calculation of the s-factors for 2009. Following this audit and correction made to S1 parameter performance result, SKM confirms that the reported results are accurate and in accordance with the STPIS. These results and s-factors are shown in the tables below.

It is noted that the S-Factor calculations accept the exclusion of the Bayswater CT failure as reported by TransGrid.

- **Table 4 Performance Results from Jan to Jun 2009**

Performance Parameters (As per 2004/05–2008/09 ACCC's Determinations)		Before Audit		After Audit	
		Without Exclusions	With Exclusions	Without Exclusions	With Exclusions
S1	Transmission circuit availability (%)	97.745681%	98.028050%	98.305503%	98.587872%
S2	Transformer availability (%)	98.180100%	98.256073%	98.180100%	98.256073%
S3	Reactive plant availability (%)	98.735566%	98.735566%	98.735566%	98.735566%
S4	Reliability (Events > 0.05 and ≤0.4 system minutes)	1	1	1	1
S5	Reliability (Events > 0.4 system minutes)	0	0	0	0
S6	Average outage restoration time (minutes)	936	909	936	909

- **Table 5 Performance Results from Jul to Dec 2009**

Performance Parameters (As per 2009/10–2013/14 AER's Determinations)		Before Audit		After Audit	
		Without Exclusions	With Exclusions	Without Exclusions	With Exclusions
S1	Transmission circuit availability (%)	97.423641%	97.977166%	97.943256%	98.496781%
S2	Transformer availability (%)	98.280290%	98.281765%	98.280290%	98.281765%
S3	Reactive plant availability (%)	96.534619%	96.575844%	96.534619%	96.575844%
S4	Loss of supply event frequency (Events > 0.05 system minutes)	2	1	2	1

S5	Loss of supply event frequency (Events > 0.25 system minutes)	1	0	1	0
S6	Average outage restoration time (minutes)	864	774	864	774

- **Table 6 Calculated s-factors from Jan to Jun 2009**

Performance Parameters (As per 2004/05–2008/09 ACCC's Determinations)		Before Audit		After Audit	
		Without Exclusions	With Exclusions	Without Exclusions	With Exclusions
S1	Transmission circuit availability (%)	-0.200000%	-0.200000%	-0.200000%	-0.200000%
S2	Transformer availability (%)	-0.150000%	-0.139486%	-0.150000%	-0.139486%
S3	Reactive plant availability (%)	0.019367%	0.019367%	0.019367%	0.019367%
S4	Reliability (Events > 0.05 and ≤0.4 system minutes)	0.250000%	0.250000%	0.250000%	0.250000%
S5	Reliability (Events > 0.4 system minutes)	0.200000%	0.200000%	0.200000%	0.200000%
S6	Average outage restoration time (minutes)	0.088645%	0.090918%	0.088645%	0.090918%
	Total	**0.208011%**	**0.220799%**	**0.208011%**	**0.220799%**

- **Table 7 Calculated s-factors from Jul to Dec 2009**

Performance Parameters (As per 2009/10–2013/14 AER's Determinations)		Before Audit		After Audit	
		Without Exclusions	With Exclusions	Without Exclusions	With Exclusions
S1	Transmission circuit availability (%)	-0.200000%	-0.200000%	-0.200000%	-0.200000%
S2	Transformer availability (%)	-0.038638%	-0.038465%	-0.038638%	-0.038465%
S3	Reactive plant availability (%)	-0.100000%	-0.100000%	-0.100000%	-0.100000%
S4	Reliability (Events > 0.05 system minutes)	0.000000%	0.250000%	0.000000%	0.250000%
S5	Reliability (Events > 0.25 system minutes)	0.000000%	0.100000%	0.000000%	0.100000%
S6	Average outage restoration time (minutes)	-0.046030%	0.056596%	-0.046030%	0.056596%
	Total	**-0.384667%**	**0.068131%**	**-0.384667%**	**0.068131%**

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

7. Conclusions

SKM confirms that the 2009 *Service Component* performance results summarised in Table 8 and Table 9 are accurate and in accordance with the STPIS.

It is noted that the calculations accept the exclusion of the Bayswater CT failure as reported by TransGrid.

- **Table 8 SKM assessment of TransGrid s-factor results from Jan to Jun 2009**

Performance Parameters (As per 2004/05–2008/09 ACCC's Determinations)		s-factor result
S1	Transmission circuit availability (%)	-0.200000%
S2	Transformer availability (%)	-0.139486%
S3	Reactive plant availability (%)	0.019367%
S4	Reliability (Events > 0.05 and ≤0.4 system minutes)	0.250000%
S5	Reliability (Events > 0.4 system minutes)	0.200000%
S6	Average outage restoration time (minutes)	0.090918%
	Total s-factor	**0.220799%**
	Revenue for this period	$284,428,930
	Performance Incentive	+ $628,015

- **Table 9 SKM assessment of TransGrid s-factor results from Jul to Dec 2009**

Performance Parameters (As per 2009/10–2013/14 AER's Determinations)		s-factor result
S1	Transmission circuit availability (%)	-0.200000%
S2	Transformer availability (%)	-0.038465%
S3	Reactive plant availability (%)	-0.100000%
S4	Reliability (Events > 0.05 system minutes)	0.250000%
S5	Reliability (Events > 0.25 system minutes)	0.100000%
S6	Average outage restoration time (minutes)	0.056596%
	Total s-factor	**0.068131%**
	Revenue for this period	$339,200,000
	Performance Incentive	+ $231,099

Based on these results, SKM recommends the 2009 performance incentive for TransGrid should be as follow (on the basis of the Bayswater CT failure being excluded):

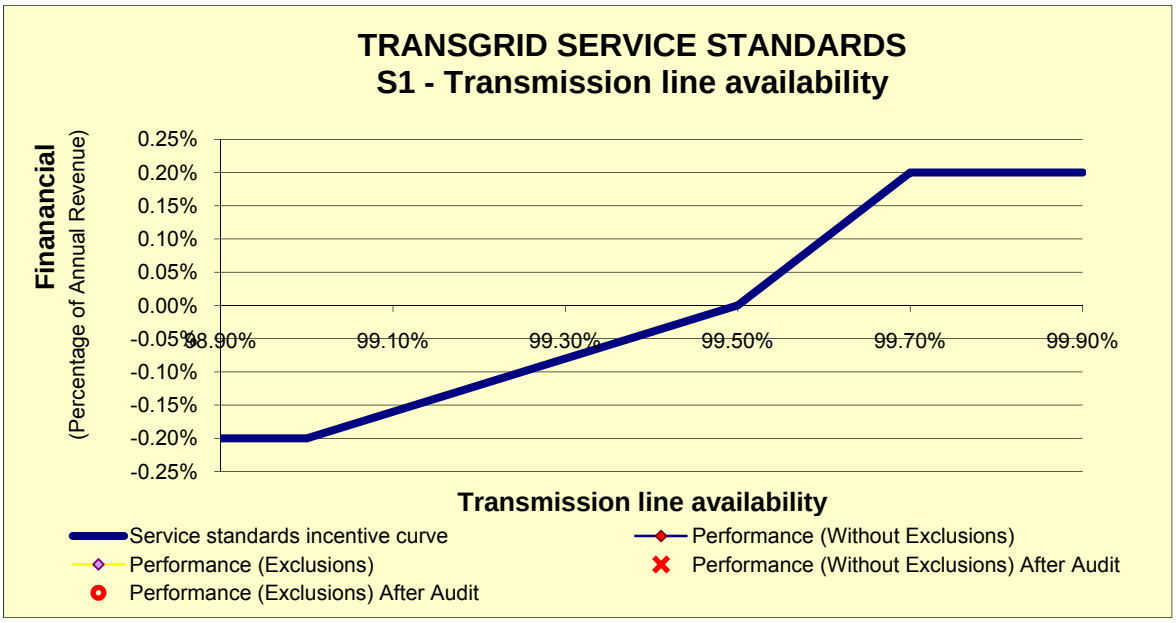
- Total s-factor result of 0.220799% or $628, 015 bonus for the Jan to Jun 2009 period; and
- Total s-factor result of 0.068131% or $231,099 bonus for the Jul to Dec 2009 period.

Appendix A 2009 Performance Parameter Profiles

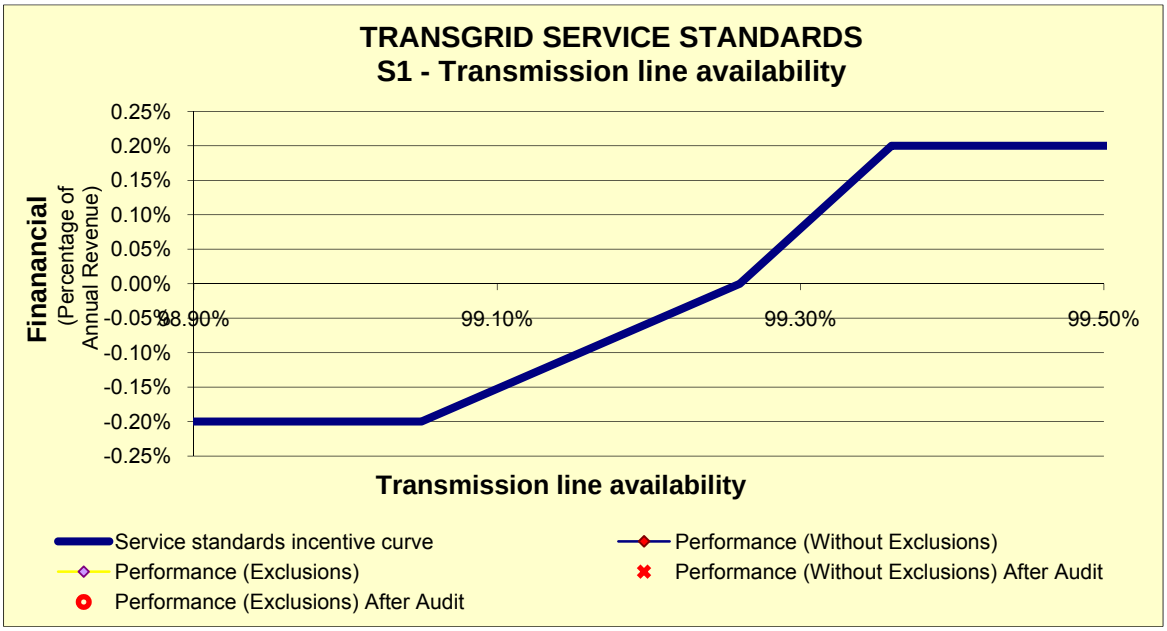
The following performance parameter profiles graphically illustrate the 2009 performance against the targets for availability, reliability and average duration outage measures.

It is noted that the calculations accept the exclusion of the Bayswater CT failure as reported by TransGrid.

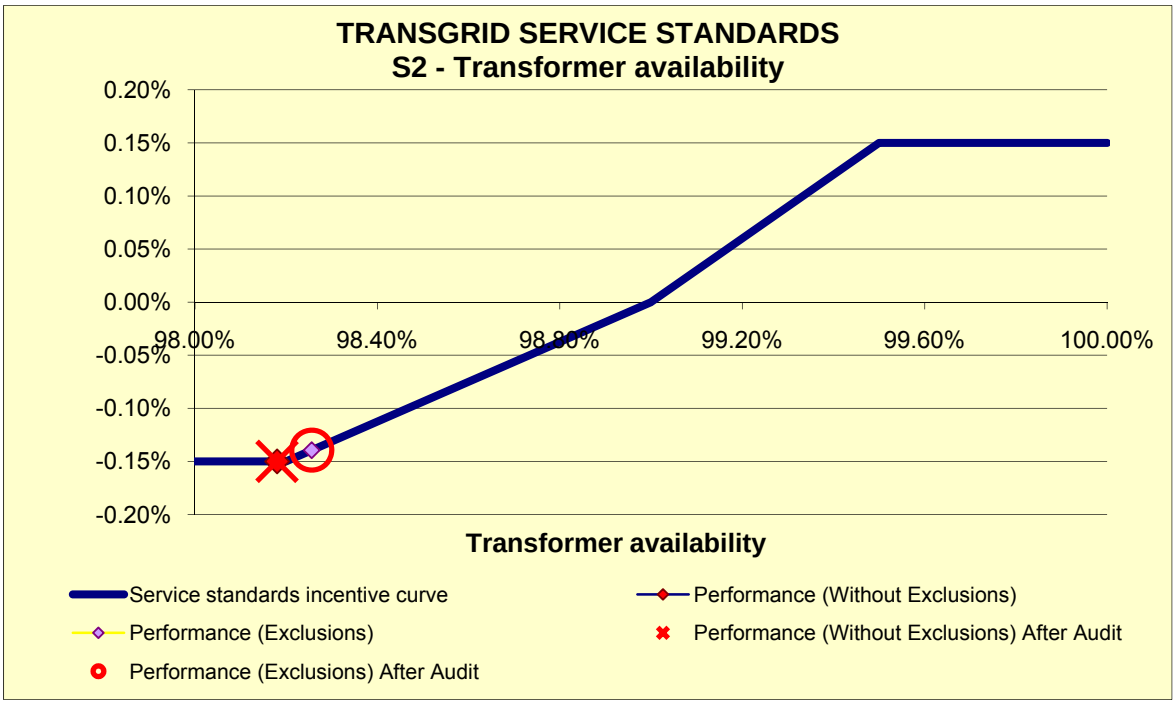
- **Figure 2 – S1 Performance Parameter Profile from Jan to Jun 2009**



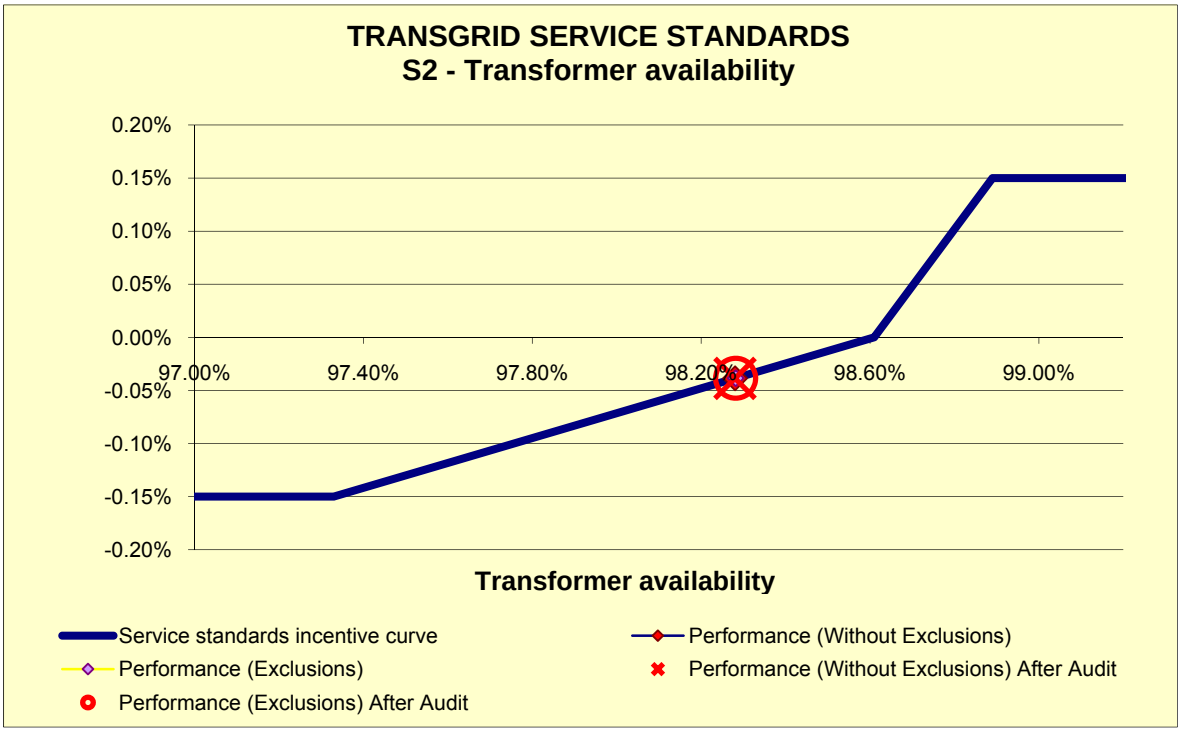
- **Figure 3 – S1 Performance Parameter Profile from Jul to Dec 2009**



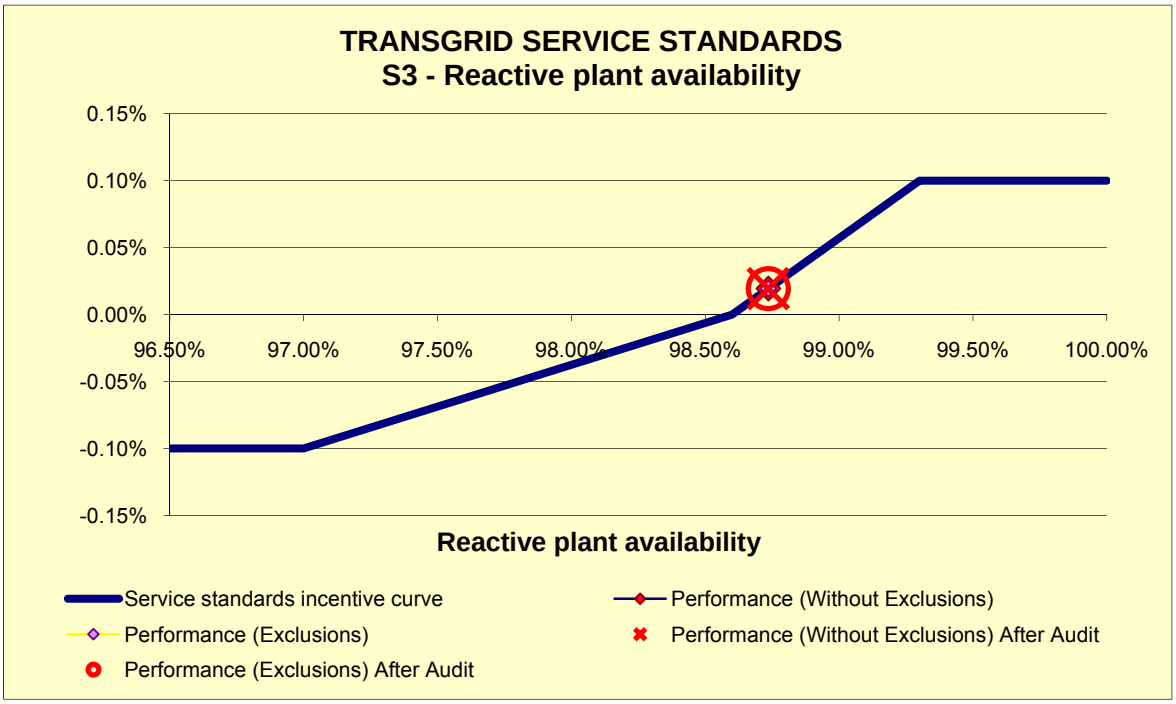
- **Figure 4 – S2 Performance Parameter Profile from Jan to Jun 2009**



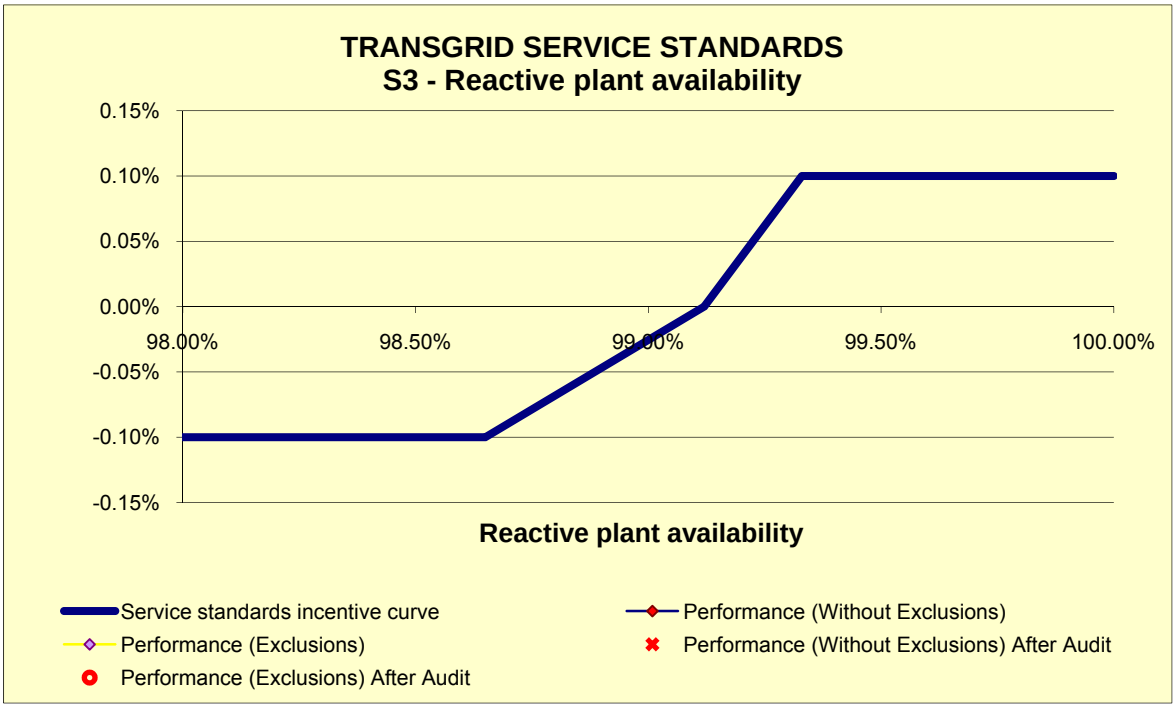
- **Figure 5 – S2 Performance Parameter Profile from Jul to Dec 2009**



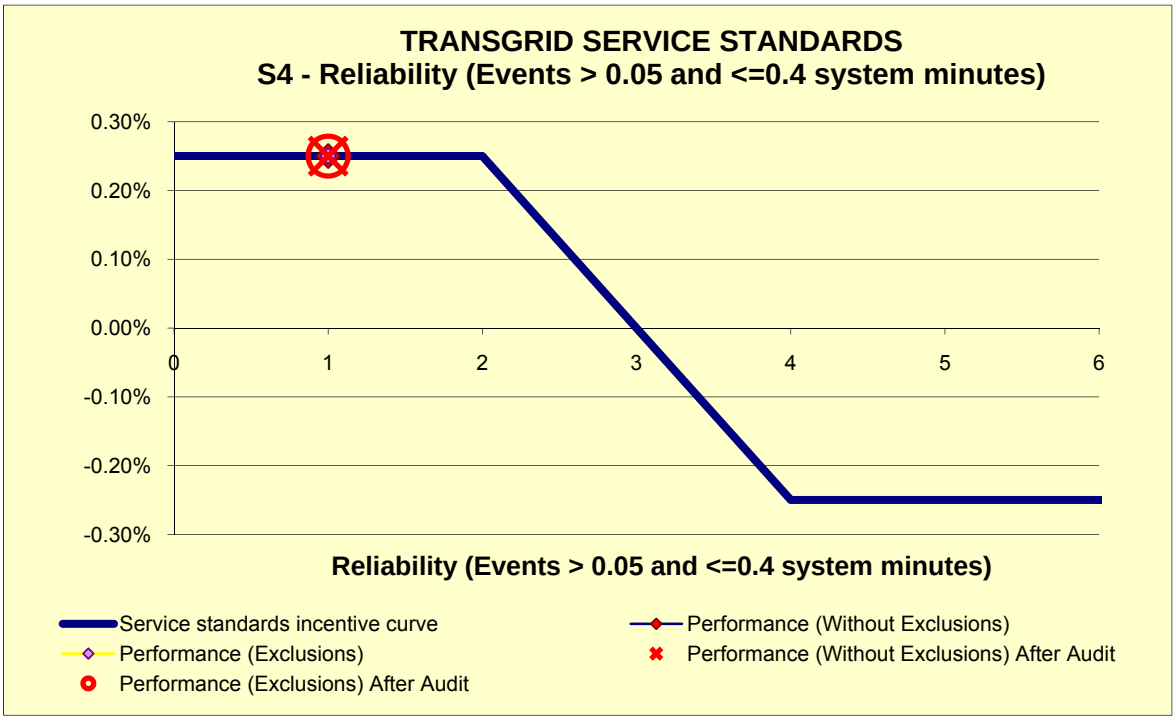
- **Figure 6 – S3 Performance Parameter Profile from Jan to Jun 2009**



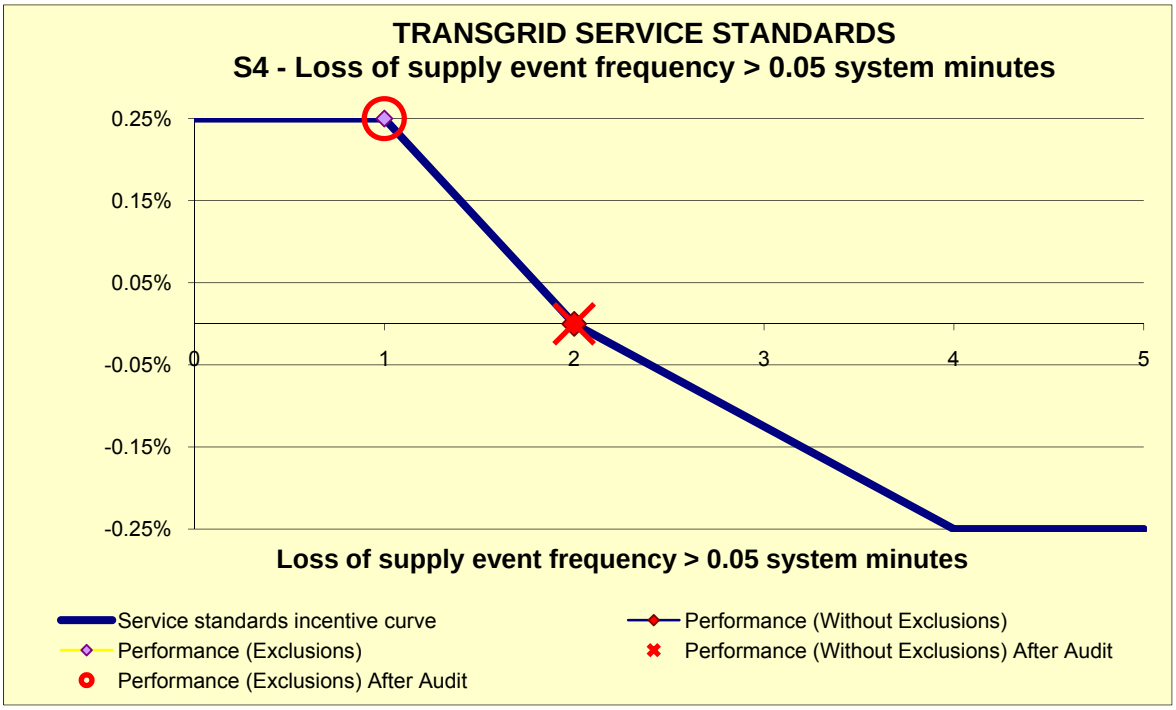
- **Figure 7 – S3 Performance Parameter Profile from Jul to Dec 2009**



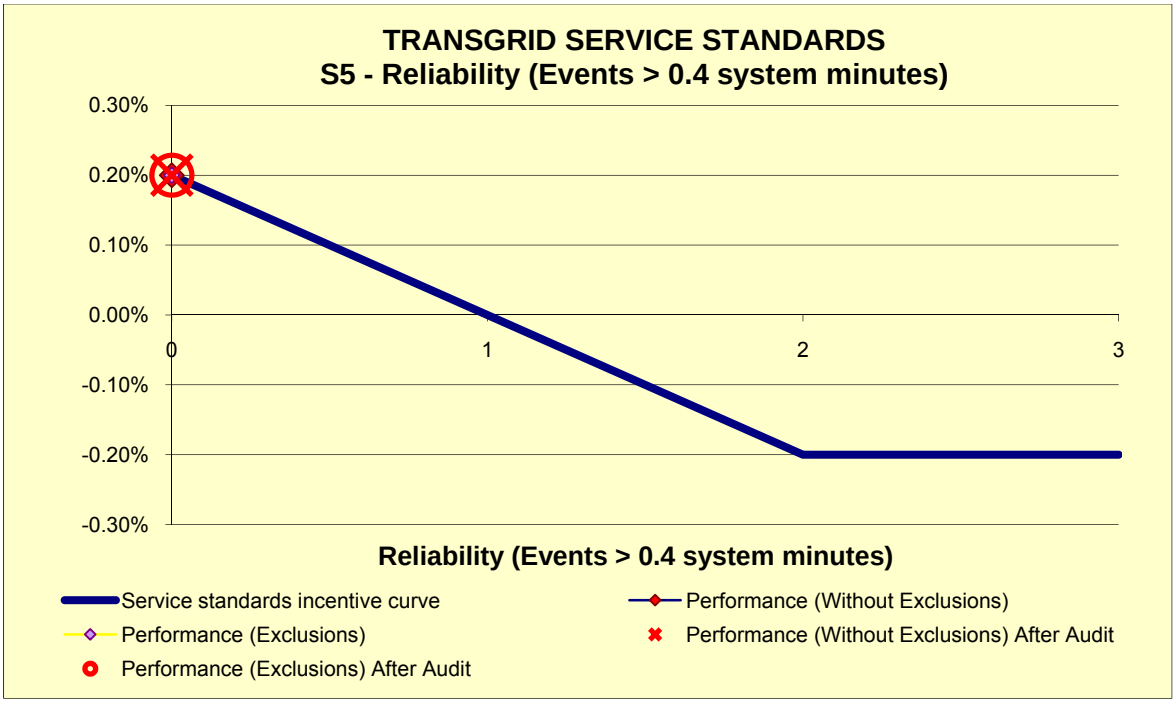
- **Figure 8 – S4 Performance Parameter Profile from Jan to Jun 2009**



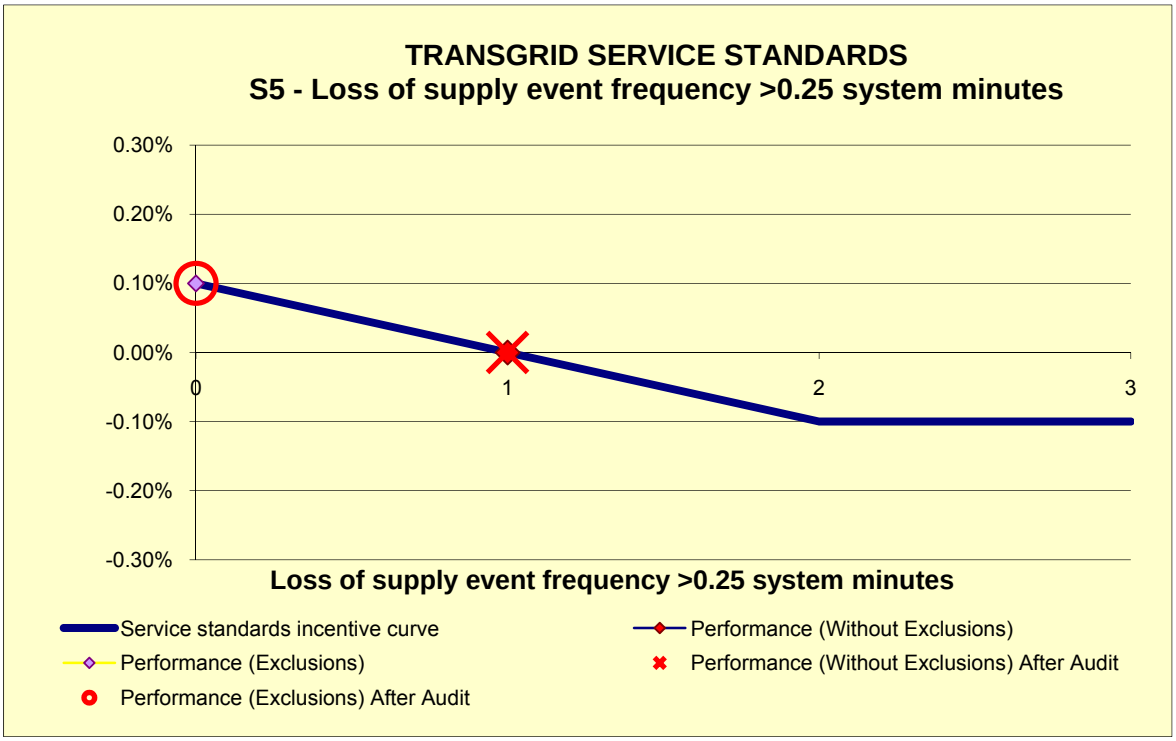
- **Figure 9 – S4 Performance Parameter Profile from Jul to Dec 2009**



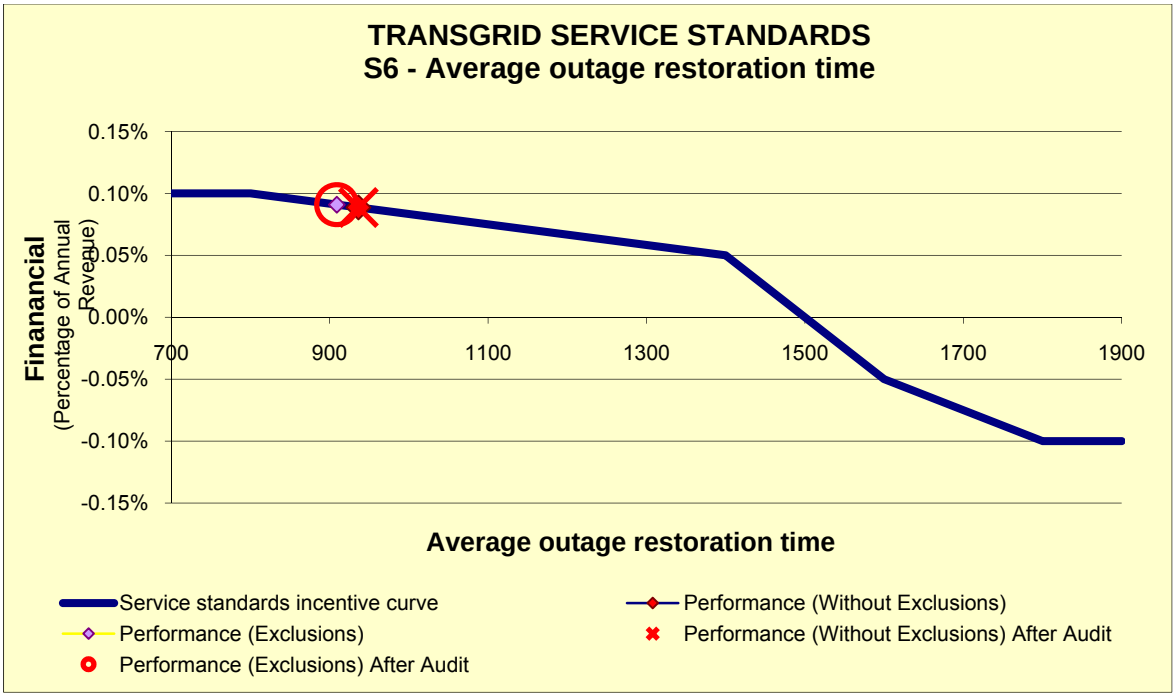
- **Figure 10 – S5 Performance Parameter Profile from Jan to Jun 2009**



- **Figure 11 – S5 Performance Parameter Profile from Jul to Dec 2009**



- **Figure 12 – S6 Performance Parameter Profile from Jan to Jun 2009**



- **Figure 13 – S6 Performance Parameter Profile from Jul to Dec 2009**