SHORT TERM PASA PROCESS DESCRIPTION

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FINAL

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Approved for distribution and use

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Version Release History

VERSION	DATE	AUTHOR	PEER REVIEW	APPROVED	COMMENTS
006	15/03/2012	EMP	PSO	Senior Manager EMP	ST PASA Process Description updated to reflect changed process (removal of the System (NEM) LRC run), and inclusion of
005	25/05/2011	EMP	PSO	Senior Manager EMP	ST PASA Process Description updated • Included semi-dispatch • Updated section 3 • Updated section 5 • Deleted old references • Corrected typos
004	01/07/2010	EMP	PSO	Senior Manager EMP	Change to AEMO document

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Contents

GLOSSARY

(a) In this document, a word or phrase *in this style* has the same meaning as given to that term in the NER.

(b) In this document, capitalised words or phrases or acronyms have the meaning set out opposite those words, phrases, or acronyms in the table below.

(c) Unless the context otherwise requires, this document will be interpreted in accordance with Schedule 2 of the *National Electricity Rules*.

TERM	MEANING
AEMO	Australian Energy Market Operator
CSV	Comma-separated values; a file format for exchanging data using commas as delimiters.
DB	Database
EMMS	Electricity Market Management System; software, hardware, network and related processes to implement the NEM (formerly MMS).
LHS	Left hand side of a constraint equation
LP	Linear program
MMS	Market Management System (see EMMS)
MMSWeb	The electricity market Management systems web portal
MNSP	Market Network Service Provider (Scheduled Network Service Provider in the National Electricity Rule)
NEM	National Electricity Market
NEMDE	NEM Dispatch Engine or Central Dispatch algorithm
NER	National Electricity Rules (the Rules)
PASA formulation	“Cegelec ESCA “Projected Assessment of System Adequacy: PASA” document
POE	Probability of exceedence
RHS	Right hand side of a constraint equation
SDL	Self-dispatch level

1 Introduction to Short Term PASA

The Projected Assessment of System Adequacy or PASA is the principal method of indicating to AEMO and market participants a forecast of the overall balance of supply and demand for electricity. The National Electricity Rules requires AEMO to prepare PASA in two time frames:

1. Short Term PASA (ST PASA) covers 6 trading days from end of the trading day covered by most recent pre-dispatch schedule with a half hourly resolution; and
2. Medium Term PASA (MT PASA) covers 24 months from the Sunday after the day of publication with a daily resolution.

The ST PASA has the following objectives:

- Provide a benchmark for AEMO to intervene in the market through the reserve trading provisions of the National Electricity Rules, and then commit extra capacity (either scheduled generation or loads) into the spot market.
- Provide information to market participants on the expected level of short term capacity reserve and hence the likelihood of interruptions due to a shortage of power.

AEMO is obliged under the National Electricity Rules[1] to document procedures it uses for the preparation of the ST PASA. This document is intended to fulfil these obligations.

1.1 Scope

The objectives of this document are to:

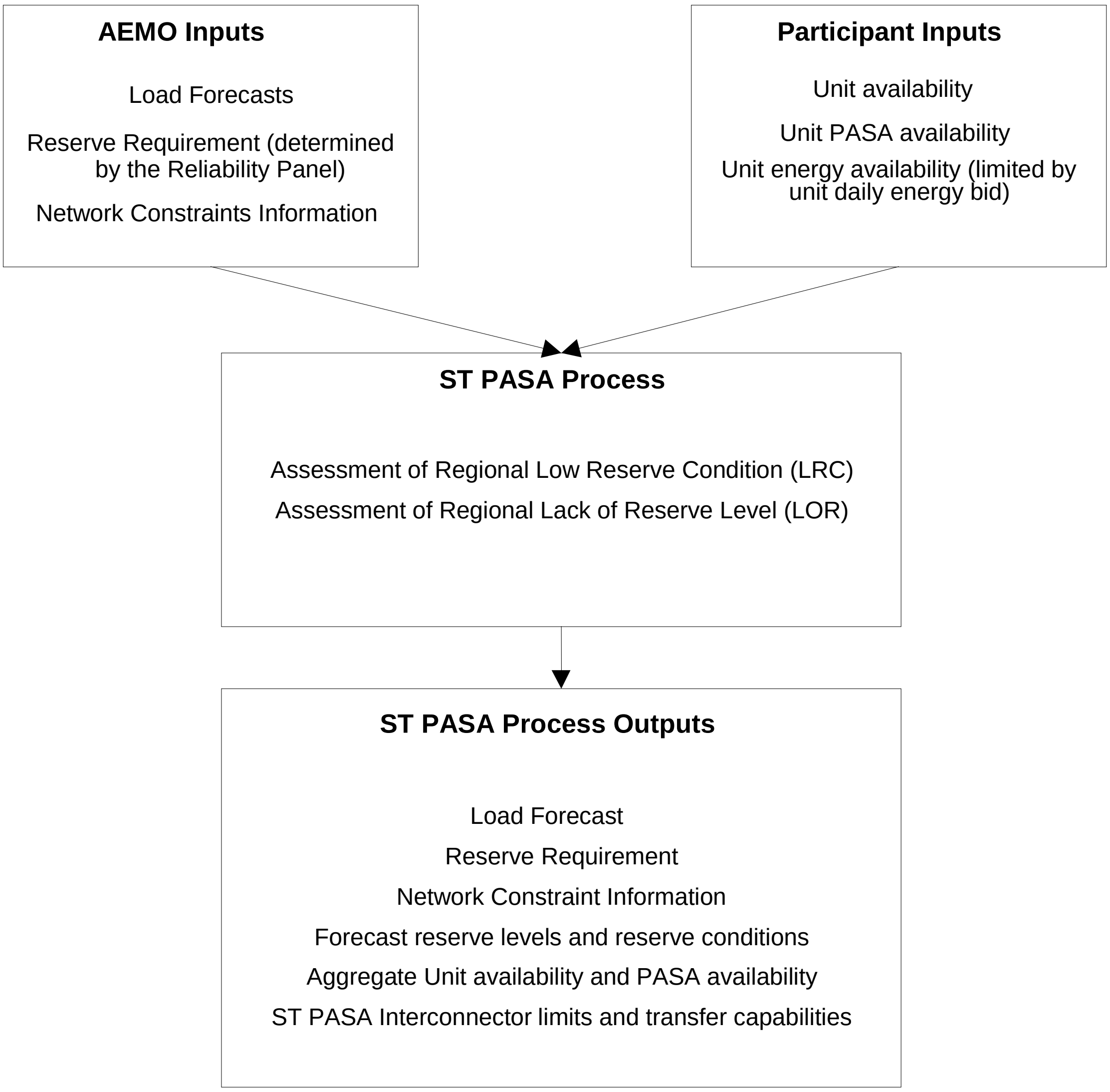
- Provide an overall description of ST PASA process.
- List the obligations of various Rules Participants (including AEMO) to provide inputs to ST PASA.
- Detail calculations performed in the ST PASA.
- Detail information of outputs produced by ST PASA process, and materials published from the process.

The scope does not include what AEMO does with the output of PASA (i.e. reserve trading and intervention procedures), and these are dealt with elsewhere (see references).

[1] Clause 3.7.3(j)

2 Short Term PASA Process

ST PASA collects information from a number of sources to provide a forecast of the adequacy of the supply/demand balance on a half hourly basis for a six day period commencing from the end of the trading day covered by the most recent pre-dispatch schedule.



3 Short Term PASA Process Cycle

Figure 1 “Primary applications involved in PASA” describes PASA processes in ST and MT timeframes. Note that some of the applications are shared by PD[2] and ST PASA processes.

Details of ST PASA process is described as follows:

1. Market Participants prepare their bids and sent this information to AEMO. The *File Loader Bids* application loads valid Energy (Unit and MNSP) and Ancillary Service Offers and Bids from the Participant File Server into MMS Database. Bid Acknowledgment files are returned to Participants.
2. The ST PASA process is initiated by MMS Timer on a cyclic basis every two hours.
3. The PASA Case Loader is used in PD PASA and ST PASA processes (MTPASA Case Loader for MT PASA) to create the input files for the PASA Solver.

   (For PD PASA only) The PASA Case Loader obtains SCADA snapshots from the MMS EMS Server.
4. The PASA Solver—a linear programming (LP) solver—takes these input files and solves the case according to the PASA Formulation.
5. Each PASA process writes its solution to an output file (PASA Solver Solution file). The PASA output file triggers the *PASA Solution Loader* to load a merged PASA Solution into the NEM Database. A *CSV Report* is generated and published to Market Participants.
6. Another automatic process replicates ST PASA and MT PASA input and solution data to the InfoServer Replication Database (Participant’s Database) for access by Market Participants. Currently it is only in use by *MMSWeb.*

[2] AEMO publishes limited results of the PD PASA runs to participants.

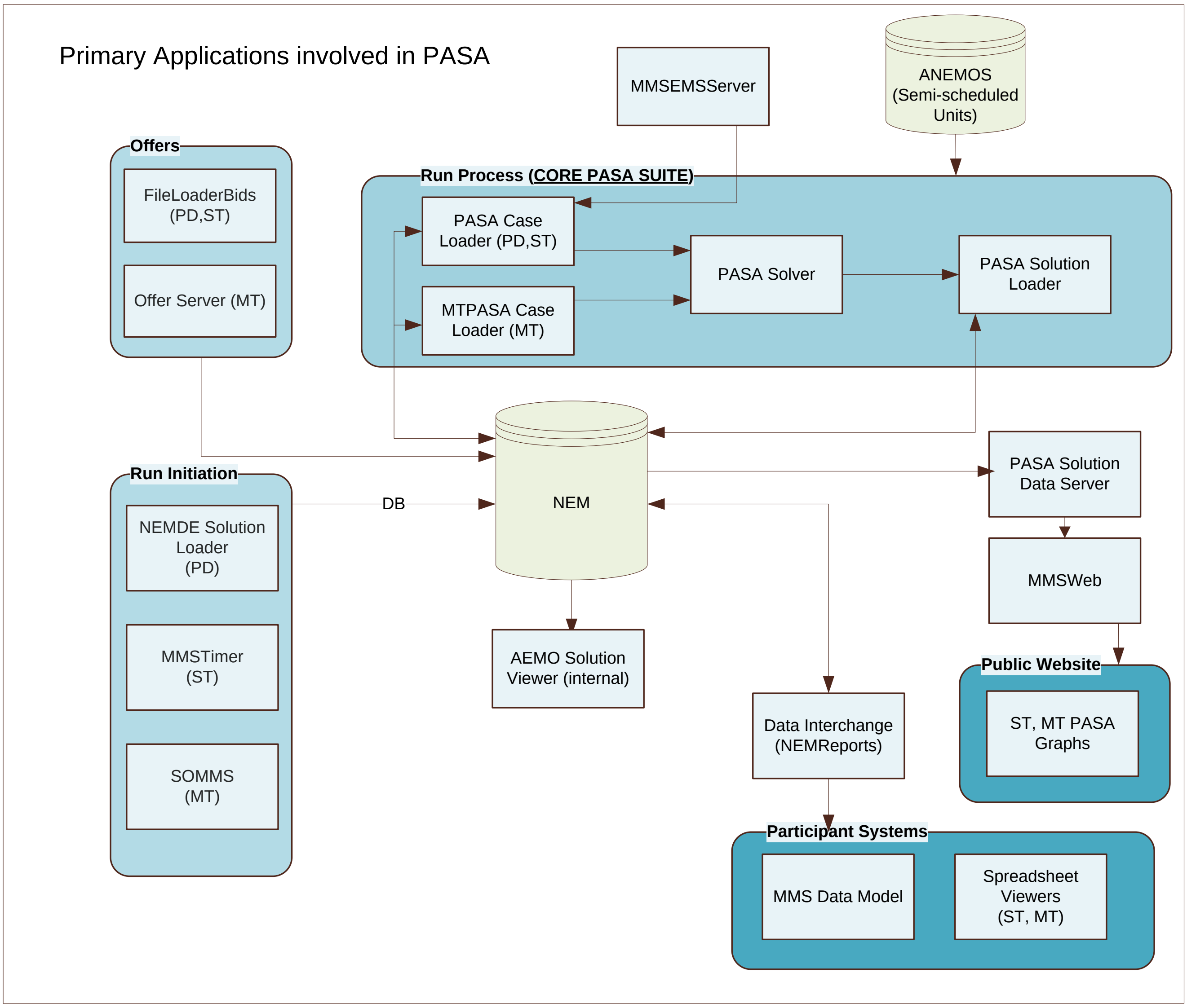


Figure 1 – Primary applications involved in PASA

4 Concepts and Definitions

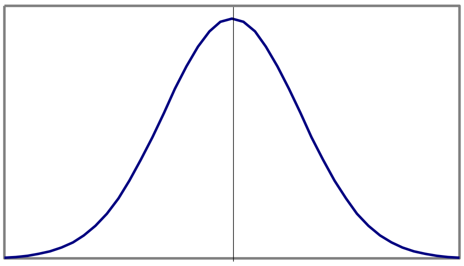
A number of concepts and definitions are used by PASA and these are discussed below before commencing a detailed explanation of the PASA processes.

4.1 “Probability of Exceedence” Demand Forecasts

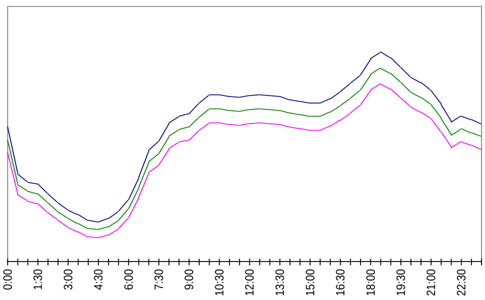
Forecasts of demand are based on historical patterns of electricity usage within each region and are based on trends, seasons (summer, winter), day of the week, public holidays etc.

The actual demand differs from the forecast (e.g. due to weather changes) usually randomly - i.e. the actual demand has a roughly equal chance of being above or below the forecast. The forecast error is distributed normally (follows a bell-shaped curve) as shown below.

AEMO is required to give three forecasts - a high forecast (with a 10% probability of being exceeded), a most probable forecast (with a 50% probability of being exceeded) and a low forecast (with a 90% probability being exceeded).



Forecast error



Examples of demand forecasts (10% POE, 50% POE, 90% POE) for a single day

Figure 2 – Forecast error and “Probability of Exceedence” Demand Forecasts

4.2 Generic Constraints

Limits on operating the power system are implemented in PASA using generic constraints. For example, flow on an interconnector can be expressed as a linear combination of various quantities such as regional demand, generation configuration and network outages. This flow can be constrained to be less than, equal to or greater than a certain limit.

A generic constraint will take the form that consists of the following three terms:

- A left-hand side (LHS) variable that represents the calculated value of the quantity being constrained.
- An operator term that defines inequality (>= or <=) or equality.
- A right-hand side (RHS) that represents the limit being applied.

AEMO will invoke a set of constraints depending on the particular system conditions (such as prior line outages). When the limit applied by a generic constraint has been reached, the constraint is known as a binding constraint.

Each generic constraint also has an associated violation penalty. These allow the bounds defined by the constraint to be violated at a cost. The “cost” is not an actual dollar value as ST PASA does not comprise pricing data, but rather a penalty associated with the violation of the constraint that indicates its relative importance. Provided the violation penalties are set at a level whereby they are only used as a last resort, constraints will only be violated when it would otherwise be impossible to determine a feasible solution to the LP. The assigning of different penalties can prioritize generic constraints, i.e. a constraint with a low penalty would be violated before a constraint with a higher penalty.

4.3 Energy Constrained Plant

Generating plant such as hydroelectric power stations cannot generally operate at maximum capacity indefinitely otherwise their energy source will be used up. Such plant is known as energy limited plant.

The ST PASA includes a process for allocating the contribution of energy limited plant to particular parts of each day so that it maximises reserves throughout each day of the PASA period. Generally, this is done by using energy limited plant at times when reserves ignoring energy constrained plant is at a minimum. In this way, reserves are on average maximised.

4.4 Inter-regional Reserve Sharing

When the total capacity of a region is greater than required for that region, the spare capacity can be allocated to another region provided the flow limit on the interconnector is not exceeded. The following example illustrates the principles.

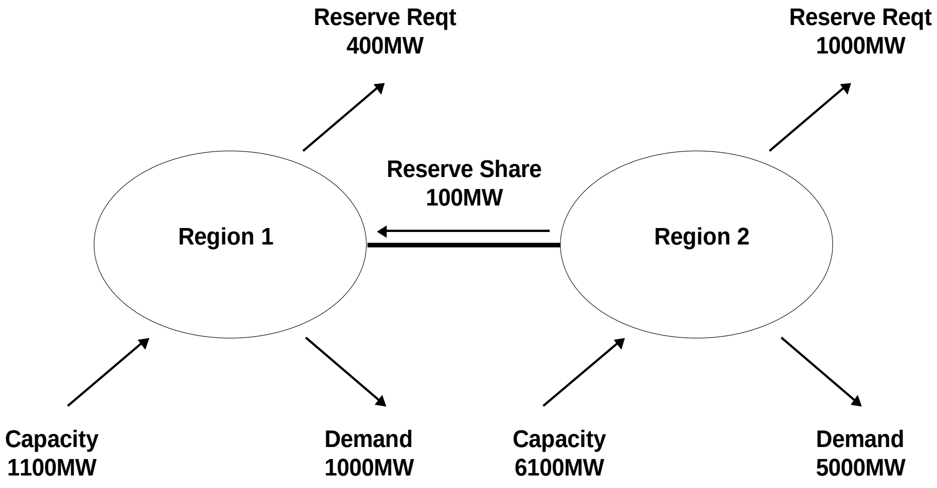


Figure 3 – An example of inter-regional reserve sharing

Note in this example that all 100 MW of surplus capacity in region 2 is supplied over the interconnector to meet the deficit capacity in region 1. The linear programming formulation attempts to optimise reserve sharing between regions along with other constraints which are described later in this document to maximise the amount of reserve that is available to the system as a whole.

4.5 Low Reserve Condition and Lack of Reserve

If capacity reserves (medium term, short term or contingency capacity reserves) fall below certain levels, AEMO may declare low reserve or three levels of lack of reserve conditions. These are defined in clause 4.8.4 of the National Electricity Rules and are summarised below:

- Low reserve condition (LRC) - this occurs when reserve conditions fall below the standards specified by the Reliability Panel (i.e. reserve is below reserve trigger level).
- Lack of reserve level 1 (LOR1) - spare capacity reserves are inadequate to restore reserves following a contingency event (i.e. reserve is below the sum of the largest and the second largest contingency[3]).
- Lack of reserve level 2 (LOR2) - a contingency event is likely to result in involuntary load shedding (i.e. reserve is below the largest contingency[4]).
- Lack of reserve level 3 (LOR3) - load shedding is required or is in progress.

[3] PASA only considers the loss of generating unit or the Basslink interconnector between Tasmania and Victoria as a contingency

[4] PASA only considers the loss of generating unit or the Basslink interconnector between Tasmania and Victoria as a contingency

5 Short Term PASA Inputs

5.1 AEMO Inputs

Under clause 3.7.3 (d) of the National Electricity Rules, AEMO is required to prepare the following information for input to the ST PASA:

1. 10% POE and 50% POE demand forecasts for each region for each trading interval
2. Reserve requirements for each region, determined in accordance with the short term capacity reserve standards.
3. Forecast network constraints.
4. Unconstrained intermittent generation forecasts for each semi-scheduled generating unit for each trading interval.

5.2 Participant Inputs

Under clause 3.7.3 (e) of the National Electricity Rules, each Scheduled Generator and Market Participant is required to prepare the following information for input to the ST PASA:

1. Available capacity of each scheduled generating unit, scheduled load or scheduled network service for each trading interval.
2. PASA availability of each scheduled generating unit, scheduled load or scheduled network service for each trading interval.
3. If applicable, daily energy availability forecasts for energy constrained scheduled generating units and energy constrained scheduled loads.

6 Short Term PASA Processing

The required ST PASA outputs are calculated through a number of processes that require solving a series of linear programmes (LP) modelled as security constrained LP problems by the ST PASA solver. The required major outputs can be categorised as the following two categories of reserve conditions:

- Low Reserve Condition (LRC)
- Lack of Reserve Conditions that indicates the level of available reserve (i.e. LOR1, LOR2, and LOR3 condition)

In order to determine the required outputs the following three assessments are included in ST PASA processing:

1. Assessment of low reserve condition, in which the ST PASA solver will determine the surplus reserve concurrently available to each region using 10% POE regional loads. The results are the output of the Capacity Adequacy (CA) run.
2. Assessment of regional low reserve level, in which the ST PASA solver will determine, for each region in turn, the maximum surplus reserve available to that region using 10% POE regional loads. The results are the output of the Maximum Surplus Reserve (MSR) run.
3. Assessment of regional lack of reserve condition, in which the ST PASA solver will determine, for each region in turn, the maximum spare capacity available to that region using 50% POE regional loads. The results are the output of the Maximum Surplus Capacity (MSC) run.

6.1 Assessment of Low Reserve Condition

The objective of the assessment of LRC is to meet the short term capacity reserve standards specified by the Reliability Panel in the ST PASA time frame. System adequacy is defined in terms of capacity above minimum requirements to meet the expected demand. System adequacy exists when expected plant capacity equals or exceeds the requirements of the various jurisdictions’ reserve policies.

The assessment utilised the security constrained LP models that evaluate system generation capacity adequacy. The objective of system generation capacity adequacy evaluation is to compute the maximum spare system generation capacity, or surplus system reserve, that can possibly be achieved to serve forecast load demand and reserve requirements subject to constraints for unit availability, interconnector availability, energy limitation, and network security. This assessment uses 10% POE Forecast data.

If the surplus reserve (as determined by the CA Run) within any region of the NEM in a given period is negative, then the reserve condition of that region will be declared as Low Reserve Condition (LRC).

6.2 Assessment of Lack of Reserve Condition (LOR)

The objective of the assessment of LOR condition is to avoid the lack of capacity in a region under several possible contingency conditions. These are referred to as LOR1 (2 contingency ‘units’), LOR2 (1 contingency ‘unit’) and LOR3 (no contingency ‘unit’) capacity violations.

The assessment utilises the security constrained LP models that evaluate regional maximum spare capacity (MSC). An MSC solve has a single study region. The goals of the LP are:

I. Find the maximum spare capacity available in each study region subject.
II. Must obey the interconnector and unit level constraints as defined in the CA LP.
III. Avoid lack of capacity in the study region under several possible contingency conditions
IV. Avoid deficit capacity in non-study regions.
V. Any deficit capacity must be encouraged to appear in the study region rather than other regions.
VI. LOR1, LOR2 and LOR3 deficit capacity must be shared across as many time periods as possible.
VII. Any degenerate solutions must be avoided

The maximum spare capacity (as determined by the MSC Run) within any region of the NEM in a given period is used to determine the as Lack Of Reserve (LOR) Condition as follows:

If MSC < 0 level then Condition is LOR 3

Else

If MSC < ‘LOR 2 level’ then Condition is LOR 2

Else

If MSC < ‘LOR 1 level’ then Condition is LOR 1

Else

No LOR Condition

7 Short Term PASA Outputs

ST PASA outputs are required under the Rules to be published daily but AEMO aims to publish the ST PASA every two hours to accommodate frequent changes in the market. Information will be made available in the AEMO website and on the Infoserver.

The published outputs for the generation capacity evaluations are as follows.

- Demand forecasts for each region with 10%, 50% and 90% probability of being exceeded.

These forecasts are pass-through information which has been used in the evaluations but has not changed in the process. They will be the same as the forecasts initially provided by AEMO.

- Short Term Capacity Reserve requirement - for each region
- Short Term Surplus Reserve (CA Run) - for each region
- Short Term Max Spare Capacity (MSC Run) - for each region
- Interchange over interconnector with other regions to achieve reserve sharing
- Reserve condition - adequate or inadequate (Low Reserve Condition)
- LOR Condition - LOR 0, 1, 2 or 3

NOTE
For specific details of the data contained in the ST PASA Public .csv file, please refer to the MMS data model document published on the AEMO website (http://www.aemo.com.au/data/market_data.html). There is a specially designed Excel-based Viewer available to assist various user groups in analysis of data in the public_stpasa_*.csv file. This is available in the participant release share.

8 References

1. AEMO operating procedure "Generic Constraints due to network limitations", document Number SO_ OP3709 (http://www.aemo.com.au/electricityops/3709.html)
2. AEMO "Spot Market Operations Timetable" (http://www.aemo.com.au/electricityops/108-0029.html)
3. National Electricity Rules (NER) (http://www.aemc.gov.au/Electricity/National-Electricity-Rules/Current-Rules.html)
4. AEMO operating procedure "Intervention, Direction and Clause 4.8.9 Instructions", document number SO_OP3707 (http://www.aemo.com.au/electricityops/3707.html)