Reliability Panel
AEMC

REVIEW

Reliability Panel AEMC

DRAFT REPORT

Annual Market Performance Review 2008-09

18 November 2009

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About the AEMC

The Council of Australian Governments, through its Ministerial Council on Energy, established the Australian Energy Market Commission (AEMC) in July 2005 to be the Rule maker for national energy markets. The AEMC is currently responsible for Rules and policy advice covering the National Electricity Market, and from 1 July 2008, concerning assess to natural gas pipeline services and elements of the broader national gas markets. It is a statutory authority. The AEMC's key responsibilities are to consider Rule change proposals, conduct energy market reviews and provide policy advice to the Ministerial Council as requested, or on AEMC initiative.

About the AEMC Reliability Panel

The Reliability Panel (Panel) is a specialist body within the AEMC and comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on the safety, security and reliability of the national electricity system and advising the AEMC in respect of such matters. The Panel's responsibilities are specified in section 38 of the NEL.

Disclaimer

The views and recommendations set out in this document are those of the Panel and are not necessarily those of the AEMC.

Foreword

A reliable national electricity system is critically important for all Australians. Consumers, energy supply and transmission and distribution organisations, and governments all have a direct interest in security and reliability.

This report presents the Reliability Panel (Panel) of the Australian Energy Market Commission (AEMC) Review of the performance of the interconnected national electricity system over the 2008-09 fiscal year in terms of reliability and security. The Panel includes stakeholders involved in electricity generation, transmission, distribution and retailing, as well as consumer representatives and the Australian Energy Market Operator (AEMO). The report has been prepared and published in accordance with the Panel's obligations under clause 8.8.3 of the National Electricity Rules (the Rules).

The events, circumstances and activities that have either positively or adversely affected the supply of electricity to consumers are assessed in terms of two main criteria: the availability of adequate bulk supply to meet consumer demand (so called "reliability"), and the technical security of the power system itself ("security"). Importantly, the Panel is responsible for dealing with reliability and security matters in the wholesale bulk electricity market and transmission.

The ultimate level of reliability and security which customers receive is also impacted by the performance of the local transmission and distribution networks. Although the Panel is not involved with local supply matters, this report also includes information from the jurisdictional regulators on the distribution network performance. This information is included to provide a composite picture of the arrangements for managing reliability performance across the National Electricity Market (NEM).

Where appropriate, the Panel offers recommendations to address the issues raised in this review.

I wish to thank all Panel members for the generous and important contributions made in the 2008-09 year.

Neville Henderson

Chair, Reliability Panel

Commissioner, Australian Energy Market Commission

Reliability Panel Members

Chairman

Neville Henderson, Commissioner, Australian Energy Market Commission

Other AEMC Reliability Panel Members

Gavin Dufty, Manager Policy and Research, St Vincent de Paul Society, Victoria

Hugh Gleeson, Chief Executive Officer, United Energy

Mark Grenning, Chief Advisor Energy, Rio Tinto

Gordon Jardine, Chief Executive, Powerlink

Tim O’Grady, Head of Public Policy, Origin Energy

Stephen Orr, Commercial Director, International Power Australia

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What is this report is about?

A reliable, secure supply of electricity is key to Australian households and businesses. Consumers of energy understand reliability and security in terms of the continuity and quality of delivered electricity, which is reliant upon all parts of the electricity supply chain including generation, high voltage transmission, and local network distribution.

This report focuses on the performance of the two areas, generation in the NEM and High Voltage Transmission connecting Queensland, NSW, ACT, Victoria, South Australia and Tasmania.

Specifically, it deals with:

- "reliability" which, for the purposes of this report, and consistent with the definitions in the Rules, relates to availability of sufficient bulk electricity generation and transmission capability; and
- "security" which relates to operation of the power system within its technical limits.

Some of a customer's interruption to supply occurs in local transmission or distribution networks. These are presently regulated in each State and Territory and the local authority publicises standards of performance for these networks. This report provides a brief overview of information on this segment of electricity supply in Section 3.

This Report contains information which was relevant from the period 1 July 2008 to 30 June 2009.

How to use this report

- The **Executive summary** provides a brief outline of the purpose and scope of this performance review and a summary of the Panel's main findings.
- The **Year in review** outlines the main events that affected the national electricity system's performance in 2008-09 and the Panel's analysis and recommendations.
- The **Technical performance assessment** section provides the comprehensive statistical data on the system's reliability and security performance over the year and an in-depth discussion of the mechanisms used to measure that performance.
- The **Network performance** section, provides an overview of the arrangements for managing the reliability of NEM distribution and transmission networks.
- The **Glossary** provides explanations of key terms and concepts for those that may not be familiar with the subject matter.

Background

National Electricity Market

The NEM is the market through which wholesale electricity is traded in the eastern and southern states of Australia. The scope of the NEM is defined by the interconnected transmission network that runs from Queensland (QLD) to South Australia (SA), and across to Tasmania (TAS). The market operates across jurisdictional regions; these are (QLD), New South Wales (NSW), Victoria (VIC), SA and TAS. The NEM commenced operation in 1998, however since that time has undergone a series of reforms to establish the current market arrangements.

The Regulatory framework

In 2003, the Ministerial Council on Energy (MCE) agreed to establish a new regulatory framework for Australia's energy market, including a package of reforms to governance, institutional arrangements, economic regulation, electricity transmission, user participation, and gas market development.

Under this regulatory framework, the national electricity objective was developed, which is specified in section 7 of the National Electricity Law (NEL) and is as follows:

> *The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—*
>
> *(a) price, quality, safety, reliability and security of supply of electricity; and*
>
> *(b) the reliability, safety and security of the national electricity system.*

To help achieve this objective, the Rules were drawn up to replace the previous National Electricity Code; the AEMC was set up to manage market development and rule-making; and the Australian Energy Regulator (AER) was established to monitor compliance with the Rules. The Rules, the AEMC and the AER came into operation on 1 July 2005.

Australian Energy Market Commission (AEMC)

The responsibilities of the AEMC are to:

- administer and publish the Rules;
- undertake the Rule-making process under the new NEL;
- make determinations on proposed Rules;
- undertake reviews on its own initiative or as directed by the MCE; and
- provide policy advice to the MCE in relation to the NEM.

The Reliability Panel

The Panel was established by the AEMC under section 38 of the NEL. It includes electricity industry and consumer representatives, and is chaired by a Commissioner of the AEMC. Its responsibilities are specified under clause 8.8.1(a) of the Rules. Some of these responsibilities are:

- reviewing and determining the power system security and reliability standards;
- determining and maintaining guidelines governing the exercise of AEMO's power to issue power system directions;
- determining and maintaining guidelines and policies governing the exercise of AEMO's power to contract for the provision of reserves;
- monitoring, reviewing and reporting on the performance of the market in terms of power system security and reliability;
- determining the system restart standard on the advice of AEMO;
- monitoring and reviewing the system standards, as well as access, performance and plant standards for connecting to the network, in terms of their effects on power system security;
- developing and publishing principles and guidelines that determine how AEMO should maintain power system security while taking into account the costs and benefits to the extent practicable; and
- determining guidelines identifying or providing for the identification of operating incidents and other incidents that are of significance for the purposes of the definition of "Reviewable operating incident".

Until 30 June, 2005 the Panel was under the auspices of the National Electricity Code Administrator (NECA). On 1 July, 2005 the Panel was transferred to the AEMC. A list of the current Panel Members was outlined in the introductory part of this report.

Executive summary

This report reviews the performance of the national electricity system in terms of reliability and security over the 2008-09 fiscal year. It examines the events, circumstances and activities that have either positively or adversely affected the supply of electricity to consumers (with the exception of local electricity transmission and distribution networks), and it offers recommendations to improve performance in the future.

In accordance with the requirements under clause 8.8.3(f) of the Rules, a presentation was presented at the Australian Energy Market Forum on 29 October 2009. The purpose of this presentation was to inform interested parties of the draft report and the Panel's process to undertake the review.

Performance of the power system is reviewed by the Panel in terms of two main criteria: the availability of adequate bulk supply to meet consumer demand ("reliability"), and the technical security of the power system itself ("security"). The Panel is responsible under the Rules, for determining the standards for reliability and security against which the national electricity system's performance is to be assessed.

The current standard for reliability is that there should be sufficient generation and bulk transmission capacity so that, over the long-term using a moving average of the actual observed levels of annual unserved energy (USE) for the most recent ten financial years, no more than 0.002% of the annual energy of consumers in any region is at risk of not being supplied. That is, the maximum permissible expected USE is 0.002% (this is the "Reliability Standard").

Reliability of supply can be affected by many factors. For example, there may not be enough generating plant capacity available to meet demand in the first place; the plant that is available may be prevented from operating due to unexpected events; there may not be enough transmission capability available to convey the electricity to distribution networks; or the distribution networks themselves may not have sufficient capability.

Some matters that affect continuity of supply, such as the impact of transmission or distribution network failures, lie outside the scope of the Reliability Standard and the responsibility of the Reliability Panel. Also, where USE is the result of a controlled response to prevent power system collapse due to multiple unanticipated disruptions,[1] rather than as the result of insufficient generation or bulk transmission capacity being made available, this is formally classified as a security issue and is not considered part of the Reliability Standard. Such security issues are addressed in their own right in this report.

1 See *contingency events* in the Glossary for full explanation of this term.

Year in review: summary

In summary, the Panel's assessment of the National Electricity Market's performance is as follows:

Reliability

- There were reliability issues in 2008-09 due to the extreme weather conditions in the Victoria and South Australia regions, which resulted in USE and the Reliability Standard was exceeded (on an annualized basis and complied over the longer term).

- Since the market started in December 1998, averages for USE due to shortfalls in available capacity indicate that all regions remain within the Reliability Standard.

- Tasmania joined the National Electricity Market (NEM) in May 2005. Since that time there has been no breach of the Reliability Standard in this region.

- During the 2008-09 fiscal year, an additional 1,153 MW of generating capacity (scheduled and non-scheduled) was registered to be brought into service in the future.

- The projected rate of growth of the 10% Probability of Exceedence (POE) summer maximum demand over the next ten years for the medium growth scenario is 3.6% in Queensland, 2.2% in New South Wales, 2.2% in Victoria, 2.0% in South Australia and 1.6% in Tasmania.

- In May 2007, NEMMCO published a report on the impact of the current drought on system reliability for the second quarter (Q2) 2007 to Q1 2009.[2] AEMO, the successor of NEMMCO from 1 July 2009, has subsequently published a quarterly update to this report. The latest update was published in September 2009, covering the study period from May 2009 to April 2011. This report advised that under the low rainfall scenario, the NEM is likely to exceed the Reliability Standard of 0.002% USE during the 2010-11 fiscal year in New South Wales and Victoria.[3]

Security

- Five major incidents involving multiple contingency events are discussed in this report. The Panel notes that AEMO has taken the appropriate actions to maintain the reliability and security of the power system during the 2008-09 fiscal year; however, the existing contingency reclassification process needs to be more transparent and consistently applied.

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2 AEMO's Drought Reports are available at: www.aemo.com.au/corporate/drought.html.

3 From 31 March 2010, the Drought Reports will be replaced by the Energy Adequacy Assessment Projections (EAAP).

- The five incidents discussed all resulted in disruption to customer load. The Panel notes that a number of other incidents during the 2008-09 fiscal year also resulted in some localised interruptions.
- There was one instance during the bushfires in Victoria where a transmission network element exceeded its secure line ratings for longer than the performance standards permit under the Rules.
- Several frequency deviations occurred over the year and there was an instance in Tasmania where frequencies were not restored to the normal frequency operating band sufficiently quickly and the frequency operating standards were breached.
- Voltage was generally maintained within advised limits.
- System damping times for significant events were generally within requirements.

Transmission and distribution networks

The Panel has also included an overview of the reliability performance of transmission and distribution networks in Chapter 3 in order to provide context for the bulk supply Reliability Standard.

Consultation

The Panel invites interested stakeholders to provide any comments that they may have in respect of this review. Submissions are due by 5 pm (AEDT) on Friday, 4 December 2009 and must be submitted electronically via the Australian Energy Market Commission's (AEMC) homepage at www.aemc.gov.au.

Or by post to:
Australian energy Market Commission
PO Box A2449
SYDNEY SOUTH NSW 1235

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1 Year in review - reliability and security

This section of the report discusses and makes recommendations concerning the most significant incidents and issues that affected the performance of the national electricity system in 2008-09. Included in the analysis is a discussion on what the Panel can learn.

This section reviews the performance of the power system in the context of the following broad areas:

- scope of the performance review: reliability and security;
- the major power system incidents; and
- other security issues.

Since the 1999-2000 summer peak, scheduled demand on the NEM mainland has grown by 8,925 MW or 35.2 percent, with an annual average growth rate of approximately 3.4 percent (almost twice the rate of growth of energy over the same period). Between 1999-2009, summer aggregate scheduled generation capacity on the mainland has risen by more than 6,300 MW, with additional increases from smaller unscheduled plant.[4]

In respect of new capacity and changes to existing capacity in 2008-09, the Panel notes that a total of 3,159 MW of new plant (including both scheduled/semi-scheduled and non-scheduled plant) has been registered with AEMO to be brought into service in the future.

1.1 Scope of the performance review: reliability and security

The 'health' of the power system is often discussed in terms of supply reliability and power system security.

Reliability is generally associated with the notion of measuring the continuity of electricity supply to customers. This can be affected by factors ranging from the availability of adequate generating plant capacity to meet demand, the incidents of unexpected contingency events on generation and transmission equipment, the availability of adequate transmission capability to convey the electricity to distribution networks and the performance of the distribution network down to end users of electricity.

The Panel's standard for reliability is that there should be sufficient generation and bulk transmission capacity so that the maximum permissible unserved energy (USE), or the maximum allowable level of electricity at risk of not being supplied to customers is 0.002% of the annual energy consumption for the associated region or

4 Scheduled generating plant participates in the central dispatch process operated by AEMO, while non-scheduled generating plant is not subject to central dispatch.

regions per financial year. Compliance with the Reliability Standard should be measured over the long-term using a moving average of the actual observed levels of annual USE for the most recent 10 financial years.

This standard does not take into account USE that is caused by local transmission or distribution failures. Such events are outside the scope of the Panel's responsibility, and failures of that type have not been catered for in setting the standard. The Panel; however, summarises the transmission and distribution network reliability in the NEM in Section 3 of this report.

The Reliability Standard also does not consider any USE that is the result of non-credible (or multiple) contingency events. Interruption of consumer load in these circumstances is a controlled response to prevent power system collapse, rather than the result of insufficient generation or bulk transmission capacity being made available. These non-credible contingency events are formally classified as *power system security* issues and are addressed separately in this report. USE arising from these events is generally not counted against the Reliability Standard.

The Panel revised and clarified the NEM Reliability Standard as part of its Comprehensive Reliability Review (CRR). The final CRR report was published in December 2007 and contains the Panel's revised Reliability Standard in Appendix D.[5]

The Panel has also determined the frequency operating standards to regulate the performance of power system, for the NEM mainland and for Tasmania. The frequency operating standards that apply in the NEM mainland were amended on 16 April 2009 following publication of the Panel's final determination on the "*Review of the Mainland Frequency Operating Standards during Periods of Supply Scarcity*".[6] The amended frequency operating standards commenced operation from the date of publication of the final determination. The amendments concerned the minimum allowable frequency for a single generator contingency during load restoration following an islanding event to be:

- 48.0 Hz for the Queensland and South Australian regions;
- 48.5 Hz for the New South Wales and Victorian regions; and
- the critical frequency in cases where an island incorporates more than one region, which is the maximum value of the critical frequencies for these regions.

5 Appendix D is also reproduced on Reliability Panel's guidelines and standards homepage. For further information see: http://www.aemc.gov.au/Panels-and-Committees/Reliability-Panel/Guidelines-and-standards.html.

6 For further information on the amendments to the NEM mainland frequency operating standards see: http://www.aemc.gov.au/Market-Reviews/Completed/Review-of-Mainland-Frequency-Operating-Standards-during-Periods-of-Supply-Scarcity.html.

The Panel published the amended frequency operating standards that apply in Tasmania on 19 December 2008.[7] The amended frequency operating standards for Tasmania commenced operation from 28 October 2009.[8]

1.2 Major power system incidents

This section describes and provides commentary on the six major power system incidents that occurred during the 2008-09 financial year that resulted in the involuntary shedding of customer load for both reliability and system security events. These incidents include:

- Black system condition in North Queensland, 22 January 2009;
- Actual lack of reserve (LOR3) in Victoria and South Australia regions, 29-30 January 2009;
- Unplanned outages of South Morang to Keilor and South Morang to Sydenham 500 kV transmission lines in the Victoria region, 30 January 2009;
- Extreme weather conditions and bush fires in the Victoria region, 7 February 2009;
- Load shedding in Victoria and system separation between Victoria region and New South Wales, 8 February 2009; and
- Multiple trip of Woree to Chalumbin 275 kV lines (876 and 877) resulting in the loss of supply to Far North Queensland, 8 March 2009.

AEMO has investigated all six incidents and in each case has published a report on its findings in accordance with clause 4.8.15 of the National Electricity Rules (Rules).[9]

The load shedding event in the Victoria and South Australia regions on 29-30 January 2009 resulted in USE that was greater than 0.002% in both regions for the 2008-09 fiscal year. However, it should be noted that the long-term Reliability Standard was not breached due to this load shedding.

Black system condition in North Queensland, 22 January 2009

Two similar non-credible contingencies occurred on the 275 kV network between the Ross and Strathmore substations. The first event occurred at 03:25 hours in the morning while the second incident happened at 17:31 hours in the afternoon.

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7 For further information on the amendments to the Tasmanian frequency operating standards see: http://www.aemc.gov.au/Market-Reviews/Completed/Tasmanian-reliability-and-frequency-standards-review.html.

8 AEMO Communication No. 106 – NEM – Revised Tasmanian Frequency Operating Standards – Implementation Date 00:00hr on Wednesday 28 October 2009..

9 AEMO, *Operating Incident Reports*, http://www.aemo.com.au/reports/nemreports.html#ops.

Excerpt from NEMMCO's Power System Incident Report[10]

On 22 January 2009 two similar non-credible contingencies occurred on the 275 kV network between Ross and Strathmore substations.

In the first instance, the Ross-Strathmore (879) 275 kV line tripped due to a single phase to ground fault on the "C" phase. The trip of 879 was followed by the trip of the Ross-Strathmore line (880) only at the Strathmore end, with successful auto-reclosing. The 132 kV connection to North Queensland remained in service.

In the second incident at 17:31 hrs, the Ross-Strathmore (879) 275 kV line tripped due to a single phase to ground fault on the "C" phase. The trip of 879 was again followed by the trip of the Ross-Strathmore (880) 275 kV line at Strathmore substation. The 880 line auto-reclosed but then tripped at Ross. The Clare to Townsville South 7130 and 7131 parallel 132 kV lines also tripped in this instance, blacking out North Queensland. Approximately 786 MW of load and 430 MW of generation was interrupted.

NEMMCO declared a black system condition in North Queensland at 17:36 hours as more than 60% of North Queensland demand had been interrupted. Powerlink was instructed to begin load restoration at 17:56 hours and all remaining load was restored by 19:50 hours. NEMMCO cancelled the black system condition at 19:53 hours.

Comments

The Panel notes the then NEMMCO's recommendations to minimise disruption to the power system during system restart through:

- NEMMCO and Powerlink reviewing the procedure for restoration of a black system in Queensland;
- Powerlink advising NEMMCO where similar protection schemes to those identified during this event as having potential hidden deficiencies are located and the timeframe for Powerlink to review and rectify the inadequacies in these schemes; and
- Powerlink advising NEMMCO of the outcome of its investigation of the auto-reclose function on the 879 line.

NEMMCO notes in its Power System Incident Report that the above recommendations are to be investigated and actioned by the end of August 2009. The Panel understands that the above tasks have been completed.

The Panel intends to consider a review of System Restart Ancillary Services (SRAS) as part of its 2010 work programme. The intention of this review is to provide

[10] AEMO, "*Power System Incident Report: Black System Condition in North Queensland on 22 January 2009*", www.aemo.com.au/reports/232-0123.html

recommendations on the relevant system restart standard for the NEM and include guidelines on the required reliability of primary and secondary restart services as required under clauses 8.8.3(a)(5) and 8.8.3(aa)(4) of the Rules.

Actual lack of reserve (LOR 3) in Victoria and South Australia regions, 29-30 January 2009

Extreme temperatures occurred in Victoria and South Australia on 29-30 January 2009. This led to extremely high demands in these regions. There were also short notice reductions in the availability of Basslink and progressive reductions in the availability of a number of Victorian generators at short notice on both days.

> Excerpt from NEMMCO's Power System Incident Report[11]
>
> On 29 January 2009, NEMMCO declared an actual lack of reserve (LOR 3) condition in Victoria from 1240 hours to 1520 hours and in South Australia from 1350 hours to 1522 hours. The maximum load instructed to be shed was 280 MW in Victoria (actual load shedding due to rotational load shedding and discrete load block sizes was 390 MW) and 140 MW in South Australia (actual load shedding was 140 MW).
>
> On 30 January 2009, NEMMCO declared an actual LOR3 condition in Victoria from 1225 hours to 1615 hours and in South Australia from 1252 hours to 1535 hours. The maximum load instructed to be shed was 340 MW in Victoria (actual load shedding was 390 MW) and 90 MW in South Australia (actual load shedding was 90 MW).

Comments

The Panel notes the commentary by AEMO on the impact of the high demand on the projections in MTPASA in respect of POE levels. The Panel also notes the conclusions and recommendations by AEMO, including:

- no change is warranted for the POE levels in MTPASA as the temperatures observed were more consistent with a 1 percent POE, rather than a 10 percent POE event, which MTPASA is based on; and

- review of the implications of reduced generator capacity at high temperatures and Basslink availability for future MTPASA summer assessments.

The Panel agrees with AEMO that the load shedding and restoration on both days was timely, well managed and appropriate. Also the sharing between Victoria and South Australia was equitable to the extent that it was possible. Similarly, power system issues resulting from the lack of reserves were well managed.

[11] AEMO, "*Power System Incident Report – Actual Lack of Reserve (LOR3) in Victoria and South Australia Regions on 29-30 January 2009*", www.aemo.com.au/reports/232-0128.html

However, the Panel notes that the USE due to the lack of reserves for both regions exceeded the 0.002% of annual energy consumption; however, as detailed in section 1.4 below the Reliability Standard is interpreted as a long-term (ten year) average and as such during this event the Reliability Standard was not exceeded.

The unplanned outages of South Morang to Keilor and South Morang to Sydenham 500 kV transmission lines in the Victoria region, 30 January 2009

A non-credible multiple contingency event occurred on 30 January 2009 in the Victoria region following a period of extreme weather conditions throughout South Australia and Victoria. There are three 500 kV transmission lines from South Morang that supply the interconnector to South Australia. These lines also supply most of the load on the west-side of Melbourne and western Victoria.

Excerpt from NEMMCO's Power System Incident Report[12]

On the 30 January 2009, the South Morang to Keilor 500 kV line tripped at 1412 hours leaving only two of three 500 kV lines in service. At 1701 hours the South Morang to Sydenham No.2 line had to be taken out of service as an emergency outage leaving only one 500 kV line in service (South Morang to Sydenham No.1 line). The power system was subsequently in an insecure state for the contingent loss of the remaining line. NEMMCO restored the power system to a secure operating state by instructing 1200 MW of load shedding, increased supply from South Australia and directing two generators to maximise their output. All load was restored by 2215 hours and the South Morang to Sydenham No. 2 500 kV line was returned to service at 2301 hours.

Comments

With the removal from service of the South Morang to Sydenham No.1 500 kV, the Panel agrees with AEMO that the shedding of 1200 MW of load was appropriate to maintain the power system in a secure operating state. The Panel considers that the measures taken to restore the power system security and to reduce the amount and duration of load shedding were generally good. Given the number of transmission lines out of service at the time, viable alternatives such as network reconfiguration were not available to avoid or reduce load shedding.

Extreme weather conditions and bush fires in the Victoria region and separation of New South Wales and Victoria, 7 and 8 February 2009

A multiple contingency event occurred when Victoria experienced extreme weather conditions on Saturday 7 February 2009. Bushfires and lightning caused seven major

12 AEMO, "*Power System Incident Report – Unplanned Outages of South Morang to Keilor and South Morang to Sydenham 500kV Transmission Lines in Victoria Region on 30 January 2009*", www.aemo.com.au/reports/232-0127.html

transmission lines to trip out of service, eventually leading to the separation of the Victoria and NSW regions on Sunday 8 February 2009.

> Excerpt from NEMMCO's Power System Incident Report[13]
>
> Extremely high temperatures, low humidity, very strong winds with the presence of lightning and other factors caused bushfires in Victoria that progressively reduced the transmission network capability between the Latrobe Valley and South Morang, between Dederang and South Morang Terminal Stations and the Victoria 220 kV outer grid.
>
> A number of significant transmission lines tripped due to the bushfires and remained out of service for extended periods of time. A separation event occurred between the New South Wales and Victoria regions at 00:16 hours on 8 February 2009, resulting from the transmission network outages due to the bushfires. During the separation event, load shedding was instructed twice by the System Operator to maintain the continuous rating of an essential 220 kV transmission line. The NSW and Victoria regions were re-synchronised at 01:44 hours. However, load shedding was instructed a further two times in order to maintain the continuous rating of transmission lines. In total approximately 198 MW of customer load was shed during the separation event.

Comments

The Panel notes that during this event that NEMMCO was required to shed load on a number of occasions to maintain power system security.

The Panel agrees with NEMMCO that the protection systems on the power system operated correctly to protect the assets and ensure safety under very extreme conditions. Restoration of the power system was carried out in accordance with the asset owner's restoration policy and care had to be taken when restoring transmission lines as fire fighting crews were present at various locations in Victoria.

Reclassification of contingency events was carried out in accordance with the AEMO operational procedures for reclassification of contingency events. The Panel notes that AEMO is reviewing these procedures to ensure ongoing reclassification of contingency events is performed appropriately.

As a result of this incident, NEMMCO made a number of recommendations including:

- determine whether the occurrence of this non-credible contingency event is reasonably possible, and if so initiate the appropriate re-classification action as required by the Rules; and

[13] AEMO, "*Power System Incident Report - Extreme Weather Conditions and Bushfires in the Victoria Region on 7 February 2009*", www.aemo.com.au/reports/232-0129.html

- investigate the interaction between outage constraint equations created by the Constraint Automation Tool under conditions similar to 7 February 2009 and system normal equations.

AEMO is following up on the investigation and completion of these recommendations.

Loss of supply to Far North Queensland due to multiple trip of Woree to Chalumbin 275 kV lines (876 and 877) resulting in the, 8 March 2009

A multiple contingency event occurred in far Northern Queensland on the Chalumbin to Woree 275 kV (876 and 877) lines.

> Excerpt from NEMMCO's Power System Incident Report[14]
>
> At 2030 hours on 8 March 2009, severe electrical storms in far Northern Queensland resulted in high voltage faults on the Chalumbin to Woree 275 kV lines. The concurrent trip of these lines, resulted in the loss of the 275 kV supply to Woree substation, which resulted in 178 MW of customer load loss in Cairns, Cairns City, Kamerunga and Edmonton substations. The Barron Gorge units 1 and 2 were the only generating units connected to the power system north of Chalumbin after the lines tripped, but also tripped less than one second after the trip of the lines.

Comments

AEMO notes in its Power System Incident Report that it did not have any information on the lightning activity that was observed in Far North Queensland at the time of the incident. Therefore, AEMO did not consider it necessary to reclassify the loss of both lines as a credible contingency prior to the incident.

The Panel notes that the mainland NEM power system frequency and voltage remained within the normal operating frequency and voltage bands during the event.

The two lines were restored to service within a short time of the event. The Panel understands that auto-reclose functionality has been implemented on both of these lines, which should be effective in managing similar events in the future.

1.3 Other security issues

A number of other security issues occurred during the year as follows.

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14 AEMO, "*Power System Incident Report : Multiple Trip of Woree to Chalumbin 275 kV lines (876 & 877) resulting in the loss of supply to Far North Queensland*", www.aemo.com.au/reports/232-0133.html

Other events

In addition to those events reported in section 1.2, 55 contingency events were reported by AEMO for the 2008/09 financial year. 33 of these events were classified by AEMO as multiple contingency events.

Some of the events resulted in customer load interruptions in order to maintain power system security. With the exception of the reliability events of the 29-30 January 2009, there were no other customer load interruptions due to power system reliability issues.

Directions

AEMO issued twelve directions throughout the 2008-09 financial year to manage local power system security issues. Further discussion on the directions issued by AEMO are covered in section 2.21. This compares with six during 2007-08, ten during 2006-07, 60 during 2005-06, 41 during 2004-05 and ten during 2003-04.

Of the directions during the 2008-09 financial year, one was in New South Wales, two in Queensland, four in South Australia and five in Victoria.

Frequency deviations

During the 2008-09 fiscal year, the frequency on the mainland NEM deviated from the normal operating band on 20 occasions. The frequencies remained outside the normal band for more than five minutes on all 20 of these occasions. However, there were no occasions where the frequency was outside the normal operating band for more than 10 minutes. The longest deviation outside of the normal operating band was 584 seconds due the trip of Kogan Creek from 700 MW on 13 September 2008.

The frequency in Tasmania deviated from the normal operating band on 5 occasions (compared with 2 during the 2007-08 fiscal year). On four occasions the frequency remained outside the normal operating band for longer than five minutes; however, for one of these occurrences the frequency excursion lasted for more than 46 minutes, which is a breach of the Tasmanian frequency operating standards, following the reduction of Basslink transfers to Victoria on 29 January 2009.[15]

1.4 Lessons from reliability and security events

Reliability results

Since market start in December 1998, the long-term moving average of the actual observed levels of annual USE for the most recent ten financial years due to supply shortages are as follows:

- New South Wales, 0%;

[15] For further information see section 2.14 Frequency operating standards.

- Queensland, 0%;
- South Australia, 0.00051%;
- Victoria, 0.00044%; and
- Tasmania, 0%.

The values of USE given above are calculated in accordance with the amended definition of the Reliability Standard published with the Comprehensive Reliability Review (CRR) in December 2007. Under this definition the Reliability Standard excludes USE associated with power system security incidents that result from:

- multiple or non-credible contingencies;
- planned outages of intra-regional transmission or distribution network elements; or
- industrial action or 'acts of God' at existing generating or inter-regional transmission facilities.

Therefore the USE that occurred as a result of industrial action in South Australia and Victoria in January and February 2000 has been excluded from the calculated USE values above.

Tasmania joined the NEM in May 2005. Since then, there has been no breach of the Reliability Standard in the Tasmanian region.

In May 2007, in accordance with a Panel recommendation to the MCE, NEMMCO published a report on the impact of the current drought on system reliability for Q2 2007 to Q1 2009.[16] From this time NEMMCO and subsequently AEMO has published an updated drought report each quarter. The latest update was published in September 2009, covering the study period from August 2009 to July 2011. The report advised that under the short-term average rainfall scenario, the Reliability Standard is not expected to be exceeded in any region of the NEM. However, under the low rainfall scenario, the Reliability Standard of 0.002% USE is expected to be exceeded during the 2009-10 summer in Victoria and during the 2010-11 summer in both New South Wales and Victoria.[17]

Security results

The Panel remains concerned about the amount of USE that has resulted from system security events throughout the 2008-09 financial year, such as the approximately 2780 MWh of load shedding that occurred on 30 January 2009 in Victoria due to unplanned line outages.

16 AEMO, *Drought reports*, http://www.aemo.com.au/corporate/drought.html.

17 The Drought Reporting published by AEMO will be replaced by the Energy Adequacy Assessment Projection (EAAP) from 31 March 2010.

System security events, including non-credible contingency events, can have a serious impact on the supply of electricity to consumers. From a consumers perspective the impact of security events are not clearly distinguishable from that of reliability events, especially as they occur at the bulk supply level.

Non-credible contingency events can indicate unexpected operation of plant at times when the power system is most stressed. When the power system is experiencing a credible contingency event, it is important that power system plant respond in accordance with defined performance standards to minimise the potential for cascading (i.e. non-credible contingency) events. The alternative of operating the power system to cater for non-credible contingency events without having to shed customer load would result in conservative operating limits, particularly for interconnector. This could also result in high electricity prices for end use consumers and potentially reduced reliability.

1.5 Panel initiated reliability and security reviews

NEM Reliability Settings: VoLL, CPT and Future Reliability Review

The Panel sought consultation from stakeholders in relation to its Exposure Draft of a proposed Rule change and proposed Rule on 16 September 2008. The proposed Rule change was submitted to the AEMC on 18 December 2008 and the final Rule determination and National Electricity Amendment (NEM Reliability Settings: VoLL, CPT and Future Reliability Review) Rule 2009 No. 13 commenced operation on 28 May 2009. The main impacts of the Rule were that:

1. the term "Value of Lost Load (VoLL)" was renamed the "Market Price Cap";
2. the Market Price Cap is to increase from $10,000/MWh to $12,500/MWh, with effect from 1 July 2010;
3. the Cumulative Price Threshold is to increase from $150,000 to $187,500, also with effect from 1 July 2010; and
4. the annual review of VoLL was replaced with an integrated review of the reliability standard and settings to take place every two years, with two years' notice of any change.

Review of Operational Arrangements for the Reliability Standard

The Panel made a number of recommendations in relation to the operationalisation of the bulk supply reliability standard in the final report of its CRR. This included a number of reviews it would undertake as a response to issues raised during consultation. This review has also been initiated in response to the MCE directed review into energy market frameworks in light of the impact on electricity supplies of the extreme heat wave of 29-31 January 2009.[18]

Therefore, the AEMC provided terms of reference that require the Panel to review the operational arrangements for the reliability standard including:

- the methodology and process used by NEMMCO for calculating the minimum reserve levels (MRLs), especially where the MRLs apply across more than one jurisdiction;
- the MRLs and associated arrangements and standards to be used in the short-term reserve assessment of reliability;
- the current "Guidelines for management of electricity supply shortfall events" (sometimes referred to as 'share the pain' guidelines) that were issued by the Panel in September 1998;
- the need and possible design of a short-term version of the Reliability and Emergency Reserve Trader (RERT) that could be used in a critical emergency;
- whether the wording of the standard as published by the Panel in the CRR could be clarified to give better guidance to NEMMCO as to how to operationalise the standard; and
- whether the Rules should be amended to clarify the requirement for market participants to inform NEMMCO, via dispatch bids or offers, of their actual capability under the prevailing or forecast temperature conditions.

The terms of reference specify that the Panel should complete this review by 31 December 2009. The Panel published an Issues Paper on 26 June 2009 and subsequently published its Draft Report on 30 October 2009.

The Panel published an Exposure Draft Rule change on 1 May 2009 regarding the need and possible design of a short-term version of the RERT that could be used in a critical emergency. The exposure draft contained a discussion of the policy intent of the Panel, a draft Rule and amended interim RERT guidelines. Six submissions were received from stakeholders during consultation. Following amendments to reflect the views of stakeholders the Panel submitted a Rule change proposal to the AEMC on 11 August. The Panel requested that the AEMC assess the Rule change proposal under the expedited Rule making process (section 96 of the NEL). This Rule change proposal was considered by the AEMC and on 15 October 2009 the AEMC published its Rule determination and final Rule on the short-notice RERT. The Panel published its interim amendments to the RERT Guidelines on 29 October 2009 in accordance with National Electricity Amendment (Improved RERT Flexibility and Short-notice Reserve Contracts) Rule No.19 2009. These interim amendments to the RERT guidelines replace those developed and published by the Panel on 24 November 2008.

18 For further information, see Ministerial Council on Energy, *18th Meeting Communiqué 6 February 2009*, http://www.ret.gov.au/Documents/mce/about/meetingcomms.html

Reliability Standard and Settings Review

Prior to National Electricity Amendment (NEM Reliability Settings: VoLL, CPT and Future Reliability Review) Rule 2009 No. 13, the Panel was required to perform an annual review of the market price cap (previously known as VoLL). The Panel is now required to conduct a biennial review of the Reliability Standard and settings in accordance with clause 3.9.3A of the Rules. The Panel is required to complete this review by 30 April 2010, with any recommended changes to the Reliability Standard or the market settings to take effect from 1 July 2012.

The review focuses on the longer term issues of:

- the form and level of the existing Reliability Standard, and whether these are still appropriate for current market arrangements, given that more than 0.002% of annual (but not ten year) unserved energy was observed during the high temperature incidents in Victoria and South Australia on 29 and 30 January 2009; and

- the recommended market price cap (MPC), cumulative price threshold (CPT) and market floor price necessary to achieve the Reliability Standard.

On 26 June 2009, the Panel published an Issues Paper for the Review of the Reliability Standard and Settings.

1.6 Climate change

The AEMC recently reviewed the energy market frameworks in light of Climate Change Policies.

The report culminated in the development of an implementation plan that covers two types of recommendations. The first set of recommendations propose amendments to existing energy market frameworks, relating to areas of the existing frameworks that are considered potential stress points for the relevant energy markets and require change to continue to promote the desired market outcomes. The second set of recommendations consider improvements which can be implemented through the existing regulatory mechanisms/processes.[19]

The MCE is planning to review the recommendations at its ministerial meeting in December. Following consideration of the recommendations by the MCE, the Panel will assess the implications of this review on the reliability of the power system taking into account any implications or recommendations from the Report.

[19] Further information may be found at: www.aemc.gov.au/Market-Reviews/Completed/Review-of-Energy-Market-Frameworks-in-light-of-Climate-Change-Policies.html

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2 Technical performance assessment

This part of the report contains comprehensive statistical data on the power systems reliability and security performance over the year as well as discussion on the mechanisms used to measure that performance.

The Panel acknowledges the AER and AEMO for their assistance in the preparation of the data in this section.

2.1 Reliability management

The overall arrangement for ensuring the Reliability Standard is met, including the safety mechanism arrangements if the market mechanisms fail, is illustrated in the reliability model in Figure 1. The operation of each element of the model is explained and analysed in detail in this section.

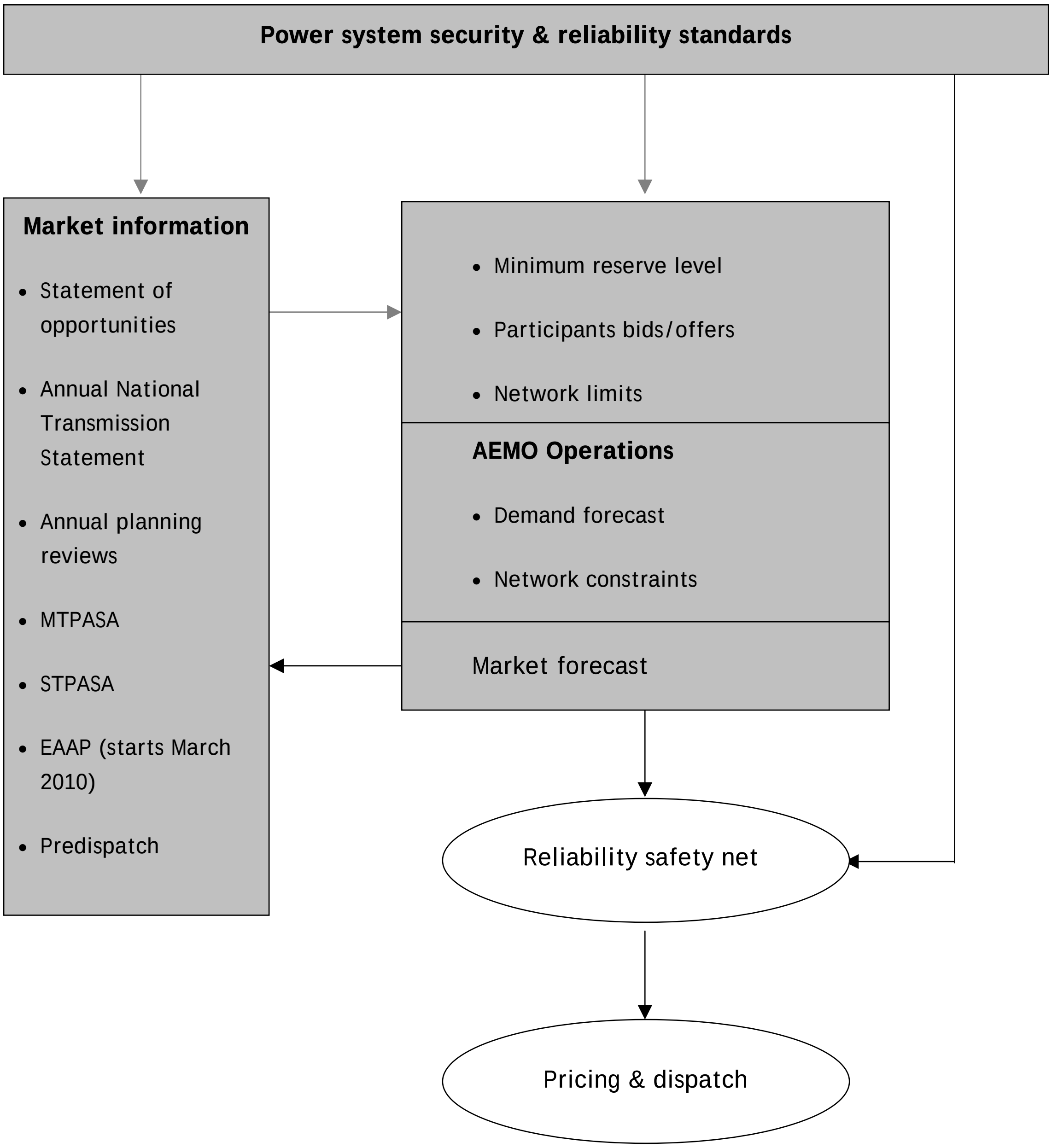
The national market aligns incentives for decisions by market participants about plant operation with overall reliability outcomes. There is an extensive suite of information published by AEMO to support those decisions.

Market information provides data and projections with increasing levels of detail closer to the time of dispatch. The annual Electricity Statement of Opportunities (ESOO) provides information for ten years ahead. The shortest term, called the pre-dispatch schedule, provides five minute projections of dispatch, consumer demand and market price.

Market information is derived from technical data and advice of the commercial intentions for plant operation provided to AEMO by participants. AEMO develops forecasts of demand and aggregates participant information to produce overall forecasts for publication. Participants are encouraged to adjust their intentions and are obliged to provide revised data to AEMO. The final data is used by AEMO to operate the power system and facilitate the operation of the market.

In addition, the reliability safety net allows AEMO to monitor the level of reserve in each region and may intervene if these reserves fall below the margins necessary to meet the Reliability Standard determined by the Panel.

Figure 1: Reliability model



2.2 Energy market Reliability Standard

The Reliability Standard of 0.002% unserved energy (USE) is designed to measure whether there is sufficient available capacity to meet demand. It is the basis for AEMO's calculation of minimum reserve levels for market information purposes, and if necessary intervention through reserve contracting under the Reliability and Emergency Reserve Trader (RERT), or its directions powers. Reliability within a market region depends on the reserve within that region and other regions and on the capability of interconnectors.

Reliability of the energy market is measured by comparing the component of any energy not supplied to customers as a result of insufficient generating or bulk transmission capability against the Standard. This excludes energy not supplied due to management of security and performance of local transmission or distribution networks, and is therefore only part of the overall measure of continuity of supply to customers. As noted previously, Chapter 3 of this report provides a summary of information on distribution network reliability in order to provide context for the Reliability Standard.

Reliability is driven by the adequacy of investment and level of generating and transmission plant presented to AEMO for dispatch in the market. The market design relies on commercial signals in the market price to create incentives for market participants to bring capacity online. The Reliability Standard sets the threshold at which AEMO may intervene in the operation of the market to ensure sufficient available capacity. Security, however, is the product of the technical performance characteristics of plant and equipment connected to the power system and how it is operated by AEMO and network service providers.

Performance assessment

During the 2008-09 fiscal year, USE accrued as a result of a reliability incident in the South Australia and Victoria regions on 29-30 January 2009. While the extreme weather conditions at this time resulted in USE exceeding 0.002% in both regions for the 2008-09 fiscal year, it should be noted the long-term Reliability Standard was not breached. For further information see Section 1.2 (major power system incidents) of Chapter 1.

2.3 Minimum reserve levels

The Reliability Standard of 0.002% USE is a statistical risk of not meeting consumer demand over time. To meet the Standard operationally, AEMO calculates minimum reserve levels (MRLs) for each region or combination of regions. These calculations take into account plant performance characteristics such as forced outage rates, the characteristics of demand including weather, market price sensitivity and the capability of the network.

MRLs provide AEMO with an operational trigger for intervention to maintain supply reliability. AEMO may intervene using reserve contracting or its power for directions if the reserves delivered by the market are below the designated MRL. The medium-term and short-term assessment of system adequacy (medium-term and short-term PASA), predispatch schedule and market notices (see Chapter 2.9) alert the market to the potentiality of reserve levels being below the MRL threshold. This information and a participants response are central aspects of the management of reliability in the NEM.

The methodology used by AEMO to determine the MRLs is probabilistic. The calculation process first requires determining a minimum level of generation capacity that will deliver the Reliability Standard in all regions (i.e. expected USE = 0.002%). The MRLs are derived by comparing the minimum generation requirement with a demand condition which has all regions at their maximum 10% probability of exceedence (POE[20]) demand and taking into account reserve available across interconnectors.

In 2006, NEMMCO completed a review of the MRLs. That review was finalised in September 2006 and those values of the MRLs have been operational in the NEM since 24 October 2006. The Panel and AEMO are currently in the process of reviewing and updating the MRLs, with the amended levels anticipated to be utilised as the baseline for future MRL recalculations.[21]

For the 2009-10 fiscal year, the MRLs to apply in the NEM are outlined in Table 1.

Table 1: Revised minimum reserve levels

	QLD*	NSW	VIC & SA	SA*	TAS
2005-06	610 MW	-290 MW	530 MW	265 MW	144 MW
2006-07	480 MW	-1490 MW	615 MW	-50 MW	144 MW
2007-08[22]	560 MW	-1430 MW	615 MW	-50 MW	144 MW
2008-09**	560 MW	-1430 MW	615 MW	-50 MW	144 MW
2009-10**	560 MW	-1430 MW	615 MW	-50 MW	144 MW

* This is a local requirement and must be met by generation within the region assuming 0 MW supporting flow from neighbouring regions

**These levels were defined following the abolition of Snowy region of the NEM. Note that the levels prior to the abolition of the Snowy region remain valid as the underlying physical transmission network, generation and load conditions have not changed.

The industry will benefit from further refinement of the MRLs for different applications and time horizons. These different time horizons could, for example, include forecasts of reserves one week ahead in addition to the ten year projections

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20 See Glossary for definition.

21 For further information on the MRL recalculation process see, http://www.aemc.gov.au/Market-Reviews/Open/Review-of-Operationalisation-of-the-Reliability-Standards.html.

22 The 2007-08 NSW MRL was determined assuming the abolished Snowy region provided 1,878 MW of support. Assuming a maximum import capability into NSW of approximately 4,000 MW (2,900 MW from Snowy and 1,100 MW from QLD) there is 2,122 MW spare import capability. This spare import capability provides NSW with access to share significant spare capacity with neighbouring regions. This has resulted in NSW having a large negative MRL.

of system adequacy in AEMO's annual Electricity Statement of Opportunities (ESOO). In particular, refinement could focus on how the minimum reserve level criterion can best be applied in the short-term to avoid the risk of unnecessary intervention or load shedding.

In the CRR, the Panel recommended that a taskforce review the methodology and process for calculating MRLs.[23] The CRR also recommended that AEMO conduct a review of the level of short-term reserves that should be used in the short-term PASA. AEMO and the Panel are considering the inclusion of short-term MRLs in conjunction with its review on updating the current MRLs.[24]

Performance assessment

Table 2 summarises the results for each region of instances where the reserves fell below the MRLs. For the last ten years, the data shows a general reduction in forecast reserve shortfalls, with the exception of South Australia during the Moomba crisis of January and February 2001.

The Panel notes that the forecast duration below the MRLs for South Australia were high in 2006-07, 2007-08 and 2008-09. AEMO advised the Panel that this is because South Australia experienced hotter summers on average during these years, and the intermediate generating plants were not committed when the forecast MRL calculations were last undertaken.

Table 2: Forecast duration below the minimum reserve levels

	Year	QLD	NSW	VIC	SA	TAS
Forecast duration below the threshold (hours)	2008 - 2009	4.5	5.5	18	182	7.5
	2007 - 2008	26.5	5	27	124	0
	2006 - 2007	14	9	0	196	0
	2005 - 2006	0	0	0	0	0
	2004 - 2005	17.5	0	0	6	-
	2003 - 2004	11.5	4.5	17.5	645	-
	2002 - 2003	2.5	3.5	7	115.5	-
	2001 - 2002	1	0	0	45.5	-
	2000 - 2001	188	8	67	716	-
	1999 - 2000	43	33	145	699	-

The forecasts reflect the outcomes of the supply-demand at the time of calculation. Under these circumstances, AEMO advised the market of its forecasts and sought a market response to eliminate the deficit in supply. In South Australia the market

[23] AEMC Reliability Panel 2007, *Comprehensive Reliability Review*, Final Report, December 2007, Sydney.

[24] For further information, see Chapter four of the Panel's Review of the Operational Arrangements for the Reliability Standard. http://www.aemc.gov.au/Market-Reviews/Open/Review-of-Operationalisation-of-the-Reliability-Standards.html.

response for additional capacity was generally received from the intermediate generation plants.

The Panel notes that there is still no distinction made between short and medium-term MRLs in PASA and the predispatch schedule, even though there is greater certainty about demand in the short-term. This highlights the importance for the industry to consider the need to develop MRLs for different applications and timeframes closer to real time. Demand forecasting for different applications and timeframes is further discussed in Section 2.10 of Chapter 2.

2.4 Market information

Market information is provided in a number of formats and timeframes ranging from the annual ten year ESOO to the detailed five minute and thirty minute price and demand predispatch schedule. Market information also includes Annual Planning Reviews, the National Transmission Statement (to be replaced by the National Transmission Network Development Plan (NTNDP) from 2010)[25], medium-term PASA, short-term PASA and market notices. Each is described and analysed below.

Electricity Statement of Opportunities, National Transmission Statement and Annual Planning Reviews

Each year AEMO publishes an ESOO for the following ten years.[26] This is complemented by Annual Planning Reviews that are prepared by each transmission network service provider (TNSPs). The Annual Planning Reviews focus on networks and include forecasts of transfer capacities, potential constraints and possible intra-regional augmentations. The SOO typically included NEMMCO's Annual National Transmission Statement (ANTS). However, the 2009 ESOO does not include the ANTS with AEMO indicating that the interim National Transmission Statement (NTS) will be published in December 2009. The NTS provides an integrated overview of the current state and potential future development of major national transmission flow paths.

These documents provide technical and market data, in addition to useful information about market opportunities, for both existing registered and intending market participants. The information includes:

- forecasts of energy use, peak demands, generator capabilities and other means of meeting electrical energy requirements, and ancillary service requirements necessary for the secure operation of the power system;

- forecasts of inter and intra-regional transmission network capabilities and a summary of network augmentation projects that will affect these capabilities (the

25 Under clause 5.6A.2, AEMO must no later than 31 December each year publish the NTNDP for the following year.

26 From 2009, the Statement of Opportunities (SOO) published by NEMMCO up until 2008 was renamed the Electricity Statement of Opportunities (ESOO).to be published by AEMO.

inter-regional transfer capabilities reflect the network's ability to exchange energy between regions within the NEM);

- AEMO's assessment of the adequacy of supply, referred to as the supply/demand balance; and
- a brief summary of significant initiatives and projects expected to influence market development over the coming years.

On 22 July 2008, the AEMC published its final report to the MCE on the National Transmission Planning Arrangements Review. The report recommended the following:

- establishing a National Transmission Planner (NTP) as one of the functions of AEMO;
- the NTP will become responsible for the functions currently carried out by the Inter-Regional Planning Committee;
- the NTP will publish an annual NTNDP from 2010. The NTNDP will outline the long-term efficient development of the power system, including future and current capability of the national transmission network and development options; and
- the NTNDP will replace the ANTS.

Performance assessment

Table 3 compares the forecast demand, for medium growth and 10%, 50% and 90% POE, with the actual maximum demand. The forecast demand values shown are from the 2009 ESOO.

It can be observed that most of the maximum demand falls within the 90% POE and 10% POE levels. However, the following exceptions apply:

- Winter 2008: the maximum demand in New South Wales and Queensland were above the 10% POE levels;
- Winter 2008: the maximum demand in Victoria was below the 90% POE level;
- Summer 2008/09: the maximum demand in Queensland was below the 90% POE level;
- Summer 2008/09: the maximum demand in Tasmania was above the 10% POE level; and
- Winter 2009: the maximum demand in Queensland, New South Wales, South Australia and Tasmania were below the 90% POE levels.

Table 3: 2009 ESOO maximum demand comparison

Region	QLD	NSW	Vic	SA	Tas
Winter 2008					
2008 SOO Peak Forecast (10% POE)	8,196	14,140	8,448	2,533	1,809
(50% POE)	8,075	13,770	8,254	2,432	1,786
(90% POE)	7,923	13,400	8,106	2,332	1,766
Actual maximum demand	8,204	14,287	8,037	2,439	1,718
Summer 2008/2009					
2008 SOO Peak Forecast (10% POE)	10,042	14,860	10,525	3,408	1,445
(50% POE)	9,493	14,010	9,937	3,091	1,420
(90% POE)	9,103	13,160	9,422	2,831	1,405
Actual maximum demand	8,699	14,097	10,445	3,318	1,479
Winter 2009					
2009 SOO Peak Forecast (10% POE)	8,726	14,703	8,328	2,730	1,886
(50% POE)	8,606	14,313	8,190	2,580	1,863
(90% POE)	8,434	13,963	8,084	2,460	1,843
Actual maximum demand	7,687	12,981	8,130	2,358	1,677

The methodology that is used in determining load forecasts was augmented with some of the recommendations from a report by KEMA commissioned in 2005 by NEMMCO.[27] In addition, as a result of the making of National Electricity Amendment (NEM Reliability Settings: Information, Safety Net and Directions) Rule 2008 No. 6 in June 2008, AEMO is required to provide the Panel a report on the accuracy of the ESOO demand forecasts by 1 November each year in accordance with clause 3.13.3(u) of the Rules.

In the 2008-09 fiscal year, the national summer peak reached a new record of 35,554 MW in January 2009. The national winter peak demand reached 34,345 MW in July 2008. This is up from 34,363 MW the previous winter and 31,950 MW the previous summer. Maximum demands that occurred in the 2008-09 fiscal year were as follows:

- 8,707 MW in Queensland in February 2009;
- 14,289 MW in New South Wales in July 2008;
- 10,494 MW in Victoria in January 2009;
- 3,314 MW in South Australia in January 2009; and
- 1,740 MW in Tasmania in July 2008.

[27] KEMA, June 2005, *Review of the Process for Preparing the SOO Load Forecasts*.

Figure 2 shows the relationship between the regional peak demand and the coincident national peak, since market start. It can be obtained from this Figure that national peak demand does not necessarily coincide with the regional peak. Increase coincidence in regional peak demands would have resulted in an increase national peak.

Figure 2: Combined peak demand and demand for each region

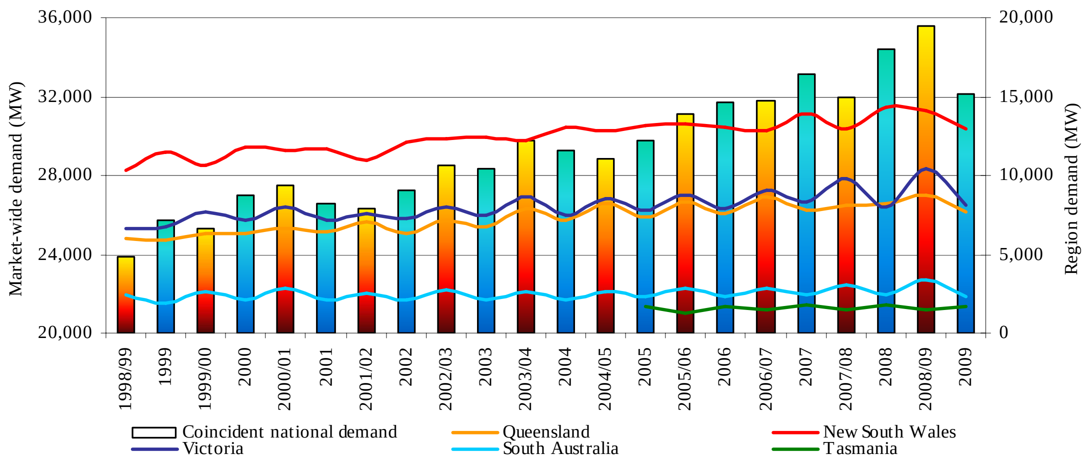
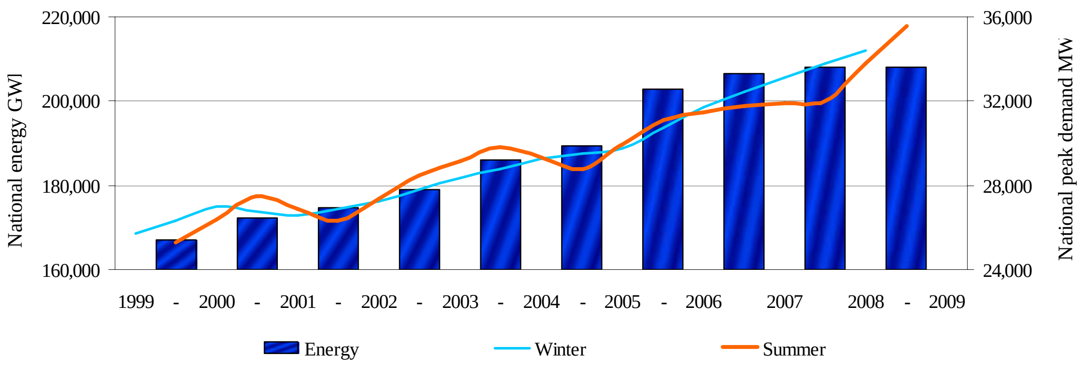


Figure 3 details the annual average growth in total demand in comparison with the national summer and winter peak demand. It can be observed from this Figure that energy demand has grown significantly since market start. The Panel notes that greater investment in generation and/or interconnector capacities may be required to meet future demand growth – especially during the summer peak – while also maintaining the reliability of the power system. It is the Panel's objective that sufficient generating capacity be available to maintain levels of USE within the 0.002% Reliability Standard.

Figure 3: National energy requirements



2.5 Medium-term PASA

Medium-term PASA is a comparison of the aggregate supply and demand balance at the time of anticipated daily peak demand, based on a 10% POE for each day over the next two years.

Medium-term PASA information is provided:

- to assist participants in planning for maintenance, production planning and load management activities over the medium term; and
- the basis for any intervention decisions by AEMO, for example invoke the RERT.

Demand forecasts are prepared by AEMO. Generation and demand-side daily availability estimates are submitted by participants under clause 3.7.2(d) of the Rules. In addition, planned network outages are submitted to AEMO by network service providers under clause 3.7.2(e) of the Rules.

The ability to forecast network capability and in particular interconnector capability is important for the reliable and efficient operation of the market. Every month, AEMO and the TNSPs publish planned network outage information for the following 13 months. AEMO also determines and publishes an assessment of the projected impact of network outages on intra and inter-regional power transfer capabilities, and provides limit equation information and plain English descriptions of the impact for all TNSPs.

Interconnector capability can be a function of the pattern of generation, availability of reactive support and certain network services.

Table 4 depicts the frequency of outages submitted by TNSPs to AEMO during the 2008-09 fiscal year.

Table 4: Transmission outages submitted to AEMO

Region	QLD	NSW[1]	VIC	SA	TAS	MurrayLink	Terranora	Total
Total outages[2]	873	1447	1225	716	346	54	50	4711
Scheduled with less than 4 days notice	33%	19%	27%	24%	21%	57%	24%	25%
Forced outages[3]	9%	6%	10%	7%	4%	44%	2%	8%

[1] The NSW TNSP arranges Snowy outages
[2] Only primary plant outages (affecting load carrying capability) are included.
[3] Outages not previously notified to AEMO, including failures and amendments by TNSPs in response to unforseen extreme conditions.

In some circumstances, outages scheduled at short notice increase overall reliability and market efficiency by taking advantage of the most recent market information; however, short notice outages can also increase uncertainty for market participants and management of reliability and power system security. Other outages have little effect on reliability.

Performance assessment

As sufficient reserve levels were generally maintained in the power system, medium-term PASA accuracy is generally satisfactory for its primary function of checking reliability at peak times well in advance of operation.

In May 2005, medium-term PASA was enhanced to share reserve deficits across regions more equitably. This means that where a reserve shortfall exists, medium-term PASA reports this in each of the affected regions and attempts to share the reserve shortfall in proportion to the demand in the regions. This functionality was used in the 2008-09 fiscal year.[28]

Medium-term PASA now has the ability to produce two sets of results: one where there are no network outages modelled and another where network outages are modelled. In November 2005, the release of the Market Management System (MMS) further improved medium-term PASA by including an assessment of network outages based on 50% POE demand forecasts, while reliability was assessed against 10% POE demand forecasts.

AEMO in consultation with the medium-term PASA Users Reference Group, continually reviews the medium-term PASA process to:

- identify and develop options to address aspects of the medium-term PASA process that need improvement; and
- ensure that documentation is thorough and adequate for user needs.

Documentation was updated for the medium-term PASA outlook graphs in September 2008, and for the medium-term PASA process in June 2009.[29]

2.6 Short-term PASA

Short-term PASA is an aggregate supply and demand balance comparison for each half-hour of the following seven days.[30]

Demand forecasts are prepared by AEMO. Generation and demand side availabilities are submitted by participants in accordance with clause 3.7.3(e) of the Rules. Transmission outage programs are supplied by TNSPs under clause 3.7.3(g) of the Rules. This information is to assist participants in optimising short-term physical and commercial planning for maintenance, production planning and load management activities.

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28 Within the *Review of Operational Arrangements for the Reliability Standard*, the Panel is currently considering the guidelines for management of electricity supply shortfall events (sometimes referred to as share the pain guidelines). www.aemc.gov.au/Market-Reviews/Open/Review-of-Operationalisation-of-the-Reliability-Standards.html.

29 ESOO reference in here

30 For further information see, www.aemo.com.au/data/stpasa.shtml.

Performance assessment

Enhancements have been made to improve consistency between the medium-term PASA and short-term PASA systems, most notably in the management of constraints and in the optimisation of the medium-term PASA. The medium-term PASA currently uses a common linear programme solver similar to that used in short-term PASA. This functionality in the PASA processes was used throughout the 2008-09 fiscal year.

2.7 Energy Adequacy Assessment Projection (EAAP)

On 26 June 2008, the AEMC made a Rule that introduced the EAAP as an information mechanism. The EAAP is a quarterly information mechanism which will provide the market with projections of the impact of generation input constraints on energy availability.

Both the AEMC and the Panel consider that the EAAP will function as an additional source of information of the market regarding when and where energy constraints may impact on energy availability. It is anticipated to also lead to an improved market response to projected shortfalls in reserve.

Under clause 3.7C(d) of the Rules, AEMO is required to publish the first EAAP by 31 March 2010.

2.8 Predispatch

Predispatch is an aggregate supply and demand balance comparison for each half-hour of the next day. It contains forecasts of market price and its sensitivity to changes in demand. Forecasts of individual scheduled generator and scheduled loads are presented to relevant participants, but not to other parties until the following day.

Demand forecasts are prepared by AEMO. Generation and demand-side availabilities are submitted by participants. The effects of transmission outages scheduled by TNSPs are also incorporated. Forecasts of reserves in each region are also published. Scheduled outages should not breach the power system security and reliability standards.

Predispatch information is used to assist participants in optimising very short-term physical and commercial planning for maintenance, production planning and load management activities in conjunction with the other information mechanisms available.

There is also a five minute predispatch process designed to enhance information on demand and supply for the subsequent hour, in particular for the operation of fast start generators.

Performance assessment

Analysis of predispatch information generally shows that when supply is tight, forecast prices are initially high until participants rebid to increase their availability. This is consistent with an appropriate market response. The forecast of high prices provides an incentive for additional capacity to be presented to the market.

Accuracy of the demand forecasts by AEMO used in predispatch is an important determinant of the accuracy of the predispatch overall.

Table 5, which was provided by the AER, summarises the number of trading intervals affected by significant variations between predispatched and actual prices during the 2008-09 fiscal year, as well as the most probable reasons for the variations.

The Table illustrates that there are a large number of trading intervals that are affected by significant variations between predispatched and actual prices. These variations are due to changing conditions, such as regional demand or generator availability, and the impact of these variations is calculated in successive pre-dispatch runs.

The Panel considers that predispatch has been working satisfactorily as an indicator of reliability and security. Its utility to the market; however, will always be affected by the accuracy of demand forecasts. The Panel notes that load forecasting is a continuing challenge. A related problem is forecasting the output of increasing quantities of intermittent generation such as wind farms.

Table 5: Trading intervals affected by price variation

Reason for price variation	Number of trading intervals affected by variations									
	QLD		NSW		VIC		SA		TAS	
Demand	1,065	54%	1,074	56%	1,517	55%	1,326	53%	2,138	37%
Availability	713	36%	681	35%	1,006	37%	954	38%	3,568	62%
Combination (e.g. combination of changes in plant availability, demand, rebidding activities)	194	10%	142	7%	201	7%	217	9%	3	0%
Other (e.g. network outages	18	1%	24	1%	25	1%	23	1%	34	1%
Trading intervals affected	1,733	10%	1,723	10%	2,478	14%	2,229	13%	5,467	31%

The number of trading interval affected for each of the reasons above (in row 2 to row 4) do not necessarily equal the total number of trading intervals affected (row 5). A number of forecasts are published for each trading interval, multiple variations, sometimes with different reasons can occur in the one trading interval.

The Snowy region price variations have been excluded. Movements in availability of Snowy generation generally impact directly on neighbouring regions.

2.9 Market notices

Market notices are *ad hoc* notifications of events that impact on the market, such as advance notice of Low Reserve Conditions, status of market systems, or price adjustments. They are electronically issued by AEMO to market participants to allow them a more informed market response.

Performance assessment

There were 4,693 market notices issued by NEMMCO during the 2008-09 fiscal year. These notices are summarised by type in Table 6.

Table 6: Market notices

Type of notice	Number of notices
Administered Price Cap	19
Constraints	2
General Notice	110
Inter-regional Transfer	964
Market Intervention	32
Market Systems	116
MDPI	20
NEM Systems	4
Non-Conformance	2,693
Power System Events	19
Price Adjustment	15
Reclassify Contingency	270
Reserve Notice	398
Settlements Residue	29
Test	2

Overall, market notices are considered to be an effective method of communicating with market participants and the wider public. The quality of the notices, and/or their timeliness has not been considered by the Panel in its assessment. .

2.10 Demand forecast

AEMO's forecasts of demand are crucial to all processes and inaccurate forecasts can contribute to less efficient market actions. Accurate forecasting is in part dependent on the quality of weather forecasts and knowledge on participant demand management activities.

Performance assessment

The medium-term PASA demand forecast is a 10% POE forecast with a daily resolution. This forecast uses the summer and winter weekday 10% POE demand forecasts consistent with the most recent ESOO and sculpts the remainder of the year by estimating seasonal and weekend fluctuations.

Table 7 summarises the percentage of days when actual demand was greater than medium-term PASA forecast demand, as well as the average amount by which actual demand exceeded forecast demand for those days. The Panel notes that the medium-term PASA forecasts for New South Wales, Victoria and South Australia improved compared with the 2007-08 forecasts.

Table 7: Medium-term PASA demand forecasts comparison

	QLD	NSW	VIC	SA	TAS
Proportion of weekdays where demand greater than 10 per cent POE forecast	0.8%	0.8%	7.4%	0.5%	6.6%
Weekdays demand deviation	17%	19%	14%	25%	11%
Weekend days where demand greater than 10 per cent POE forecast	0.3%	1.4%	4.1%	0.5%	7.1%

Table 8 shows the average short-term PASA demand forecast accuracy for two, four and six days ahead. The Panel notes that the short-term PASA demand forecast was less accurate compared to that in 2007-08, with deviations of between 0.5–1.0% compared with the previous financial year.

Table 8: Accuracy of short-term PASA demand forecasts

Short-term PASA demand forecast absolute percentage deviation	QLD	NSW	VIC	SA	TAS
2 days ahead	3.0%	3.6%	3.9%	8.3%	5.1%
4 days ahead	2.6%	3.0%	3.2%	6.8%	4.2%
6 days ahead	2.4%	2.6%	2.8%	5.6%	3.7%

Table 9 shows the average predispatch demand forecast deviation twelve hours ahead. The Panel notes that the accuracy of the predispatch demand forecast in 2008-09 was similar to that of 2007-08, with only minor deviations of 0.1% for each jurisdiction.

Table 9: Accuracy of predispatch demand forecasts

Predispatch demand forecast absolute percentage deviation	QLD	NSW	VIC	SA	TAS
12 hours ahead	1.9%	2.2%	2.4%	4.3%	3.3%

NEMMCO investigated the methods of introducing time varying scaling factors to determine half hourly 10% POE forecast demand using the 50% POE forecast demand. In respect of predispatch, AEMO has implemented time varying scaling factors for NSW, Victoria and Queensland. This enables the 10% POE and the 50% POE forecasts to converge as the time to dispatch gets closer.

The time varying scaling factors for the short-term PASA period have been derived and need to be verified before they are implemented in AEMO's market systems.

An outcome of this process would be to reduce the level of reserve shortfall for periods closer to dispatch timeframe.

Forecast performance versus demand level

Figures 4 to 8 depict the demand forecast four hours ahead for the summer period to assess whether forecast performance varies with levels of demand. Note that the horizontal axis in each graph denotes the median value of demand.

For each region there are four graphs. The first graph examines the absolute deviations for equal sized samples of demand. Demand is grouped into samples of tenth percentile, with the median values of each grouped sample shown on the horizontal axis of the graph. For each group of demand samples, the average and maximum forecast demand deviations are plotted.

The second graph shows the top 10% of actual demand in one percentage groupings.

The third graph examines raw deviations in tenth percentile groupings and plots the average raw deviation and the maximum demand forecast deviation for each grouped sample. Similarly, the fourth graph plots the raw deviations in one percentile groups for the top tenth percentile demand level. Any underlying bias (imbalance of over's and under's) in forecasting would be expected to show up here.

The graphs for each region show that forecasting is generally less reliable towards the top end of demand.

For example, in Queensland, the maximum deviation between forecast and actual demand in the top tenth percentile, ranges from 734 MW lower than forecast to 999 MW higher than forecast.

These forecast errors are large compared to those in lower demand levels. For example, the maximum deviation between forecast and actual demand in the bottom tenth percentile, ranges from 684 MW lower than forecast to 329 MW higher than forecast.

The deviation between forecast and actual demand appears to follow a similar trend within the other NEM regions.

The Panel notes that the four hour ahead demand forecasts:

- appear to be consistently biased toward under estimation for high demand periods; and
- appear to have maximum under estimates that could be difficult to cover on notice shorter than four hours.

Historical forecast performance

The short-term PASA demand forecasts as shown in Figure 9, were consistently reliable for the 2008-09 fiscal year, typically around two to four percent in each region. This was especially the case in the Queensland, and New South Wales regions. The involuntary load shedding events of January and the extreme weather events of February led to large deviations in the South Australia and Victoria regions. The Panel also notes that the demand forecasting errors in South Australia were consistently high for many months.

Wind forecast

To improve the assessment if the demand forecasts, the Panel considers it may be necessary in the future to report separately the accuracies of the underlying demand forecasts and wind generation forecasts as the penetration of wind generation increases.

Phase 1 of the Australian Wind Energy Forecasting System (AWEFS) was implemented internally in NEMMCO on 12 September 2008. NEM market participants currently receive wind generation forecasts as part of the updated MMS release implemented from November 2008. The Panel notes that Phase 2 of the AWEFS will be implemented by May 2010. The Panel considers that where appropriate, it would assess the performance of the AWEFS in future reports.

Figure 4: Queensland demand forecast deviation four hours ahead

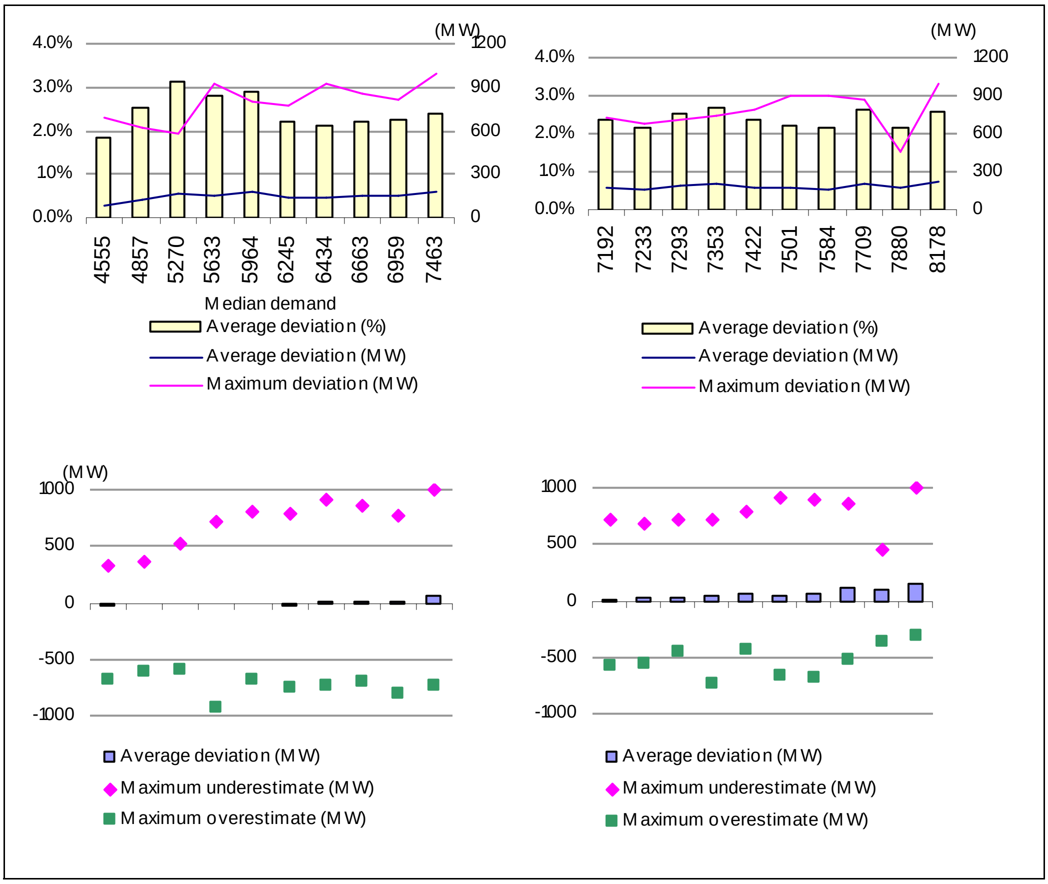


Figure 5: New South Wales demand forecast deviation four hours ahead

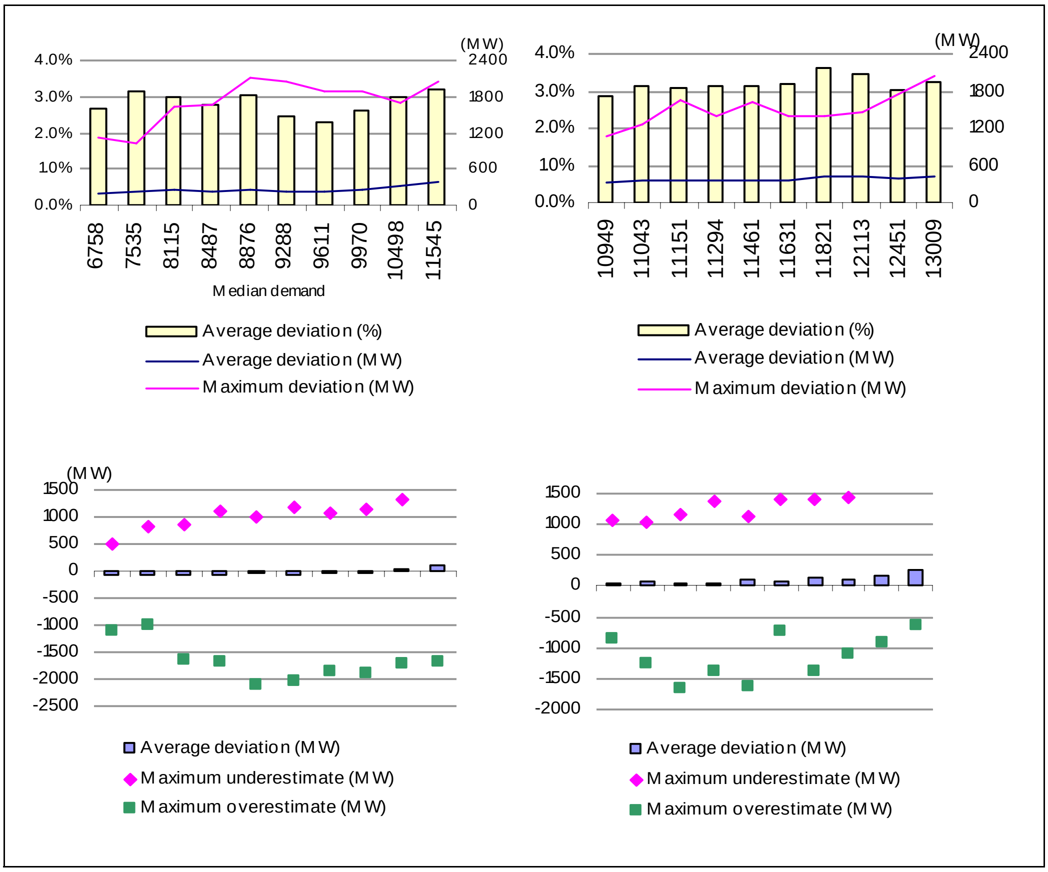


Figure 6: South Australia demand forecast deviation four hours ahead

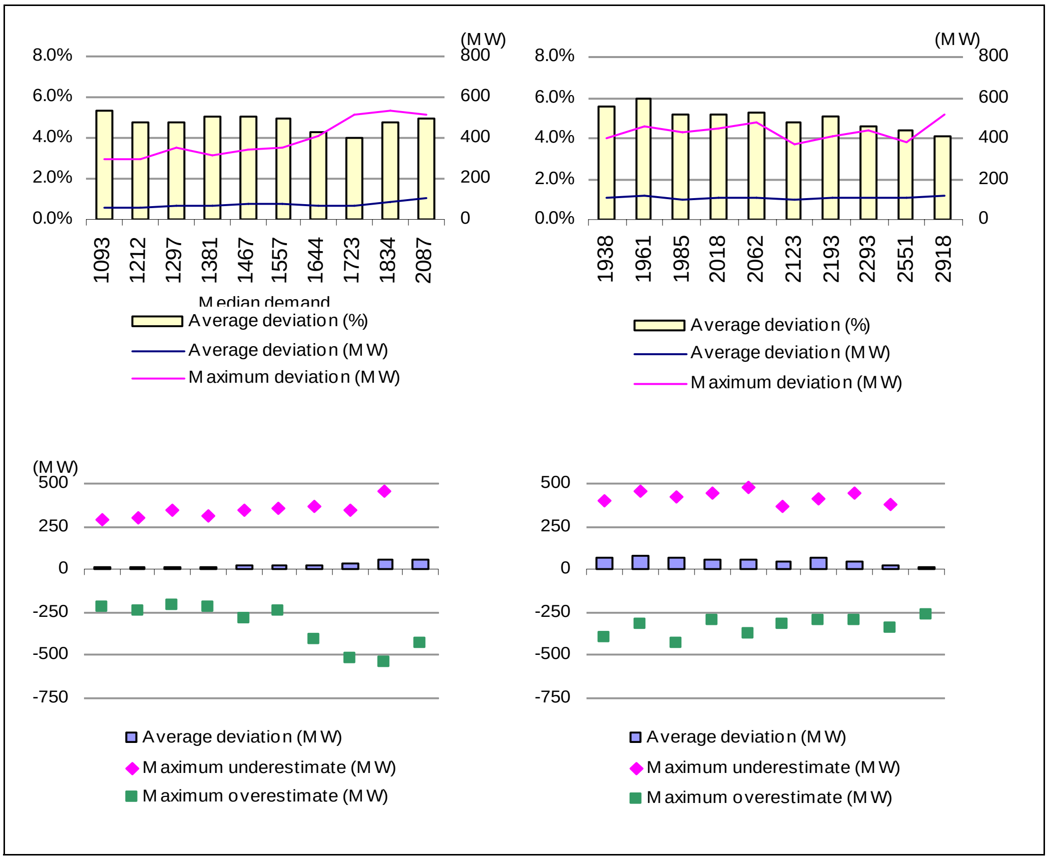


Figure 7: Victoria demand deviation forecast four hours ahead

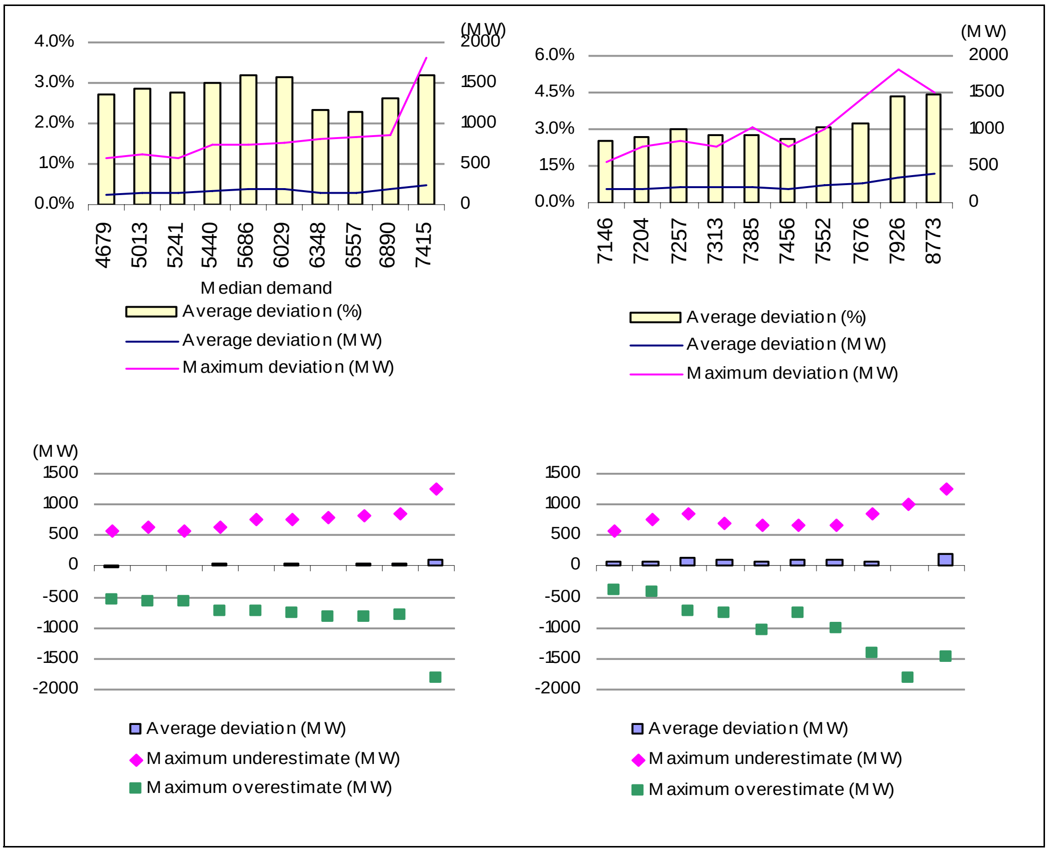


Figure 8: Tasmania demand forecast deviation four hours ahead

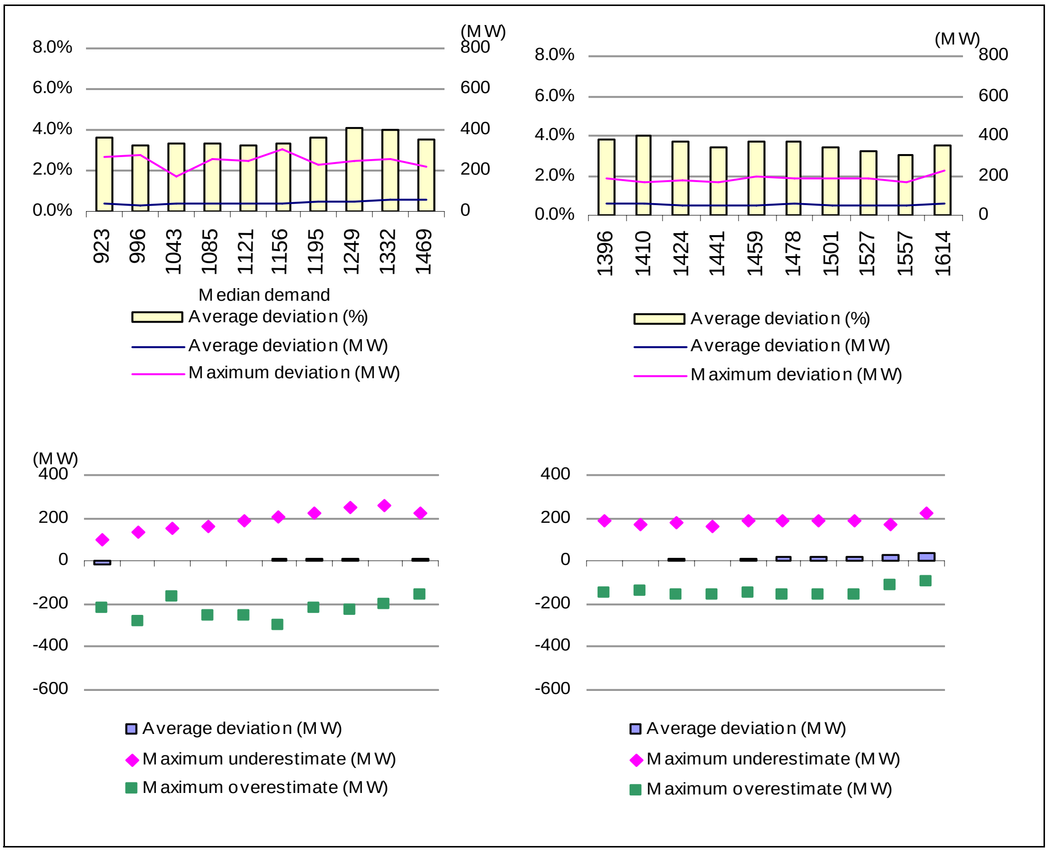
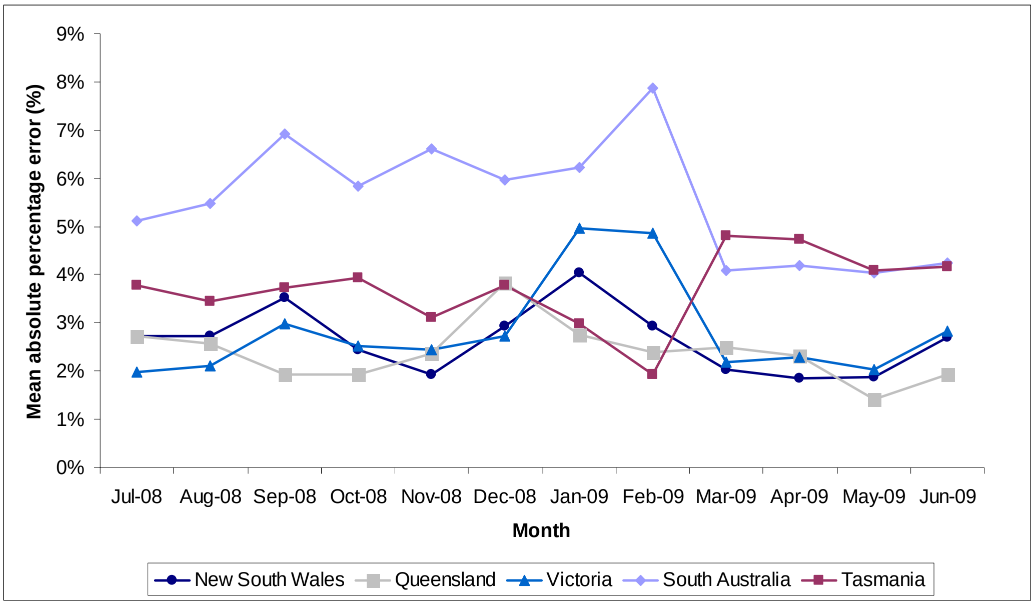


Figure 9: Mean absolute percentage error (two day ahead – short-term PASA)



2.11 Dispatch and pricing

Dispatch is the process that AEMO uses to meet demand from all or part of the bids and offers by scheduled generators and network service providers. Pricing is the process of calculating the associated market price for a dispatch interval.

Efficient short-term market prices are an important aspect of maintaining reliability. The Panel is continuing to examine the standards for power system operation to ensure they are technically and economically well suited to a market environment.

Operational reliability management is essentially complete at the time of dispatch. The design of the dispatch and pricing provisions of the Rules are fundamental to reliability outcomes in the market.

The short-term market prices are subject to a market price cap of $10,000/MWh and a market floor price -$1,000/MWh. The price cap was formerly called the Value of Lost Load (VoLL); however, with the making of National Electricity Amendment (NEM Reliability Settings: VoLL, CPT and Future Reliability Review) Rule 2009 No. 13[31], was renamed the market price cap.

In accordance with clause 3.14.2(c) of the Rules, short-term market prices are also subject to the Administered Price Cap of $300/MWh if the Cumulative Price Threshold (CPT) is exceeded. Currently, the CPT is set at $150,000.

Refer to Section 1.5 "Panel initiated reliability and security reviews" in Chapter 1 for a discussion on the changes to the reliability settings that take effect from 1 July 2010.

31 AEMC 2009, National Electricity Amendment (NEM Reliability Settings: VoLL, CPT and Future Reliability Review) Rule 2009, Final Rule Determination, 28 May 2009, Sydney

From 1 July 2010, the market price cap to apply is $12,500/MWh, market floor price is -$1,000/MWh and the CPT is to be set at $187,500.

Performance assessment

The Panel notes AEMO's efforts to continuously improve the dispatch process. The Panel considers that this is very important to ongoing improvement in the operation of the NEM in terms of power system security and reliability.

2.12 Reliability safety net

AEMO has the power to issue direction as a last resort measure, or to contract for the provision of reserves to maintain power system security and reliability.[32] While there is no distinction between the types of directions, there are different impacts on market pricing. For the purpose of this report, the Panel make the following distinction:

- Reliability directions are those that affect a whole region and therefore require intervention or 'what-if' pricing (i.e. spot prices are determined as if the direction had not occurred).
- Directions for local security issues, which do not affect pricing are covered under the topic of Security (Section 2.13 of this report).

Performance assessment

During the 2008-09 fiscal year, the Panel notes that AEMO did not exercise the RERT.

During the 2008-09 fiscal year AEMO issued two directions for reliability. On 30 January, high temperatures in South Australia and Victoria resulted in AEMO[33] declaring LOR2 and LOR3 conditions for both regions. The conditions resulted in the need for load shedding. To reduce the extent of load shedding, AEMO directed one participant in South Australia to increase their generation output to maintain the power system in a reliable state. On 31 January, AEMO issued a further direction to a participant in South Australia to increase its generation output to maintain the power system in a reliable state.

2.13 Security

This section analyses the arrangements for security and assesses the performance of the NEM against the power system security standards for the 2008-09 fiscal year.

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[32] The Panel submitted a Rule change proposal to the AEMC on 11 August 2009, proposing amendments to improve RERT flexibility and short-notice reserve contracts. For further information see: www.aemc.gov.au/Electricity/Rule-changes/Open/Improved-RERT-Flexibility-and-Short-notice-Reserve-Contracts.html.

[33] At the time of this incident, NEMMCO was the system operator.

The power system security standards for the technical operation of the power system are set by a combination of the Rules and determinations by the Panel. With few exceptions, these standards require that no consumer load should be involuntarily interrupted in order to manage power system security following a single credible contingency, for example, the unplanned shutdown of a single generating unit. The simultaneous unplanned shutdown of more than one unit is not under normal conditions termed credible (see Glossary).

Security management

Maintaining the security of the power system is one of AEMO's key objectives. The power system is deemed secure when all equipment is operating within safe loading levels and will not become unstable in the event of a single credible contingency. Secure operation depends on the combined effect of controllable plant, ancillary services, and the underlying technical characteristics of the power system plant and equipment.

AEMO determines the total technical requirements for all services needed to meet the different aspects of security from: the Panel's power system security and reliability standards; market Rule obligations; knowledge of equipment performance; design characteristics; and modelling of the dynamic behaviour of the power system. This allows AEMO to determine the safe operating limits of the power system and associated ancillary service requirements.

Some of the requirements are inherent in the frequency sensitivity of demand and generator plant, for example, the inertia of generator rotors. Others rely on the correct operation of network protection and control schemes. The rest are procured as part of the scheduling process from commercial ancillary services, the mandatory capability of generators and as a last resort load shedding arrangements. If necessary AEMO may direct participants to provide services.

There is some scope for scheduled sources to make good any deficiencies from inherent and designed sources. It is not always feasible, however to pre-test or measure every possible contribution without the test itself threatening security. Consequently, there is heavy reliance on measurements from the occasional system disturbance.

Figure 10 illustrates the overall arrangements for security. The operation of each element is explained and analysed in this section.

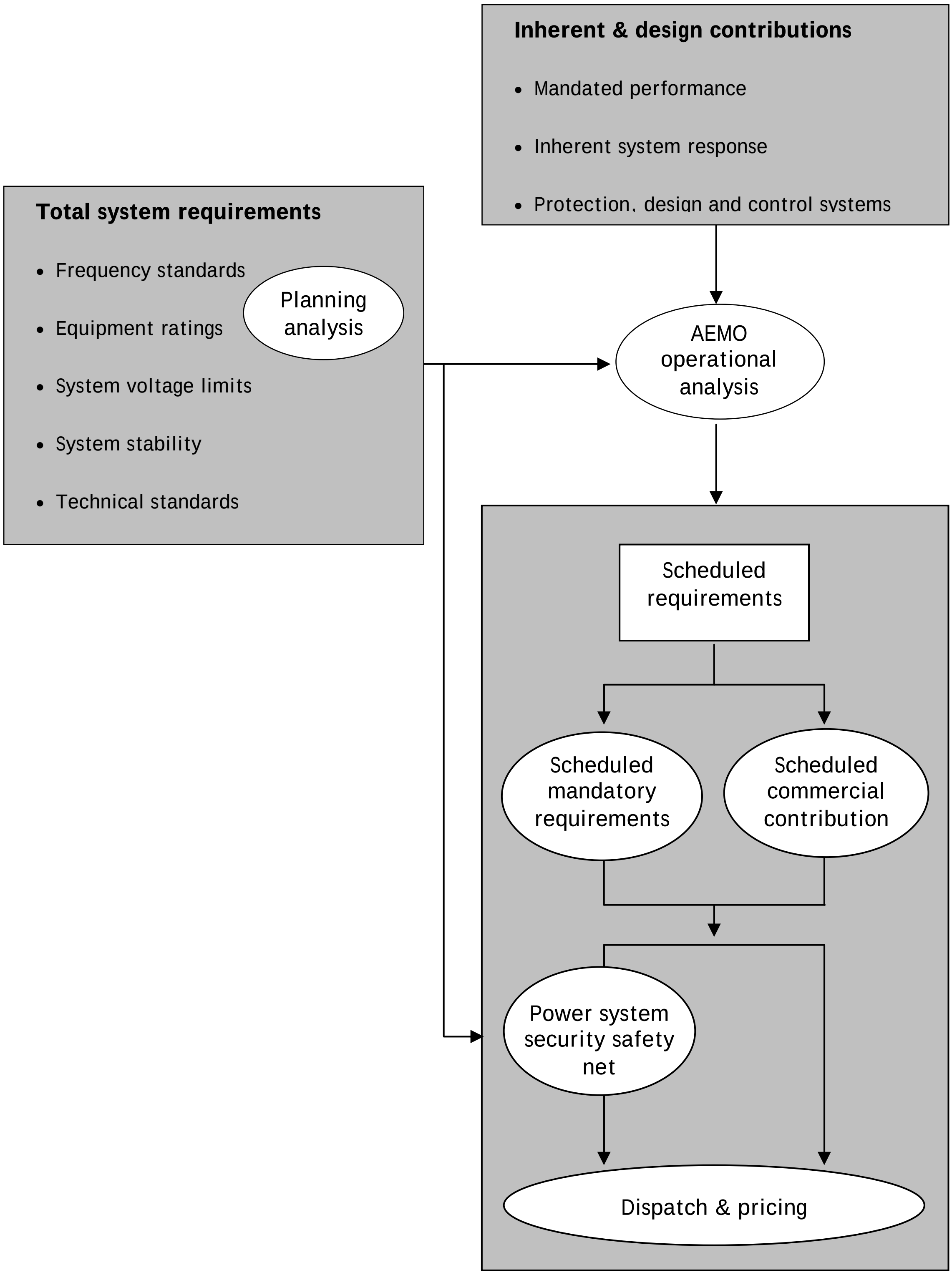
Power system models

Prior to the Rule change, National Electricity Amendment (Technical Standards for Wind Generation and Other Generator Connections) Rule 2007 No. 2 generators were required to provide models of their generating units to AEMO. AEMO used these models to assess power system security and provided these models to Registered Participants on request. However, following the making of this Rule, the access to models was restricted to AEMO and those directly affected NSPs to protect the intellectual property of the generators, in particular new technologies such as wind generators.

To remove some of the restrictions on access to modelling information, the AEMC made National Electricity Amendment (Confidentiality Arrangements in Respect of Information Required for Power System Studies) Rule 2009 No. 4 in February 2009. The final Rule specified among other things that:

- functional block diagrams, source code and other proprietary information will be encrypted to prevent its disclosure, while information required for power system studies that is not considered confidential information will be available;
- NSPs are allowed to disseminate relevant information between themselves while maintaining the confidentiality of proprietary information;
- the information must be contained in a Releasable User Guide to aid market participants in undertaking power system studies; and
- to obtain information from NEMMCO a participant must be either a Registered or Intending Participant. A Connection Applicant must also be either of these two types of participant.

Figure 10: Security model



2.14 Total system requirements

To meet the power system security standards, a number of technical requirements must be satisfied. They include the technical standards, frequency operating standards, equipment ratings, system voltage limits, system stability criteria, and generator performance standards. These requirements are addressed by AEMO as part of its planning and operational activities and are discussed below.

Technical standards framework

The technical standards framework is designed to maintain the security and integrity of the power system by establishing clearly defined standards for the performance of the system overall. The framework comprises a hierarchy of standards:

- **System standards** define the performance of the power system, the nature of the electrical network and the quality of power supplied.
- **Access standards** specify the quantified performance levels that plant (consumer, network or generator) must have in order to connect to the power system.
- **Plant standards** set out the technology specific standards that is met by particular facilities would assure compliance with the access standards.

The system standards establish the target performance of the power system overall.

The access standards define the range within which power operators may negotiate with network service providers, in consultation with AEMO, for access to the network. AEMO and the relevant network service provider need to be satisfied that the outcome of these negotiations is consistent with their achieving the overall system standards. The access standards also include minimum standards below which access to the network will not be allowed.

The system and access standards are tightly linked. For example, the access standard is designed to meet the frequency operating standards, which is a system standard. In defining the frequency operating standards consideration would need to be given to the cost of plant in meeting the required access standards.

The plant standards can be used for new or emerging technologies, such as wind power. The standard allows a class of plant to be connected to the network if that plant meets some specific standard such as an international standard. To date the Panel has not been approached to consider a plant standard.

Registered performance standards

The performance of all generating plant must be registered with AEMO as a performance standard. Registered performance standards represent binding obligations. To ensure a plant meets its registered performance standards on an ongoing basis, participants are also required to set up compliance monitoring programmes. These programmes must be lodged with AEMO. If plant does not meet its registered performance standards and compliance programme obligations, this is a breach of the Rules.

The new technical standards regime, which came into effect in late 2003, 'grandfathered' the performance of existing plant. This established a process to specify the registered standard of existing plant as the capability defined through any existing derogation, or connection agreement or the designed plant performance.

A plant's performance standard once set, does not vary unless an upgrade is required, which would need a variation in the connection agreement.

Changes to the Rules were introduced in March 2003, with effect from 16 November 2003. the period between November 2003 and November 2004 allowed for all existing generators to register their existing performance with NEMMCO. The last phase of the process is, where the obligation for a person to whom a performance standard applies, to establish a compliance regime within six months of the approval of the performance standard.

Changes to the performance standards

The AEMC has conducted a number of reviews which have resulted in some changes to the process where performance standards of a generator are registered. They include:

- Review into the enforcement of and compliance with technical standards;[34]
- Technical Standards for Wind and Other Generator Connections Rule change;[35]
- Resolution of Existing Generator Performance Standards Rule change;[36]
- Performance Standard Compliance of Generators Rule change;[37] and
- Reliability Panel Technical Standards Review.[38]

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34 AEMC 2006, *Review of enforcement of and compliance with technical standards*, Report, 1 September 2006, Sydney, www.aemc.gov.au/Market-Reviews/Completed/Review-into-the-enforcement-of-and-compliance-with-technical-standards.html.

35 AEMC 2007, National Electricity Amendment (*Technical Standards for Wind and other Generator Connections*) Rule 2007, Rule Determination, 8 March 2007, Sydney, www.aemc.gov.au/Electricity/Rule-changes/Completed/Technical-Standards-for-Wind-Generation-and-Other-Generator-Connections.html.

36 AEMC 2006, National Electricity Amendment (*Resolution of existing generator performance standards*) Rule 2006 No. 21, Rule Determination, 7 December 2006, Sydney, www.aemc.gov.au/Electricity/Rule-changes/Completed/Resolution-of-existing-generator-performance-standards.html.

37 AEMC 2008, National Electricity Amendment (*Performance Standard Compliance of Generators*) Rule 2008 No. 10, 23 October 2008, Sydney, www.aemc.gov.au/Electricity/Rule-changes/Completed/Performance-Standard-Compliance-of-Generators.html.

In addition, as a result of the making of AEMC 2008, National Electricity Amendment (*Performance Standard Compliance of Generators*) Rule 2008 No. 10, the Panel undertook and completed a review into a program for generator compliance. This culminated in the construction of a Template for Generator Compliance Programs that was published by the Panel in July 2009.[39]

Frequency operating standards

Control of power system frequency is crucial to security. To this end, the Panel determines the frequency operating standards that cover normal conditions, as well as the period following critical events when frequency may be disturbed. The frequency operating standards also specify the maximum allowable deviations between Australian Standard Time and electrical time (based on the frequency of the power system). The frequency operating standards are the basis for determining the level of quick acting response capabilities, or ancillary service requirements necessary to manage frequency. Tasmania has separate frequency operating standards to the NEM mainland.

The frequency operating standards require that during periods when there are no contingency events or load events, the frequency must be maintained with the normal operating frequency band (49.85 Hz to 50.15 Hz in both Tasmania and the NEM mainland) for no less than 99 percent of the time. The frequency operating standards also require that following a credible contingency event, the system frequency should not exceed the normal operating frequency excursion band for more than five minutes on any occasion. Following either a separation or multiple contingency event, the system frequency should not exceed the normal operating frequency excursion band for more than ten minutes.

NEM mainland frequency operating standards

The frequency operating standards that apply on the NEM mainland to any part of the power system other than an island are shown in Table 10.

38 AEMC Reliability Panel, *Reliability Panel Technical Standards Review*, Final Report, 30 April 2009, Sydney, www.aemc.gov.au/Market-Reviews/Completed/Reliability-Panel-Technical-Standards-Review.html.

39 AEMC Reliability Panel 2009, *Template for Generator Compliance Programs*, Final Report, 31 July 2009, Sydney, www.aemc.gov.au/Market-Reviews/Completed/Template-for-Generator-Compliance-Programs.html.

Table 10: NEM Mainland frequency operating standards (except "islands")

Condition	Containment	Stabilisation	Recovery
accumulated time error	5 seconds		
no contingency event or load event	49.75 to 50.25 Hz[2], 49.85 to 50.15 Hz 99% of the time [1]	49.85 to 50.15 Hz within 5 minutes	
generation event or load event	49.5 to 50.5 Hz	49.85 to 50.15 Hz within 5 minutes	
network event	49 to 51 Hz	49.5 to 50.5 Hz within 1 minute	49.85 to 50.15 Hz within 5 minutes
separation event	49 to 51 Hz	49.5 to 50.5 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
multiple contingency event	47 to 52 Hz	49.5 to 50.5 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes

[1] This is known as the *normal operating frequency band*.
[2] This is known as the normal operating frequency excursion band.

The frequency operating standards that apply on the NEM mainland to any part of the power system that is islanded are shown in Table 11.

Table 11: NEM Mainland frequency operating standards for "island" conditions

Condition	Containment	Stabilisation	Recovery
no contingency event or load event	49.5 to 50.5 Hz		
generation event, load event or network event	49 to 51 Hz	49.5 to 50.5 Hz within 5 minutes	
the separation event that formed the island	49 to 51 Hz or a wider band notified to AEMO by a relevant Jurisdictional Coordinator	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
multiple contingency event including a further separation event	47 to 52 Hz	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes

On 16 April 2009 the Panel published its final determination for the review of the mainland frequency operating standards during periods of supply scarcity. In its final determination, the Panel amended the frequency operating standards for the NEM mainland that apply in an islanded region during periods of load restoration. Table 12 outlines the minimum allowable frequency for a single generator contingency event during load restoration, following an islanding event. That is:

- 48.0 Hz for the Queensland and South Australian regions;

- 48.5 Hz for the New South Wales and Victorian regions; and
- in cases where an island incorporates more than one region, the critical frequency to be adopted is the maximum value of the critical frequencies for these regions.

Table 12: NEM Mainland frequency operating standards during supply scarcity

Condition	Containment	Stabilisation	Recovery
no contingency event or load event	49.5 to 50.5 Hz		
generation event, load event or network event **Refer to notes below for specific requirements to be satisfied prior to use of this provision**	48 to 52 Hz (Queensland and South Australia) 48.5 to 52 Hz (New South Wales and Victoria)	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
multiple contingency event or separation event	47 to 52 Hz	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes

The mainland *frequency operating standards* during *supply scarcity* apply if:

1. A situation of *supply scarcity* is current.
2. In cases where an island incorporates more than one region then the critical frequency to be adopted be the maximum value of the critical frequencies for these regions (e.g. for an island comprised of the regions of Victoria and South Australia the critical frequency would be 48.5 Hz).
3. The power system has undergone a contingency event, the frequency has reached the Recovery frequency band and AEMO considers the power system is sufficiently secure to begin load restoration.
4. The estimated amount of load available for under-frequency load shedding within the power system or the island is more than the amount required to ensure that any subsequent frequency excursions would not go below the proposed Containment and Stabilisation bands as a result of a subsequent generation event, load event, network event or a separation event during load restoration.
5. The amount of generation reserve available for frequency regulation is consistent with AEMO's current practice.

Tasmanian frequency operating standards

Although Tasmania is a part of the NEM, the Tasmanian power system is not synchronised with that of the NEM mainland. This is due to the Basslink interconnector between the two systems being an asynchronous direct current (DC) connection.

The frequency operating standards adopted in Tasmania allow for wider variations than the NEM mainland equivalents. This is due to the State's small size, predominately hydro-electric generation mix and the relatively large contingencies that can occur there. Importantly, Tasmanian customers have not experience any significant problems as a result of the wider range of frequencies. The frequency operating standards that apply in Tasmania to any part of the power system other than an island are shown in Table 13.

Table 13: Current Tasmanian frequency operating standards (except "islands")

Condition	Containment	Stabilisation	Recovery
Accumulated time error	15 seconds		
No contingency event or load event	49.75 to 50.25 Hz, 49.85 to 50.15 Hz 99% of the time	49.85 to 50.15 Hz within 5 minutes	
Load event	49.0 to 51.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Generation event	47.5 to 51.0 Hz	49.85 to 50.15 Hz within 5 minutes	
Network event	47.5 to 53.0 Hz	49.0 to 51.0 Hz within 1 minute	49.85 to 50.15 Hz within 5 minutes
Separation event	46 to 55 Hz	47.5 to 51.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	46 to 55 Hz	47.5 to 51.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes

The frequency operating standards in Table 14 apply in Tasmania to a power system that is an island or becomes islanded.

Table 14: Current Tasmanian frequency operating standards for "islanded" conditions

Condition	Containment	Stabilisation	Recovery
No contingency event, or load event	49.0 to 51.0 Hz		
Generation event or network event	47.5 to 53.0 Hz (Note)	49.0 to 51.0 Hz within 5 minutes	
Load event	47.5 to 53.0 Hz (Note)	49.0 to 51.0 Hz within 10 minutes	
The separation event that formed the island	46 to 60 Hz	47.5 to 53.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes
Multiple contingency event including a further separation event	46 to 60 Hz	47.5 to 53.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes

(Note) Where it is not feasible to schedule sufficient frequency control ancillary services to limit frequency excursions to within this range, operation of the under frequency load shedding scheme or the over frequency generator shedding scheme is acceptable on the occurrence of a further contingency event.

On 18 December 2008, the Panel submitted its final report outlining the amended frequency operating standards to apply in Tasmania to the AEMC for publication.[40] The amended frequency operating standards for Tasmania will take effect on completion of the following:

1. under frequency load shedding scheme (UFLSS); and

2. over-frequency generator shedding scheme (OFGSS); and

3. revised FCAS trapeziums and control settings for Tasmanian generating units; and

4. frequency control special protection scheme (FCSPS); and

5. Basslink frequency controller;

which must be no later than 31 December 2009, or a date agreed by the Reliability Panel in accordance with the consultation process under clause 8.8.3.

The amended frequency operating standards that apply in Tasmania to any part of the power system other than an island are outlined in Table 15.

40 AEMC 2008, *Tasmanian Frequency Operating Standard Review*, Final Report, 18 December 2008, Sydney, Appendix A. http://www.aemc.gov.au/Market-Reviews/Completed/Review-of-Frequency-Operating-Standards-for-Tasmania.html.

Table 15: Amended Tasmanian frequency operating standards (except "islands")

Condition	Containment	Stabilisation	Recovery
Accumulated time error	15 seconds		
No contingency event or load event	49.75 to 50.25 Hz, 49.85 to 50.15 Hz 99% of the time	49.85 to 50.15 Hz within 5 minutes	
Load and generation event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Network event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Separation event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes

(Note) the size of the largest single generator event is limited to 144 MW[41], which can be implemented for any *generating system* with a capacity that is greater than 144 MW by the automatic tripping of load.

The amended frequency operating standards that apply in Tasmania to any part of the power system that is islanded are outlined in Table 16.

Table 16: Amended Tasmanian frequency operating standards for "island" conditions

Condition	Containment	Stabilisation	Recovery
No contingency event, or load event	49.0 to 51.0 Hz		
Load and generation event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 minutes	
Network event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 minutes	
Separation event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes
Multiple contingency event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes

(Note) the size of the largest single generator event is limited to 144 MW[42], which can be implemented for any *generating system* with a capacity that is greater than 144 MW by the automatic tripping of load.

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41 AEMO may in accordance with clause 4.8.9 direct a Generator to exceed the 144 MW contingency limit if NEMMCO reasonably believes this would be necessary in order to maintain a reliable operating state.

42 ibid.

Performance assessment

The power system frequency was generally maintained within the limits set by the Panel. There were some instances, however, where the frequency did not meet the requirements of the frequency operating standards.

NEM mainland

Table 15 shows the number of times the frequency moved outside the normal operating band during the 2008-09 fiscal year for the NEM mainland.

The frequency moved outside the normal operating band 20 times during the 2008-09 fiscal year. This is slightly less than the 2007-08 fiscal year, where the frequency moved outside the operation band 25 times.

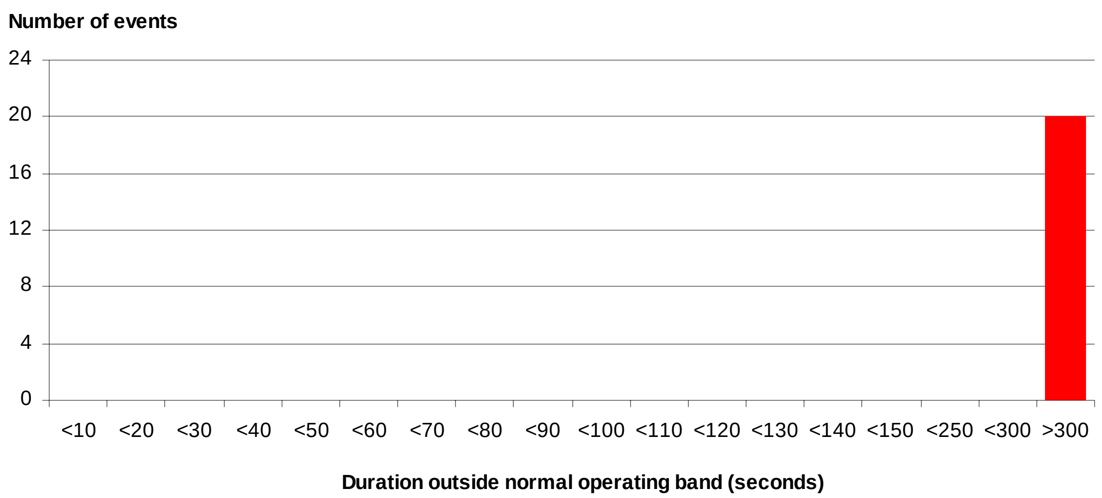
Table 15: Frequency events on the mainland, 2008-09

Frequency events - Mainland regions	Total	Low frequency	High frequency
Number of events			
outside normal operating frequency band	20	20	0
outside normal operating frequency excursion band	5	5	0
Events where duration exceeds 300 seconds[1]	20	20	0

[1] The Frequency operating standards require recovery to the normal band within 300 seconds for Generators, load and network events

Figure 12 shows that the duration of all the frequency excursion events in the 2008-09 fiscal year were longer than five minutes. This is similar to the outcome observes during the 2007-08 fiscal year.

Figure 12: Duration of frequency events on the NEM mainland



A minimum frequency of 49.71 Hz for a duration of 584 s occurred on the NEM mainland, following the trip of Kogan Creek whilst generating at 700 MW. On no occasion did the frequency on the NEM mainland exceed the upper limit of the normal operating frequency band in 2008-09.

In 2001, the Panel introduced a probabilistic frequency standard. In response to that standard, the requirement for regulation frequency control ancillary services (FCAS)[43] (raise and lower), in the mainland, which is used to manage minor fluctuations in frequency, has been progressively reduced by NEMMCO since June 2003.

In June 2006, sculpted FCAS requirements were introduced.[44]

On 17 December 2007 changes to the regulating FCAS requirements for the NEM mainland were implemented. These changes were introduced on a trial basis and use FCAS constraint equations in dispatch to determine amounts of regulation FCAS (raise and lower) based on the time error.[45]

The principle is that the FCAS dispatch constraints will set regulation to the current levels of 130 (for raise)/120 (for lower) if the time error remains inside +/- 1.5s. After that the constraints will add 60 MW of regulation per 1s deviation from that with the upper limit of 250 MW.

Changes in the raise and lower regulation frequency control ancillary services (FCAS) requirements for the NEM mainland are illustrated in Table 16.

43 Note that FCAS is not a Rules defined term. Under the Rules, these services are termed Market Ancillary Services.

44 NEMMCO Communication, 16 June 2006

45 NEMMCO Communication, 7 December 2007

Table 16: Reductions to raise and lower regulation FCAS requirement (Mainland)

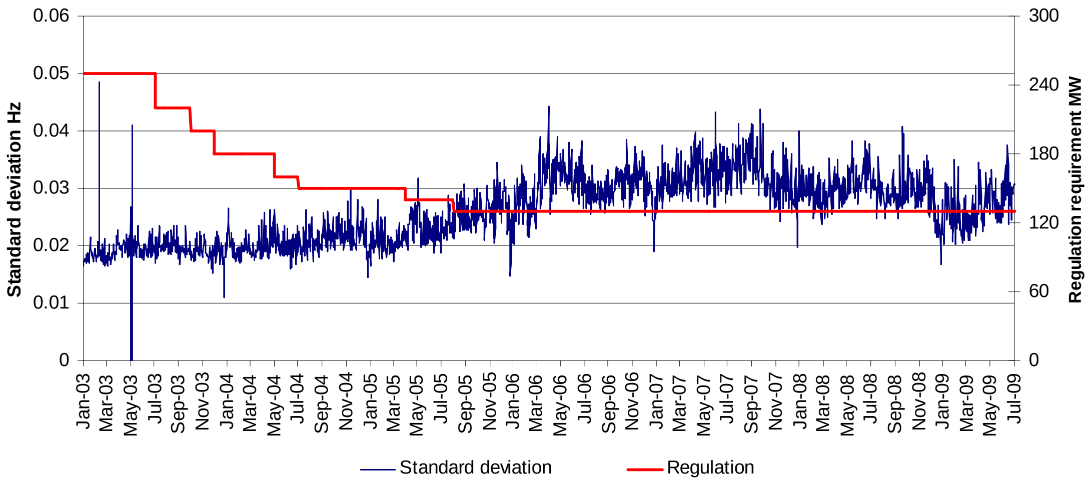
Month	Enabled regulation FCAS (MW)	
July 2003	250	
July 2003	220	
October 2003	200	
March 2004	180	
May 2004	160	
July 2004	150	
April 2005	140	
August 2005	130	
June 2006	Time sculpted FCAS raise requirement introduced on 27 June 2006	120 (Lower)
December 2007	Based on the time error	

Note: AEMO Power System Operations continue to have discretion to increase the raise regulating service requirement as needed at other times.

Figure 13 shows the distribution of the measured frequency and the requirement for regulation FCAS (raise and lower) on the NEM mainland for each day since January 2003. As the level of regulation FCAS was decreased for the NEM mainland, the standard deviation of the frequency generally increased.

AEMO develops FCAS constraint equations in dispatch to determine the required amounts of regulation FCAS (raise and lower) based on the accumulated time error. AEMO is working towards co-optimising regulation and the related contingency services.

Figure 13: Daily standard deviation of frequency and regulation FCAS enabled on the NEM mainland



Tasmania

Table 17 shows the number of times the frequency moved outside the normal frequency operating band during the 2008-09 fiscal year for Tasmania.

Table 17: Frequency events in Tasmania 2008-09

Frequency events – Tasmania	Total	Low frequency	high frequency
Number of events			
outside normal operating frequency band	5	2	3
outside normal operating frequency excursion band	5	2	3
Events where duration exceeds 300 seconds	4	4	0

There were five occasions where the frequency moved outside the normal frequency operating band. This is slightly higher than the 2007-08 fiscal year where there were two such occurrences.

The duration of four of the frequency events were longer than that stated in the frequency operating standards. These events each exceeded 300 seconds as shown in Figure 14.

A minimum frequency of 48.63 Hz occurred in Tasmania on 6 September 2008 following Basslink tripping from 380 MW while importing to Tasmania. This low frequency excursion event lasted for 300 s. A maximum frequency of 51.45 Hz occurred on 29 January 2009, as a result of high temperatures forcing Basslink to adhere to design specifications and back off to zero transfer capability. This was classified as a load event. For this load event, the duration of the excursion above the normal operating band was 2,776 s, which is a breach of the Tasmanian frequency operating standards. However, it should be noted that on 30 January 2009, while similar conditions prevailed in Tasmania and Basslink backed off to zero transfer capability, the duration of the high frequency event was 532 s, which is within the frequency operating standards.

Figure 14: Duration of frequency events in Tasmania

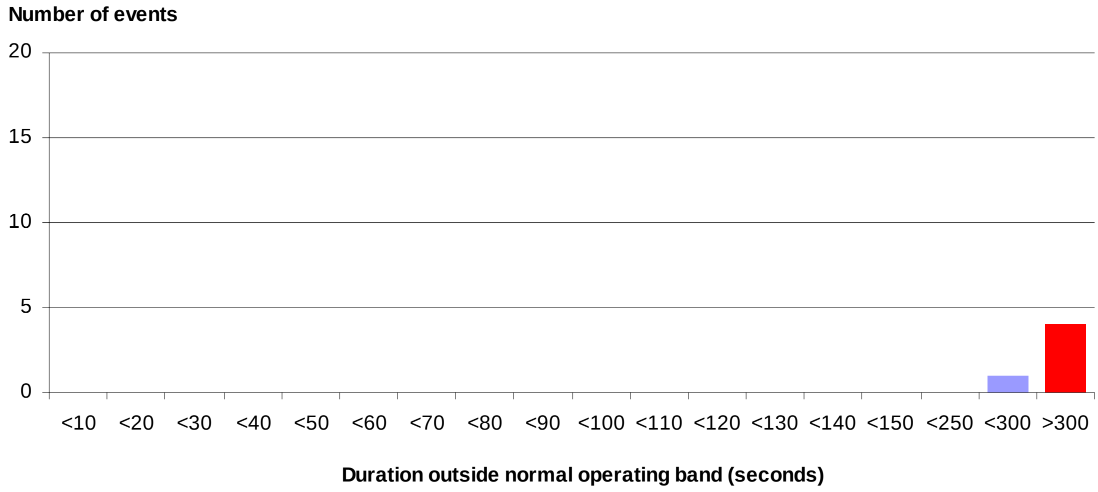
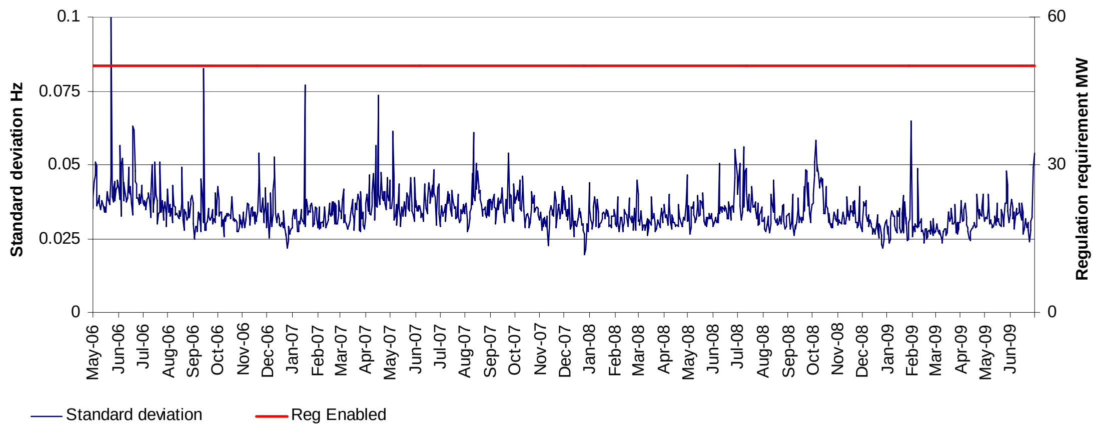


Figure 15 shows the distribution of the measured frequency and the requirement for regulation FCAS (raise and lower) for each day since 29 April 2005 for Tasmania.

Figure 15: Daily standard deviation of frequency and regulation FCAS enabled in Tasmania



Equipment ratings

Asset owners provide a statement about the envelope within which AEMO may operate individual items of plant and equipment. AEMO then allows for the occurrence of any single credible contingency event before the ratings are reached.

Performance assessment

There were five incidents where an interconnector was above its secure line rating limit. In that instance, following the separation of Victoria and NSW during the Victorian bushfires on 8th February 2009, and subsequent establishment of an interconnector that included the BATS-BETS 220 kV line, load shedding was undertaken to maintain the continuous rating of the BATS-BETS 220 kV line. – is this an example of this? Yes, for this unusual outcome.

While the power system operates in a dynamic environment, there are instances where interconnectors exceed their secure limit for small periods of time; however, this is generally corrected within a dispatch interval.

Potential overloads are reported through AEMO's online monitoring systems.

System voltage limits

This is the standard agreed between AEMO and the TNSPs for the envelope within which the transmission network voltage is maintained. AEMO has systems to monitor the performance of voltage levels against the limits advised by the TNSPs.

The Panel notes that an adequate supply of suitably located responsive reactive power (to reduce) voltage instability is vital in maintaining power system stability.

Performance assessment

AEMO advised that it was generally able to maintain voltages within advised limits throughout the 2008-09 fiscal year except during the North Queensland system black on 22 January 09, when the Ross and Chalumbin 275 kV substations exceeded their satisfactory voltage limits for 14 minutes and 4 minutes respectively.

System stability

Transferring large amounts of electricity between generators and consumers over a wide area presents technical challenges to stability of the power system. One of AEMO's core obligations is to ensure that stability of the power system is maintained. The primary means of achieving this is to carry out technical analysis of threats to stability. Under the Rules, generators and TNSPs monitor indicators of system instability and report their findings to AEMO. AEMO then analyses the data to determine whether the standards have been met. AEMO also uses this data to confirm and report on the correct operation of protection and control systems.

AEMO has a number of real time monitoring tools which help it meet its security obligations and which provide valuable feedback on the planning process. These tools include State estimator, power flow and contingency analysis software. Two additional tools have been introduced in the last couple of years, and a third tool is currently under development.

The first consists of monitoring equipment that detects oscillatory disturbances on the power system that could lead to a security threat. This equipment, set up in conjunction with Powerlink, measures small changes in the power flow on key interconnectors and analyses these changes to determine the state of the power system. A system upgrade in 2006-07 permitted a larger number of locations to be observed simultaneously and to enhance historical analysis of power system oscillatory stability.

The second key security analysis tool is the online Dynamic Security Assessment (DSA) tool. The DSA uses real time data from the AEMO energy management system to simulate the behaviour of the power system for a variety of critical network, load and generator faults. This type of analysis has traditionally been performed by off-line planning staff. The DSA tool uses actual system conditions and network configuration to automatically assess the power system. A hardware upgrade in the 2008 reduced the automatic assessment process to approximately every three to four minutes.

In addition, AEMO is also working with TNSPs to develop a NEM-wide high speed monitoring system (HSM). The HSM will compliment AEMO's oscillatory stability monitoring capability and enhance observability of power system disturbances in operational timeframes and for post contingency analysis.

Performance assessment

AEMO's reviews of significant events showed system damping times were generally within the stipulated requirements.

However, AEMO has highlighted the need to maintain adequate monitoring using high speed monitors and advanced analysis techniques to ensure that causes of poor damping can be located and addressed in a timely manner.

There were a number of occasions when these real-time monitoring tools identified the need to reduce transfer capability. On these occasions, the power system conditions at the time were used to review limits and constraints. It is important for transparency and predictability in dispatching the market, to ensure that these more restrictive limits are fed back into the processes for determining limits and the constraint equations used to manage those limits.

Some dispatch scenarios and power system configurations were not considered when system limits were originally determined. Online real time monitoring allows for these scenarios to be identified and fed back to the relevant TNSP.

2.15 Market rule standards

Many of the NEM market standards are codified definitions and procedures. For example, the definition of a credible contingency and the requirement to return the power system to a secure operating state within thirty minutes (see Glossary) are defined in chapter 4 of the Rules. Automatic protection schemes, including consumer load shedding, protect the integrity of the overall system if multiple contingency events occur within the thirty minute timeframe. These standards are similar to those used by the State utilities prior to the NEM.

Performance assessment

44 transmission related non-credible contingency events were reported by AEMO during the 2008-09 fiscal year.

Four generation related non-credible contingency events and seven combined transmission/generation events were also identified.

2.16 AEMO planning analysis

AEMO is required to determine total operational requirements for frequency, voltage and stability management and operation within equipment ratings and standards under the Rules. Constraint equations used in the market systems and AEMO's operating procedures are derived in this process.

Performance assessment

The quality of AEMO's analysis is difficult to measure directly. An indirect measure of performance is provided by the overall technical performance of the power system compared with operating standards. Analysis in other sections of this report of the technical performance of the power system – for example, frequency, system stability, and loading against equipment ratings – suggests that AEMO is generally performing this function satisfactorily.

2.17 Inherent and design contributions

A portion of the total requirements for security is derived from the inherent response of consumer demand to variation in frequency and the fundamental physical characteristics of power system equipment. The inertia of the physical mass of generators determines how susceptible the power system is to disturbances. This inherent response is taken into account when determining the requirements for services scheduled by AEMO. The components of the inherent system response and design contributions include mandated performance, system response and the performance of protection and control systems. The components are described and analysed below.

The Panel will closely watch the effects of the introduction of alternative technologies, such as wind generation, over the coming years.

Mandated performance

In many cases satisfactory performance of the power system relies on both the correct operation of individual items of participant equipment and on the coordination of their operating characteristics. The Rules require the actual response to be measured by participants and reported to AEMO. AEMO also compares the actual system and participant response to power system events with the requirements of the Rules.

Inherent system response

The inherent system response is the automatic response of plant and equipment to disturbances over which there is no direct operational control. Examples include the change in demand placed on the system by consumer load when power system frequency or voltage varies from normal, and the rate at which large generating units can change speed or alter output. Although it is not a large contributor to the overall security response, inherent response reduces the need for response from other sources such as ancillary services.

Inherent load relief[46] is determined by AEMO based on analysis of system performance during frequency disturbances. This value is them taken into account when determining the requirements for FCAS scheduled by AEMO.[47]

Performance of protection and control systems

Protection and control systems are the automatic fast acting systems such as the facilities to isolate power system faults, and emergency control systems installed to enhance network transfer capability and safeguard the power system in the event of multiple contingency events. The provision of generator protection and control systems is documented through the registration process and connection agreements. Under the Rules, the performance is recorded by the plant operator and provided to AEMO following system disturbances.

Performance assessment

AEMO has investigated and reported on power system events, including the six major events detailed in Section 1.2 of Chapter 1. Generally these investigations did not find any major problems with the protection schemes.

2.18 AEMO operational analysis

The inherent and design contributions are analysed by AEMO and compared with the total requirements to determine the requirements for scheduled contributions to ensure secure operation. The additional requirements are in the form of scheduled mandatory and commercial contributions and of necessary intervention. This analysis is performed close to dispatch.

This analysis can have a significant impact on commercial and system security outcomes. For example, AEMO's online monitoring tools may identify the need to reduce interconnector transfer capability in order to maintain security. On these occasions the power system conditions at the time are used to review limits and constraints. It is important for transparency and predictability in dispatching the market, to ensure that these more restrictive limits are fed back into the processes for determining limits and the constraint equations used to manage those limits. AEMO

46 Load relief occurs when frequency dependent loads vary in a manor that favours frequency recovery, as the amount of generator response that is required to recover the frequency is reduced.

47 An estimate of the load relief factor is taken as 1.5% per 1% of frequency change, that is, for every 0.5 Hz, the load relief is 1.5% of the demand.

therefore refers these situations to the relevant TNSP for further action and potential updating of limit advice.

2.19 Scheduling

Scheduled services are added to the inherent and design contributions to ensure the total control capability meets the overall requirement. Scheduled services include mandatory requirements and commercially acquired services. Examples of scheduled mandatory requirements include generating unit reactive power output in accordance with the performance standards, governor performance and capacitor bank switching for voltage control.

2.20 Scheduled commercial contribution

These are the commercially sourced ancillary services required to balance the total requirement. Examples include generating unit reactive power output beyond the performance standards, and frequency control ancillary services. AEMO's scheduling process is reviewed in the market auditor's reports.[48]

2.21 Power system directions

Power system directions are the power system security safety net mechanisms available to AEMO to issue directions to maintain the power system in a secure operating state. For the purposes of this report, reliability directions are those that affect a whole region and therefore require intervention of 'what if' pricing. A direction for a local security issue does not affect pricing.

AEMO issued 12 directions during the 2008-09 fiscal year to manage local security issues, Table 18 shows a comparison with past financial years.

Table 18: Number of directions issued by AEMO

	QLD	NSW	VIC	SA	TAS	Total
2008-09	3	1	5	4	0	13
2007-08	5	0	0	1	1	7
2006-07	3	0	6	1	0	10
2005-06	1	52	0	0	8	61
2004-05	8	0	0	34	0	42

Between 11 and 14 November 2008, NEMMCO instructed three registered participants in Victoria and one in New South Wales to operate in synchronous condenser mode to provide reactive power ancillary services to maintain the power system in a secure state.

48 Market audit reports are available to registered market participants.

On 22 January 2009, when there was only limited generation available in north Queensland due to the black system conditions, AEMO issued a direction to the only Registered Participant with available plant in north Queensland to generate to maintain the power system in a secure state. Similarly on 23 January, AEMO issued a direction when a constraint equation was violated to maintain the power system in a secure state.

On 30 January 2009, AEMO issued directions to generators in Victoria to restore the power system to a secure state and reduce the amount of load to be shed, AEMO issued the directions when the 30-minute period for restoring power system security had expired.

On 30 January, high temperatures in South Australia and Victoria resulted in NEMMCO declaring LOR2 and LOR3 conditions for both regions. The conditions resulted in the need for load shedding. To reduce the extent of load shedding, NEMMCO directed two participants in Victoria and one in South Australia to increase their generation output. On 31 January, NEMMCO issued a direction to a participant in South Australia to increase its unit's output to maintain the power system in a reliable state.

The remaining two directions were issued to a fast start unit in South Australia on 17 and 18 June. On these days, contingency analysis for the South Australia region indicated that the loss of the Playford to Davenport line, would cause the flow across the Cultana to Whyalla line to exceed its rating. To overcome the post contingent overload, AEMO invoked constraints to start a fast start generator. According to AEMO, when the generator received its initial dispatch targets, it bid itself unavailable on the grounds it was uneconomical to start. On receiving the unavailable bid AEMO issued a direction to the generator to synchronise and follow dispatch targets.

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3 Network performance

While the Panel is responsible for dealing with reliability and security matters in the wholesale bulk electricity market and transmission, the ultimate level of reliability and security which customers receive is also impacted by the performance of the local transmission and distribution network. Although the Panel is not involved with local supply matters, this section includes an overview of the jurisdictional arrangements for managing the reliability performance of the NEM distribution and transmission networks.

3.1 Distribution network performance

The Distribution Network Service Providers (DNSP) performance data may not be directly comparable between jurisdictions because the performance data was supplied independently by each jurisdiction. In some cases, the data reported by each jurisdiction is subject to qualification. Stakeholders should refer to the respective jurisdictional publications when interpreting the data.

Queensland

The Queensland Electricity Act 1994 and the Electricity Regulation 2006 define the arrangements for the Queensland DNSPs. The Queensland Department of Mines and Energy set the existing performance standards for the Queensland DNSPs. The minimum service standards are in Schedule 1 of the Queensland Electricity Industry Code (QEIC). The Queensland Competition Authority (QCA) has been responsible for administering the QEIC since 1 July 2007 and is required to review minimum service standards (MSS) and guaranteed service levels (GSL) to apply from the beginning of the next regulatory control period which commences on 1 July 2010. In April 2009, the QCA published its Final Decision on the Electricity Distribution Network MSS and GSL to apply in Queensland from 1 July 2010.[49] In addition, on 28 August 2009, the QCA published its Draft Decision on proposed amendments to the GSL claim procedures under the QEIC.

The QCA collects service quality data to verify that the electricity distributors meet the minimum service standards and to monitor their performance against guaranteed service levels. The QCA also reports on the network performance.

Table 19 shows a summary of the performance of the Queensland DNSPs including target and actual performance values for each DNSP.

49 Queensland Competition Authority, April 2009, *Review of Minimum Service Standards and Guaranteed Service Levels to Apply in Queensland from 1 July 2010*, www.qca.org.au/electricity/service-quality/RevMinServStandLev.php.

Table 19: Performance of the Queensland DNSPs for the 2008-09 Year

DNSP	Feeder	Target				Performance[50]	
		SAIDI		SAIFI		SAIDI	SAIFI
		2007-08	2008-09	2007-08	2008-09	2008-09	2008-09
Energex	CBD	20	20	0.33	0.33	2.868	0.053
	urban	134	122	1.54	1.45	90.540	1.040
	Short-rural	244	232	2.63	2.56	226.866	2.549
Ergon	urban	195	180	2.50	2.30	216.85	2.33
	Short-rural	550	500	5.00	4.5	608.54	4.93
	Long - rural	1,090	1,044	8.50	7.80	1107.96	7.73

Table 23 indicates that Energex outperformed against its target SAIDI and SAIFI for all feeder categories during 2008-09. Conversely, Ergon Energy underperformed against all its targets with the exception of long-rural SAIFI. In addition, while not shown in Figure 34, Ergon Energy's actual performance in 2008-09 deteriorated across all feeder categories in comparison to the previous year. Ergon Energy indicated that its reliability performance for 2008-09 was adversely impacted by the increase in planned outages and planned outage durations as a result of the suspension of live line work practices in February 2009 and an increase in failures of air break switches respectively. In addition, the extended wet season in the Ergon Energy network adversely impacted unplanned performance during the year.[51] More detailed performance information is available from network performance reports available on the QCA website.

The network performance standards are enforced at the discretion of the Queensland Department of Mines and Energy. The QCA also monitors service quality performance but there are no financial or other implications linked to performance.

New South Wales

The Electricity Supply Act 1995 covers the licensing framework for the New South Wales DNSPs. The network performance standards are implemented licence conditions imposed by the Minister.

From August 2005 the network performance standards for the New South Wales DNSPs have been set by the Minister for Energy through Ministerially imposed

50 SAIDI and SAIFI performance data for 2007-08 and 2008-09 were based on data provided by DNSPs under the Authority's Service Quality Reporting Guidelines.

51 Ergon Energy, *Electricity Distribution Quarterly Service Quality Report April - June 2009,* www.qca.org.au/electricity/service-quality/RevMinServStandLev.php

licence conditions. These licence conditions were amended on 1 December 2007 and are published on the Independent Pricing and Regulatory Tribunal's (IPART[52]) website (conditions 14-19).[53]

The performance of the New South Wales DNSPs against the performance standards is monitored by IPART by various means including:

- periodic self exception reporting;
- compliance audits;
- Energy and Water Ombudsman's complaints;
- industry complaints; and
- media reports.

Performance of a DNSP is commonly measured by the System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI) and Customer Average Interruption Duration Index (CAIDI).[54]

Table 20 and Table 21 show a summary of the performance of the New South Wales DNSPs including an overall target for each DNSP and the actual performance by feeder classification. More detailed performance information is available from network performance reports available on each of the DNSPs websites.

The DNSPs are required by the Electricity Supply (Safety and Network Management) Regulation 2002 to publish annual reports on network performance, against their Network Management Plans. IPART also produces a licence compliance report, which from 2007 includes compliance with the reliability standards.

The network performance standards are enforced under the Electricity Supply Act 1995, Schedule 2, Clauses 8 and 8A. Under clause 8 the Minister can impose fines or cancel a distribution licence if the holder of the licence has knowingly contravened the requirements of this Act or the regulations, the conditions of the licence, or an endorsement attached to the licence.

52 IPART is the independent body that oversees regulation of the water, gas, electricity and public transport industries in New South Wales.

53 The Minister For Energy and Utilities, 2005, *Design, Reliability and Performance Licence Conditions Imposed On Distribution Network Service Providers*, http://www.ipart.nsw.gov.au/

54 See the Glossary for further information.

Table 20: Performance of the NSW DNSPs for the 2008-09 Year (SAIDI)

	Country Energy		Energy Australia		Integral Energy		NSW
	Target	Actual	Target	Actual	Target	Actual	Actual
CBD Feeders	n/a	n/a	51	41.7	n/a	n/a	41.7
Urban Feeders	131	110	84	93.5	84	62	85.8
Short Rural Feeders	316	285	340	217.2	300	182	244.7
Long Rural Feeders	720	483	780	608.7	n/a	165	484.7
All Feeders	n/a	267	n/a	108.5	n/a	89.3	142.1

Table 21: Performance of the NSW DNSPs for the 2008-09 year (SAIFI)

	Country Energy		Energy Australia		Integral Energy		NSW
	Target	Actual	Target	Actual	Target	Actual	Actual
CBD Feeders	n/a	n/a	0.32	0.55	n/a	n/a	0.55
Urban Feeders	1.88	1.36	1.24	1.15	1.24	0.8	1.07
Short Rural Feeders	3.12	2.58	3.70	2.44	2.80	1.9	2.39
Long Rural Feeders	4.70	3.47	7.00	4.34	n/a	1.5	3.48
All Feeders	n/a	2.37	n/a	1.31	n/a	1.1	1.50

Australian Capital Territory

The Utilities Act underpins all of the codes and performance and compliance requirements for ACT DNSP.

The Independent Competition and Regulatory Commission (ICRC) sets the performance standards for the ACT DNSP. These standards are available in the

Electricity Distribution Supply Standards Code[55] and in the Consumer Protection Code,[56] which also has minimum service standards.

The DNSP and other licensed utilities must report annually to the ICRC on their performance and compliance with their licence obligations. The ICRC publishes the results in its compliance and performance reports.

Table 22 shows a summary of the performance of the ACT DNSP for 2008-09. More detailed performance information is available from network performance reports available on the ICRC website.

Table 22: Performance of the ACT DNSP 2008-09 fiscal year

		Feeder Category		Network
		Urban	Rural Short	
SAIDI	Overall	93.2	52.9	91.7
	Distribution network—planned	59.4	35.9	58.6
	Distribution network—unplanned	33.7	17.0	33.0
	Normalised distribution network—unplanned	30.4	17.0	29.9
SAIFI	Overall	0.88	0.446	0.87
	Distribution network—planned	0.25	0.174	0.25
	Distribution network—unplanned	0.63	0.271	0.62
	Normalised distribution network—unplanned	0.60	0.271	0.59
CAIDI	Overall	105.4	118.6	105.6
	Distribution network—planned	235.6	205.8	234.8
	Distribution network—unplanned	53.5	62.5	53.5
	Normalised distribution network—unplanned	50.6	60.0	50.8

Victoria

The Electricity Industry Act 2000 and the Essential Services Commission Act 2001 cover the network performance requirements for the Victorian DNSPs. From 1

55 IRCR, 2000, *Electricity Distribution (Supply Standards) Code*, http://www.icrc.act.gov.au/__data/assets/pdf_file/0016/16630/electricitydistributionsupplystandardscodecw.pdf

56 IRCR, 2007, *Consumer Protection Code*, http://www.icrc.act.gov.au/__data/assets/pdf_file/0011/47909/Consumer_Protection_Code.pdf

January 2009, responsibility for the compliance monitoring and enforcement of the DNSPs' distribution licence conditions was transferred from the Essential Services Commission of Victoria (ESC) to the Australian Energy Regulator (AER).[57]

The ESC sets performance targets for unplanned SAIFI, unplanned SAIDI and Momentary Average Interruption Frequency Index (MAIFI) for the 2006-10 regulatory control period for calculation of the financial incentive for improving supply reliability. Financial rewards and penalties apply to DNSPs depending on how their performance compares to their respective performance targets, in accordance with the S-factor scheme.[58] DNSPs are also required to make guaranteed service level (GSL) payments to the worst served customers if there have been excessive sustained supply outages and momentary interruptions.[59]

The performance indicators for the Victorian DNSPs are reported to the AER. The distribution licence requires independent audits of these indicators on a rotating basis. All DNSPs were last audited in mid-2009. The ESC also publishes annual comparative performance reports for the distributors.

All Victorian DNSPs were severely impacted by the 2 April 2008 storm.[60] Table 23 shows a summary of the performance of the Victorian DNSPs. This includes target and actual performance values for each DNSP in Victoria. More detailed performance information is available from network performance reports available on the AER's website. No deductions have been made here for the significant impact on performance of unusual events, including the impact of the 2 April storm, for which exclusions have been granted for the purpose of the service incentive scheme of Victoria. Figure 33a presents the same performance data but with deductions allowed under the service incentive scheme in Victoria.

57 The ESC is still responsible for regulatory framework rule making regarding DNSPs' licence conditions in Victoria.

58 Details of the S-factor scheme are available from the *Electricity Distribution Price Review 2006-10* documents, available from the ESC's website at http://www.esc.vic.gov.au/public/Energy/Regulation+and+Compliance/Decisions+and+Determinations/Electricity+Distribution+Price+Review+2006-10 .

59 Details of the guaranteed service level payments are contained in clause 6 of the *Electricity Distribution Code (EDC)*, available at http://www.esc.vic.gov.au/public/Energy/Regulation+and+Compliance/Codes+and+Guidelines/

60 Essential Services Commission, *Review findings report, Electricity Distribution Businesses' Responses to the Storm Events of 2 April 2008*

Table 23: Performance of the Victorian DNSPs for the 2008 year

		Target				Performance			
		Unplanned interruptions		Planned interruptions		Unplanned interruptions		Planned interruptions	
DNSP	Feeder	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI
Jemena	Urban	73	1.27	6	0.03	111.42	1.18	9.22	0.04
	Short rural	113	2.25	14	0.08	173.42	2.78	25.57	0.09
CitiPower	CBD	14	0.25	6	0.02	10.37	0.16	2.79	0.02
	Urban	35	0.80	10	0.03	51.70	0.61	4.64	0.02
Powercor	Urban	98	1.63	16	0.09	93.38	1.40	14.79	0.07
	Short rural	118	1.80	35	0.15	107.89	1.46	28.57	0.13
	Long rural	297	3.30	70	0.25	214.96	2.14	28.90	0.21
SP AusNet	Urban	109	1.82	16	0.09	205.95	1.38	39.35	0.14
	Short rural	185	2.73	35	0.15	365.37	2.63	74.61	0.34
	Long rural	300	4.28	70	0.30	344.35	3.65	89.97	0.46
United Energy	Urban	59	1.06	16	0.10	262.94	1.27	16.33	0.05
	Short rural	96	2.03	35	0.15	464.60	2.01	25.17	0.09

Notes:

1. Performance figures are based on National Reporting Framework format and include both Planned and Unplanned interruptions.

2. An electricity Distribution Business Comparative performance report is available from the ESC's website at www.esc.vic.gov.au/public/Energy/Regulation+and+Compliance/Performance+Reports/

The enforcement of the network performance standards is through adjustment to the DNSP's revenue, based on the unplanned SAIDI, SAIFI and MAIFI values, performance of the distribution call centres, and through payments to customers where the GSL requirements are not met.

Table 24 show the performance data for the Victorian DNSPs with the impact of a number of extreme events excluded from the service performance data.

Table 24: Performance of the Victorian DNSPs for the 2008 year – impact of excluded events removed from the service performance data

		Target				Performance			
		Unplanned interruptions		Planned interruptions		Unplanned interruptions		Planned interruptions	
DNSP	Feeder	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI
Jemena	Urban	73	1.27	6	0.03	61.88	0.89	9.22	0.04
	Short rural	113	2.25	14	0.08	97.75	1.44	25.57	0.09
CitiPower	CBD	14	0.25	6	0.02	10.35	0.16	2.79	0.02
	Urban	35	0.80	10	0.03	23.88	0.41	4.64	0.02
Powercor	Urban	98	1.63	16	0.09	79.91	1.28	14.79	0.07
	Short rural	118	1.80	35	0.15	97.08	1.33	28.57	0.13
	Long rural	297	3.30	70	0.25	194.88	1.97	28.90	0.21
SP AusNet	Urban	109	1.82	16	0.09	73.59	0.99	39.35	0.14
	Short rural	185	2.73	35	0.15	146.13	2.19	74.61	0.34
	Long rural	300	4.28	70	0.30	199.62	3.31	89.97	0.46
United Energy	Urban	59	1.06	16	0.10	61.39	0.92	16.33	0.05
	Short rural	96	2.03	35	0.15	84.8	1.56	25.17	0.09

South Australia

The DNSP supply restoration and reliability standards are established in South Australia by the Essential Services Commission (ESCOSA) through the Electricity Distribution Code and the Electricity Distribution Price Determination 2005-2010 (EDPD).

The reliability and performance standards established by ESCOSA for the DNSP, ETSA Utilities, comprise three main elements:

- **Average Standards**

  Average service standards for network reliability performance measured by frequency and duration of supply interruptions experienced by customers. Standards are based on the DNSP performance averaged across all customers connected to the network within each of seven defined regions. The standards to be met for the 2005-2010 period were determined on the basis of historical reliability performance in the period 2000-2004. Customer service standards are also established in this way. Average standards underpin the distribution prices permitted to be charged by the DNSP and are specified in the Electricity Distribution Code.

- **Incentives to improve reliability to poorly served customers**

  Service Incentive (SI) Scheme provided for in the EDPD provides a financial incentive (increased revenue) for the DNSP to improve reliability service to the worst served consumers comprising approximately 15% of the customer base. A penalty applies if performance worsens beyond established benchmarks. The SI scheme also includes telephone responsiveness, although this is focussed on all customers not solely on poorly served customers.

  The key difference between the SI scheme established for the DNSP in South Australia and those established in some other jurisdictions is that the SI scheme focuses on driving reliability performance improvements for poorly served customers, rather than for all customers.

- **GSL scheme**

  Both the average standards and the SI scheme involve an assessment of DNSP performance as experienced by a group of customers (e.g. performance averaged across customers in the defined regions, or the worst served 15% of customers). The third major component of the service standard framework for the DNSP is a GSL scheme, which involves payments for poor service by the DNSP to individual customers.

  The Electricity Distribution Code establishes GSLs in relation to a number of timeliness matters (e.g. timeliness of appointments; connections; and street light repair). It also requires the DNSP to make specified payments if the frequency of interruptions or the duration of any single interruption exceeds the thresholds set out in the Code. Payments range from, $80 for a single outage which is 12-15 hours duration to $320 for a single outage exceeding 24 hours and $80 for 9-12 interruptions per annum, to $160 for more than 15 interruptions per annum.

DNSP reliability performance is reported to ESCOSA on a quarterly basis pursuant to Electricity Guideline 1. The DNSP and other regulated entities are required to provide verification of compliance with relevant regulatory obligations and codes on an annual basis pursuant to the requirements set out in Guideline 4. ESCOSA publishes the results in annual compliance and performance reports available from its web-site.

The performance of the South Australian DNSP fir the 2007-08 fiscal year is illustrated in Table 25. For the final report, the Panel anticipates that the data for the 2008-09 fiscal year will be available for publication.

Table 25: Performance of the South Australian DNSP for the 2007-08 Year

Region	SAIDI (Minutes)			SAIFI (No of Interruptions)			CAIDI (Minutes)		
	Target	Performance	Variation	Target	Performance	Variation	Implied Target	Performance	Variation
Adelaide Business Area	25	16	-35%	0.30	0.13	-56.7%	80	125	+56%
Major Metropolitan Areas	115	109	-5%	1.40	1.23	-12.1%	82	89	+9%
Central	240	202	-16%	2.10	1.49	-29.0%	115	136	+18%
Eastern Hills/ Fleurieu Peninsula	350	252	-28%	3.30	2.39	-27.6%	105	106	+1%
Upper North & Eyre Peninsula	370	361	-3%	2.50	1.99	-20.4%	150	181	+21%
South East	330	328	-1%	2.70	2.65	-1.9%	120	124	+3%
Kangaroo Island	450	565	+26%	N/A	7.85	N/A	N/A	72	N/A
Total Network	165	150	-9%	1.70	1.45	-14.7%	97	104	+7%

Tasmania

The Tasmanian Energy Regulator sets network performance requirements through the Tasmanian Electricity Code (TEC), price determinations and regulations.

On 1 January 2008, the regulator amended the TEC to incorporate new distribution network supply reliability standards, which were developed jointly by the Office of the Tasmanian Energy Regulator, the Tasmanian Office of Energy Planning and Conservation, and Aurora Energy. These form part of the price/service package reflected in the regulator's 2007 price determination and are designed to align the reliability standards more closely to the needs of the communities served by the network. Further details on the standards are contained in chapter 8 of the TEC.[61]

The new distribution network supply reliability standards has two parts:

- minimum network performance requirements specified in the TEC for each of five community categories: Critical Infrastructure, High Density Commercial, Urban and Regional Centres, Higher Density Rural and Lower Density Rural; and

61 Office of the Tasmanian Economic Regulator, 2005, *Tasmanian Electricity Code*, http://www.energyregulator.tas.gov.au

- a guaranteed GSL supported by the TEC and relevant guidelines.[62]

For 2007-08, the Tasmanian DNSP has continued to report against the former supply reliability standards for the purposes of the 2003 price determination and for year-on-year comparison.

Table 26: Performance of the Tasmanian DNSP 1 July 2008 to 30 June 2009 (against the former supply reliability standards)

Feeder	Performance		
	CAIDI	SAIDI	SAIFI
CBD	105	22	0.21
Urban	140	464	3.32
Rural	115	152	1.32
System	133	220	1.65

Table 26 shows a summary of the performance of the Tasmanian DNSP against the former supply reliability standards. Similarly, Table 27 shows the new network performance standards against the amended TEC.

Table 27: Performance of the Tasmanian DNSP 1 July 2008 to 30 June 2009 (against the amended TEC)

Community Category	Performance against the amended TEC			
	SAIDI	TEC (12 month Category Limit)	SAIFI	TEC (12 month Category Limit)
Critical Infrastructure	60	30	0.21	0.20
High Density Commercial	69	60	0.62	1.00
Urban and Regional Centres	199	120	1.42	2.00
Higher Density Rural	563	480	3.44	4.00
Lower Density Rural	687	600	3.97	6.00

The following Table 28 shows the performance indices for each individual community in the Tasmanian region..

62 Office of the Tasmanian Economic Regulator, 2007, *Guideline - Guaranteed Service Level (GSL) Scheme*, http://www.energyregulator.tas.gov.au

Table 28: Individual community performance indices (1 July 08 to 30 June 09)

Community category	Average number of interruptions		Average minutes off supply		Total no of communities below the limit for either frequency or duration	Total no of communities below the limit in both frequency and duration
	TEC Community limit	Number of non-complying communities	TEC Community limit (mins)	Number of non-complying communities		
Critical Infrastructure	0.2	1/1	30	1/1	1/1	1/1
High Density Commercial	2.0	1/8	120	2/8	3/8	0/8
Urban and Regional Centres	4.0	3/32	240	12/32	12/32	3/32
Higher Density Rural	6.0	5/33	600	11/33	11/33	5/33
Lower Density Rural	8.0	3/27	720	11/27	11/27	3/27
		13/101		37/101	38/101	12/101

3.2 Transmission network

This section includes an overview of the jurisdictional arrangements for managing the reliability performance of the NEM transmission networks.

New South Wales

TransGrid is obliged to meet the requirements of Schedule 5.1 of the Rules. TransGrid's planning obligations are also interlinked with the distribution licence obligations imposed on all DNSPs in NSW. These licence obligations are generally N-1 in most urban and rural areas with a higher standard of N-2 in CBD areas.

In addition to meeting requirements imposed by the Rules, connection agreements, environmental legislation and other statutory instruments, TransGrid must meet the statutory obligations contained in the New South Wales Electricity Supply (Safety and Management) Regulation 2008 . This includes lodging and then complying with a Network Management Plan with the NSW Department of Water and Energy. TransGrid issued an updated Network Management Plan in February 2009. The plan is required to be reviewed every two years.

Under this plan, TransGrid's planning and development of its transmission network is required to be on an "N-1" basis, except under conditions such as radial supplies, inner metropolitan areas, and the CBD. Transmission network developments servicing inner metropolitan and CBD areas are planned on a modified "N-2" basis or, when required, to accommodate AEMO's operating practices.

Victoria

Prior to the establishment of AEMO on 1 July 2009, VENCorp published Annual Planning Reports (VAPR). The reports provided forecasts for energy demand and supply, and identified future development needs for the shared electricity transmission network.

Consequently, from 1 July 2009 AEMO became responsible for planning the shared transmission network in Victoria. It undertakes its responsibility in accordance with Victorian legislation, Licence obligations, the Rules and the Victorian Electricity System Code.

AEMO assesses new augmentations under the market benefits limb of the AER's Regulatory Test, which considers both the benefits and costs of alternative options. AEMO calculates the market benefits of options using a probabilistic planning process that explicitly values the risk of involuntary load curtailment or the value of customer reliability (VCR), associated with transmission constraints. The VCR as at 2009 is set at $ 55,000. AEMO also considers a sector specific VCR where the transmission constraint affects only a reasonably distinguishable subset of the Victorian load.

Queensland

The mandated reliability obligations and standards are contained in Schedule 5.1 of the Rules, the Queensland Electricity Act, the transmission authority, and in Connection Agreements with the distribution networks. In addition, the AER sets and administers reliability-based service standards targets which involve an annual financial incentive (bonus/penalty).

Consistent with the Rules, its transmission authority requirements and Connection Agreements with ENERGEX, Ergon Energy and Country Energy, Powerlink plans future network augmentations so that the reliability and power quality standards of Schedule 5.1 of the Rules can be met during the worst single credible fault or contingency (N-1 conditions) unless otherwise agreed with affected participants. This is based on satisfying the following obligations:

- to ensure as far as technically and economically practicable that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid (Electricity Act 1994, S34(2));

- the transmission entity must plan and develop its transmission grid in accordance with good electricity industry practice such that … the power transfer available through the power system will be adequate to supply the forecast peak demand during the most critical single network element outage (Transmission Authority No T01/98, S6.2(c)); and

- the Connection Agreements between Powerlink and ENERGEX, Ergon Energy and Country Energy include obligations regarding the reliability of supply as required under schedule 5.1.2 of the Rules. Capacity is required to be provided such that forecast peak demand can be supplied with the most critical element out of service, i.e. N-1. Following the EDSD report in 2004, ENERGEX and Ergon are required to plan their subtransmission networks (which interact with the Powerlink transmission network) to the N-1 criterion.

South Australia

In addition to the reliability performance obligations set out in Schedule 5.1 of the Rules, ElectraNet is also subject to the Electricity Transmission Code (ETC) administered by ESCOSA.[63] The ETC sets specific reliability standards (N, N-1, N-2 etc.) for each transmission exit point.

ESCOSA concluded a review of the definitions of specific reliability under clause 2.2.2 of the ETC in 2006. The associated changes to the ETC took effect from 1 July 2008 to align with the AER's current price determination for ElectraNet.[64] As part of the review, ESCOSA sought to clarify network reliability standards for the Adelaide CBD, which is supplied jointly by ElectraNet and ETSA Utilities, and ElectraNet will be required to install a new transmission connection point to the CBD by the end of 2011. This will ensure that future CBD demand growth can be met with a greater level of reliability. ElectraNet has developed a proposed solution to meet this requirement which satisfies the requirements of the Regulatory Test[65], and is proceeding to complete this augmentation within the required timeframe.

Tasmania

In addition to the network performance requirements located in schedule 5.1 of the National Electricity Rules (Rules), Transend is obliged to meet the requirements of its transmission licence, *ESI (Network Performance Requirements) Regulations 2007,* and the terms of its connection agreements. The Connection Agreements between Transend and its customers include obligations regarding the reliability of supply as required under chapter 5 of the Rules.

The objective of the *ESI (Network Performance Requirements) Regulations 2007* is to specify the minimum network performance requirements that a planned power system of a TNSP must meet in order to satisfy the reliability limb of the regulatory test in the Rules. Transend is required by the terms of its licence to plan and procure all transmission augmentations to meet these network performance requirements.

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63 ESCOSA, 2008, *Electricity Transmission Code*, http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ElecTransCodeET05.pdf.

64 ESCOSA, 2006, *Review Of The Reliability Standards Specified In Clause 2.2.2 Of The Electricity Transmission Code Final Decision*, http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ReviewReliabilityElectricityTransmissionCodeFinalDec.pdf.

65 ElectraNet Pty Ltd, 10 July 2009, *Proposed New Large Network Asset, Adelaide Central Region, South Australia: Final Report*, http://www.aemo.com.au/consultations/0179-0009.html

The AER's service target performance incentive scheme (STPIS) sets and administers reliability based service standards targets which involve an annual financial incentive (bonus/penalty) incorporated in Transend's 2009 – 2014 revenue determination. The STPIS covers all prescribed transmission services except where transmission customers have agreed to varying levels of connection services under their connection agreements.

3.3 Transmission reliability standards review

On 13 April 2007, the Council of Australian Governments (COAG) asked the MCE to request he AEMC to develop a detailed implementation plan for the national transmission planning function.[66] COAG also asked the MCE to request the AEMC to review the jurisdictional transmission reliability standards and develop a consistent national framework. The final report of the Energy Reform Implementation Group (ERIG) recommended that the review should be undertaken by the Panel.

The AEMC has therefore requested the Panel to undertake a review of the jurisdictional transmission reliability standards with a view to developing a consistent national framework for network security and reliability.

On 1 September 2008, the Panel provided its final report, "Towards a Nationally Consistent Framework for Transmission Reliability Standards" to the AEMC. This report provides the Panel's final recommendations for delivering a nationally consistent framework for transmission reliability standards.

The AEMC considered the Panel's recommendations, in the context of its recently completed report on the National Transmission Planner and the revised Regulatory Investment Test for Transmission (RIT-T, contained in the report published on 22 July 2008)[67] and provided its final advise to the MCE on 30 September 2008.

The RIT-T Rule change National Electricity Amendment (Regulatory Investment Test for Transmission) Rule 2009 No. 15 was completed and published by the AEMC on 25 June 2009 and the Rules commenced on 1 July 2009.[68]

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66 Ministerial Council on Energy, *13th Meeting Communiqué*, 25 May 2007. www.ret.gov.au/Documents/mce/about/meetingcomms.html.

67 AEMC 2008, *National Transmission Planning Arrangements*, Final Report to the MCE, 30 June 2008, Sydney. www.aemc.gov.au/Market-Reviews/Completed/National-Transmission-Planner.html.

68 National Electricity Amendment (*Regulatory Investment Test for Transmission*) Rule 2009 No. 15, www.aemc.gov.au/Electricity/Rule-changes/Completed/Regulatory-Investment-Test-for-Transmission.html.

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4 Glossary[69]

AEMC	The Australian Energy Market Commission, which is established under section 5 of the Australian Energy Market Commission Establishment Act 2004 (SA).
AEMO	Australian Energy Market Operator
AER	The Australian Energy Regulator, which is established by section 44AE of the Trade Practices Act 1974 (Cth).
ANTS	Annual National Transmission Statement produced by NEMMCO
available capacity	The total MW capacity available for dispatch by a scheduled generating unit or scheduled load (i.e. maximum plant availability) or, in relation to a specified price band, the MW capacity within that price band available for dispatch (i.e. availability at each price band).
AWEFS	Australian Wind Energy Forecasting System
CAIDI	Customer Average Interruption Duration Index (CAIDI). The sum of the duration of each sustained customer interruption (in minutes) divided by the total number of sustained customer interruptions (SAIDI divided by SAIFI). CAIDI excludes momentary interruptions (one minute or less duration).
cascading outage	The occurrence of a succession of outages, each of which is initiated by conditions (e.g. instability or overloading) arising or made worse as a result of the event preceding it.
Code	see *National Electricity Code*
contingency events	These are events that affect the power system's operation, such as the failure or removal from operational service of a generating unit or transmission element. There are several categories of contingency event, as described below. **credible contingency event** A contingency event whose occurrence is considered "reasonably possible" in the circumstances. For example: the unexpected disconnection or unplanned reduction in capacity of one operating generating unit; or the unexpected disconnection of one major item of transmission plant.

69 These definitions have been provided to assist the reader of this report and should not be relied upon as the legal definition of the term. Formal definitions of some of these terms can be found in the glossary of the National Electricity Rules. Some of these definitions have been sourced with permission from AEMO's Electricity Statement of Opportunities.

	non-credible contingency event A contingency event whose occurrence is *not* considered "reasonably possible" in the circumstances. Typically a non-credible contingency event involves simultaneous multiple disruptions, such as the failure of several generating units at the same time.
CPT	Cumulative Price Threshold
COAG	Council of Australian Governments
CRR	Comprehensive Reliability Review
demand-side management (DSM)	The planning, implementation and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand.
demand-side participation (DSP)	The situation where consumers reduce their electricity consumption in response to a change in market conditions, such as the spot price.
directions	These are instructions NEMMCO issues to participants under clause 4.8.9 of the Rules to take action to maintain or re-establish the power system to a secure operating state, a satisfactory operating state, or a reliable operating state.
dispatch	The act of initiating or enabling all or part of the response specified in a dispatch bid, dispatch offer or market ancillary service offer in respect of a scheduled generating unit, a scheduled load, a scheduled network service, an ancillary service generating unit or an ancillary service load in accordance with clause 3.8 (NER), or a direction or operation of capacity the subject of a reserve contract as appropriate.
distribution network	The apparatus, equipment, plant and buildings (including the connection assets) used to convey and control the conveyance of electricity to consumers from the network and which is not a transmission network.
DNSP	Distribution network service provider
DSM	see *demand-side management*
DSP	see *demand-side participation*
EAAP	Energy Adequacy Assessment Projection
ERIG	Energy Reform Implementation Group
ESCOSA	Essential Services Commission (SA)
ETC	Electricity Transmission Code administered by ESCOSA
FCAS	see *frequency control ancillary services*

frequency control ancillary services	Those ancillary services concerned with balancing, over short intervals, the power supplied by generators with the power consumed by loads (throughout the power system). Imbalances cause the frequency to deviate from 50 Hz.
GSL	Guaranteed service level
ICRC	Independent Competition and Regulatory Commission (ACT)
interconnector	A transmission line or group of transmission lines that connect the transmission networks in adjacent regions.
interconnector flow	The quantity of electricity (in MW) being transmitted by an interconnector.
IRPC	Inter-Regional Planning Committee
jurisdictional planning body	The transmission network service provider responsible for planning a NEM jurisdiction's transmission network.
lack of reserve (LOR)	This is when reserves are below specified reporting levels.
load	A connection point (or defined set of connection points) at which electrical power is delivered, or the amount of electrical power delivered at a defined instant at a connection point (or aggregated over a defined set of connection points).
load event	In the context of frequency control ancillary services, a load event: involves a disconnection or a sudden reduction in the amount of power consumed at a connection point and results in an overall excess of supply.
load shedding	Reducing or disconnecting load from the power system either by automatic control systems or under instructions from NEMMCO. Load shedding will cause interruptions to some energy consumers' supplies.
LOR	see *lack of reserve*
low reserve condition (LRC)	This is when reserves are below the minimum reserve level.
LRC	see *low reserve condition*
MAIFI	Momentary Average Interruption Frequency Index (MAIFI). The total number of customer interruptions of one minute or less duration, divided by the total number of distribution customers.
medium-term Projected Assessment of System Adequacy (medium-term PASA)	A comprehensive programme of information collection, analysis and disclosure of medium-term power system reliability prospects. This assessment covers a period of 24 months and: enables market participants to make decisions concerning supply, demand and outages must be issued weekly by NEMMCO.

minimum reserve level	The minimum reserve margin calculated by NEMMCO to meet the Reliability Standard.
Ministerial Council on Energy (MCE)	The MCE is the national policy and governance body for the Australian energy market, including for electricity and gas, as outlined in the COAG Australian Energy Market Agreement (AEMA) of 30 June 2004.
MMS	Market Management System
MSS	Minimum Service Standards
multiple contingency event	see *contingency events*
MURG	MT PASA User Reference Group
National Electricity Code	The National Electricity Code was replaced by the National Electricity Rules on 1 July 2005.
National Electricity Market (NEM)	The National Electricity Market is a wholesale exchange for the supply of electricity to retailers and consumers. It commenced on 13 December 1998, and now includes Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia, and Tasmania.
National Electricity Market Management Company (NEMMCO)	The National Electricity Market Management Company established in 1996 to: • administer and manage the NEM in accordance with the National Electricity Rules • develop the market and improve its efficiency • coordinate power system planning. On the 1 July 2009 NEMMCO was replaced by AEMO. AEMO has amalgamated the roles of six separate organisations that formerly operated the Australian electricity and gas markets (NEMMCO, VENCorp, ESIPC, REMCO, GMC and GMRO).
National Electricity Law (NEL)	The NEL is contained in a Schedule to the National Electricity (South Australia) Act 1996. The NEL is applied as law in each participating jurisdiction of the NEM by the application statutes.
National Electricity Rules (NER)	The National Electricity Rules came into effect on 1 July 2005, replacing the National Electricity Code.
national electricity system	The generating systems, transmission and distribution networks and other facilities owned, controlled or operated in the states and territories participating in the National Electricity Market.
NCAS	see *network control ancillary services*
NEM	see *National Electricity Market*

NEMMCO	see *National Electricity Market Management Company*
NECA	National Electricity Code Administrator
NER	see *National Electricity Rules*
NTNDP	National Transmission Network Development Plan
network	The apparatus, equipment and buildings used to convey and control the conveyance of electricity. This applies to both transmission networks and distribution networks.
network capability	The capability of a network or part of a network to transfer electricity from one location to another.
network control ancillary services (NCAS)	Ancillary services concerned with maintaining and extending the operational efficiency and capability of the network within secure operating limits.
network event	In the context of frequency control ancillary services, the tripping of a network resulting in a generation event or load event.
network flow	The quantity of electricity (in MW) being transmitted by a network.
network service providers	A person who operates as either a transmission network service provider (TNSP) or a distribution network service provider (DNSP).
Network services	The services (provided by a TNSP or DNSP) associated with conveying electricity and which also include entry, exit, and use-of-system services.
NTP	National Transmission Planner
operating state	The operating state of the power system is defined as *satisfactory*, *secure* or *reliable*, as described below. **satisfactory operating state** The power system is in a satisfactory operating state when: • it is operating within its technical limits (i.e. frequency, voltage, current etc. are within the relevant standards and ratings) *and* • the severity of any potential fault is within the capability of circuit breakers to disconnect the faulted circuit or equipment. **secure operating state** The power system is in a secure operating state when: • it is in a satisfactory operating state *and* • it will return to a satisfactory operating state following a single credible contingency event. **reliable operating state**

	The power system is in a reliable operating state when: • NEMMCO has not disconnected, and does not expect to disconnect, any points of load connection under clause 4.8.9 (NER) • no load shedding is occurring or expected to occur anywhere on the power system under clause 4.8.9 (NER) *and* • in NEMMCO's reasonable opinion the levels of short term and medium term capacity reserves available to the power system are at least equal to the required levels determined in accordance with the power system security and reliability standards.
participant	An entity that participates in the National Electricity Market.
PASA	see *medium-term Projected Assessment of System Adequacy* and *short-term Projected Assessment of System Adequacy*
plant capability	The maximum MW output which an item of electrical equipment is capable of achieving for a given period.
Probability of Exceedance (POE)	PoE relates to the weather/temperature dependence of the maximum demand in a region. A detailed description is given in the NEMMCO SOO.
power system	The National Electricity Market's entire electricity infrastructure (including associated generation, transmission, and distribution networks) for the supply of electricity, operated as an integrated arrangement.
QCA	Queensland Competition Authority
QEIC	Queensland Electricity Industry Code
regions	The National Electricity Market's electricity regions currently include Queensland, New South Wales, Victoria, Snowy, South Australia, Australian Capital Territory.
reliability (power system)	The measure of the power system's ability to supply adequate power to satisfy demand, allowing for unplanned losses of generation capacity.
reliability of supply	The likelihood of having sufficient capacity (generation or demand-side response) to meet demand (the consumer load).
Reliability Standard	The Panel's current standard for reliability is that there should be sufficient generation and bulk transmission capacity so that, over the long term, no more than 0.002% of the annual energy of consumers in any region is at risk of not being supplied, or to put it another way, so that the maximum permissible unserved energy (USE) is 0.002%.
RERT	Reliability and Emergency Reserve Trader
reserve	The amount of supply (including available generation capability, demand-side participation and interconnector capability) in excess of the demand

	forecast for a particular period.
reserve margin	The difference between reserve and the projected demand for electricity, where: • Reserve margin = (generation capability + interconnection reserve sharing) – peak demand + demand-side participation.
reserve trader	The role adopted by NEMMCO to contract for additional reserves, where: • reserves are forecast to fall below a minimum reserve margin • a market response appears unlikely.
Rules	see *National Electricity Rules*
SAIDI	System Average Interruption Duration Index (SAIDI). The sum of the duration of each sustained customer interruption (in minutes), divided by the total number of distribution customers. SAIDI excludes momentary interruptions (one minute or less duration).
SAIFI	System Average Interruption Frequency Index (SAIFI). The total number of sustained customer interruptions, divided by the total number of distribution customers. SAIFI excludes momentary interruptions (one minute or less duration).
SCADA demand	The sum of the: • SCADA measurement of the scheduled generation (measured at the generator terminals) in a region *plus* • the net measured interconnector flow into a region (measured at the region boundary).
scheduled load	A market load which has been classified by NEMMCO as a scheduled load at the market customer's request. A market customer may submit dispatch bids in relation to scheduled loads.
security (power system)	The safe scheduling, operation and control of the power system on a continuous basis.
separation event	In the context of frequency control ancillary services, this describes the electrical separation of one or more NEM regions from the others, thereby preventing frequency control ancillary services being transferred from one region to another.
short-term Projected Assessment of System Adequacy (short-term PASA)	The PASA in respect of the period from two days after the current trading day to the end of the seventh day after the current trading day inclusive in respect of each trading interval in that period.
SOO	Statement of Opportunity produced by NEMMCO
spot market	Wholesale trading in electricity is conducted as a spot market. The spot

	market allows instantaneous matching of supply against demand. The spot market trades from an electricity pool, and is effectively a set of rules and procedures (not a physical location) managed by NEMMCO (in conjunction with market participants and regulatory agencies) that are set out in the Rules.
spot price	The price for electricity in a trading interval at a regional reference node or a connection point.
supply-demand balance	A calculation of the reserve margin for a given set of demand conditions, which is used to minimise reserve deficits by making use of available interconnector capabilities.
TEC	Tasmanian Electricity Code
technical envelope	The power system's technical boundary limits for achieving and maintaining a secure operating state for a given demand and power system scenario.
transmission network service provider (TNSP)	A person who owns, operates and/or controls the high-voltage transmission assets that transport electricity between generators and distribution networks.
transmission networks	The high-voltage transmission assets that transport electricity between generators and distribution networks. Transmission networks do not include connection assets, which form part of a transmission system.
transmission system	The combination of a transmission network and connection assets, which is connected to other transmission systems or a distribution system.
TRNPP	Tasmanian Reliability and Network Planning Panel
TNSP	see *transmission network service provider*
unserved energy (USE)	The amount of energy that cannot be supplied because there are insufficient supplies (generation) to meet demand.
Value of Lost Load (VoLL)	A value set by the Reliability Panel, and assessed as the value of lost electrical consumption. The current spot price, price cap is set at $10 000 per MWh.
VCR	Value of customer reliability

AEMC	The Australian Energy Market Commission, which is established under section 5 of the Australian Energy Market Commission Establishment Act 2004 (SA).
AEMO	Australian Energy Market Operator
AER	The Australian Energy Regulator, which is established by section 44AE of the Trade Practices Act 1974 (Cth).
ANTS	Annual National Transmission Statement produced by NEMMCO
available capacity	The total MW capacity available for dispatch by a scheduled generating unit or scheduled load (i.e. maximum plant availability) or, in relation to a specified price band, the MW capacity within that price band available for dispatch (i.e. availability at each price band).
AWEFS	Australian Wind Energy Forecasting System
CAIDI	Customer Average Interruption Duration Index (CAIDI). The sum of the duration of each sustained customer interruption (in minutes) divided by the total number of sustained customer interruptions (SAIDI divided by SAIFI). CAIDI excludes momentary interruptions (one minute or less duration).
cascading outage	The occurrence of a succession of outages, each of which is initiated by conditions (e.g. instability or overloading) arising or made worse as a result of the event preceding it.
Code	see *National Electricity Code*
contingency events	These are events that affect the power system's operation, such as the failure or removal from operational service of a generating unit or transmission element. There are several categories of contingency event, as described below. **credible contingency event** A contingency event whose occurrence is considered "reasonably possible" in the circumstances. For example: the unexpected disconnection or unplanned reduction in capacity of one operating generating unit; or the unexpected disconnection of one major item of transmission plant. **non-credible contingency event** A contingency event whose occurrence is *not* considered "reasonably possible" in the circumstances. Typically a non-credible contingency event involves simultaneous multiple disruptions, such as the failure of several generating units at the same time.
CPT	Cumulative Price Threshold
COAG	Council of Australian Governments

CRR	Comprehensive Reliability Review
demand-side management (DSM)	The planning, implementation and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand.
demand-side participation (DSP)	The situation where consumers reduce their electricity consumption in response to a change in market conditions, such as the spot price.
directions	These are instructions NEMMCO issues to participants under clause 4.8.9 of the Rules to take action to maintain or re-establish the power system to a secure operating state, a satisfactory operating state, or a reliable operating state.
dispatch	The act of initiating or enabling all or part of the response specified in a dispatch bid, dispatch offer or market ancillary service offer in respect of a scheduled generating unit, a scheduled load, a scheduled network service, an ancillary service generating unit or an ancillary service load in accordance with clause 3.8 (NER), or a direction or operation of capacity the subject of a reserve contract as appropriate.
distribution network	The apparatus, equipment, plant and buildings (including the connection assets) used to convey and control the conveyance of electricity to consumers from the network and which is not a transmission network.
DNSP	Distribution network service provider
DSM	see *demand-side management*
DSP	see *demand-side participation*
EAAP	Energy Adequacy Assessment Projection
ERIG	Energy Reform Implementation Group
ESCOSA	Essential Services Commission (SA)
ETC	Electricity Transmission Code administered by ESCOSA
FCAS	see *frequency control ancillary services*
frequency control ancillary services	Those ancillary services concerned with balancing, over short intervals, the power supplied by generators with the power consumed by loads (throughout the power system). Imbalances cause the frequency to deviate from 50 Hz.
GSL	Guaranteed service level
ICRC	Independent Competition and Regulatory Commission (ACT)

interconnector	A transmission line or group of transmission lines that connect the transmission networks in adjacent regions.
interconnector flow	The quantity of electricity (in MW) being transmitted by an interconnector.
IRPC	Inter-Regional Planning Committee
jurisdictional planning body	The transmission network service provider responsible for planning a NEM jurisdiction's transmission network.
lack of reserve (LOR)	This is when reserves are below specified reporting levels.
load	A connection point (or defined set of connection points) at which electrical power is delivered, or the amount of electrical power delivered at a defined instant at a connection point (or aggregated over a defined set of connection points).
load event	In the context of frequency control ancillary services, a load event: involves a disconnection or a sudden reduction in the amount of power consumed at a connection point and results in an overall excess of supply.
load shedding	Reducing or disconnecting load from the power system either by automatic control systems or under instructions from NEMMCO. Load shedding will cause interruptions to some energy consumers' supplies.
LOR	see *lack of reserve*
low reserve condition (LRC)	This is when reserves are below the minimum reserve level.
LRC	see *low reserve condition*
MAIFI	Momentary Average Interruption Frequency Index (MAIFI). The total number of customer interruptions of one minute or less duration, divided by the total number of distribution customers.
medium-term Projected Assessment of System Adequacy (medium-term PASA)	A comprehensive programme of information collection, analysis and disclosure of medium-term power system reliability prospects. This assessment covers a period of 24 months and: enables market participants to make decisions concerning supply, demand and outages must be issued weekly by NEMMCO.
minimum reserve level	The minimum reserve margin calculated by NEMMCO to meet the Reliability Standard.
Ministerial Council on Energy (MCE)	The MCE is the national policy and governance body for the Australian energy market, including for electricity and gas, as outlined in the COAG Australian Energy Market Agreement (AEMA) of 30 June 2004.
MMS	Market Management System

MSS	Minimum Service Standards
multiple contingency event	see *contingency events*
MURG	MT PASA User Reference Group
National Electricity Code	The National Electricity Code was replaced by the National Electricity Rules on 1 July 2005.
National Electricity Market (NEM)	The National Electricity Market is a wholesale exchange for the supply of electricity to retailers and consumers. It commenced on 13 December 1998, and now includes Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia, and Tasmania.
National Electricity Market Management Company (NEMMCO)	The National Electricity Market Management Company established in 1996 to: • administer and manage the NEM in accordance with the National Electricity Rules • develop the market and improve its efficiency • coordinate power system planning.
National Electricity Law (NEL)	The NEL is contained in a Schedule to the National Electricity (South Australia) Act 1996. The NEL is applied as law in each participating jurisdiction of the NEM by the application statutes.
National Electricity Rules (NER)	The National Electricity Rules came into effect on 1 July 2005, replacing the National Electricity Code.
national electricity system	The generating systems, transmission and distribution networks and other facilities owned, controlled or operated in the states and territories participating in the National Electricity Market.
NCAS	see *network control ancillary services*
NEM	see *National Electricity Market*
NEMMCO	see *National Electricity Market Management Company*
NECA	National Electricity Code Administrator
NER	see *National Electricity Rules*
NTNDP	National Transmission Network Development Plan
network	The apparatus, equipment and buildings used to convey and control the conveyance of electricity. This applies to both transmission networks and distribution networks.
network capability	The capability of a network or part of a network to transfer electricity from one location to another.

network control ancillary services (NCAS)	Ancillary services concerned with maintaining and extending the operational efficiency and capability of the network within secure operating limits.
network event	In the context of frequency control ancillary services, the tripping of a network resulting in a generation event or load event.
network flow	The quantity of electricity (in MW) being transmitted by a network.
network service providers	A person who operates as either a transmission network service provider (TNSP) or a distribution network service provider (DNSP).
Network services	The services (provided by a TNSP or DNSP) associated with conveying electricity and which also include entry, exit, and use-of-system services.
NTP	National Transmission Planner
operating state	The operating state of the power system is defined as *satisfactory*, *secure* or *reliable*, as described below. **satisfactory operating state** The power system is in a satisfactory operating state when: • it is operating within its technical limits (i.e. frequency, voltage, current etc. are within the relevant standards and ratings) *and* • the severity of any potential fault is within the capability of circuit breakers to disconnect the faulted circuit or equipment. **secure operating state** The power system is in a secure operating state when: • it is in a satisfactory operating state *and* • it will return to a satisfactory operating state following a single credible contingency event. **reliable operating state** The power system is in a reliable operating state when: • NEMMCO has not disconnected, and does not expect to disconnect, any points of load connection under clause 4.8.9 (NER) • no load shedding is occurring or expected to occur anywhere on the power system under clause 4.8.9 (NER) *and* • in NEMMCO's reasonable opinion the levels of short term and medium term capacity reserves available to the power system are at least equal to the required levels determined in accordance with the power system security and reliability standards.
participant	An entity that participates in the National Electricity Market.
PASA	see *medium-term Projected Assessment of System Adequacy* and *short-*

	term Projected Assessment of System Adequacy
plant capability	The maximum MW output which an item of electrical equipment is capable of achieving for a given period.
Probability of Exceedance (POE)	PoE relates to the weather/temperature dependence of the maximum demand in a region. A detailed description is given in the NEMMCO SOO.
power system	The National Electricity Market's entire electricity infrastructure (including associated generation, transmission, and distribution networks) for the supply of electricity, operated as an integrated arrangement.
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reliability of supply	The likelihood of having sufficient capacity (generation or demand-side response) to meet demand (the consumer load).
Reliability Standard	The Panel's current standard for reliability is that there should be sufficient generation and bulk transmission capacity so that, over the long term, no more than 0.002% of the annual energy of consumers in any region is at risk of not being supplied, or to put it another way, so that the maximum permissible unserved energy (USE) is 0.002%.
RERT	Reliability and Emergency Reserve Trader
reserve	The amount of supply (including available generation capability, demand-side participation and interconnector capability) in excess of the demand forecast for a particular period.
reserve margin	The difference between reserve and the projected demand for electricity, where: • Reserve margin = (generation capability + interconnection reserve sharing) – peak demand + demand-side participation.
reserve trader	The role adopted by NEMMCO to contract for additional reserves, where: • reserves are forecast to fall below a minimum reserve margin • a market response appears unlikely.
Rules	see *National Electricity Rules*
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	duration of each sustained customer interruption (in minutes), divided by the total number of distribution customers. SAIDI excludes momentary interruptions (one minute or less duration).
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SCADA demand	The sum of the: • SCADA measurement of the scheduled generation (measured at the generator terminals) in a region *plus* • the net measured interconnector flow into a region (measured at the region boundary).
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separation event	In the context of frequency control ancillary services, this describes the electrical separation of one or more NEM regions from the others, thereby preventing frequency control ancillary services being transferred from one region to another.
short-term Projected Assessment of System Adequacy (short-term PASA)	The PASA in respect of the period from two days after the current trading day to the end of the seventh day after the current trading day inclusive in respect of each trading interval in that period.
SOO	Statement of Opportunity produced by NEMMCO
spot market	Wholesale trading in electricity is conducted as a spot market. The spot market allows instantaneous matching of supply against demand. The spot market trades from an electricity pool, and is effectively a set of rules and procedures (not a physical location) managed by NEMMCO (in conjunction with market participants and regulatory agencies) that are set out in the Rules.
spot price	The price for electricity in a trading interval at a regional reference node or a connection point.
supply-demand balance	A calculation of the reserve margin for a given set of demand conditions, which is used to minimise reserve deficits by making use of available interconnector capabilities.
TEC	Tasmanian Electricity Code

technical envelope	The power system's technical boundary limits for achieving and maintaining a secure operating state for a given demand and power system scenario.
transmission network service provider (TNSP)	A person who owns, operates and/or controls the high-voltage transmission assets that transport electricity between generators and distribution networks.
transmission networks	The high-voltage transmission assets that transport electricity between generators and distribution networks. Transmission networks do not include connection assets, which form part of a transmission system.
transmission system	The combination of a transmission network and connection assets, which is connected to other transmission systems or a distribution system.
TRNPP	Tasmanian Reliability and Network Planning Panel
TNSP	see *transmission network service provider*
unserved energy (USE)	The amount of energy that cannot be supplied because there are insufficient supplies (generation) to meet demand.
Value of Lost Load (VoLL)	A value set by the Reliability Panel, and assessed as the value of lost electrical consumption. The current spot price, price cap is set at $10 000 per MWh.
VCR	Value of customer reliability