Australian Energy Market Commission

AEMC Reliability Panel

Annual Electricity Market Performance Review 2008

Draft Report

October 2008

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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. It is a statutory authority. Our 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 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

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.

In this report, the Reliability Panel (Panel) of the Australian Energy Market Commission (AEMC) reviews the performance of the interconnected national electricity system over the 2007-08 year in terms of reliability and security. The Panel includes people involved in electricity generation, transmission, distribution and retailing, as well as consumer representatives and the electricity system operator. The report has been prepared and published in accordance with the Panel's obligations under clause 8.8.3 of the National Electricity Rules (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 2007-08 year.

Ian C Woodward
Chair, Reliability Panel
Commissioner, Australian Energy Market Commission

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What 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.

Some of customers' interruptions to supply occur 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 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.

How to use this report

- Read the three-page **Executive summary** for a brief outline of the purpose and scope of this performance review and for a summary of the Panel's main findings.
- Read **Year in review** for a discussion of the main events and activities that affected the national electricity system's performance in 2007-08 and for the Panel's analysis and recommendations.
- Read the **Technical performance assessment** for comprehensive statistical data on the system's reliability and security performance over the year and for an in-depth discussion of the mechanisms used to measure that performance.
- Read the **Network performance** section for an overview of the arrangements for managing the reliability of NEM distribution and transmission networks.
- If you are new to the subject matter of this report, please refer to the **Glossary** at the back for explanations of key terms and concepts.

Background

National Electricity Market

The NEM is a wholesale exchange for electricity in the participating states and territories of Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia, and Tasmania. Its development was part of the broad energy reforms undertaken over the last decade. The NEM commenced operation on 13 December 1998.

Regulatory framework

In 2003, the Ministerial Council on Energy (MCE) decided to establish a new regulatory framework for Australia's energy market. It agreed to 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, which is specified in section 7 of the National Electricity Law (NEL), 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 is 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 under clause 8.8.1(a) of the Rules. Some of them are:

- reviewing and determining the power system security and reliability standards;
- determining and maintaining guidelines governing the exercise of NEMMCO's power to issue power system directions;
- determining and maintaining guidelines and policies governing the exercise of NEMMCO'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 NEMMCO;
- 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 NEMMCO 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. Section 4 of this report contains a list of the current Panel Members.

This Report contains information which was relevant from the period 1 July 2007 to 30 June 2008.

Executive summary

This report reviews the performance of the national electricity system in terms of reliability and security over the 2007-08 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.

The final report will be produced following a public consultation process in accordance with the requirements under clause 8.8.3 of the Rules. As part of the consultation process, the Panel publishes and seeks consultation on this draft report. Submissions on this draft report close on 14 November 2008.

This draft report will be presented in the NEM Forum on 30 October 2008. In accordance with the requirements under clause 8.8.3(f) of the Rules, interested parties will have an opportunity to comment on this draft report during the forum.

Performance 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, 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% (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 Panel to report on them. 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.

Year in review: Summary

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

Reliability

- There was no USE due to reliability issues in 2007-08. However, the Panel notes that there were times where the capacity fell below the minimum reserve standard.
- Since market started in December 1998, averages for USE due to shortfalls in available capacity indicate that New South Wales and Queensland remain within the Reliability Standard. Conversely, South Australia and Victoria fell outside the Standard in the year 2000, when there was a coincidence of industrial action, high demand and temporary unavailability of generating units in Victoria. In terms of the long term averages, Victoria remains outside the Standard due to that single event. In every year since 2000, South Australia and Victoria have met the Reliability Standard.
- Tasmania joined the NEM in May 2005. Since then, there has been no breach of the reliability standard in the region.
- Over 2007-08, an additional 1,410 MW of generating capacity (scheduled and non-scheduled) was registered to be brought into service.
- The rate of growth of the summer maximum demand is 3.6% in Queensland, 2.3% in New South Wales, 1.8% in Victoria, 1.6% in South Australia and 2.3% in Tasmania.[2]
- While the reliability of the NEM to date has been satisfactory, the Panel indicated in its Comprehensive Reliability Review (CRR) that there appears to be risks on the horizon that may impact the NEM achieving the reliability standard in the future if the amount of investment in new generation required to meet expected demand is either delayed in timing or does not occur. Therefore, the Panel is preparing a Rule change proposal to increase the Value of Lost Load (VoLL) in order to provide the market with a larger price signal for new capacity investment. This Rule change proposal is discussed in further detail in section 1.5 of this report.
- In May 2007, NEMMCO published a report on the impact of the current drought on system reliability for Q2 2007 to Q1 2009.[3] NEMMCO subsequently published a series of updates to this report. The lastest update was published in September 2008, covering the study period from 1 August 2008 to 31 July 2010. This report advised that, under the low rainfall scenario, the NEM would exceed its reliability standard of 0.002% during the 2009-2010 year in South Australia and Victoria.
- On 26 June 2008, the AEMC made a Rule which introduced the Energy Adequacy Assessment Projection (EAAP) and Reliability and Emergency Reserve Trader (RERT) in the NEM. This Rule was proposed by the Panel as part of the CRR recommendations.

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[2] "2008 Energy and Maximum Demand Projection", available on the NEMMCO website at www.nemmco.com.au.

[3] Drought Scenarios Investigation report is available in NEMMCO's website NEMMCO's website http://www.nemmco.com.au/about/drought.html

Security

- Three major incidents involving multiple contingency events are discussed in this report. The Panel notes that NEMMCO have taken the appropriate actions to maintain the reliability and security of the power system; however, the contingency reclassification process needs to be more transparent and consistently applied.
- The three incidents did not result in disruptions to customer loads. However, the Panel noted that the other incidents during the 2007-08 year resulted in some localised interruptions.
- There were no major instances where a transmission network element exceeded its ratings.
- Several frequency deviations occurred over the year and in some instances the frequencies were not restored sufficiently quickly so as to meet the frequency standard.
- Voltage was generally maintained within advised limits.
- System damping times for significant events were generally within requirements.

Conclusions

The Panel noted that the process for contingency reclassification needs to be more transparent, consistently applied and rigorous, and considers that the recent Rule change "Reclassification of Contingency Events"[4] is likely to be crucial in achieving this outcome.

Although the Reliability Standard was not breached, there has been some amount of USE due to security events during the year. The Panel continues to be concerned that these events are having an impact on the continuity of consumer supply, and that from a consumer perspective their impact is not clearly distinguishable from that of the reported reliability events, particularly as they occur at the bulk supply level.

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

Notwithstanding the issues raised following specific incidents, the reliability and security performance of the power system during the 2007-08 year appear to have been generally robust.

[4] AEMC, 2008, *Reclassification of Contingency Events*, http://www.aemc.gov.au/electricity.php?r=20080407.133712

1 Year in review – Reliability and Security

This part of the report discusses and makes recommendations concerning the most significant incidents and issues that affected the performance of the national electricity system in 2007-08.

The section reviews the performance of the power system under the following headings:

- scope of the performance review: reliability and security;
- the major power system incidents;
- other security issues; and
- discussion: what can the Panel learn?

Since the 1999-2000 summer, peak scheduled demand on the mainland has grown by 5,370 MW or 21.2%, with annual growth averaging around 2.6%. Over the same time, summer aggregate scheduled generation capacity on the mainland has risen by more than 4,500 MW, with additional increases from smaller and unscheduled plant.[5]

In terms of new capacity and changes to existing capacity in 2007-08, the Panel notes that:

- a total of 1,410 MW of new plant (scheduled and non-scheduled) has been registered to be brought into service; and
- a number of minor changes have been made to the registered ratings of existing plant.

For technical information about the power system's performance in 2007-08, see Section 2 of this report, *Technical performance assessment*.

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 consumers. 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 the consumer's premises.

[5] Scheduled generating plant participates in the central dispatch process operated by NEMMCO. Non-Scheduled generating plant is not subject to central dispatch.

The Panel's 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, the maximum permissible USE is 0.002%.

In applying this standard, the Panel does not take account of USE that is caused by local transmission or distribution network 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 an overview of the transmission and distribution network reliability in the NEM in Section 3 of this report.

The Panel also does not consider in its reliability measurements any USE that is the result of non-credible (or multiple) contingency events as the 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 is currently reviewing available statistical information to identify whether there have been patterns in non-credible contingency events.

The Panel revised and clarified the NEM Reliability Standard as part of its CRR. The final CRR report was published in December 2007, and contains the Panel's revised Reliability Standard in Appendix D.

To regulate the performance of power system security, the Panel has determined the frequency operating standards for the mainland[6] and for Tasmania. The Panel is also reviewing the frequency operating standards for Tasmania. This will be discussed in greater detail in Section 2.14.

1.2 Major power system incidents

This section describes and offers comments on the three major power system incidents that occurred during the year:

- New South Wales and Queensland, 28 February 2008
- New South Wales, 24 October 2007
- Queensland, 28 January 2008

[6] The mainland frequency standards were determined by the Panel in September 2001 and are available on the NECA website at www.neca.com.au.

In accordance with clause 4.8.15 of the Rules, NEMMCO has investigated all three incidents and in each case published a report[7] on its findings.

These events did not result in a breach of the Reliability Standard.

New South Wales and Queensland, 28 February 2008

A non-credible contingency event led to separation of New South Wales and Queensland.

On the 28 February 2008 at 05:43 hrs, disconnector 8E3 at the Armidale 330 kV substation failed, causing a phase to earth fault. This resulted in the tripping of the 330kV bus section 5 and the Armidale – Tamworth 330 kV (85) line, Armidale - Dumaresq 330 kV (8E) line, No. 6 transformer as well as off-loading Armidale - Coffs Harbour 330 kV (87) line. The Directlink opened at Mullumbimby at the same time. No load was interrupted.

Approximately 16 seconds after the initial fault, Armidale - Dumaresq (8C) 330 kV line tripped separating Queensland transmission network from the rest of the power system.

Comments

The Panel noted and agrees with NEMMCO that, in accordance with clause 4.2.6(f) of the Rules, the trip of a switchyard busbar is a non-credible contingency event.

The Panel notes that NEMMCO has taken the appropriate actions to maintain the security of the power system in response to this event. In particular, the Panel notes that the applicable Frequency Operating Standards were met in Queensland, the rest of mainland and Tasmania.

The Panel also noted that NEMMCO's investigation on this event has identified several potential deficiencies and fifteen recommendations have been developed to address them. The recommendations involve:

- addressing some issues associated with protection system;
- developing action plans to manage circumstances where significant FCAS deficits were observed for extended periods; and
- investigation of issues in relation to FCAS provision.

[7] NEMMCO, *Operating Incident Reports*, http://www.nemmco.com.au/opreports/opreports.html#ReportsMarketEvents

New South Wales, 24 October 2007

A multiple contingency event occurred in New South Wales where a 330 kV transmission line and a 330 kV main bus tripped at the same time.

At 15:26 hours (EST) on 24 October 2007, the Mount Piper to Marulan (35) 330 kV transmission line tripped at Mount Piper and tripped, auto-reclosed and reopened at Marulan. At the same time the 330 kV Main Bus at Mount Piper tripped.

NEMMCO's investigation revealed that the trip of the Mount Piper to Marulan (35) 330 kV transmission line was due to a lightning strike. The associated outage of the Mount Piper Main Busbar was due to a wiring error.

Comments

The Panel notes that this event posed no risk to power system security. The power system remained in a secure operating state during the events. There was also no loss of load as a result of the outages.

The Panel also notes that the wiring error has been rectified.

The Panel notes that in the Power System Incident Report, NEMMCO did not report on whether it has reclassified this event as a credible contingency event under this abnormal condition. The AEMC's recent Rule change "Reclassification of Contingency Event"[8] will require NEMMCO to report every six months on all reclassification decisions. The Panel anticipates that this would promote the transparency, confidence and ongoing improvement on NEMMCO's reclassification process.

Queensland, 28 January 2008

A multiple contingency event occurred at Braemar Power Station in Queensland which involved the loss of both units 1 and 2.

At 15:12:49 hrs, GT11 (Braemar PS Unit 1) sustained a trip during testing of the change-over of combustion mode systems from ramp-up to low-emissions. In addition, at 15:12:52, GT12 (Braemar PS Unit 2) also sustained a trip, the root cause of which was not clearly defined at this time.

[8] AEMC, 2008, *Reclassification of Contingency Events*, http://www.aemc.gov.au/electricity.php?r=20080407.133712

Comments

The Panel noted that the power system remained secure during this event, and there was no interruption to customer loads as a result of the unit trips.

The Panel also noted that NEMMCO initially reclassified the loss of Units 1 and 2 as a single credible contingency,[9] but this reclassification was subsequently revoked[10] following advice from NewGen Power that the trips were not due to an electrical disturbance.

The Panel noted that NEMMCO was not able to conclusively determine the cause of the Unit 2 trip due to the unavailability of a high-speed data record at that time.

The Panel also noted that a high-speed data recorder has been connected to a generating unit to store high speed data for more accurate analysis of any future trip of Braemar generating units.

NEMMCO and NewGen Power will closely monitor the Braemar Power Station generating units over the next 12 months. The Panel anticipates that the high-speed data would assist NEMMCO in its reclassification decision making.

In addition, it is important that NEMMCO's reclassification process is transparent and applied consistently. The Panel anticipates that the recent Rule change "Reclassification of Contingency Event"[11] is likely to be essential in achieving this outcome.

1.3 Other security issues

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

Other events

In addition to those reported in section 1.2, twenty-eight contingency events were reported by NEMMCO for the year. Eight of these include multiple contingency events.

Some of the events resulted in customer load interruptions in order to maintain the security of the power system. There were no customer load interruptions due to power system reliability issues.

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[9] NEMMCO's Market Notice 20342
[10] NEMMCO's Market Notice 21608
[11] AEMC, 2008, *Reclassification of Contingency Events*, http://www.aemc.gov.au/electricity.php?r=20080407.133712

Directions

NEMMCO issued 6 directions throughout the 2007-08 year to manage local security issues. This compares to 10 during 2006-07, 60 during 2005-06, 41 during 2004-05 and 10 during 2003-04.

One of these directions was in South Australia, three were in Queensland and two in Tasmania.

Frequency deviations

During the year the frequency on the mainland deviated from the normal operating band on 25 occasions. The frequencies remained outside the normal band for more than 5 minutes on 24 of these occasions. On 2 of these occasions, the frequencies were outside the normal band for more than 10 minutes.

The frequency in Tasmania deviated from the normal operating band on 2 occasions (compared to 59 last year). On both of these occasions, frequency remained outside the normal band for more than 10 minutes, which was longer than the standard allows.

System Separation and Load Shedding 16 January 2007

On 16 January 2007, a major event occurred on the interconnected power system during bushfires in northern Victoria. The event resulted in separation of the power system into three electrical islands. The Panel reported this event on the "Annual Electricity Market Performance Review 2007"[12].

In this report, the Panel noted that both the AER and NEMMCO identified deficiencies in the management of the power system and recommended actions to address them. NEMMCO has addressed a significant number of these recommendations.[13]

1.4 Lessons from Reliability and Security Events

Reliability results

There was sufficient generation capacity to meet consumer demand at all times during the 2007-08 year. With the exception of the incident in NSW on 1 December 2004, there was sufficient capacity from the energy market to meet consumer demand at all times and in all regions for the seventh consecutive year.

[12] AEMC, 2008, *Annual Electricity Market Performance Review - Reliability and Security 2007 Report*, http://www.aemc.gov.au/electricity.php?r=20071218.163902

[13] NEMMCO, 2008, *Progress on Recommendations from Power System Incident Report on 16 January 2007 Event*, http://www.nemmco.com.au/opreports/232-0076.htm

Since market start in December 1998, the long-term averages for USE due to supply shortages are as follows:

- New South Wales, 0.00001%;
- Queensland, 0%;
- South Australia, 0.00198%; and
- Victoria, 0.0079%.

South Australia and Victoria fell outside the Reliability Standard in the year 2000, when there was a coincidence of industrial action, high demand and temporary unavailability of generating units in Victoria during January and February. In terms of the long term averages, Victoria remains outside the Standard due to that single event. In every year since 2000, South Australia and Victoria have met the Reliability Standard.

Tasmania joined the NEM in May 2005. Since then, there has been no breach of reliability standard in the 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.[14] NEMMCO subsequently published a series of updates to this report. The latest update was published in September 2008, covering the study period from 1 August 2008 to 31 July 2010. This report advised that, under the low rainfall scenario, the NEM would exceed its reliability standard of 0.002% during the 2009-2010 year in South Australia and Victoria.

Security results

While none of the incidents this year resulted in USE due to insufficient supply, the Panel remains concerned that there has been some USE due to power system security issues.

System security events, including non-credible contingency events, can have a serious impact on consumer supply, and from a consumer perspective their impact is not clearly distinguishable from that of reliability events, particularly 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, which is to operate the power system to cater for non-credible contingency events without having to shed consumer

[14] NEMMCO, *Drought Reports*, http://www.nemmco.com.au/about/drought.html

load, would result in very conservative operating limits, particularly in respect of interconnector flows. This could also result in high electricity prices.

The Panel is currently preparing draft guidelines, in accordance with clause 8.8.1(a)(2a), that determine how NEMMCO should maintain power system security under clause 4.2.6(b) of the Rules while taking into account that costs and benefits to the extent practicable. The Panel intends to publish these draft guidelines for consultation in 2009.

1.5 Comprehensive Reliability Review

The Panel published the CRR report on 21 December 2007.[15]

In accordance with the recommendation of the CRR report, the Panel has submitted, or will submit, the following review or Rule change proposals to the AEMC:

- Rule change proposal "NEM Reliability Settings: Information, Safety Net and Directions";[16]
- Rule change proposal "NEM Reliability Settings: VoLL, CPT and Future Reliability Review;"[17] and
- Review of MRL methodology.

<u>NEM Reliability Settings: Information, Safety Net and Directions</u>
On 26 June 2008, in response to the Panel Rule proposal, the AEMC made the National Electricity Amendment (NEM Reliability Settings: Information, Safety Net and Directions) Rule 2008 No.6.

This Rule determination resulted in the following changes to the Rules:

- introduction of EAAP. This will be further discussed in section 2.7 of this report;
- introduction of RERT to replace the Reserve Trader arrangement;
- requirement on NEMMCO to report annually on the accuracy of its Statement of Opportunities (SOO) load forecasts; and
- extension of NEMMCO's reliability directions powers without sunset.

A savings and transitional provision of this Rule, in clause 11.21.6, states that the "Reliability Panel must amend the *power system security and reliability standards* in accordance with clause 8.8.3 to take into account the Amending Rule and those amendments are to take effect from the commencement date." The Panel considers that it does not need to further amend the *power system security and reliability standards* (to comply with this savings

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[15] AEMC, 2007, *Comprehensive Reliability Review*, http://www.aemc.gov.au/electricity.php?r=20051215.142656
[16] AEMC, 2008, *NEM Reliability Settings: Information, Safety Net and Directions*, http://www.aemc.gov.au/electricity.php?r=20080307.151409
[17] AEMC, 2008, *NEM Reliability Settings: VoLL, CPT and Future Reliability Review*, http://www.aemc.gov.au/electricity.php?r=20080916.180000

and transitional Rule) because the Panel is of the view that the standards were reviewed as part of the CRR and are already consistent with the final Rule.

NEM Reliability Settings: VoLL, CPT and Future Reliability Review

On 16 September 2008, the Panel released for consultation an Exposure Draft of a proposed Rule change along with the Proposed Rule and a mark up of the Proposed Rule.

This Exposure Draft seeks to:

- increase the level of VoLL from the existing level of $10,000/MWh to $12,500/MWh, effective from 1 July 2010;
- define the (Cumulative Price Threshold) CPT in the Rules as 15 times VoLL;
- replace the term "Value of Lost Load (VoLL)" with "Market Price Limit"; and
- replace the current annual review of VoLL with a reliability standard and settings review (i.e. the reliability standard, VoLL, CPT, and the market floor price) which is to take place every two years with two years' notice of any change.

1.6 Climate change

The AEMC is currently reviewing the energy market frameworks in light of Climate Change Policies.

If necessary, the Panel will assess the implication of this review on the reliability of the power system.

2 Technical performance assessment

This part of the report contains comprehensive statistical data on the system's 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 NEMMCO 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.

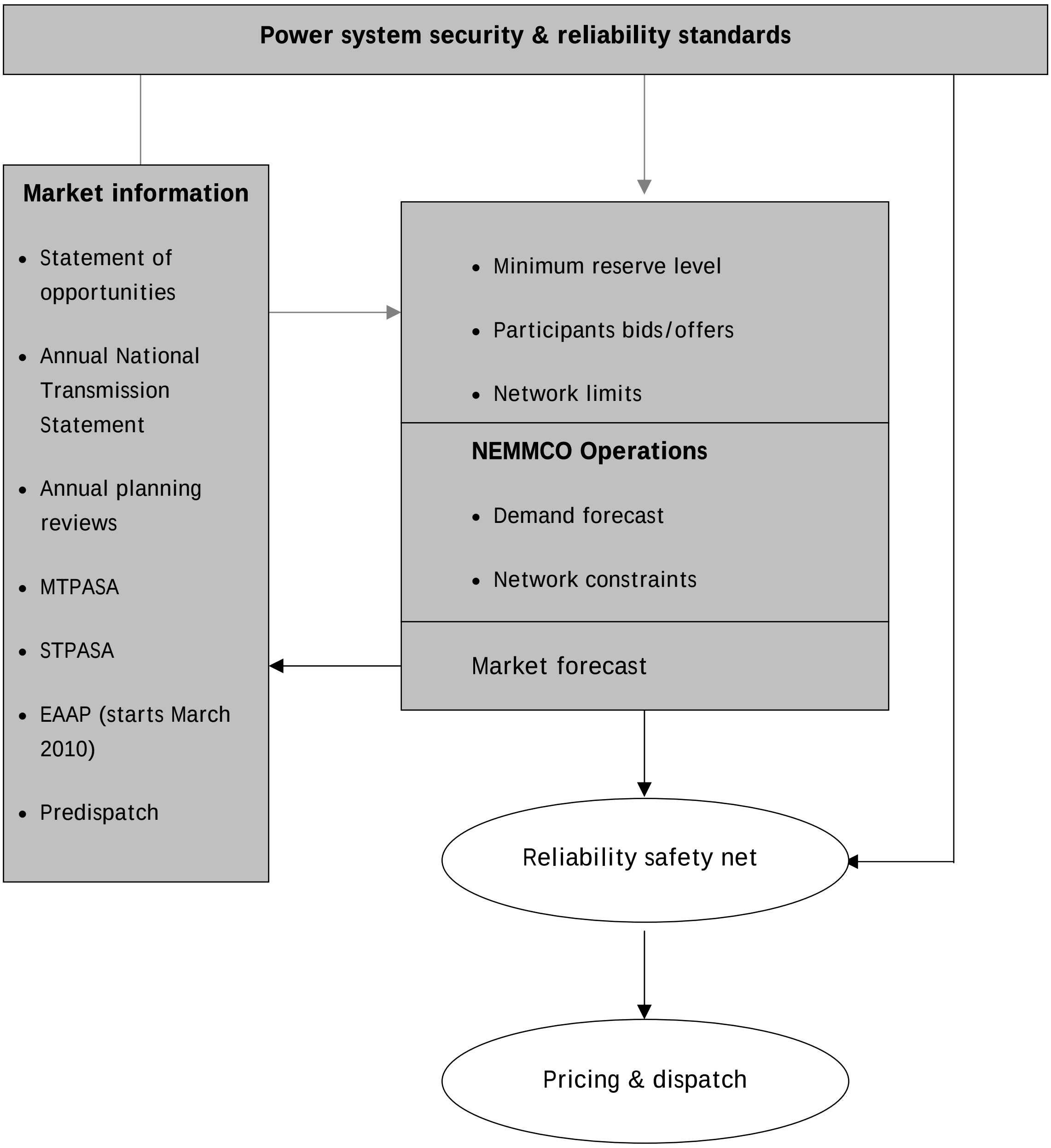
The national market aligns incentives for decisions by market participants about plant operation with overall reliability outcomes. There is an extensive suite of information published by NEMMCO to support those decisions.

Market information provides data and projections with increasing levels of detail closer to the time of dispatch. The annual SOO provides information for 10 years ahead. The shortest term information provides 5 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 NEMMCO by participants. NEMMCO 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 NEMMCO. The final data is used by NEMMCO to operate the market and power system.

In addition, the reliability safety net allows NEMMCO to monitor the level of reserve in each region and may intervene if these reserves fall below margins necessary to meet the Panel's standard.

Figure 1: Reliability model



2.2 Energy market Reliability Standard

The Reliability Standard of 0.002% unserved energy is designed to measure whether there is sufficient available capacity to meet demand. It is the basis for NEMMCO's calculation of minimum reserve levels for market information purposes, and if necessary intervention through reserve contracting or direction. 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 consumers 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 consumers. As noted previously, Section 3 of this report provides summary 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 NEMMCO 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 to market. The Reliability Standard sets the threshold at which NEMMCO may intervene in the operation of the market to ensure sufficient capacity is presented. 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 NEMMCO and network service providers.

This year's report does not include any USE due to the impact of intra-regional constraints on reliability.

Performance assessment

No USE occurred during 2007-08 as a result of a reliability incident and, therefore, the reliability standard was met in all regions. For the seventh consecutive year there was sufficient capacity from the energy market to meet consumer demand at all times in all regions - with the exception of one incident in New South Wales on 1 December 2004, which was reported in the 2005 Annual Electricity Market Performance Review.[18]

[18] The Panel's 2005 Annual Electricity Market Performance Review is available at www.aemc.gov.au.

2.3 Minimum reserve level

The 0.002% USE Reliability Standard is a statistical risk of not meeting consumer demand over time. To meet the standard operationally, NEMMCO calculates minimum reserve levels 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.

Minimum reserve levels provide NEMMCO with an operational trigger for intervention to maintain supply reliability. NEMMCO may intervene using reserve contracting or its power of direction if the reserves delivered by the market is below the designated minimum reserve level. The medium-term and short-term assessments of system adequacy (medium-term PASA and short-term PASA), predispatch and market notices (see Section 2.9) alert the market to the potential of reserve levels below the threshold. This information and participants' responses are central parts of the management of reliability in the national market.

The methodology used by NEMMCO to determine the minimum reserve levels 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 minimum reserve levels are derived by comparing the minimum generation requirement with a demand condition which has all regions at their maximum 10% probability of exceedence (POE[19]) demand and taking into account reserve available across interconnectors.

In 2006, NEMMCO completed a review of the minimum reserve levels. This review was finalised in September 2006 and has been operational since 24 October 2006.[20]

For financial year 2008-09, NEMMCO has published the minimum reserve levels that will apply following the abolition of the Snowy region on 1 July 2008. The 2006 assessment itself remains unchanged as the underlying physical transmission network, generation and load conditions have not changed.

These minimum reserve levels are illustrated in Figure 2.

[19] See Glossary for definition

[20] NEMMCO, *2006 Regional Minimum Reserve Levels*, http://www.nemmco.com.au/powersystemops/240-0020.html

Figure 2: Revised minimum reserve levels

	QLD *	NSW	VIC & SA	SA *	TAS
2007-08	560 MW	-1430 MW	615 MW	-50 MW	144 MW
2008-09**	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 the Snowy region of the NEM. Note that the levels remain valid as the underlying physical transmission network, generation and load conditions have not changed.

The 2007-08 NSW minimum reserve level has been determined assuming Snowy provides 1,878 MW support to NSW. 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 resulted in NSW having a large negative minimum reserve level.

The industry will benefit from further refinement of the minimum reserve levels for different applications and time horizons. These different horizons could, for example, include forecasts of reserve one week ahead and 10 year projections of system adequacy in NEMMCO's annual SOO. In particular the work could focus on how the minimum reserve level criterion can best be applied in the short term to avoid the risk of excessive intervention.

In the CRR[21], the Panel recommended that a taskforce review the methodology and process for calculating minimum reserve levels. The Pane will establish this task force in 2009.

Performance assessment

Figure 3 summarises the results, in each region, where the reserves fell below the minimum reserve levels. For the last nine years, the figure shows a general reduction in forecast reserve shortfalls, with the exception of South Australia during the Moomba crisis of January and February 2004.

The Panel notes that the forecast durations below the minimum reserve levels for South Australia were rather high in 2006-07 and 2007-08. NEMMCO advised the Panel that this is because South Australia experienced hot summers in 2006-07 and 2007-08, and the intermediate plants were not committed when the forecast calculations were undertaken.

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21 AEMC, 2007, *Comprehensive Reliability Review*, http://www.aemc.gov.au/electricity.php?r=20051215.142656

The forecasts reflected the outcomes of supply-demand balance at the time of calculation. Under these circumstances, NEMMCO advised the market of its forecasts and sought a market response to eliminate the deficit in supply. In South Australia the response generally comes from the intermediate generation plants.

Figure 3: Forecast Duration below the minimum reserve levels

	Year	QLD	NSW	VIC	SA	TAS
Forecast duration below the threshold (hours)	2007 - 2008	0	3	27	101	0
	2006 - 2007	14	9	0	196	0
	2005 - 2006	0	0	0	0	0
	2004 - 2005	17.5	0	0	6	0
	2003 - 2004	11.5	4.5	17.5	645	0
	2002 - 2003	2.5	3.5	7	115.5	0
	2001 - 2002	1	0	0	45.5	0
	2000 - 2001	188	8	67	716	0
	1999 - 2000	43	33	145	699	0

The Panel notes that there is still no distinction made between short and medium term minimum reserve levels in PASA and predispatch, even though there is greater certainty about demand in the short term. Again, this highlights the importance for the industry of developing minimum reserve levels for different applications and time horizons. Demand forecasting for different applications and time horizons is discussed further in Section 2.10.

2.4 Market information

Market information is provided in a number of formats and timeframes ranging from the 10-year SOO to the detailed 5 minute and 30 minute price and demand predispatch. Market information also includes Annual Planning Reviews, the Annual National Transmission Statement, the Medium Term Projected Assessment of System Adequacy (medium-term PASA), the Short Term Projected Assessment of System Adequacy (short-term PASA), and market notices. Each is described and analysed below.

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

Each year NEMMCO publishes a SOO for the next 10 years. This is complemented by Annual Planning Reviews, prepared by transmission network service providers (TNSPs), which focus on networks and include forecasts of transfer capacities, potential constraints and possible intra-regional augmentations. The SOO also incorporates the Annual National Transmission Statement (ANTS), prepared by NEMMCO in conjunction with the Inter-Regional Planning Committee (IRPC), which 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, as well as useful information about market opportunities, for existing market participants, intending code participants and other interested parties. They include:

- forecasts of energy usage, 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 inter-regional transfer capabilities reflect the network's ability to exchange energy between the regions of the national market);
- NEMMCO'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.[22] Some of this report's recommendations are:

- establishing a National Transmission Planner (NTP) as one of the functions of the proposed new Australian Energy Market Operator (AEMO);
- the NTP will become responsible for the functions currently performed by the IRPC;
- The NTP will publish a National Transmission Network Development Plan (NTNDP) each year. 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

Figure 4 compares the forecast demand, for medium growth and 10%, 50% and 90% POE, with the actual maximum demands. The forecast demand values shown are from the 2007 SOO.

It can be observed in Figure 4 that, as expected, most of the maximum demands fall within the 90% POE and 10% POE levels. However, the following exceptions apply:

- Winter 2007: the maximum demand in Victoria was above the 10% POE level;
- Summer 2007-08: the maximum demand in Queensland was below the 90% POE level;

[22] AEMC 2008, *National Transmission Planning Arrangements - Final Report to MCE*, http://www.aemc.gov.au/electricity.php?r=20070710.172341

- Summer 2007-08: the maximum demand in Tasmania was above the 10% POE level;
- Winter 2008: the maximum demand in Victoria was above the 10% POE; and
- Winter 2008: the maximum demand in South Australia was below the 90% POE.

The Panel notes that in 2005 NEMMCO engaged KEMA Consulting to review the processes used to prepare the load forecasts in the SOO. Most of the recommendations made by KEMA have been incorporated into the load forecast preparation process.

On 26 June 2008, the AEMC made the National Electricity Amendment (NEM Reliability Settings: Information, Safety Net and Directions) Rule 2008 No.6.[23] Under this Rule, NEMMCO is required to report to the Panel on the accuracy of the SOO demand forecasts each year.

Figure 4: SOO maximum demand forecast comparison

Region	QLD	NSW	VIC	SA	TAS
Winter 2007					
2007 SOO Peak forecast (10% POE)	8,049	13,980	7,972	2,479	1,774
(50% POE)	7,895	13,700	7,831	2,432	1,751
(90% POE)	7,785	13,410	7,713	2,381	1,732
Actual maximum demand	7,838	13,894	8,307	2,383	1,749
Summer 2007-2008					
2007 SOO Peak forecast (10% POE)	9,981	15,020	10,026	3,311	1,405
(50% POE)	9,461	13,820	9,198	2,990	1,381
(90% POE)	9,149	12,610	8,704	2,741	1,365
Actual maximum demand	8,083	12,944	9,776	3,077	1,455
Winter 2008					
2008 SOO Peak forecast (10% POE)	8,369	14,370	8,032	2,547	1,805
(50% POE)	8,210	14,070	7,831	2,499	1,781
(90% POE)	8,096	13,780	7,713	2,447	1,762
Actual maximum demand	8,212	14,289	8,068	2,428	1,790

In the 2007-08 year, national summer peak demand reached 32,132 MW in March 2008. National winter peak demand reached 33,532 MW in July 2007. This is up from the record of 31,756 MW the previous summer and 32,646 MW the previous winter. Maximum demands that occurred in the 2007-08 year were as follows:

[23] AEMC, *NEM Reliability Settings: Information, Safety Net and Directions*, http://www.aemc.gov.au/electricity.php?r=20080307.151409

- 13,871 MW in New South Wales in July 2007;
- 9,818 MW in Victoria in March 2008;
- 8,068 MW in Queensland in February 2008;
- 3,151 MW in South Australia in March 2008; and
- 1,756 MW in Tasmania July 2007.

Figure 5 shows the relationship between the regional peak demands and the coincident national peak, since market start. It can be observed from this figure that national peak demand does not necessarily coincide with the regional peak. Increased coincidence in regional peak demands would have resulted in increased national peak.

Figure 5: Combined peak demand and demand for each region

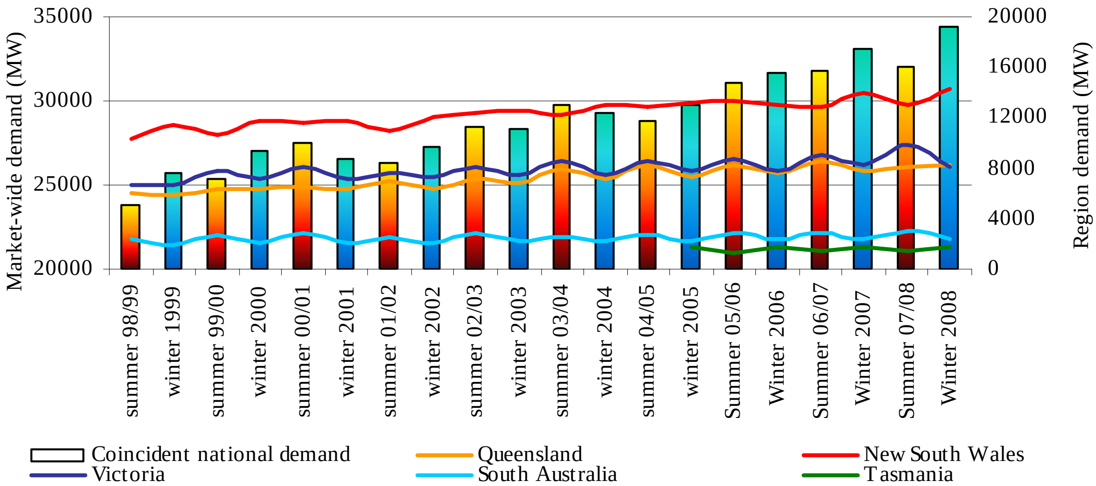
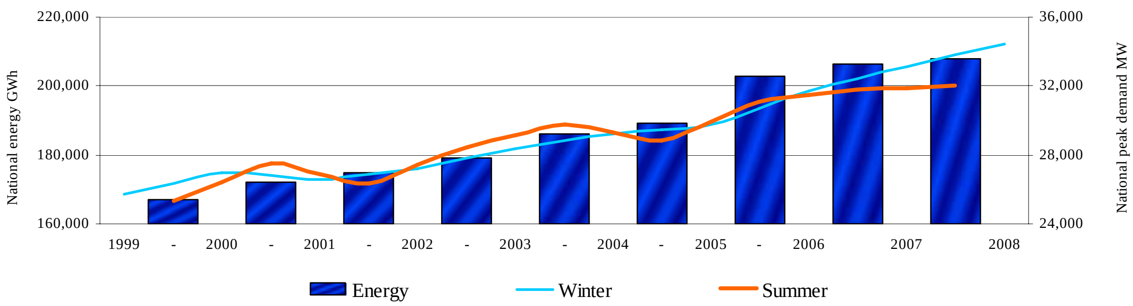


Figure 6 sets out the growth in annual total energy and the winter and summer national peak demands. It can be observed from this figure that energy demand has grown significantly since the market start. The Panel notes that sufficient investment in generation or interconnector capacities may be required to meet future demand growth while maintaining the reliability of the power system. It is the Panel's objective that sufficient plant capacity is available to keep the USE level under the target of 0.002%.

Figure 6: National energy requirements



2.5 Medium-term PASA (projected assessment of system adequacy)

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 for the next two years.

Medium term PASA information is:

- 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 NEMMCO, for example the Reserve Trader process.

Demand forecasts are prepared by NEMMCO.

Generation and demand-side daily availability estimates are submitted by participants under a Rule obligation. Transmission outage programs are supplied by TNSPs.

The ability to forecast network capability and in particular interconnector capability is important for the reliable and efficient operation of the market. Every month, NEMMCO and the TNSPs publish planned network outage information for the following 13 months. NEMMCO 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.

Figure 7 depicts the frequency of outages submitted by TNSPs to NEMMCO during 2007-08.

Figure 7: Transmission outages submitted to NEMMCO

	QLD	NSW [1]	VIC	SA	TAS	MurrayLink	Terranora	Total
Outages Frequency [2]	1,128	1,314	1,353	827	294	28	57	5,001
Scheduled with less than 4 days notice	24%	24%	25%	19%	21%	68%	40%	23%
Forced outages [3]	5%	6%	8%	7%	6%	32%	26%	7%

[1] The NSW TNSP arranges Snowy outages.
[2] Only primary plant outages (affecting load carrying capability) are included.
[3] Outages not previously notified to NEMMCO, 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, but short notice outages can also increase uncertainty for market participants and for the management of reliability and security. Other outages have little effect on reliability.

Performance assessment

Overall, 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 region demands. This functionality in MT PASA continued to be used in the financial year 2007-08.

Medium-term PASA now also has the ability to produce two sets of results: one where there are no network outages modelled, and another where they are. The November 2005 release of the Market Management System saw further improvements to medium-term PASA including an assessment of network outages based on 50% POE demand forecasts, while reliability will be assessed against 10% POE demand forecasts.[24] This functionality in MT PASA continued to be used in the financial year 2007-08.

In February 2007, NEMMCO commenced a detailed review of the MT PASA process in liaison with MT PASA User Reference Group (MURG) – a representative group of NEM participants. The adequacy of modelling energy limited plant was within the scope of the review.

[24] NEMMCO, *MTPASA Process Description (27 April 2006)*, http://www.nemmco.com.au/powersystemops/432-0004.html

2.6 Short-term PASA (projected assessment of system adequacy)

Short-term PASA is an aggregate supply and demand balance comparison for each half-hour of the coming week.

Demand forecasts are prepared by NEMMCO. Generation and demand side availabilities are submitted by participants under a Rule obligation. Transmission outage programs are supplied by TNSPs. This information is to assist participants in optimising short-term physical and commercial planning for maintenance, production planning and load management activities.

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, which now uses a common linear programme solver to short-term PASA. This functionality in PASA processes continued to be used in the financial year 2007-08.

2.7 Energy Adequacy Assessment Projection (EAAP)

On 26 June 2008, the AEMC made a Rule which introduced, as an information mechanism, the EAAP. 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, as an additional source of information for the market regarding when and where energy constraints may impact on energy availability, will lead to an improved market response to projected shortfalls in reserve.

Under clause 3.7C(d) of the Rules, NEMMCO must 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 NEMMCO. 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 reliability or security 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 5 minute predispatch process designed to enhance information on demand and supply for the next hour, in particular for the operators of fast start generators.

Performance assessment

Analysis of the 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 NEMMCO used in predispatch is an important determinant of the accuracy of the predispatch overall.

Figure 8, which was provided by the AER, summarises the number of trading intervals affected by significant variations between predispatched and actual prices during the 2007-08 period as well as the most probable reasons for the variations.

This figure illustrates that, as the number of trading intervals affected by the variation is large, predispatched prices have provided market participants the appropriate signal to react in response to the supply-demand condition. Therefore, 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 forecasting is a continuing challenge which is likely to become more complex with growth in intermittent generation such as wind farms.

Figure 8: Trading intervals affected by price variation

Reason for price variation	Number of trading intervals affected by variations (%)									
	QLD		NSW		VIC		SA		TAS	
Demand	1,746	57%	1,362	60%	1,928	58%	1,771	60%	3,350	58%
Availability	846	27%	612	27%	773	23%	640	22%	879	15%
Combination (e.g. combination of changes in plant availability, demand, rebidding activities)	467	15%	304	13%	583	18%	527	18%	1488	26%
Other (e.g. network outages)	30	1%	4	0%	17	1%	15	1%	11	0%
Trading intervals affected	2,506	14%	1,918	11%	2,772	16%	2,463	14%	4,718	27%

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 NEMMCO to market participants to allow them a more informed market response.

Performance assessment

There were 4,365 market notices issued by NEMMCO during the year. Figure 9 summarises these notices by type.

Figure 9: Market notices

Type	Number of notices
Administered Price Cap	3
Constraints	2
General notice	146
Inter-regional transfer	889
Market intervention	10
Market systems	204
MPDI	23
NEM systems	5
Non-conformance	2,345
Power system events	12
Price adjustment	19
Reclassify contingency	402
Reserve notice	218
Settlements residue	87

Overall, market notices are considered to be an effective method of communicating with market participants and the wider public. The Panel's considerations do not extend to the quality of the notices, or to their timeliness.

2.10 Demand forecast

NEMMCO'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 of participant demand management activities.

Performance assessment

The medium-term PASA demand forecast is a 10% POE[25] forecast with a daily resolution. This forecast uses the summer and winter weekday 10% POE demand forecasts consistent with the most recent SOO and sculpts the remainder of the year by estimating seasonal and weekend fluctuations. This year NEMMCO reviewed its historical demand data and produced new curves to sculpt the seasonal variations of the daily maximum demands used in medium-term PASA.

[25] Projected maximum demand levels for a given season are expected to be met or exceeded, on average, 1 year in 10.

Figure 10 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 PASA forecasts for Queensland, NSW and Tasmania have improved compared with the 2006-07 forecasts.

Figure 10: Medium-term PASA demand forecasts comparison

	QLD	NSW	VIC	SA	TAS
Proportion of weekdays where demand greater than 10% POE forecast	0.0%	0.4%	8.5%	1.5%	0.0%
Weekdays demand deviation	0%	-4%	-2%	-9%	0%
Weekend days where demand greater than 10% POE forecast	1.9%	2.9%	14.3%	2.9%	0.0%

Figure 11 shows the average short-term PASA demand forecast accuracy for 2, 4 and 6 days ahead. The Panel notes that the short term PASA demand forecast was less accurate compared to that in 2006-07.

Figure 11: Accuracy of short-term PASA demand forecasts

Short-term PASA demand forecast absolute percentage deviation	QLD	NSW	VIC	SA	TAS
2 days ahead	2.4%	2.6%	2.7%	5.7%	3.9%
4 days ahead	2.8%	2.9%	3.1%	7.3%	4.4%
6 days ahead	3.1%	3.5%	3.6%	9.1%	4.8%

Figure 12 shows the average predispatch demand forecast deviation 12 hours ahead. The Panel notes that the accuracy of predispatch demand forecast in 2007-08 was similar to that in 2006-07.

Figure 12: Accuracy of predispatch demand forecasts

Predispatch absolute demand forecast deviation	QLD	NSW	VIC	SA	TAS
12 hours ahead	1.9%	2.1%	2.3%	4.4%	3.4%

NEMMCO investigated the methods of introducing time varying scaling factors to determine half hourly 10% POE forecast demand using the 50% POE forecast demand.

NEMMCO has implemented time varying scaling factors in the Predispatch timeframe for NSW, Victoria and Queensland. This will enable the 10% POE and 50% POE forecasts to converge as the time to dispatch reduces.

The time varying scaling factors for the short-term PASA period have been derived and needs to be verified before they are implemented for production.

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

Figure 13 to Figure 17 assess, for the summer period, the demand forecast four hours ahead of dispatch, to indicate whether forecast performance varies with levels of demand.

For each region there are four graphs. The first graph examines the absolute deviations for equal sized samples of demand. Demands are grouped into samples of 10^{th} percentile and the median values of each grouped sample are shown on the horizontal axis of the graph. For each group of grouped demand samples, the average and maximum demand forecast deviation are plotted.

Similarly, the second graph examines the top 10% of actual demand in 1% groupings.

The third graph examines raw deviations in 10 percentile grouping 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 1 percentile groups for the top 10 percentile demand level. Any underlying bias (imbalance of over's and under's) in forecasting would be expected to show up here.

The figures show for every region forecasting is generally less reliable at the top end of demand.

For example, in Queensland, the maximum deviations between forecasts and actuals at the top 10 percentile range from 631 MW lower than forecast to 790 MW higher than forecast.

These forecast errors are large compared to these in the lower demand levels. For example, the maximum deviations between forecasts and actuals at the bottom 10 percentile range from 546 MW lower than forecast to 327 MW higher than forecast.

Similar trends were demonstrated in other NEM regions.

The forecast errors in NSW are large, even at low demand levels.

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 shorter notice than 4 hours.

Historical forecast performance

The short-term PASA demand forecasts were, as shown in Figure 18, consistently reliable for the year 2007/08, especially in the regions of Queensland, New South Wales and Victoria. The Panel notes that the demand forecast errors in South Australia were high in some months.

Wind forecast

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

The Panel notes that Phase 1 of the Australian Wind Energy Forecasting System (AWEFS) was implemented internally in NEMMCO on 12 September 2008, and NEM participants will receive access to the wind generation forecasts as part of the NEMMCO's implementation of the November 2008 Market Management System (MMS) Release. The Panel also notes that Phase 2 (Enhancements) of the AWEFS will be implemented by May 2010. The Panel anticipates that, where appropriate, it would assess the performance of this forecasting system in its future reports.

Figure 13: Queensland demand forecast deviation 4 hours ahead

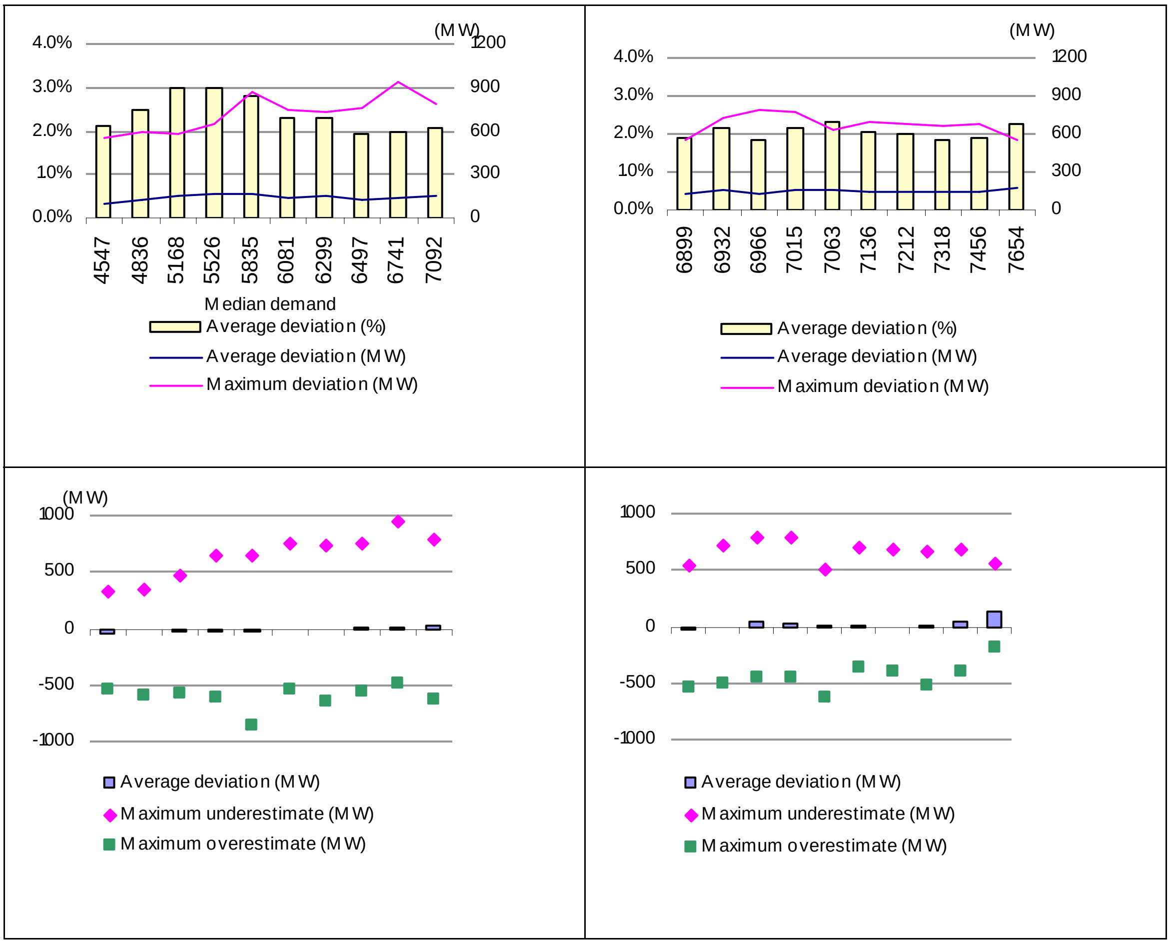


Figure 14: New South Wales demand forecast deviation 4 hours ahead

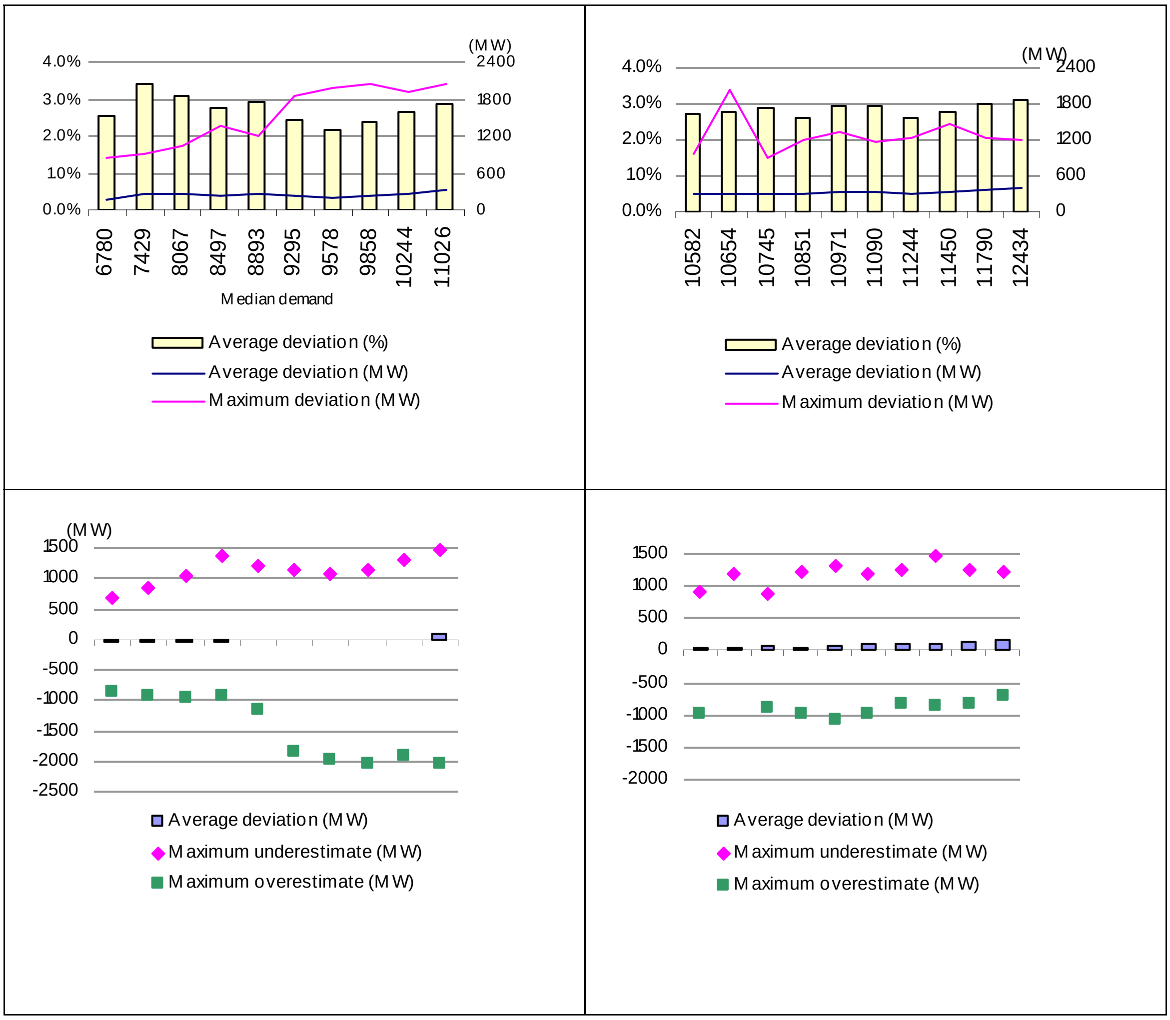


Figure 15: Victoria average demand forecast deviation 4 hours ahead

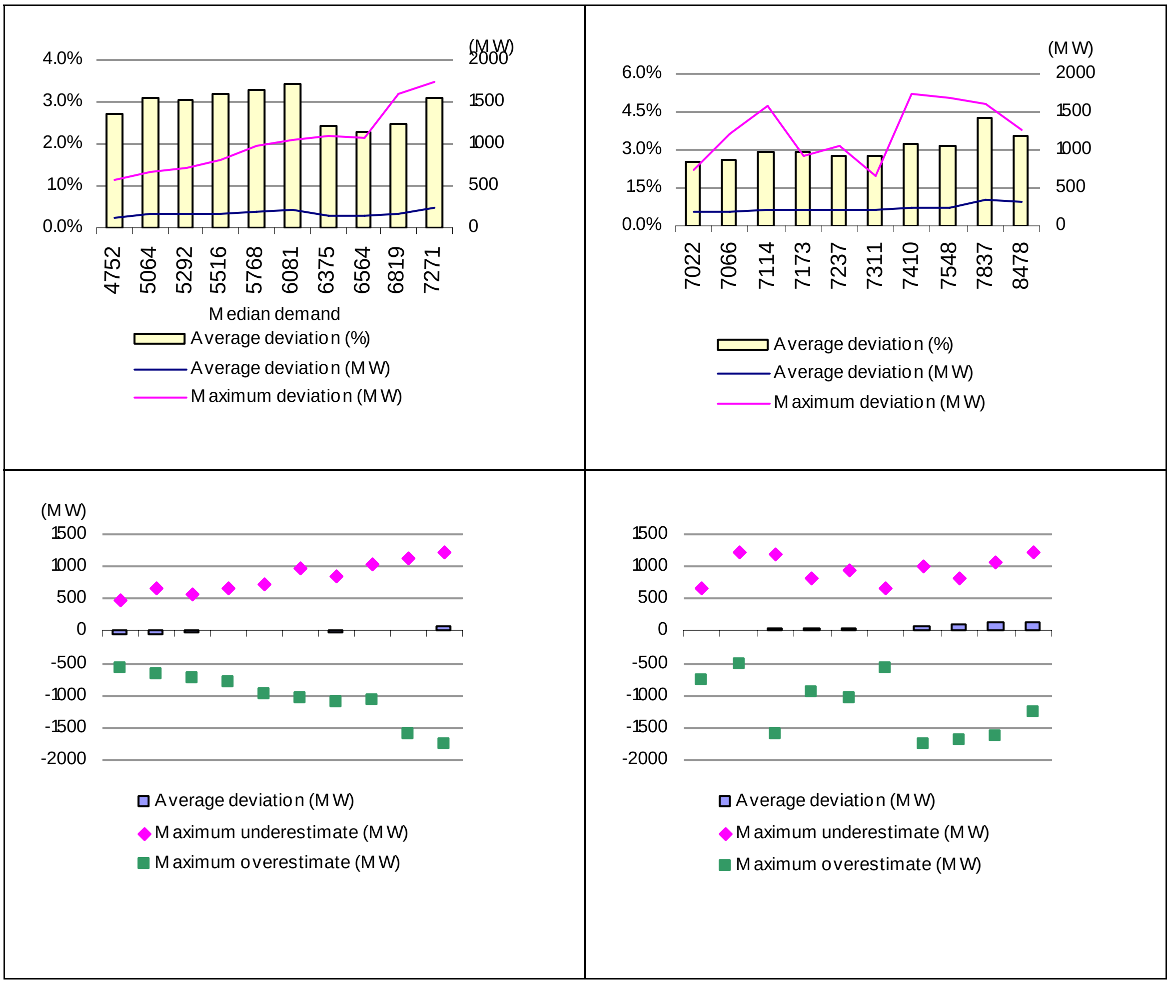


Figure 16: South Australia demand forecast deviation 4 hours ahead

Figure 17: Tasmanian demand forecast deviation 4 hours ahead

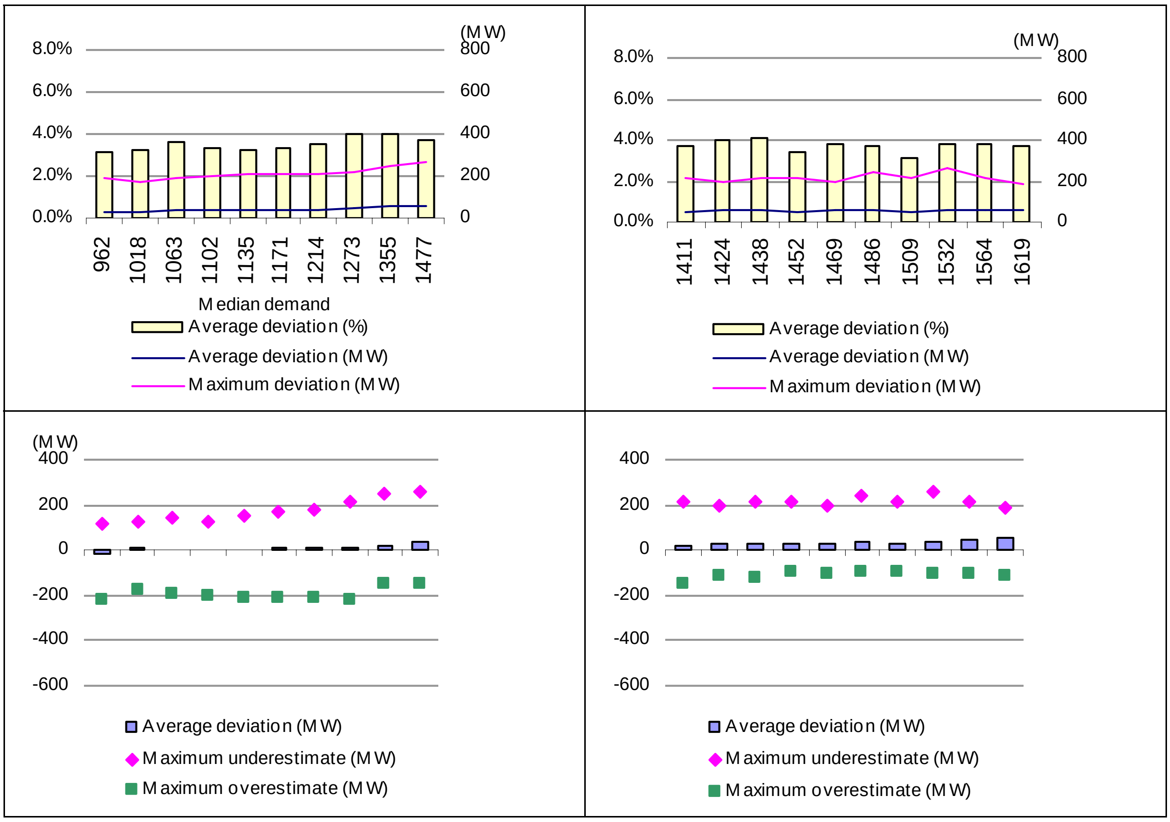
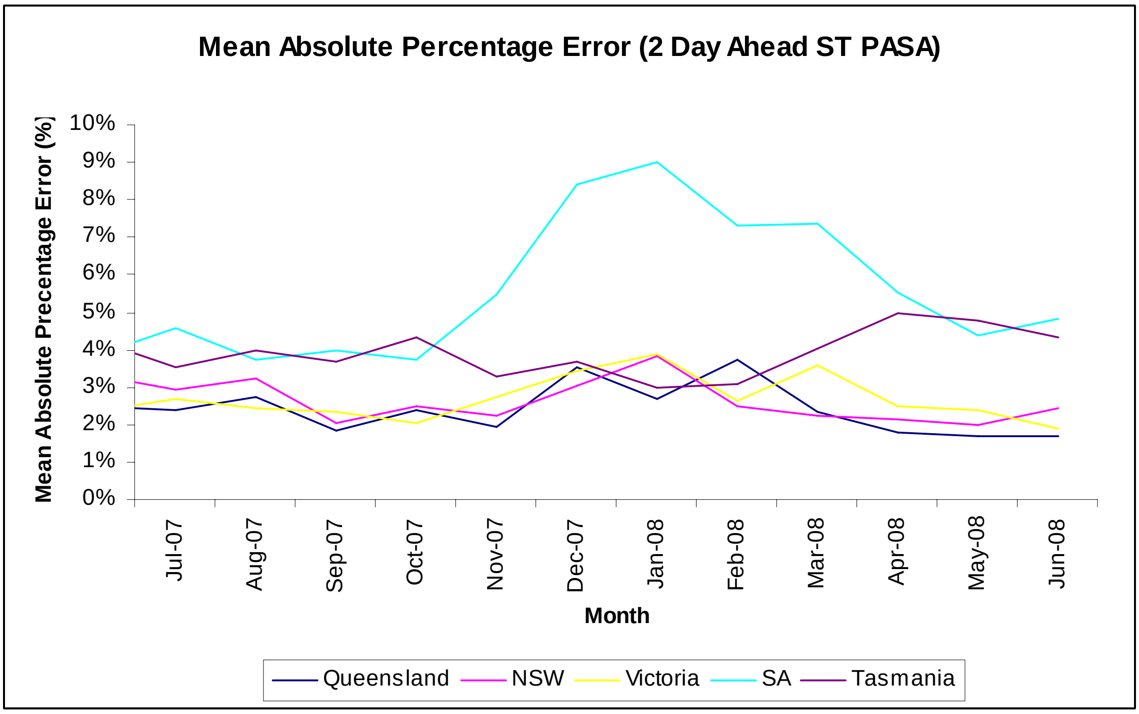


Figure 18: Mean Absolute percentage error (2 Day Ahead Short Term PASA)



2.11 Dispatch and pricing

This is the process of calling all or part of the bids and offers by scheduled generators, loads and network services to meet demand, and the calculating of associated market prices.

Efficient short-term market prices are an important part of reliability maintenance. 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 by 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 cap of $10,000/MWh and a floor of -$1,000/MWh. The price cap is known as the VoLL.

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

The Panel is currently in the process of amending the VoLL and CPT by submitting a Rule change proposal to the AEMC, as recommended in the CRR.

2.12 Reliability safety net

NEMMCO has the power to issue directions as a last resort measure or to contract for the provision of reserve to maintain reliability and power system security. Even though there is no distinction between types of direction, there are different impacts on market pricing. So, for the purposes of this report, the Panel make the 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.

On 26 June 2008, the AEMC made the National Electricity Amendment (NEM Reliability Settings: Information Safety Net and Directions) Rule 2008 No.6[26]. This Rule involves:

- improving the Reserve Trader with incremental changes to redesign it as a RERT to operate with a defined sunset period;
- requiring the Panel to develop RERT guidelines by 30 November 2008 (clause 3.20.8); and
- extending NEMMCO's reliability direction power without sunset.

Performance assessment

There were no directions for reliability for the period.

2.13 Security

This section analyses the arrangements for security and assesses the performance of the national market against the security standards during 2007-08.

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

Security management

Maintaining the security of the power system is one of NEMMCO'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 disturbance such as the sudden breakdown of a large generator. Secure operation depends on the combined effect of controllable plant, ancillary services, and the underlying technical characteristics of power system plant and equipment.

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

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[26] AEMC, *NEM Reliability Settings: Information, Safety Net and Directions*, http://www.aemc.gov.au/electricity.php?r=20080307.151409

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 from consumers. If necessary, NEMMCO 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 19 illustrates the overall arrangement for security. The operation of each element is explained and analysed in this section.

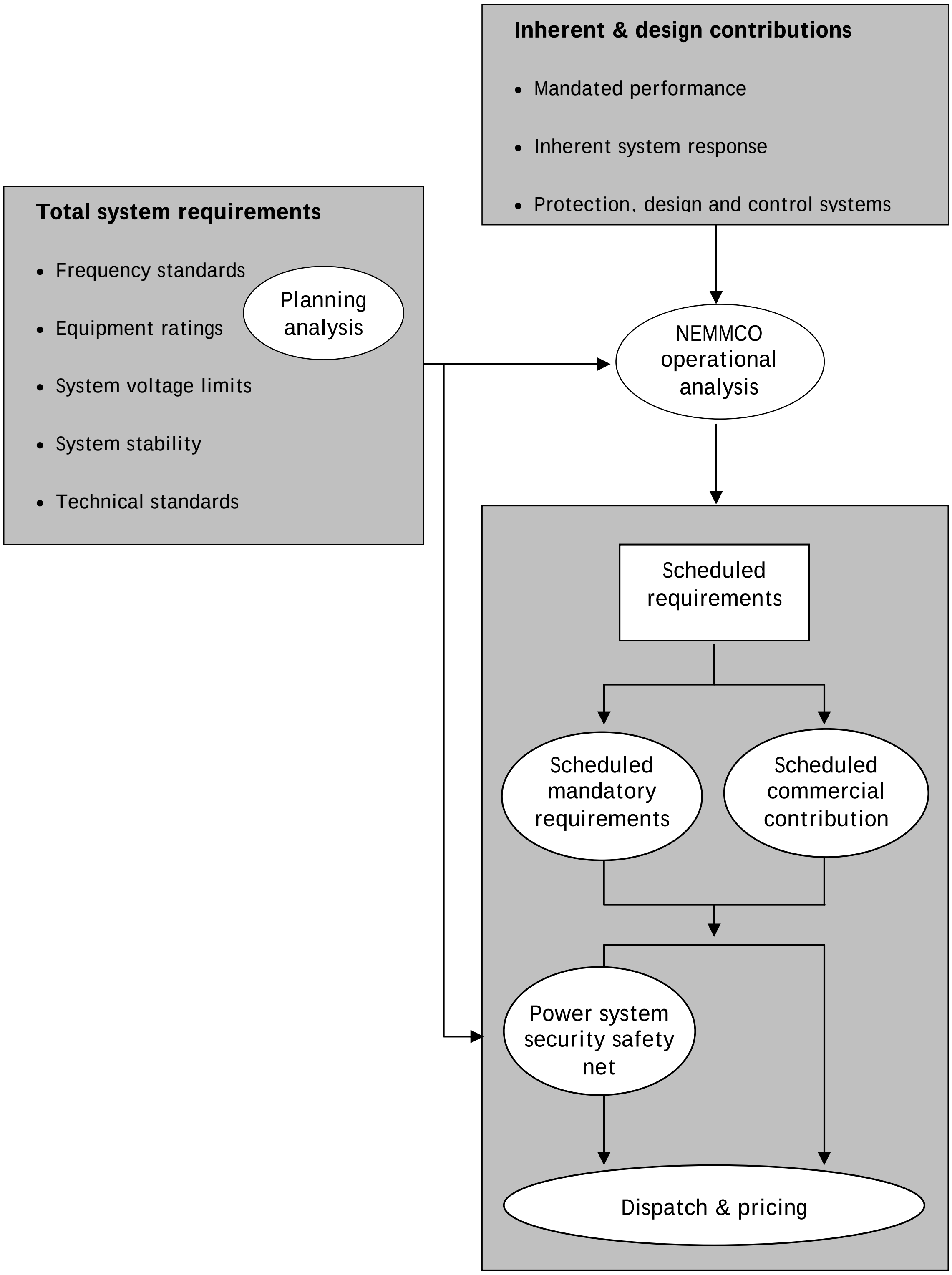
Power System Models

Prior to the Rule change "Technical Standards for Wind Generation and Other Generator Connections" generators were required to provide models of their generating units to NEMMCO. NEMMCO used these models to access system security and provided these models to Registered Participants on request. However, following this Rule change the access to the models was restricted to NEMMCO and those directly affected NSPs to protect the intellectual property of the generators, in particular new technologies such as wind generators.

The AEMC is currently considering Rule change proposal "Confidentiality arrangements in respect of information required for power system studies".[27] The purpose of this Rule change proposal is to "ensure that sufficient information can be provided to Registered Participants to undertake power system studies for planning and operational purposes thereby assisting Registered Participants to operate in an efficient and informed manner, and plan for future operation in an efficient and informed manner while protecting commercially sensitive information". The Panel anticipates that this Rule change would enhance the ability of NEM participants to have access to a more accurate model of the power system.

[27] AMEC, 2008, *Confidentiality Arrangements in Respect of Information Required for Power System Studies*, http://www.aemc.gov.au/electricity.php?r=20080424.113727

Figure 19: 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 NEMMCO as part of its planning and operational activities. They 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 which, if 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 plant operators may negotiate with network service providers, in consultation with NEMMCO, for access to the network. NEMMCO 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 standard, which is a system standard. In defining the frequency standard, consideration would need to be given to the cost of plants in meeting the required access standard.

The plant standards cater 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.

Registered performance standards

The performance of all generating plant must be registered with NEMMCO 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 NEMMCO. 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 performance 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 of the same year. 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 monitoring 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 has 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; [28]
- "Technical Standards for Wind and Other Generator Connections" Rule change;[29] and
- "Resolution Of Existing Generator Performance Standards" Rule change.[30]

The Panel is currently conducting the Technical Standards Review, and anticipates that it will conclude this review by April 2009.[31]

In addition, the AEMC is assessing rule change request Performance Standard Compliance of Generators. Further information regarding this Rule change is available on the AEMC's website.[32]

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[28] AEMC, *Review into the enforcement of and compliance with technical standards*, http://www.aemc.gov.au/electricity.php?r=20051216.173039

[29] AEMC, *Technical Standards for Wind Generation and Other Generator Connections*, http://www.aemc.gov.au/electricity.php?r=20060324.143345

[30] AEMC, *Resolution of existing generator performance standards*, http://www.aemc.gov.au/electricity.php?r=20061012.164125

[31] AEMC, *Reliability Panel Technical Standards Review*, http://www.aemc.gov.au/electricity.php?r=20080509.151254

[32] AEMC, *Performance Standard Compliance of Generators*, http://www.aemc.gov.au/electricity.php?r=20080228.150735

Frequency standards

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

The frequency operating standards require that, during periods when there are no contingency events or load events, the frequency be maintained within the normal operating frequency band (49.85 Hz to 50.15 Hz in both the mainland and Tasmania) for 99% of the time, with larger deviations permitted within the normal operating frequency excursion band (49.75 Hz to 50.25 Hz in both the mainland and Tasmania) for no more than 1% of the time. The standard also requires that following a credible contingency event, the frequency should not exceed the normal operating frequency excursion band for more than 5 minutes on any occasion. Following either a separation or multiple contingency event the frequency should not exceed the normal operating frequency excursion band for more than 10 minutes.

Mainland frequency standards

The frequency standards in Figure 20 apply on the mainland to any part of the power system other than an *island*.

Figure 20: Mainland frequency 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 standards in Figure 21 apply on the mainland to any part of the power system that is *islanded*.

Figure 21: Mainland frequency 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 NEMMCO 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

The Panel is currently reviewing the mainland frequency operating standards during periods of supply scarcity.[33]

Tasmania’s frequency standards

Although Tasmania has entered the national market, its power system is not synchronised to the mainland as Basslink is a DC connection.

The frequency standards adopted in Tasmania allow for wider variations than their mainland equivalents. This is due to the state’s small size and the relatively large contingencies that can occur there. Importantly, Tasmanian customers have not experienced any significant problems as a result of the wider range of frequencies.

Figure 22 applies to any part of the Tasmanian power system other than an *island*.[34]

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[33] AEMC, 2008, *Review of Mainland Frequency Operating Standards during Periods of Supply Scarcity*, http://www.aemc.gov.au/electricity.php?r=20080327.122851

[34] Figure 22 and Figure 23 are summaries of Tasmania’s frequency operating standards. For full details, see *Tasmanian Reliability and Frequency Standards: Determination May 2006*, available from the AEMC website http://www.aemc.gov.au/electricity.php?r=20060525.144027

Figure 22: Tasmanian frequency 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 standards in Figure 23 apply in Tasmania to a power system that is an *island* or becomes *islanded*.

Figure 23: Tasmanian frequency standards for "island" 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.

Review of frequency operating standards for Tasmania

Tasmania entered the national market on 29 May 2005, but continued to use its existing frequency standards, determined by the Tasmanian Reliability and Network Planning Panel (TRNPP), until 29 May 2007. Following this date, the frequency standards determined by the Panel on 28 May 2006 took effect.

In its final determination, the Panel foreshadowed that it would revisit the Tasmanian frequency operating standards after at least 12 months operation of Basslink.

The Panel is currently undertaking a review of the frequency operating standards for Tasmania, and anticipates that the final report for this review would be submitted to the AEMC at the end of November 2008.[35]

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 standard requirement.

Mainland

Figure 24 shows, for the mainland regions of the national market, the number of times the frequency moved outside the normal operating band during the year.

The frequency moved outside the operation band 25 times during the 2007-08 period. This is significantly more than the 2006-07 period where the frequency moved outside the operation band 12 times.

Figure 25 illustrates that the durations of most frequency events in 2007-08 were longer than 5 minutes. This is similar to the outcome in 2006-07.

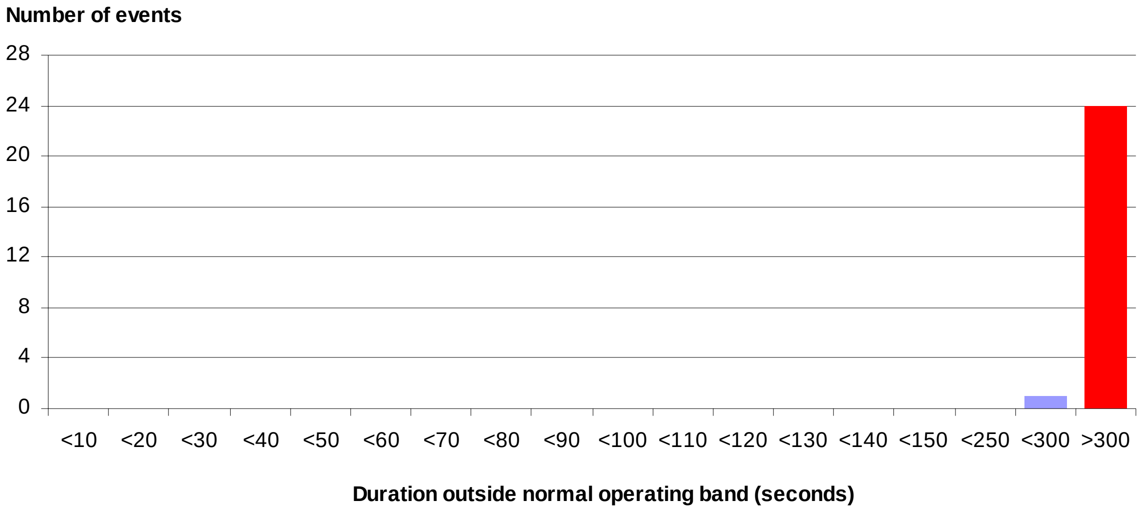
Figure 24: Frequency events on the mainland 2007-08

Frequency events – Mainland regions	Total	Low frequency	High frequency
Number of events			
outside normal operating frequency band	25	25	0
outside normal operating frequency excursion band	11	11	0
Events where duration exceeded 300 seconds[1]	24	24	0
Events where duration exceeded 600 seconds (i.e. the frequency standard)	2	2	0

[1] The frequency standards require recovery to the normal band within 300 secs for generator, load and network events.

[35] AEMC, *Review of Frequency Operating Standards for Tasmania*, http://www.aemc.gov.au/electricity.php?r=20080828.163451

Figure 25: Duration of frequency events on the mainland



A minimum frequency of 49.658 Hz occurred on the mainland following the trip of Mt Piper unit 1 whilst generating 661MW. On no occasions did the frequency on the mainland exceed the top of the normal operating frequency band in 2007-08.

In 2001, the Panel introduced a probabilistic frequency standard. In response to that standard, the requirement for regulation frequency control ancillary services (FCAS) (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.[36]

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.[37]

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 of the raise and lower regulation FCAS requirements in the mainland are illustrated in Figure 26.

[36] NEMMCO Communication, 16 June 2006
[37] NEMMCO Communication, 7 December 2007

Figure 26: Reductions to raise and lower regulation FCAS requirement (Mainland)

<table>
<tr><th>Month</th><th colspan="2">Enabled regulation FCAS (MW)</th></tr>
<tr><td>July 2003</td><td colspan="2">250</td></tr>
<tr><td>July 2003</td><td colspan="2">220</td></tr>
<tr><td>October 2003</td><td colspan="2">200</td></tr>
<tr><td>March 2004</td><td colspan="2">180</td></tr>
<tr><td>May 2004</td><td colspan="2">160</td></tr>
<tr><td>July 2004</td><td colspan="2">150</td></tr>
<tr><td>April 2005</td><td colspan="2">140</td></tr>
<tr><td>August 2005</td><td colspan="2">130</td></tr>
<tr><td>June 2006</td><td>Time sculpted FCAS raise requirement introduced on 27 June 2006</td><td>120 (Lower)</td></tr>
<tr><td>December 2007</td><td colspan="2">Based on the time error</td></tr>
</table>

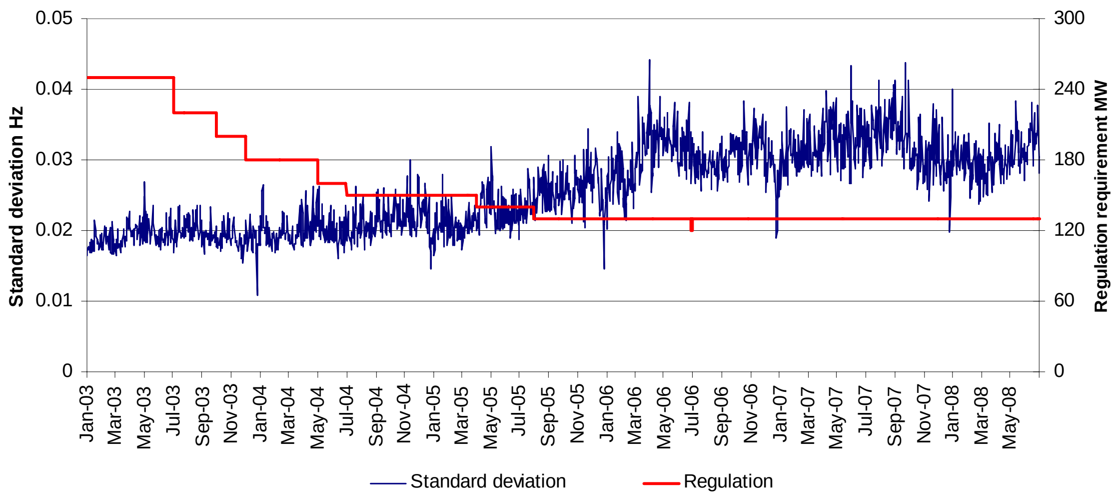
Note: NEMMCO Power System Operations continue to have discretion to increase the raise regulating service requirement as needed at other times.

Figure 27 shows for each day, since January 2003, the distribution of the measured frequency and the requirement for regulation FCAS (raise and lower) on the mainland. As the level of regulation FCAS decreased on the mainland the standard deviation of the frequency generally increased.

A standard deviation below 0.05 Hz meets the Panel's standard.

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

Figure 27: Daily standard deviation of frequency and regulation FCAS enabled on the mainland



Tasmania

Figure 28 shows, for the Tasmanian regions of the national market, how many times the frequency moved outside the normal operating band during the year.

Figure 28: Frequency events in Tasmania 2007-08

Frequency events — Mainland regions	Total	Low frequency	High frequency
Number of events			
outside normal operating frequency band	2	2	0
outside normal operating frequency excursion band	2	2	0
Events where duration exceeded 300 seconds	2	2	0
Events where duration exceeded 600 seconds (i.e. the frequency standard)	2	2	0

There were only two occasions where frequency moved outside the operation band. This is a significant improvement compared with 2006-07 where the number of such occurrences was 31.

However, the durations of the two frequency events were long, where they exceeded 300 seconds on both occasions as illustrated in Figure 29.

A minimum frequency of 48.421 Hz occurred in Tasmania on 8 June 2009 following a trip in the Basslink. On no occasions did the frequency in Tasmania exceed the top of the normal operating frequency band in 2007-08.

Figure 29: Duration of frequency events in Tasmania

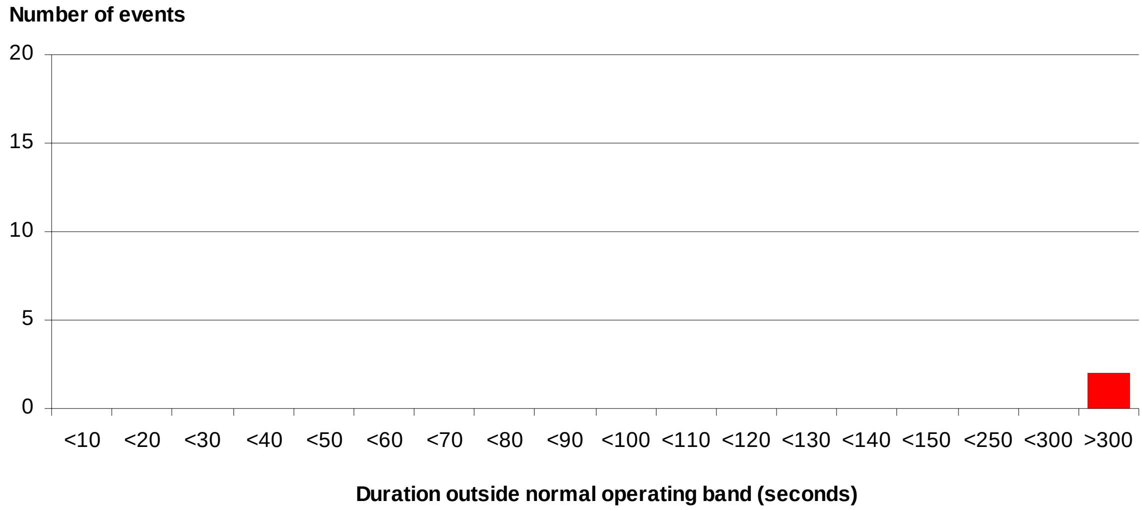


Figure 30 shows for each day, since 29 April 2005, the distribution of the measured frequency and the requirement for regulation FCAS (raise and lower) in Tasmania. A standard deviation below 0.05 Hz meets the Panel's standard.

Equipment ratings

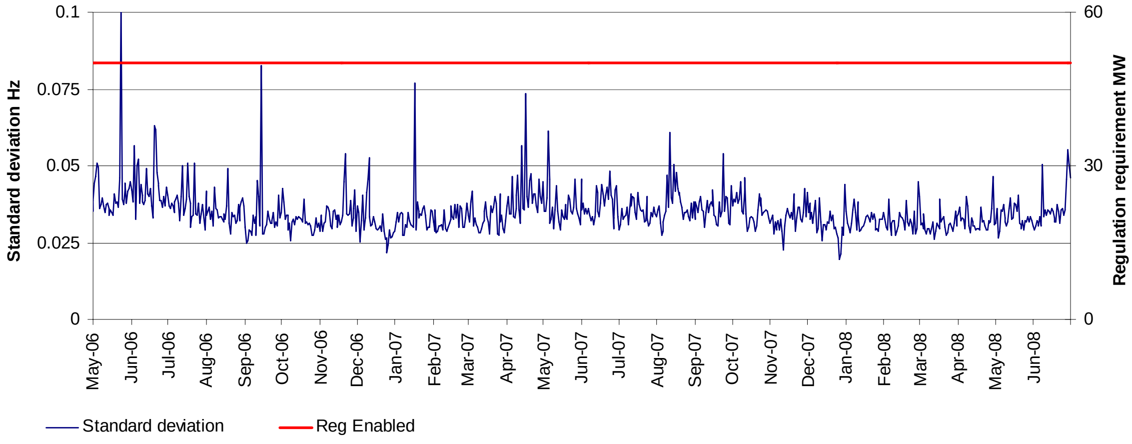
Asset owners provide a statement about the envelope within which NEMMCO may operate individual items of plant and equipment. NEMMCO then allows for the occurrence of any single credible contingency event before the ratings are reached.

Performance assessment

There were no incidents where an interconnector was above the secure limit. The power system operates in a dynamic environment and results in the interconnector exceeding the secure limit for small periods of time that is generally corrected within a dispatch interval.

Potential overloads have been managed through NEMMCO's online monitoring system.

Figure 30: Daily standard deviation of frequency and regulation FCAS enabled in Tasmania



System voltage limits

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

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

Performance assessment

NEMMCO advised that it was generally able to maintain voltages within advised limits throughout the 2007-08 year.

System stability

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

NEMMCO 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 permit 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 on-line Dynamic Security Assessment (DSA) tool. The DSA uses real-time data from the NEMMCO 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 mid 2008 reduced the automatic assessment process to approximately every 3 to 4 minutes.

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

Performance assessment

NEMMCO's reviews of significant events showed system damping times were generally within requirements.

However it 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. On line real time monitoring allows for these scenarios to be identified and fed back to the relevant TNSP.

2.15 Market rule standards

These are codified definitions and procedures. An example is the definition of a *credible contingency* and the requirement to return the power system to a secure state within

30 minutes (see Glossary). Automatic protection schemes, including consumer load shedding, protect the integrity of the overall system if multiple events occur within that 30 minute time frame. This is a similar criteria to that used for many years by state utilities.

Performance assessment

Six transmission-related non-credible contingency events were reported by NEMMCO during the year.

One generation-related non-credible contingency event was identified.

2.16 NEMMCO planning analysis

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

Performance assessment

The quality of NEMMCO'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 NEMMCO 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, for example, determines how susceptible the power system is to disturbances. This inherent response is taken into account when determining the requirements for services scheduled by NEMMCO. 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 NEMMCO. NEMMCO also compares the actual system and participant response to power system events with the requirements of the Rules.

Inherent system response

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 overall security response, inherent response reduces the need for response from other sources such as ancillary services.

Inherent load relief is determined by NEMMCO based on analysis of system performance during frequency disturbances. This value is then taken into account when determining the requirements for frequency control ancillary services scheduled by NEMMCO.

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 NEMMCO following system disturbances.

Performance assessment

NEMMCO investigated and reported power system events, including three major events, during the year. Generally these investigations did not find any major problems with the protection system.

2.18 NEMMCO operational analysis

The inherent and design contributions are analysed by NEMMCO 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, if necessary, intervention. This analysis is performed close to dispatch.

This analysis can have a significant impact on commercial and system security outcomes. For example, NEMMCO'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. NEMMCO 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 standard, 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 standard, and frequency control ancillary services. NEMMCO's scheduling process is reviewed in the market auditor's reports.[38]

2.21 Power system directions

Power system directions are the power system security safety net mechanism available to NEMMCO 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 or "what-if" pricing. A direction for a local security issue does not affect pricing.

NEMMCO issued 6 directions throughout the 2007-08 year to manage local security issues, compared with 10 during 2006-07, 60 during 2005-06, 41 during 2004-05 and 10 during 2003-04.

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[38] Market audit reports are available to registered market participants.

On 18 August, a participant in South Australia was directed to synchronise and follow dispatch targets. The direction was issued to remove constraint violations and to maintain the power system security state.

On 10 and 29 October, lightning in south west Queensland caused NEMMCO to declare the double circuit tripping of the lines in the vicinity of Dumaresq and Braemar as credible contingencies. Participants were directed to reduce output and follow dispatch targets.

A further direction was issued to a Queensland participant on 5 November. On this day, the constraints invoked to manage the unplanned outage of the Broadsound to Nebo line was violated, leading to and unsecure operation of the system. Participant was directed to synchronise and follow dispatch targets.

On 14 November Basslink was directed to vary its dispatch in the direction of Victoria to Tasmania and to follow dispatch target to maintain system security.

On 31 December, the combined outage of the Gordon power station and Chapel Street line and Basslink resulted in insufficient 6-second raise FCAS service available to meet the local requirement. A participant in Tasmania was directed to reduce the output of one of its generators so that the 6-second raise FCAS requirement for the Tasmanian region could be satisfied.

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 DNSP performance data may not necessarily 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.

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 licence conditions. These licence conditions were amended on 1 December 2008 and are published on the Independent Pricing and Regulatory Tribunal's (IPART[39]) website (conditions 14-19).[40]

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.

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

[40] 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/

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).[41]

Figure 31 and Figure 32 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 the DNSP's website.

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 will include 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.

Figure 31: Performance of the NSW DNSPs for the 2007-08 Year (SAIDI)

	Country Energy		EnergyAustralia		Integral Energy		NSW
	Target	Actual	Target	Actual	Target	Actual	Actual
CBD Feeders	n/a	n/a	54	8.1	n/a	n/a	8.1
Urban Feeders	134	80	86	84.8	86	69	79.6
Short Rural Feeders	324	233	360	219.3	300	200	222.4
Long Rural Feeders	730	431	820	543.3	n/a	824	433.9
All Feeders	n/a	225	n/a	100.3	n/a	97.8	130.0

[41] See the Glossary for further information.

Figure 32: Performance of the NSW DNSPs for the 2007-08 year (SAIFI)

	Country Energy		EnergyAustralia		Integral Energy		NSW
	Target	Actual	Target	Actual	Target	Actual	Actual
CBD Feeders	n/a	n/a	0.33	0.04	n/a	n/a	0.04
Urban Feeders	1.92	1.21	1.26	1.04	1.26	0.90	1.01
Short Rural Feeders	3.18	2.42	3.9	2.16	2.8	2.3	2.33
Long Rural Feeders	4.8	3.50	7.5	4.08	n/a	3.9	3.51
All Feeders	n/a	2.28	n/a	1.16	n/a	1.21	1.45

Victoria

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

The Essential Service Commission of Victoria (ESC) sets performance targets for unplanned SAIFI, unplanned SAIDI and Momentary Average Interruption Frequency Index (MAIFI) for the 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.[42] 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.[43]

The performance indicators for the Victorian DNSPs are reported to the ESC. The ESC requires independent audits of these indicators on a rotating basis. The ESC also publishes annual comparative performance reports for the distributors.

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[42] 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 .

[43] 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/

Figure 33 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 ESC website. No deductions have been made here for the significant impact on performance of unusual events for which exclusions have been granted for the purpose of the service incentive scheme of Victoria.

Figure 33: Performance of the Victorian DNSPs for the 2007 year

		Target				Performance			
		Unplanned interruptions		Planned interruptions		Unplanned interruptions		Planned interruptions	
DNSP	**Feeder**	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI
Alinta AE	**Urban**	73	1.27	6	0.03	104	1.57	8	0.03
	Short rural	113	2.25	14	0.08	187	4.36	29	0.08
CitiPower	**CBD**	14	0.25	6	0.02	63	0.39	4	0.01
	Urban	35	0.80	10	0.03	93	0.96	4	0.02
Powercor	**Urban**	98	1.63	16	0.09	140	1.55	11	0.05
	Short rural	118	1.80	35	0.15	204	2.35	27	0.13
	Long rural	297	3.30	70	0.25	302	3.23	30	0.24
SP AusNet	**Urban**	109	1.82	16	0.09	147	1.88	57	0.21
	Short rural	185	2.73	35	0.15	289	3.16	87	0.33
	Long rural	300	4.28	70	0.30	356	4.03	99	0.36
United Energy	**Urban**	59	1.06	16	0.10	105	1.45	18	0.06
	Short rural	96	2.03	35	0.15	112	1.79	34	0.12

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
http://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 SAIDI, SAIFI and MAIFI values, performance of the distribution call centres, and through payments to customers where the GSL requirements are not met.

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 and guaranteed service levels to apply from the beginning of the next regulatory control period which commences on 1 July 2010. On 25 July 2008, the QCA released a Discussion Paper seeking submissions on the issues to be considered in reviewing the Minimum Service Standards (MSS) and GSL requirements.

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.

Figure 34 shows a summary of the performance of the Queensland DNSPs including target and actual performance values for each DNSP. More detailed performance information is available from network performance reports available on the QCA website.

Figure 34: : Performance of the Queensland DNSPs for the 2007-08 Year

DNSP	Feeder	Target				Performance[44]	
		SAIDI		SAIFI		SAIDI	SAIFI
		2006-07	2007-08	2006-07	2007-08	2007-08	2007-08
Energex	CBD	20	20	0.33	0.33	3.811	0.032
	urban	145	134	1.64	1.54	83.863	1.044
	Short-rural	255	244	2.70	2.63	240.949	2.699
Ergon	urban	205	195	2.60	2.50	181.16	1.87
	Short-rural	570	550	5.20	5.00	460.09	3.52
	Long - rural	1,130	1,090	8.60	8.50	1,036.94	6.46

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.

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

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 Panel anticipates that the information regarding the performance of DNSPs in South Australia would become available prior to the publication time of the final version of this report. If this is the case, the Panel would publish this information in the report.

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[45].

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
- a guaranteed GSL supported by the TEC and relevant guidelines.[46]

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.

Figure 35 shows a summary of the performance of the Tasmanian DNSP against the former supply reliability standards.

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

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

Figure 35: Performance of the Tasmanian DNSP 1 July to 30 June 2008 (against the former supply reliability standards)

Feeder	Performance		
	CAIDI	SAIDI	SAIFI
CBD	68	40	0.59
Urban	130	156	1.2
Rural	127	377	2.97
System	126	272	2.15

Figure 36 shows the new network performance standards against the amended TEC.

Figure 36: Performance of the Tasmanian DNSP 1 January to 30 June 2008 (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	24	30	0.24	0.20
High Density Commercial	53	60	0.55	1.00
Urban and Regional Centres	207	120	1.49	2.00
Higher Density Rural	485	480	3.22	4.00
Lower Density Rural	605	600	3.75	6.00

ACT

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[47] and in the Consumer Protection Code,[48] which also has minimum service standards.

[47] IRCR, 2000, *Electricity Distribution (Supply Standards) Code*,

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.

Figure 37 shows a summary of the performance of the ACT DNSP for 2006-07. More detailed performance information is available from network performance reports available on the ICRC website.

The IRCR does not have any specific enforcement mechanisms other than the payments to customers prescribed in the Consumer Protection Code. The IRCR has not adopted a service standard scheme as it considered there would be little potential benefit in the ACT and was unlikely to result in the efficient level of service quality.[49]

Figure 37: Performance of the ACT DNSP 2006-07 year

		Feeder Category		Network
		Urban	Rural Short	
SAIDI	**Overall**	82.9	102.4	83.6
	Distribution network—planned	52.2	31.6	51.4
	Distribution network—unplanned	30.7	70.7	32.2
SAIFI	**Overall**	0.80	0.76	0.80
	Distribution network—planned	0.21	0.14	0.21
	Distribution network—unplanned	0.59	0.62	0.59
CAIDI	**Overall**	103.4	134.1	104.5
	Distribution network—planned	243.4	225.3	243.0
	Distribution network—unplanned	52.3	113.5	54.7

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http://www.icrc.act.gov.au/__data/assets/pdf_file/0016/16630/electricitydistributionsupplystandardscodecw.pdf

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

49 Further information is available in the IRCR's Final Decision – Review of Efficiency and Service Standard Incentive Mechanisms", available on the IRCR website at http://www.icrc.act.gov.au.

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 of "N-1" imposed on all DNSPs in NSW.

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 Electricity Supply Regulation (Safety and Management) 2002 . That includes lodging and then complying with a five year Network Management Plan with the NSW Department of Water and Energy). TransGrid issued an updated Network Management Plan in May 2008.

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, the CBD, which is planned on a modified "N-2" basis, or when required to accommodate NEMMCO's operating practices.

A revised Regulation was issued on 1 September 2008, and this will require TransGrid to re-issue the Network Management Plan every two years with the first issue under the new Regulation required by March 2009.

Victoria

In Victoria, VENCorp is the TNSP responsible for planning the shared transmission network. It undertakes its responsibility in accordance with Victorian legislation, Licence obligations, the Rules and the Victorian Electricity System Code.

VENCorp typically assesses new augmentations under the market benefits limb of the AER's Regulatory Test, which considers both the benefits and costs of alternative options. VENCorp calculates the market benefits of options using a probabilistic planning process and explicitly values the risk of involuntary load curtailment or value of customer reliability (VCR), associated with transmission constraints. The VCR is currently set at $ 47,850.[50] However VENCorp also considers a sector specific VCR where the transmission constraint affects only a reasonably distinguishable subset of the Victorian load.

[50] Vencorp 2008, *The Value of Customer Reliability Used By Vencorp For Electricity Transmssion Planning - Consultation Paper*, Melbourne, viewed 18 September 2008, http://www.vencorp.com.au/index.php?action=filemanager&folder_id=1047&pageID=7752&sectionID=7742

Queensland

The mandated reliability obligations and standards are contained in Schedule 5.1 of the Rules, the Queensland Electricity Act, the transmission licence, 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); and
- The Connection Agreements between Powerlink and ENERGEX, Ergon Energy and Country Energy include obligations regarding the reliability of supply as required under clause 5.1.2.2 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.[51] The ETC sets specific reliability standards (N, N-1, N-2 etc.) for each transmission exit point.

ESCOSA recently undertook a review of the definitions of specific reliability in clause 2.2.2 of the ETC. The associated changes to the ETC took effect from 1 July 2008 to

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

align with the AER's next price determination for ElectraNet.[52] As part of the review, ESCOSA has 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 reliably.

Tasmania

Following a request by the Office of the Tasmanian Energy Regulator, the TRNPP submitted its final report making recommendations for transmission network security and planning criteria to apply in Tasmania. The Regulator accepted the recommendations and forwarded the criteria to the Minister for Energy.

Under the Electricity Supply Industry Act 1995 , regulations were made on 3 December 2007 to give effect to the criteria. The regulations are the Electricity Supply Industry (Network Performance Requirements) Regulations 2007. The objective of these regulations is to specify, for the prescribed transmission service, the minimum network performance requirements that a planned power system of a Transmission Network Service Provider must meet in order to satisfy the reliability limb of the regulatory test in the Rules.

Transend is required to plan and develop its facilities to meet these planning criteria and to use the "reliability limb" of the AER's "regulatory test" as a justification for reliability driven augmentations of the transmission network.

Transend's performance incentive scheme is part of its current revenue cap determination as set by the AER. Transend does have some connected party specific performance schemes as part of connection agreements.

3.3 Transmission Reliability Standards Review

On 13 April 2007, the Council of Australian Governments (COAG) asked the MCE to request the AEMC to develop a detailed implementation plan for the national transmission planning function.[53] The 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.

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[52] 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.

[53] AEMC, *MCE Request Dated 3 July 2007*, http://www.aemc.gov.au/electricity.php?r=20071221.150018

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 (contained in the report published on 22 July 2008, see section 2.4),[54] and provided its final advice to the MCE on 30 September 2008.

[54] Further details regarding the National Transmission Planner and the revised Regulatory Investment Test for Transmission are available on the AEMC's website, http://www.aemc.gov.au/electricity.php?r=20070710.172341

4 Reliability Panel Members

In 2005 the AEMC undertook the process required under the Rules for appointing new Members (other than the Chairman, previously appointed by the AEMC, and NEMMCO's representative, provided by NEMMCO itself) to the Panel. Those appointments took effect from 1 January 2006 and were initially for a period of two years, which was subsequently extended by a year,

The Panel consists of the following Members:

Ian C Woodward
Chairman, Reliability Panel
Commissioner, Australian Energy Market Commission

Kerry Connors (from May 2007)
Executive Officer, Consumer Utilities Advocacy Centre

Jeff Dimery
General Manager, Merchant Power, AGL Energy

Mark Grenning
Chief Advisor Energy, Rio Tinto

Les Hosking
Managing Director and CEO, NEMMCO

Gordon Jardine
Chief Executive, Powerlink

George Maltabarow
Managing Director, EnergyAustralia

Stephen Orr
Commercial Director, International Power Australia

Geoff Willis
former CEO, Hydro Tasmania

David Swift (from March 2008)
Chief Executive, Electricity Supply Industry Planning Council

The tenures of current Panel Members expires on 31 December 2008, and the AEMC is currently undertaking a process to appoint a Panel to commence from 1 January 2009.

5 Glossary[55]

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**

[55] 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 NEMMCO's 2004 Statement of Opportunities.

	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.
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