Australian Energy Market Commission

AEMC Reliability Panel

Annual Electricity Market Performance Review 2007

Final Report

February 2008

Foreword

A reliable national electricity system is critically important for all Australians. Consumers, energy supply 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 2006-07 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.

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 distribution network. Although the Panel is not involved with local supply matters, this report also includes for the second time 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 NEM.

Where appropriate, the Panel offers recommendations as to how performance in the areas in respect of which it has oversight can be improved in the coming years.

I wish to thank all Panel members for the generous and important contributions made in the 2006-07 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.

The majority of customers' interruptions to supply occur in local 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, High Voltage Transmission and Generation in the National Electricity Market (NEM) 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 National Electricity Rules (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 two-page **Executive summary** for a brief outline of the purpose and scope of this performance review and for a summary of the Reliability Panel's (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 2006-07 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 objective of the National Electricity Market, 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 Australian Energy Market Commission (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

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 include the following:

- 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;
- reviewing the performance of the market in terms of power system security and reliability;
- determining the system restart standard on the advice of NEMMCO; 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.

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 to the period 1 July 2006 to 30 June 2007.

Executive summary

This report reviews the performance of the national electricity system in terms of reliability and security over the 2006-07 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 distribution networks), and it offers recommendations to improve performance in the future.

This report is 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 Reliability Panel (Panel) published a draft report on 18 December 2007. Submissions on this draft report closed on 17 January 2008.

The Panel has received a single submission from CitiPower and Powercor Australia in relation to the presentation of distribution network reliability statistics. The matter raised in the submission has been addressed in this final report.

The draft report was presented in the NEM Forum on 13 December 2007. In accordance with the requirements under clause 8.8.3(f) of the Rules, interested parties were also given an opportunity to comment on the draft report in a meeting.

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 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

[1] See *contingency events* in the Glossary for full explanation.

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.

As part of the Comprehensive Reliability Review (CRR),[2] the Panel has reached confirmed conclusions on, inter alia, the following matters with respect to the reliability standard in the NEM:

- The form of the standard will be USE measured over ten years looking backwards, and that it should be targeted to be achieved prospectively on an annual basis, NEM-wide and in each region.
- The level of the standard will remain unchanged at 0.002% USE.
- The scope of the standard should extend to generation and bulk transmission capacity only, and should not apply to security events and external events such as terrorism, industrial action or "acts of God".

Appendix D of the final report of the CRR contains the NEM Reliability Standard.

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 2006-07. However, the Panel notes that there were times where the capacity fell below the minimum reserve standard.
- In the long term, since market start in December 1998, averages for USE due to shortfall in available capacity indicate that New South Wales and Queensland remain within the Reliability Standard. South Australia and Victoria fell outside the Standard in the year 2000, when there was a coincidence of industrial action, high demand and temporary loss of generating units in Victoria; and their long-term averages remain outside the Standard due to that 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.
- Over the year, an additional 1 140 MW of generating capacity (scheduled and non-scheduled) was registered to be brought into service.

[2] Further details of the Panel's Comprehensive Reliability Review is available on the AEMC website at www.aemc.gov.au.

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 updates to this report in August 2007 and November 2007. There was no USE in 2006/07 due to drought.

Security

- There were a number of incidents which affected levels of continuity and security of supply within the system. Three major incidents resulted in USE are discussed in this report. This includes the bushfire event in northern Victoria which separated the NEM into three electrical islands. Various system security issues have been raised by the AER, including the issue where NEMMCO's contingency event reclassification process lacks transparency and consistency. The Panel notes that these issues are being addressed.
- 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

Although the Reliability Standard was not breached, there has been a significant amount of USE due to security events during the year. These events were often due to multiple-contingency incidents. The Panel continues to be concerned that these events are having a serious 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 2006-07 year appear to have been generally robust.

[3] Drought Scenarios Investigation report is available in NEMMCO's website NEMMCO's website http://www.nemmco.com.au/nemgeneral/900-0001.htm

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 2006-07.

The performance review is organised under the following headings:

- Scope of the performance review: reliability and security
- The major power system incidents
- Other security issues
- Discussion: what can the Reliability Panel (Panel) learn?

Since the 1999-2000 summer, peak scheduled demand on the mainland has grown by 5 171 MW or 20.4%, with annual growth averaging around 2.7%. Over the same time, summer aggregate scheduled generation capacity on the mainland has risen by more than 4 000 MW, with additional increases from smaller and unscheduled plant.

In the 2006-07 year, national summer peak demand reached 31 756 MW in February 2007. National winter peak demand during the year reached 32 646 MW in June 2007. This is up from the record of 31 027 MW the previous summer and 31 597 MW the previous winter (inclusive of Tasmania). Maximum demands occurred in the 2006-07 year at 13 076 MW in New South Wales in July 2006, 9 062 MW in Victoria in January 2007, 8 611 MW in Queensland in March 2007, 2 862 MW in South Australia in February 2007 and 1 684 MW in Tasmania in August 2006.

In terms of new capacity and changes to existing capacity in 2006-07, the Panel notes that:

- a total of 1 054 MW of new plant (scheduled and non-scheduled)[4] has been registered to be brought into service commissioned; 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 2006-07, see Section 2 of this report, *Technical performance assessment*.

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

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.

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 unserved energy (USE) is 0.002%.

In applying this standard, the Panel does not take account of USE that is caused by 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.

Nor does the Panel consider in its reliability measurements any USE that is the result of non-credible (or multiple) contingency events: 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; 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 the non-credible contingency events.

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

To regulate the performance of power system security, the Panel has determined the frequency operating standards for the mainland[5] and for Tasmania. This will be discussed in greater detail in Section 2.13.

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

1.2 The major power system incidents

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

- Victoria, 16 January 2007
- Tasmania, 22 February 2007
- Queensland, 20 June 2007

Each of these incidents led to losses of consumer load. In accordance with clause 4.8.15 of the Rules, NEMMCO has investigated all three incidents and in each case published a report[6] on its findings.

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

Victoria, 16 January 2007

Bushfires in northern Victoria has resulted in two transmission lines tripping and consequently the power system separated into three electrical islands.

A major imbalance followed which resulted in 2 490 MW of lost load in Victoria. Some lost load also occurred in South Australia.

At 15:02 hrs (Eastern Standard Time) on Tuesday 16 January 2007, NEMMCO reported that 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 comprising:

(1) Queensland, New South Wales and part of northern Victoria;

(2) the remainder of Victoria and Tasmania; and

(3) South Australia.

Victoria was importing a significant amount of power from Snowy, South Australia and Tasmania at the time of the event. Therefore, the network separation resulted in an imbalance between supply and demand in Victoria, and approximately 2 490 MW of customer load was shed through operation of the automatic under-frequency load shedding scheme in order to match demand with available supply. South Australia was reconnected to Victoria around at 15:42 hrs, and the restoration of customer loads commenced shortly afterwards. The final instruction to restore customer load was issued at 18:15 hrs.

[6] NEMMCO's system operating incidents reports are available on its website at www.nemmco.com.au

Comments

The Panel notes that both NEMMCO[7] and the AER have investigated this power system incident. In particular, the Panel notes the main findings of the investigation and outcomes, reported by the AER[8], as follows:

- The AER considers the NEMMCO's contingency reclassification process on 16 January 2007 was non-transparent and unduly relied upon the advice of a market participant. However, NEMMCO did not breach its Rules obligation with respect to contingency reclassification because clause 4.2.3(f) of the Rules provides NEMMCO with the discretion, but not the obligation, to reclassify contingency events when abnormal conditions arise. The AER considers the reclassification would have reduced the extent of load shedding event in Victoria. The AER proposed a Rule change to clause 4.2.3(f) to make it clear that NEMMCO has full responsibility for the reclassification process and decisions and to make the reclassification process more transparent, rigorous and consistent.
- During this power incident, two load blocks failed to fully shed as expected. The AER concluded that this was not the result of a breach by the relevant transmission asset owner, SP AusNet, of the relevant Rules provisions and performance standards, regarding the operation of its load shedding facilities. Nevertheless, the AER intends to target SP AusNet's protection and control systems and load shedding facilities in the upcoming round of compliance audits.
- SP AusNet may have failed to communicate or, at least, adequately communicate the unavailability of the parts of the relevant load blocks to NEMMCO and VENCorp, the body responsible for the load shedding schedule in Victoria. Accordingly, the AER recommended the establishment of formal and effective communication processes between all parties involved in load shedding to ensure that appropriate action can be taken. The AER required NEMMCO to report back to the AER and to the market in on the amended arrangements. The Panel notes that this requirement has been included in NEMMCO's Automatic Under Frequency Load Shedding Scheme (AUFLS) review and development work.[9]
- There were deficiencies in the NEMMCO's management of the load restoration process. In particular, NEMMCO did not use the Demand Offset Facility (DOF), which resulted in demand being under-forecast and insufficient generation dispatched. In turn, the AER considers this resulted in a recurrence of low frequency and NEMMCO was required to shed more customer load. The AER

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7 The results of NEMMCO's investigation is outlined in http://www.nemmco.com.au/marketandsystemevents/232-0052.htm

8 The finding of the AER is outlined in the AER's investigation report: http://www.aer.gov.au/content/index.phtml?itemId=714828

9 See letter from NEMMCO to the AER (20 December 2007) in http://www.aer.gov.au/content/index.phtml?itemId=714828

reported that NEMMCO has committed to a review of its procedures and staff training program to ensure that its emergency systems operate as intended in assisting with restoration of load. The Panel notes that NEMMCO is addressing these deficiencies.

- NEMMCO set the dispatch price to VoLL during the load restoration process following automatic load shedding. At the time, the conditions governing the application of VoLL in clause 3.9.2 of the Rules had not been satisfied. The AER considers NEMMCO's failure to comply with clause 3.9.2 highlights the difficulty associated with the assessment required by the clause and the clause is an unnecessary distraction for NEMMCO when it has more urgent system security issues to deal with. Accordingly, the AER proposed a Rule change recommending the removal of the obligation on NEMMCO to set the dispatch price to VoLL following automatic load shedding resulting from a contingency event. This means the market would determine the spot price when automatic load shedding occurs.
- NEMMCO issued a number of directions to participants in the Victorian and South Australian regions but did not apply intervention pricing. The AER considers that NEMMCO's failure to use intervention pricing in those cases amounted to a breach of clause 3.9.3 of the Rules. The AER reported that, in response to this reported breach, NEMMCO have made recommendations to improve processes and training for staff responsible for the application of intervention pricing. The AER fully supports those recommendations. The Panel notes that NEMMCO has taken steps to implement intervention pricing under disturbed system conditions.[10]
- At least one generator breached its technical standards obligations on 16 January. However, the AER also notes that this occurred during a transitional phase in which pre-existing performance standards were being reviewed and formalised. Furthermore, in the case of the possible breach, NEMMCO's report indicates that the generator trip in question actually assisted in re-stabilising the power system. Thus, the AER does not intend to take enforcement action for failure by generators to comply with the technical performance standard requirements in the Rules on 16 January. However, now that the transitional phase has ended, the AER will commence auditing generators' performance standards compliance programs to assess compliance with the relevant provisions of Chapters 4 and 5 of the Rules. The AER indicated that it will act on failure by generators to comply with the technical performance standard requirements in the Rules.
- The AER considers some market participants have breach a certain ancillary services provisions in the Rules. The AER has investigated this matter and

[10] See letter from NEMMCO to the AER (20 December 2007) in http://www.aer.gov.au/content/index.phtml?itemId=714828

issued three $20,000 infringement notices to the State Electricity Commission of Victoria (SECV).[11]

- The AER considers compliance with clause 4.9.8(d) and the relevant provisions of NEMMCO's Market Ancillary Service Specification is important for system security. The AER indicated that these issues will be treated as a high priority in its compliance audit program. The AER indicated that it will target the generators that failed to comply with the relevant FCAS requirements on 16 January.

The Panel notes that both the AER[12] and NEMMCO[13] are continuing to address the deficiencies identified above.

Tasmania, 22 February 2007

Sheffield–Farrell No 1 & No 2 220 kV lines tripped due to lightning storms across the western and central region of the Tasmania. The trip has resulted in the power system at the west coast to be islanded. A number of generating units tripped in the islanded system and eventually led its collapse of the west coast transmission system.

On the 22 February 2007 at 17:02 hrs (AEST), the Sheffield–Farrell No 1 & No 2 220 kV lines tripped due to lightning storms across the western and central regions of Tasmania. The interruption to these two circuits resulted in the disconnection of the west coast transmission network from the remainder of the Tasmanian system.

The frequency in the west coast islanded system rose to above 55 Hz and caused the operation of the Over Frequency Generation Shedding Scheme (OFGSS) and over-speed protection relay. The shutdown of all generation in the islanded west coast region due to the operation of the OFGSS and the over-speed protection relays subsequently resulted in the collapse of the islanded west coast system.

The disconnection of the west coast system resulted in generation deficit in the remaining Tasmanian system and the frequency was falling to 48.25 Hz, and initiating a rapid ramping back of Basslink export to Victoria.

Supply was restored to retail and major industrial customers between 17:29 hrs and 17:55 hrs.

Comments

The Panel notes, as outlined in NEMMCO's *Power System Incident Report*,[14] NEMMCO did not reclassify the outage of both Sheffield–Farrell No 1 & No 2 220 kV transmission

[11] http://www.aer.gov.au/content/index.phtml/itemId/715797/fromItemId/656050

[12] See letter from the AER to NEMMCO (3 October 2007) in http://www.aer.gov.au/content/index.phtml?itemId=714828

[13] See letter from NEMMCO to the AER (24 September 2007) in http://www.aer.gov.au/content/index.phtml?itemId=714828

lines to be a credible contingency event, despite the reclassification having been recommended by Transend. NEMMCO did not reclassify the outage because "lightning activity was not close and appeared to be moving away from the Sheffield–Farrell No 1 & No 2 220 kV transmission lines".

The Panel considers the reclassification may have enabled NEMMCO to take the appropriate action to minimise the severity of the impact of the power system incident.

The Panel also notes the ambiguity in the Rules in relation to the circumstances when NEMMCO is required to reclassify a contingency event. As a result, it is unclear whether NEMMCO has a reasonable ground not to exercise its option to reclassify the outage.

It is anticipated that the rule change proposed by the AER (to clause 4.2.3(f) of the Rules, regarding reclassifications), as discussed under the heading of "Victoria*, 16 January 20067*" above, will provide NEMMCO further clarification in relation to its obligation concerning contingency reclassification.

The Panel notes that several deficiencies in the power system have been identified and recommendations have been provided by NEMMCO to further strengthen the security of the system.[14]

Queensland, 20 June 2007

Double contingency event occurred on this day where a transformer has tripped which led to the loss of load, and subsequently resulted in a generating unit to trip.

At 2300 hrs on 20 June 2007, the Boyne Island Smelter in Queensland suffered the loss of its No.1 132/11 kV Plant Transformer as well as its No.1 and 5 132 kV busbars, and No. 1 and No. 3 potlines. In addition, the generating unit 4 at Gladstone Power Station tripped out of service. These events took place over a period of a few seconds.

Comments

The Panel notes that power system security was maintained during this incident. The Panel also notes that there was a minor issue with the backup protection system which led to its unintended operation during the power system incident. The Panel understands that work is being planned to modify the back up protection system.[15]

[14] Report available in NEMMCO's website: http://www.nemmco.com.au/marketandsystemevents/232-0055.htm

[15] Further information is available in NEMMCO's Power System Incident Report http://www.nemmco.com.au/marketandsystemevents/232-0062.htm

1.3 Other security issues

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

Transmission events

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

Directions

NEMMCO issued 10 directions throughout the year to manage local security issue (compared to 60 during 2005-06, 41 during 2004-05 and 10 in 2003-04). Of these, six in Victoria and one in South Australia, were related to maintaining power system security following the loss of Victoria to Snowy interconnector on 16 January.

The remaining three occasions occurred in Queensland where fast start generators were directed to synchronise their units to maintain a secure operating state.

Frequency deviations

During the year the frequency on the mainland deviated from the normal operating band on 18 occasions. The frequencies remained outside the normal band for more than 5 minutes on 12 of these occasions. On 3 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 59 occasions (compared to 630 last year). On 18 of these, frequency remained outside the normal band for more than 5 minutes; and on 9 of the frequency was outside the normal band for longer than the standard allows.

1.4 Discussion: what can the Panel learn?

Reliability results

There was sufficient generation capacity to meet consumer demand at all times during the 2006-07 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 sixth consecutive year.

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

- New South Wales, 0.0001%;
- Queensland, 0%;
- South Australia, 0.0022%; and
- Victoria, 0.0088%.

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 loss of generating units in Victoria during January and February; and their long-term averages remain outside the Standard due to that 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.

NEMMCO has published three drought reports to assess the impact of drought on reliability of electricity supply.

In May 2007, NEMMCO published a report on the impact of the current drought on system reliability for Q2 2007 to Q1 2009.[16] NEMMCO subsequently published updates to this report in August 2007 and November 2007. There was no USE in 2006/07 due to drought.

Security results

While none of the three major incidents this year resulted in USE due to insufficient supply, the Panel remains concerned that there has been a significant amount of USE due to *power system security* issues.

[16] Drought Scenarios Investigation report is available in NEMMCO's website NEMMCO's website http://www.nemmco.com.au/nemgeneral/900-0001.htm

System security event, 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 appear to 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 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 2008.

1.5 Comprehensive Reliability Review

The CRR has been completed in December 2007. In this review, the Panel has reached confirmed conclusions on the following matters:

- the NEM has to date achieved satisfactory performance against the reliability standard;
- the form, level and scope of reliability standard;
- the design and operation of a new Energy Adequacy Assessment Projection (EAAP) to enable the market to forecast and respond to projected times where there may be energy constraints;
- NEMMCO's ongoing power to issue Reliability Directions is to be retained without a sunset;
- improving the "Reserve Trader" with incremental changes to redesign it as a Reliability and Emergency Reserve Trader (RERT) to operate with a defined sunset period;
- the review of short term reserve levels is to be undertaken;
- VoLL is to be renamed Market Price Limit (MPL);
- levels of MPL and Cumulative Price Threshold (CPT); and
- the MPL is to be reviewed every two years.

The Panel notes that the Australian Energy Market Commission (AEMC) is reviewing the level of the Administered Price Cap.[17]

[17] Further details regarding the Administered Price Cap review is available on AEMC's website: http://www.aemc.gov.au/electricity.php?r=20071105.151356.

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 of 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.

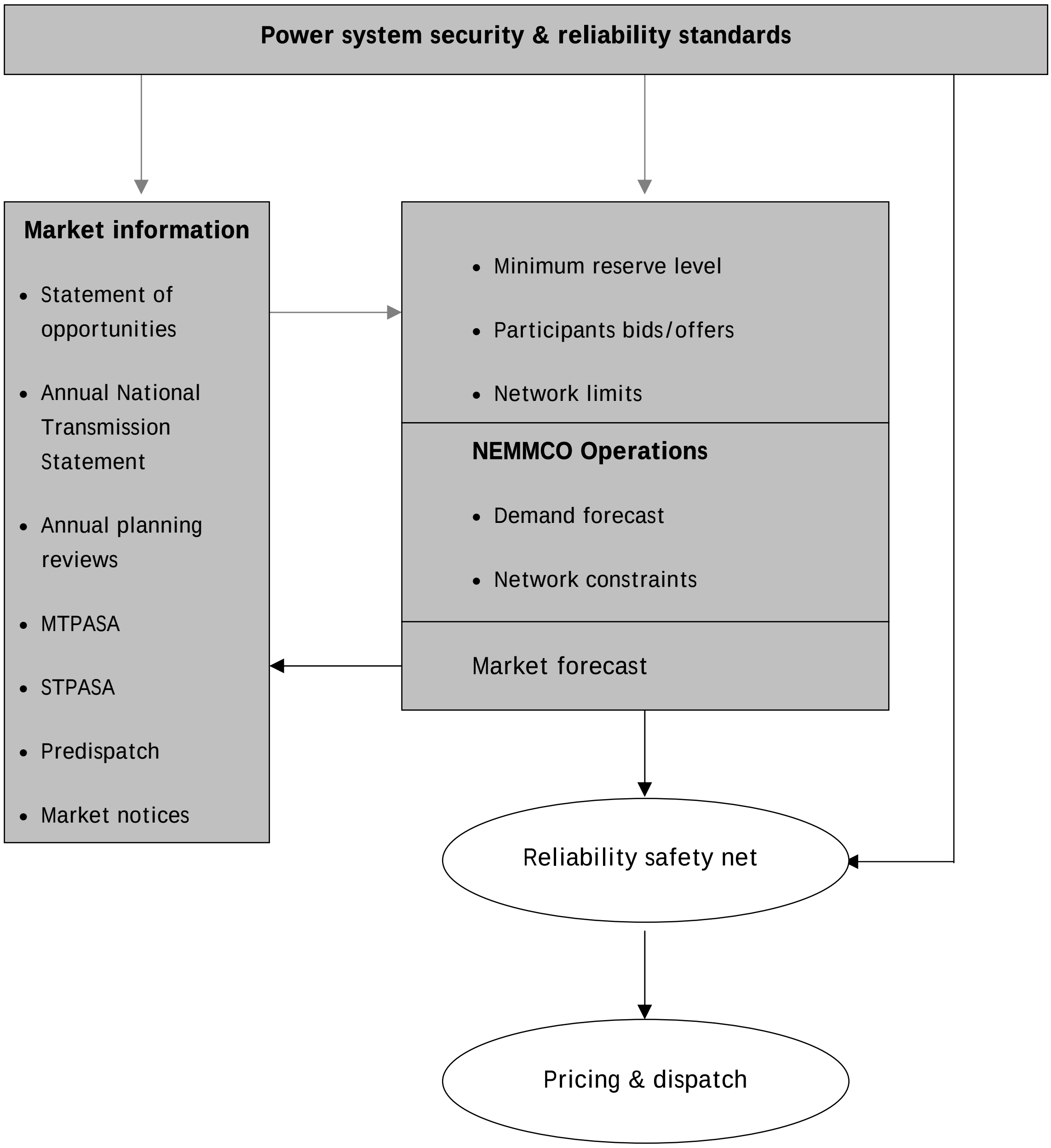
2.1 Reliability Management

The 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. NEMMCO monitors the level of reserve in each region and may intervene if these reserves fall below margins calculated by NEMMCO as necessary to meet the Panel's standard. Market information provides data and projections with increasing levels of detail closer to the time of dispatch. The annual Statement of Opportunities (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.

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

Figure 1: Reliability model



2.2 Energy market Reliability Standard

The Reliability Standard of 0.002% unserved energy is designed to deliver 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.[18]

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 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 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-network constraints on reliability.

Performance assessment

No USE occurred during 2006-07 as a result of a reliability incident and, therefore, the reliability standard was met in all regions. For the sixth 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.[19]

[18] The reliability standard and associated reliability arrangements in the NEM are the subject of the Panel's Comprehensive Reliability Review, details of which are available at www.aemc.gov.au.

[19] 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 reserve 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 2.8) 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% POE demand and taking into account reserve available across interconnectors. In particular Snowy generation capacity is shared between Victoria and NSW.

In December 2005, NEMMCO has commenced a review of the minimum reserve levels. This review was finalised in September 2006 and was 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. 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.

[20] The review can be found in NEMMCO's website http://www.nemmco.com.au/powersystemops/240-0020.htm

Figure 2: Revised minimum reserve levels

	QLD *	NSW	VIC & SA	SA *	TAS
2006-07	480 MW	– 1490 MW	615 MW	-50 MW	144 MW
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

** This 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 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 4000 MW (2900 MW from Snowy and 1100 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.

Performance assessment

Figure 3 summarises the results, in each region, where the reserves fell below the minimum reserve levels. For the last eight 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.

Figure 3: Forecast Duration below the minimum reserve levels

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

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 2.9.

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 the 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.

Performance assessment

Figure 4 compares the forecast demand, for medium growth and 10%, 50% and 90% probability of exceedence (POE), with the actual maximum demands. The forecast demand values shown are from the 2006 SOO (apart from the 2007 winter values which were published in 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 exception applies:

- Winter 2006: the maximum demands in Tasmania and New South Wales were below the 90% POE level;
- Summer 2006-07: the maximum demands in Queensland, New South Wales and South Australia were below to 90% POE level; and
- Winter 2007: the maximum demand in Victoria was way above the 10% POE.

The Panel notes that in 2005 NEMMCO engaged KEMA Consulting to review the processes used to prepare the load forecasts in the SOO. KEMA Consulting's report is available on the NEMMCO website.[21]

A number of recommendation has been made by KEMA and they have been incorporated into the load forecast preparation process.

To monitor the ongoing performance of the forecasting process, the Comprehensive Reliability Review (CRR) has requested that NEMMCO report to the Panel, each

[21] The KEMA report "Review of the process for preparing the SOO load forecasts" is available on the NEMMCO website at www.nemmco.com.au.

November, on the accuracy of the most recent SOO demand forecasts and on improvements in the forecasting process that will be used to prepare the subsequent SOO.

Figure 4: SOO maximum demand forecast comparison

Region	QLD	NSW	VIC	SA	TAS
Winter 2006 2006 SOO Peak forecast (10% POE)	7 875	13 780	7 891	2 409	1 894
(50% POE)	7 730	13 460	7 790	2 364	1 875
(90% POE)	7 584	13 160	7 680	2 315	1 822
Actual maximum demand [1]	7 615	13 078	7 846	2 364	1 697
Summer 2006-2007 2006 SOO Peak forecast (10% POE)	9 675	14 750	10 234	3 441	1 498
(50% POE)	9 168	13 780	9 421	3 222	1 480
(90% POE)	8 818	13 050	8 981	2 922	1 464
Actual maximum demand [1]	8 594	12 868	9 012	2 860	1 473
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 [1]	7 838	13 894	8 307	2 383	1 749

[1] The demand for comparison with the SOO forecasts (up to 6 August 2007 for the 2007 winter).

In the 2006-07 year, national summer peak demand reached 31 756 MW in February 2007. National winter peak demand reached 32 646 MW in June 2007. This is up from the record of 31 027 MW the previous summer and 31 597 MW the previous winter. Maximum demands occurred in the 2006-07 year were as follows:

- 13 076 MW in New South Wales in July 2006;
- 9 062 MW in Victoria in January 2007;
- 8 611 MW in Queensland in March 2007;
- 2 862 MW in South Australia in February 2007; and
- 1 684 MW in Tasmania August 2006.

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

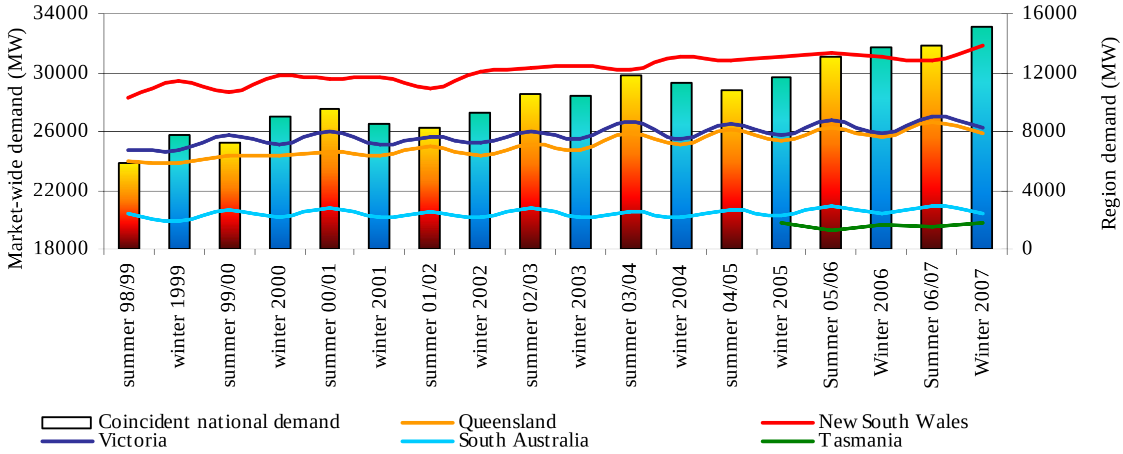
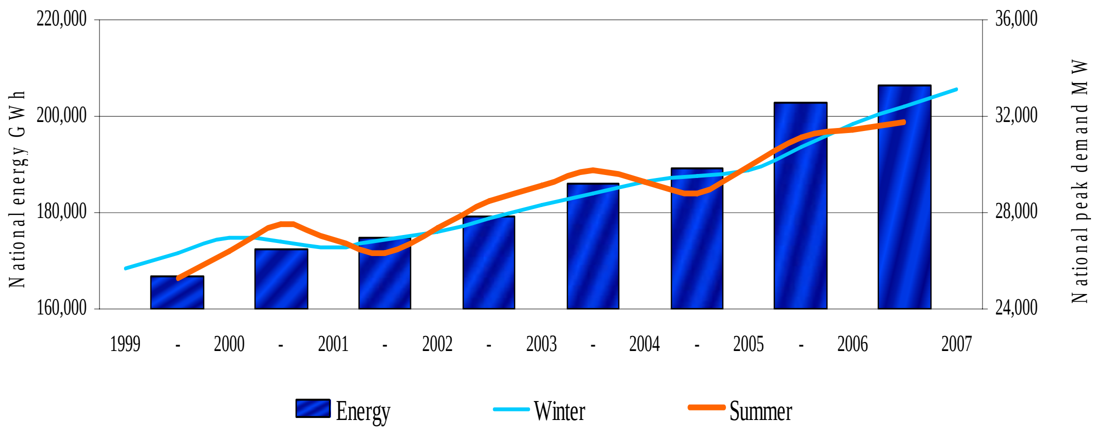


Figure 6 sets out the growth in annual total energy and the winter and summer national peak demands. It can be observed from this figure that energy demand has grown significant since the market start. It is the Panel's objective that sufficient plant capacity is available to keep the USE level under 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. 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.

Figure 7: Transmission outages submitted to NEMMCO

	QLD	NSW [1]	VIC	SA	TAS	MurrayLink	Terranora	Total
Outages Frequency [2]	1 039	1 141	1 402	984	397	13	55	5 031
Scheduled with less than 4 days notice	26%	22%	33%	21%	22%	80%	58%	26%
Forced outages [3]	7%	6%	11%	5%	6%	23%	22%	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 level was 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 2006-07.

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.[22] This functionality in MT PASA continued to be used in the financial year 2006-07.

NEMMCO is also undertaking ongoing work with Tasmanian participants to improve the modelling of energy limited plant in Tasmania.

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

[22] The NEMMCO report "MTPASA Process Description" of 27 April 2006, available at http://www.nemmco.com.au/dispatchandpricing/556.htm

NEM participants. The adequacy of modelling energy limited plant was within the scope of the review.

The consultation on Energy Adequacy Assessment Projection (EAAP) process commenced afterwards. NEMMCO considered it was prudent that the enhancements to energy modelling in MT PASA process should be investigated after the EAAP process is sufficiently progressed.

In the meantime, the regular drought investigations are undertaking energy adequacy assessments for Tasmania for the next two years based on two rainfall assumptions.

NEMMCO will consider liaising with Tasmanian participants on modelling of energy limited plant in Tasmania if the above processes do not sufficiently meet the requirements.

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. 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 2006-07.

2.7 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, provided by the AER, summarises the number of trading intervals affected by significant variations between predispatched and actual prices during the 2006-07 period as well as the most probable reasons for the variations.

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	2 377	58%	2 667	60%	2 815	60%	3 334	63%	2 602	55%
Availability	958	23%	1 009	23%	973	21%	883	17%	869	18%
Combination (e.g. combination of changes in plant availability, demand, rebidding activities)	737	18%	747	17%	868	19%	1 057	20%	1 269	27%
Other (e.g. network outages)	17	0%	15	0%	24	1%	21	0%	5	0%
Trading intervals affected	3 235	18%	3 603	21%	3 858	22%	4 295	25%	4 015	23%

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 for the one trading interval.

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

Figure 8 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 still with growth in non-scheduled generation such as wind farms.

2.8 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 2 784 market notices issued by NEMMCO during the year. Figure 9 summarises these notices by type.

Figure 9: Market notices

Type	Number of notices
General notice	70
Changes to inter-regional transfer capability	484
Reclassify contingency	228
Reserve notice	279
Market systems	198
Market intervention	13
Non-conformance	1 381
Settlements residue	72
Price adjustment	16
Manual priced dispatch interval	16
Power system events	21
NEM systems	6

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.

2.9 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 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.

Figure 10 summarises the percentage of days when actual demand was greater than forecast demand, as well as the average amount by which actual demand exceeded forecast demand for those days.

Figure 10: Medium-term PASA demand forecast comparison

	QLD	NSW	VIC	SA	TAS
Proportion of weekdays where demand greater than 10% POE forecast	0.8%	2.3%	1.2%	1.9%	0.8%
Weekdays demand deviation	-1%	-3%	-6%	-4%	-1%
Weekend days where demand greater than 10% POE forecast	27.6%	14.3%	0.0%	1.0%	5.7%

Figure 11 shows the average short-term PASA demand forecast accuracy for 2, 4 and 6 days ahead.

Figure 11: Accuracy of short-term PASA demand forecast

Short-term PASA demand forecast absolute percentage deviation	QLD	NSW	VIC	SA	TAS
2 days ahead	2.3%	3.0%	3.0%	5.2%	3.7%
4 days ahead	2.7%	3.6%	3.4%	6.7%	4.2%
6 days ahead	2.9%	3.8%	3.6%	7.8%	4.2%

Figure 12 shows the average predispatch demand forecast deviation 12 hours ahead.

Figure 12: Accuracy of predispatch demand forecast

Predispatch absolute demand forecast deviation	QLD	NSW	VIC	SA	TAS
12 hours ahead	1.9%	2.3%	2.4%	4.2%	3.2%

It can be observed, in Figure 10, Figure 11 and Figure 12 that the demand forecasts during the year have been generally fairly accurate. The exceptions were the demand forecasts for weekend days for the regions of Queensland, New South Wales and Tasmania.

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 an 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 deviation between forecasts and actuals at the top 10 percentile is large, ranging from 610 MW lower than forecast to 928 MW higher than forecast.

NEMMCO investigated the methods of introducing time varying scaling factors to determine half hourly 10% POE forecast demand using the 50% POE forecast demand. The functionality to use time varying scaling factors to determine 10% POE forecast demand using 50% POE forecast demand in Predispatch and Short Term PASA timeframes was delivered in January 2007.

NEMMCO has implemented time varying scaling factors in the Predispatch timeframe. 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 awaiting to be verified before implementing in production. The expected completion for this work would be early 2008.

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

The short-term PASA demand forecasts were, as shown in Figure 18, consistently reliable since July 2005, especially in the regions of Queensland, New South Wales and Victoria.

Figure 13: Queensland demand forecast deviation 4 hours ahead

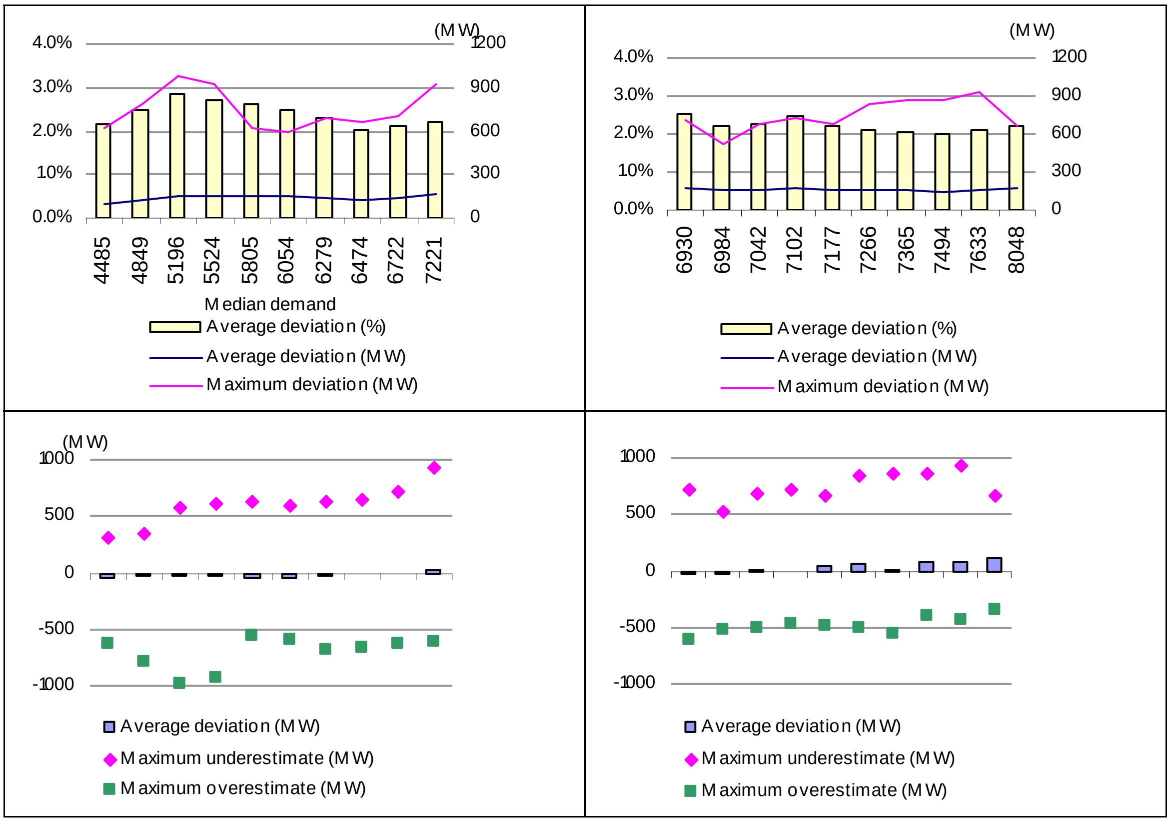


Figure 14: New South Wales demand forecast deviation 4 hours ahead

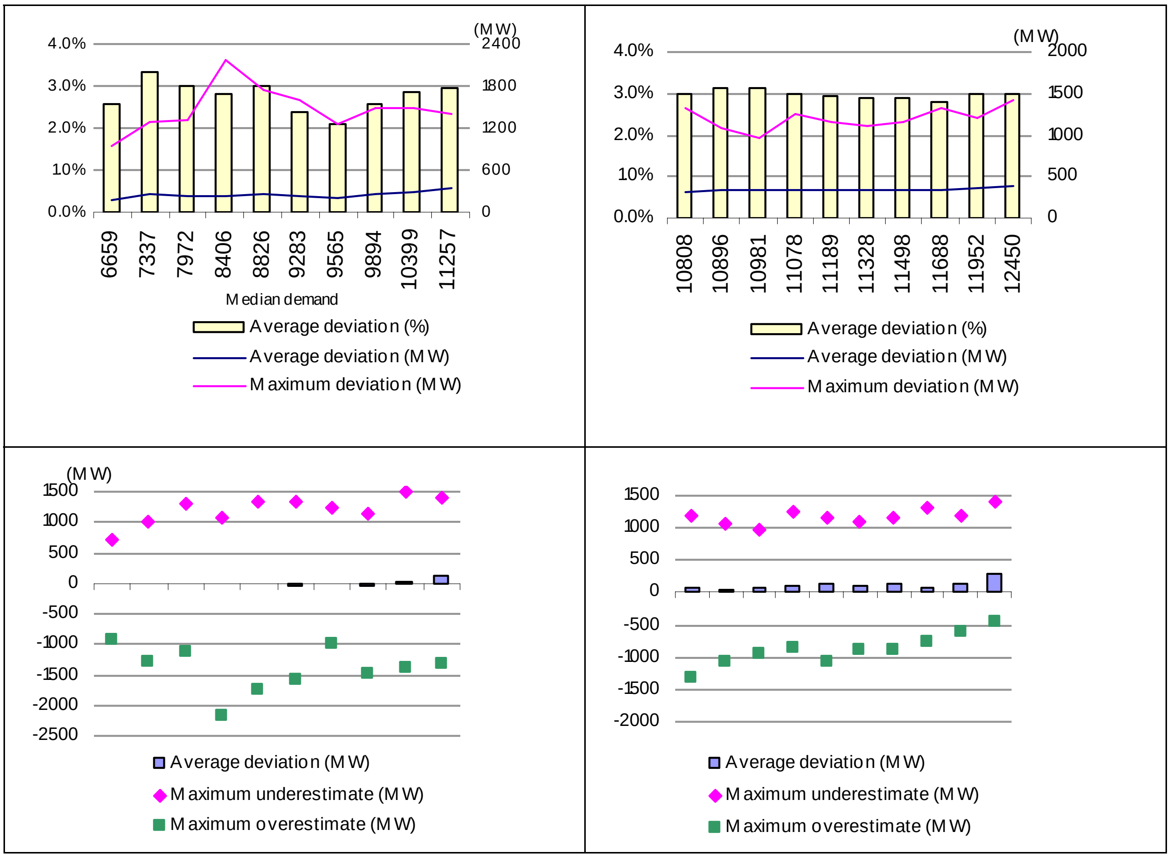


Figure 15: Victoria average demand forecast deviation 4 hours ahead

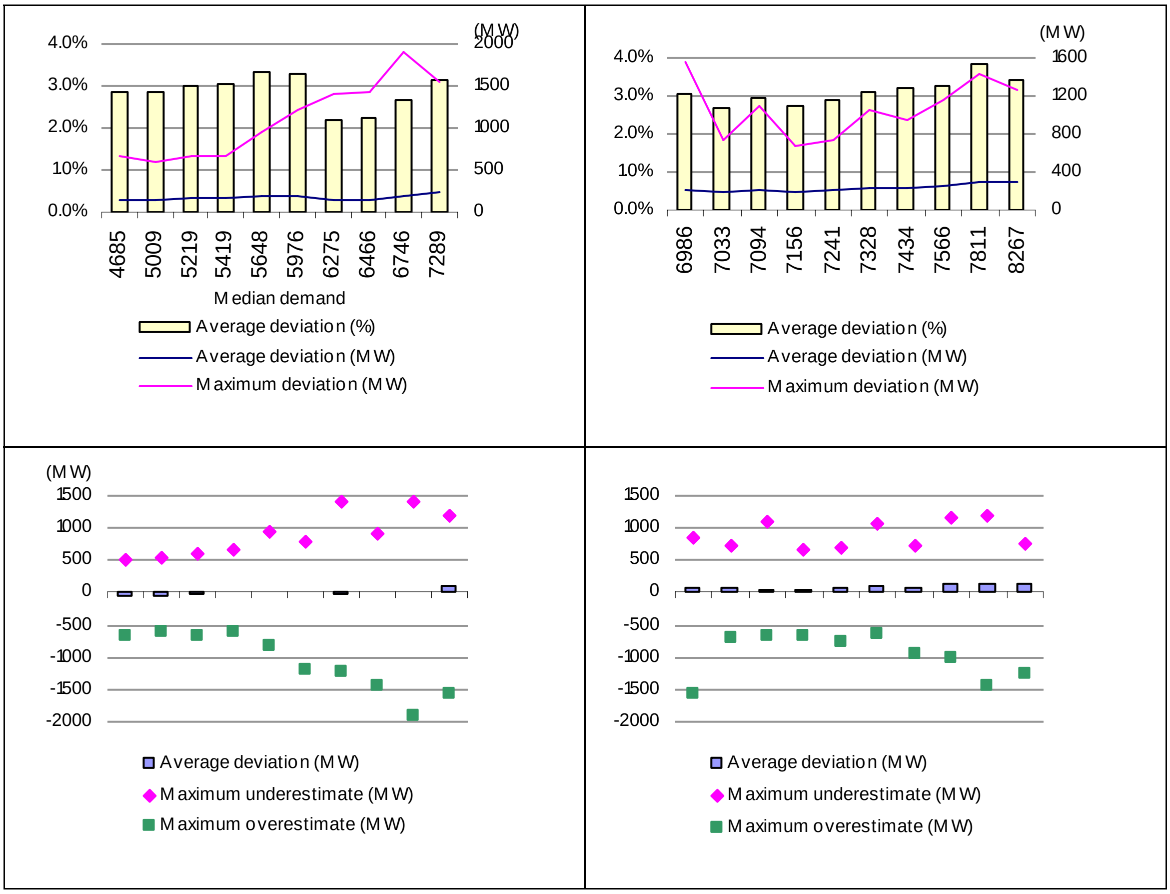


Figure 16: South Australia demand forecast deviation 4 hours ahead

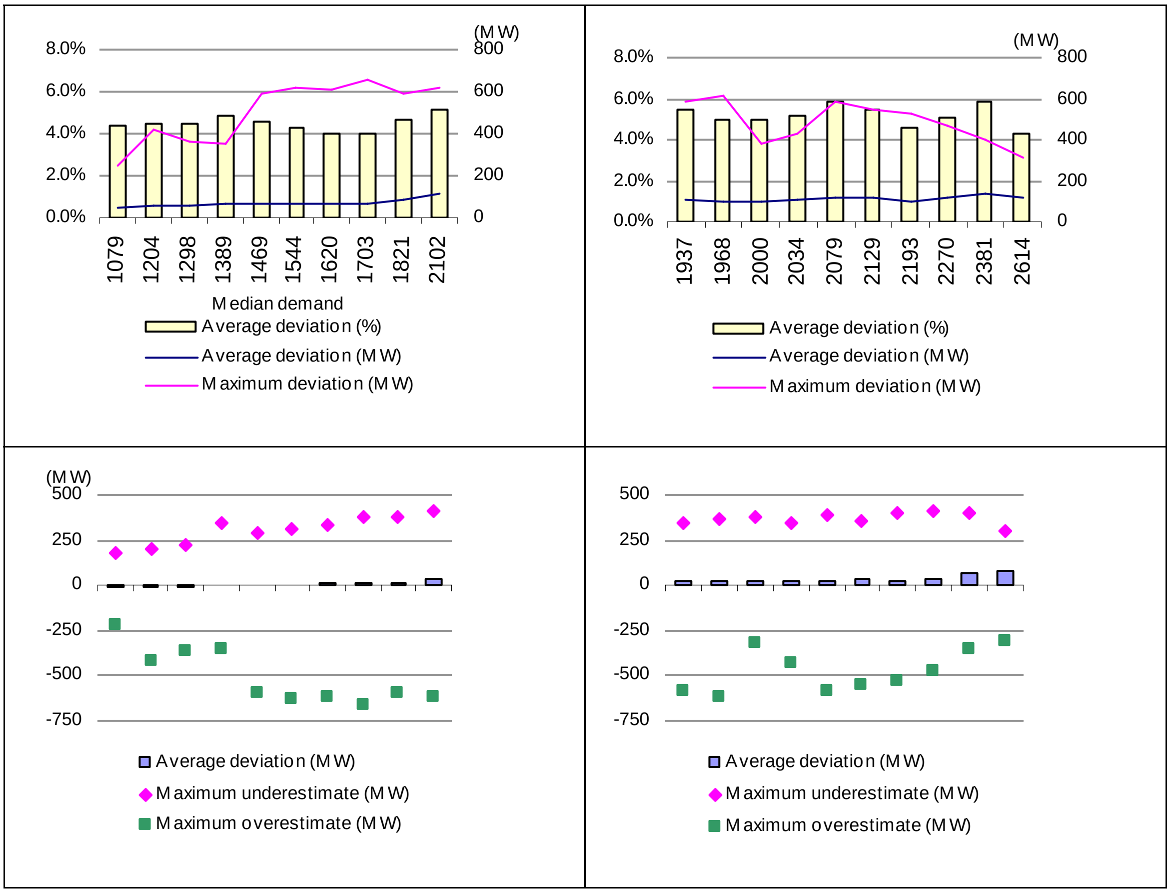


Figure 17: Tasmanian demand forecast deviation 4 hours ahead

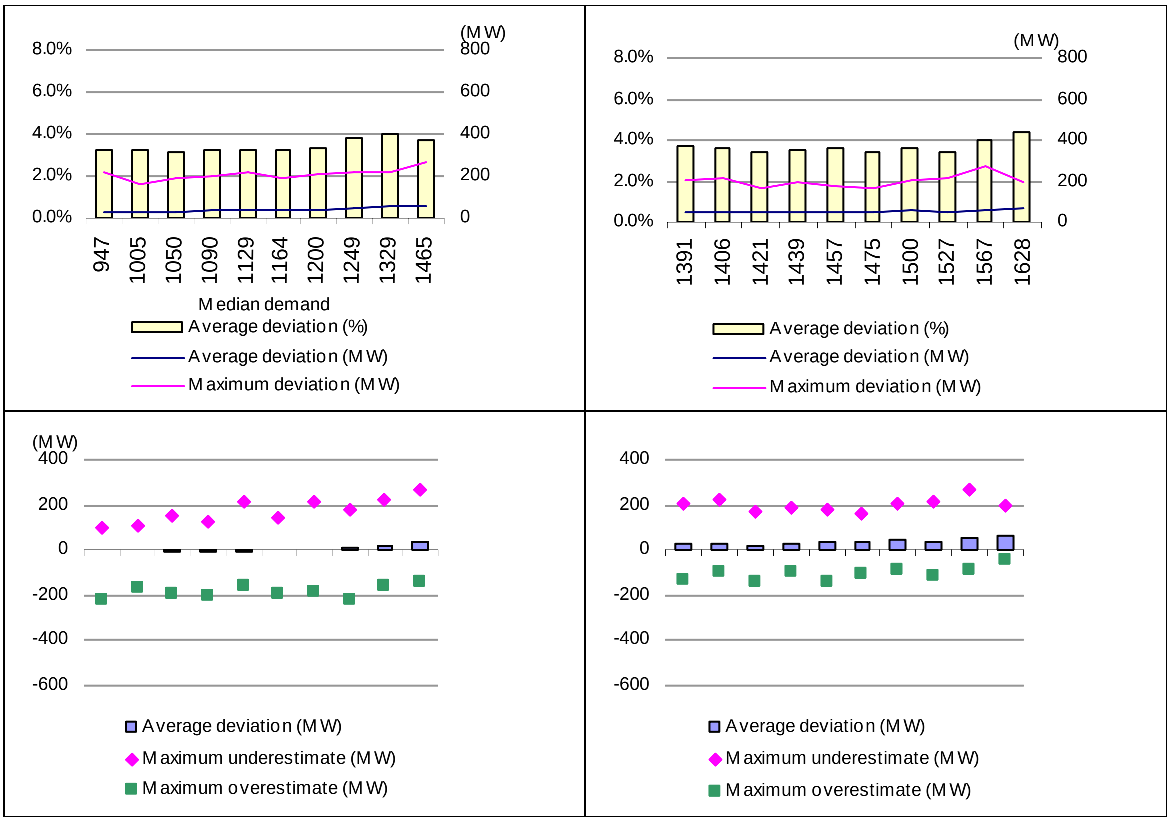
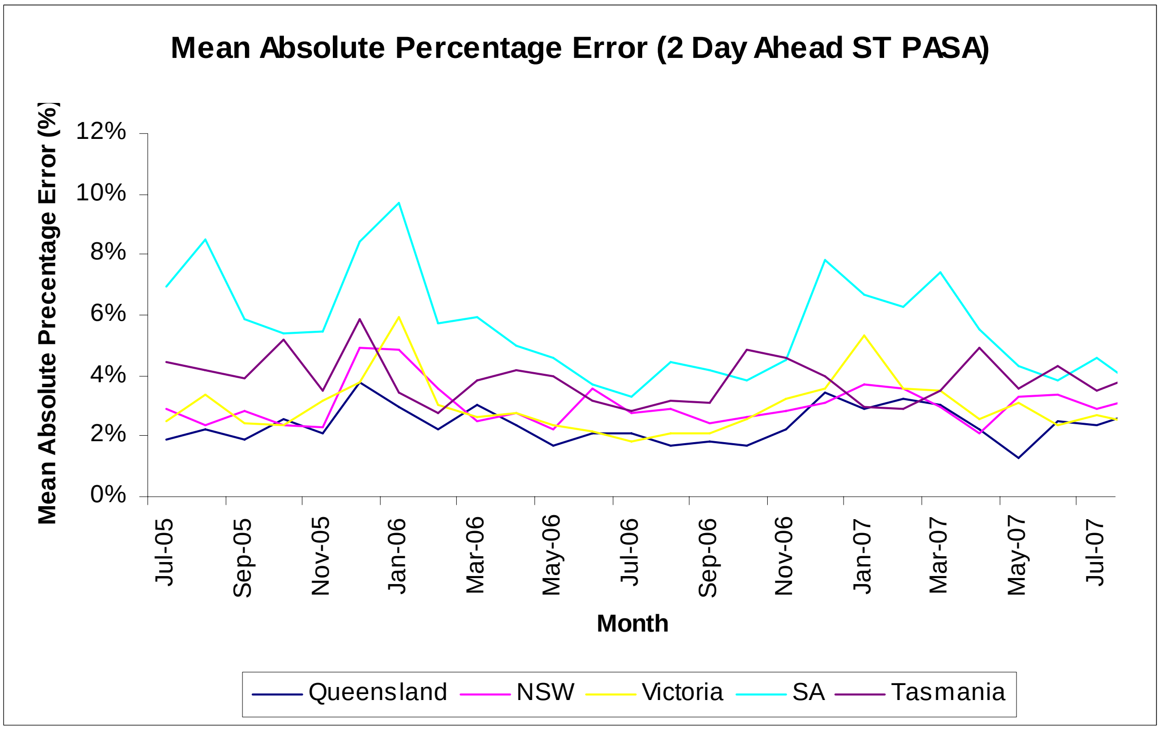


Figure 18: Mean Absolute percentage error (2 Day Ahead Short Term PASA)



2.10 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.

2.11 Reliability safety net

NEMMCO has powers 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 now 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 *Security* (in the following pages).

Performance assessment

There were no directions for reliability for the period.

On 18 May 2006, the AEMC Commissioners made the National Electricity Amendment (Reliability Safety Net Extension) Rule 2006 No.7. This extended NEMMCO's power to contract for additional reserves to meet the reliability standard from the then expiry date of 30 June 2006 to 30 June 2008. This extension allowed sufficient time for the Panel undertake its CRR that includes the need for, and the form of, the safety net.

As part of the CRR, the Panel has advised it plan to improve the Reserve Trader with incremental changes to redesign it as a Reliability Emergency Reserve Trader (RERT) to operate with a defined sunset period.

2.12 Security

This section analyses the arrangements for security and assesses the performance of the national market against the security standards during 2006-07.

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.

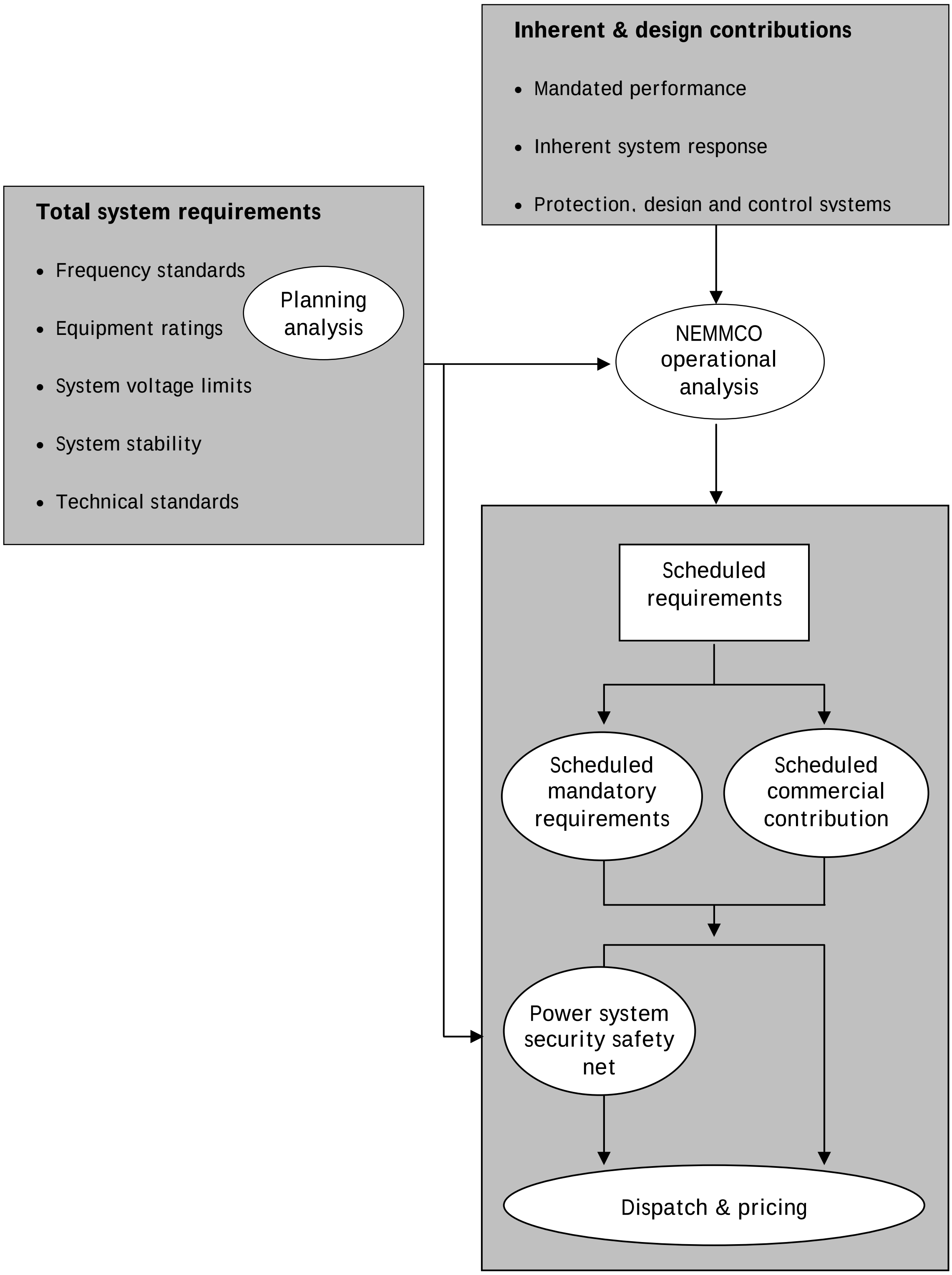
NEMMCO determines the total technical requirements for all services needed to meet the different aspects of security from: the Panel's standards; market rule obligations; knowledge of equipment performance; design characteristics; and modelling of the dynamic behaviour of the power system. This allows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

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.

Figure 19: Security model



2.13 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, 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.

This technical standards framework has been phased in over the last five years. More recently, 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 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 registration process

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

- Review into the enforcement of and compliance with technical standards; [23]
- "Technical Standards for Wind and Other Generator Connections" Rule change;[24] and
- "Resolution Of Existing Generator Performance Standards" Rule change.[25]

Performance assessment

In the 2006-07 year there were three major multiple contingency events with an interruption customer supply:

- Victoria, 16 January 2007
- Tasmania, 22 February 2007
- Queensland, 20 June 2007

23 Detail of the review is available in http://www.aemc.gov.au/electricity.php?r=20051216.173039
24 Detail of the rule change is available in http://www.aemc.gov.au/electricity.php?r=20060324.143345
25 Detail of the rule change is available in http://www.aemc.gov.au/electricity.php?r=20061012.164125

A description and commentary on each incident can be found in the section "Major power system incidents" in *Year in Review*.

The Panel understands that, in response to these events, appropriate measures have been taken to further strengthen the security of the system.

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.

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.

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 other than an *island*.

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

Tasmania's frequency standards

Tasmania entered the national market on 29 May 2005, but has 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 have taken effect.[26]

The Panel intends to review the Tasmanian frequency standard to align the Tasmanian frequency standards with those in the reminder of the NEM.

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*.[27]

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

26 The Panel's determination on the Tasmanian Reliability and Frequency standards is available on the AEMC website.

27 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 www.aemc.gov.au .

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.

Performance assessment

Frequency deviation events have occurred in the 2006-07 years. In some instances, it was necessary to shed loads and, on two occasions, it was necessary to island parts of the power system to prevent further cascading events from occurring.

A description and commentary on this incident can be found in the section "Major power system incidents" in *Year in review*.

Maintaining frequency and time deviation within these limits is the responsibility of NEMMCO.

In summary the power system frequency was generally maintained within the limits set by the Panel. There were some instances, however, where the frequency does 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 12 times during the 2006-07 period. This is a significant improvement compared to the 2005-06 period where the frequency moved outside the operation band 56 times.

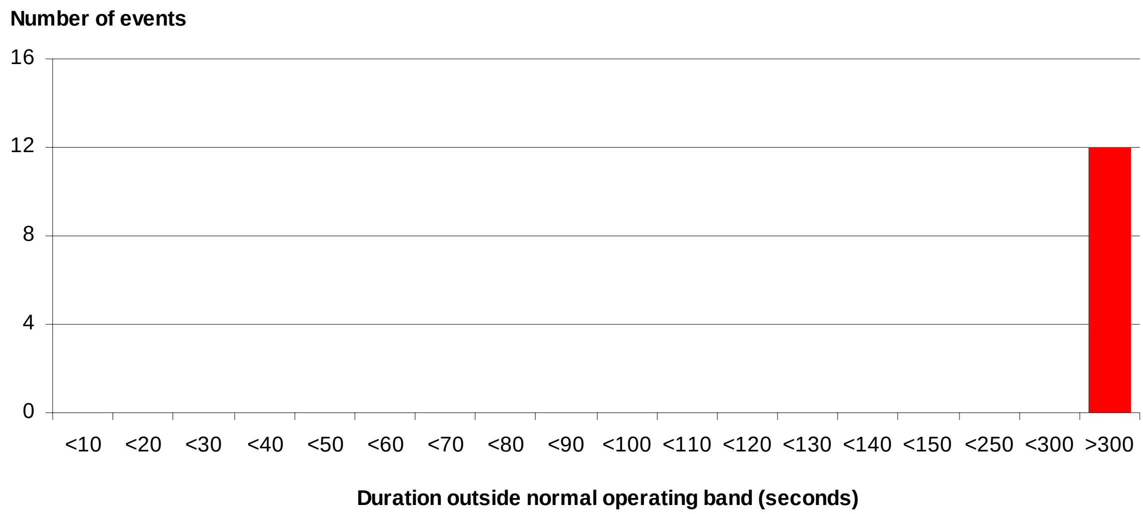
However, the frequency events in the mainland were more prolonged in 2006-07 compared to those in 2005-06. Figure 25 illustrates that the durations of all frequency events in 2006-07 were longer than 5 minutes. This is in sharp contrast with the durations of frequency events in 2005-06, where a major proportion of the events lasted well below the 5 minute level.

Figure 24: Frequency events on the mainland 2006-07

Frequency events — Mainland regions	Total	Low frequency	High frequency
Number of events			
outside normal operating frequency band	12	12	0
outside normal operating frequency excursion band	6	6	0
Events where duration exceeded 300 seconds[1]	12	12	0
Events where duration exceeded 600 seconds (i.e. the frequency standard)	3	3	0

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

Figure 25: Duration of frequency events on the mainland



A minimum frequency of 49.343 Hz occurred on the mainland following the system separation and load shedding event on 16 January 2007. On no occasions did the frequency on the mainland exceed the top of the normal operating frequency band in 2006-07.

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. The reductions are shown in Figure 26. In June 2006, sculpted FCAS requirements, as shown in Figure 27, were introduced.

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

Month	Enabled regulation FCAS (MW)	
July 2003	250	
July 2003	220	
October 2003	200	
March 2004	180	
May 2004	160	
July 2004	150	
April 2005	140	
August 2005	130	
June 2006	Time sculpted FCAS raise requirement introduced on 27 June 2006. See Figure 27.	120 (Lower)

Figure 27: Sculpted FCAS Raise Requirement

	Time			
	04:30 to 07:00	16:30 to 19:00	22:30 to 23:30	Others
Weekdays (MW)	250	250	250	130
Saturday (MW)	130	130[28]	130	130
Sunday (MW)	130	250	130	130

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

Figure 28 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

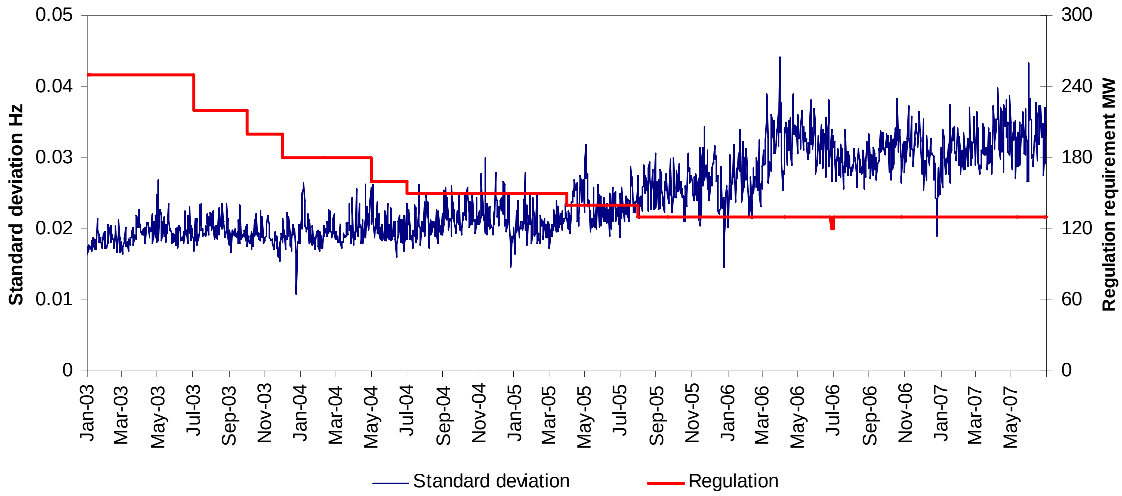
[28] To be increased to 250 MW from 3 August 2006

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

The graph illustrates that the reduction in regulation requirement has not impacted significantly on the quality of the power system frequency.

The reduction in regulation is matched by an increase in the corresponding delayed contingency service. NEMMCO is working towards optimising the financial trade-off between regulation and the related contingency service.

Figure 28: Daily standard deviation of frequency and regulation FCAS enabled on the mainland



Tasmania

Figure 29 shows, for the Tasmanian regions of the national market, how many times the frequency moved outside the normal operating band during the year.

Figure 29: Frequency events in Tasmania 2006-07

Frequency events — Mainland regions	Total	Low frequency	High frequency
Number of events			
outside normal operating frequency band	31	22	9
outside normal operating frequency excursion band	28	20	8
Events where duration exceeded 300 seconds	18	12	6
Events where duration exceeded 600 seconds (i.e. the frequency standard)	9	4	5

A minimum frequency of 47.712 Hz occurred in Tasmania on 14 September following a trip in the Basslink. A maximum frequency of 51.685 Hz occurred in Tasmania on 10 December 2006 following generating units in Tasmania went above their energy targets.

Figure 30 shows, for the 31 events in Tasmania, the time spent outside the normal operating frequency band. It highlights the 18 events of more than 5 minutes duration.

As in the case for mainland, the number of frequency events in Tasmania for 2006-07 was far less than those for 2005-07. The number of event in 2006-07 is 31 compared to 630 in 2005-06.

Figure 30: Duration of frequency events in Tasmania

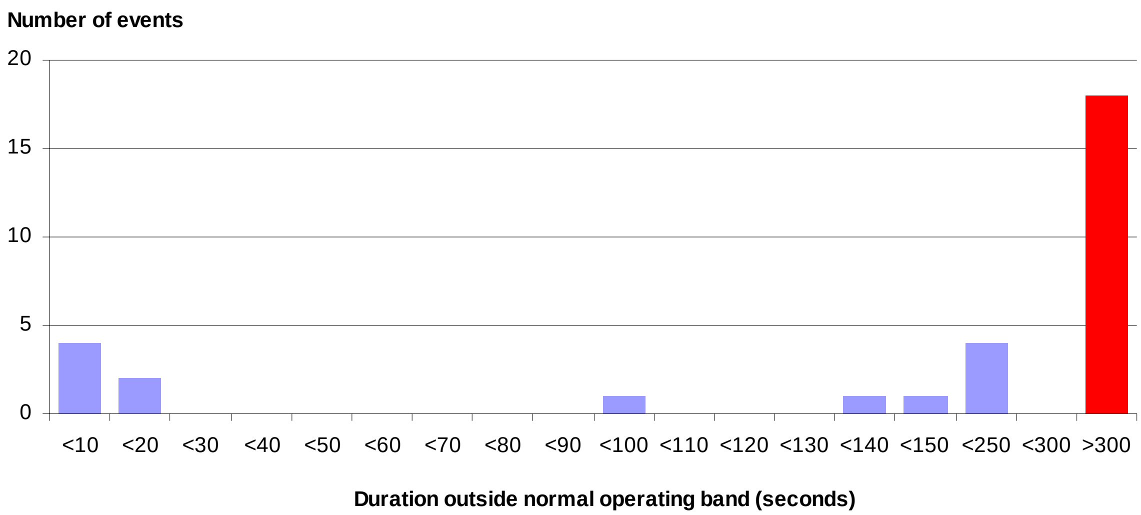
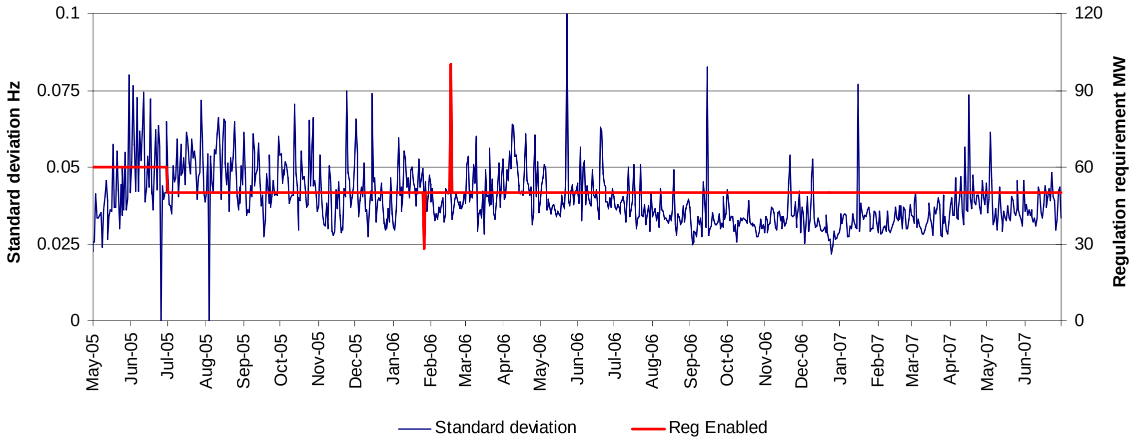


Figure 31 shows for each day, since 29 April 2005, the distribution of the measured frequency and the requirement for regulation FCAS (raise and lower) in Tasmania. A standard deviation below 0.05 Hz meets the Panel's standard.

Figure 31: Daily standard deviation of frequency and regulation FCAS enabled in Tasmania



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.

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 recently developed a system to monitor the performance of voltage levels against the limits advised by the TNSPs.

Performance assessment

NEMMCO was generally able to maintain voltages within advised limits throughout the 2006-07 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. During 2006-07 this system was upgraded to 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 approximately every 7 to 8 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.

2.14 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

Thirteen transmission-related non-credible contingency events were reported by NEMMCO during the year. (This compares with 6 in the previous year and 7 the year before that).

Three generation-related non-credible contingency events were identified.

2.15 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.

2.16 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 a large generating unit 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 major problem with the protection system

2.17 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.

Performance assessment

This analysis can have significant impact on commercial and system security outcomes. There were a number of occasions, for example, when NEMMCO's online monitoring tools identified the need to reduce interconnector transfer capability in order to maintain security. 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. NEMMCO therefore refers these situations to the relevant TNSP for further action and potential updating of limit advice.

2.18 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.

2.19 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.[29]

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

2.20 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.

Performance assessment

NEMMCO issued 10 directions throughout the year to manage local security issue (compared to 60 during 2005-06, 41 during 2004-05 and 10 in 2003-04). Of these, six in Victoria and one in South Australia, were related to maintaining power system security following the loss of Victoria to Snowy interconnector on 16 January.

The remaining three occasions occurred in Queensland where fast start generators were directed to synchronise their units to maintain a secure operating state.

On 10 January, due to the lightning in the vicinity in northern Queensland, the loss of Nebo to Strathmore line was considered to be a credible contingency event. At 4.16 pm, a direction was issued to a participant in north Queensland to synchronise its plant to the network.

On 20 May, high demand in north Queensland caused a system normal network constraint to violate. The violated constraint sets transient limits for the loss of the Nebo to Strathmore line and affects the generation of a number of units in north Queensland. At 1.01 pm a participant in north Queensland was directed to synchronise one of its generating units with the network. A second direction was issued at 5.40 pm to a participant in north Queensland for a similar circumstance.

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 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.

As noted in CitiPower and Powercor's submission, 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 of the data.

3.1 Distribution network performance

New South Wales

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

From August 2005 the network performance standards for the New South Wales DNSPs have been set by the Minister for Energy through Ministerially imposed licence conditions. These licence conditions are published on the Independent Pricing and Regulatory Tribunal's (IPART[30]) website (conditions 14-19).[31]

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.

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

31 The relevant licensing conditions are available at the IPART website at http://www.ipart.nsw.gov.au/electricity/documents/DesignReliabilityandPerformanceLicenceConditionsImposedonDistributionNetworkServiceProviders.PDF .

Figure 32 and Figure 33 shows 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 the DNSP websites.

Figure 32: Performance of the NSW DNSPs for the 2006-07 Year (SAIDI)

	Country Energy		EnergyAustralia		Integral Energy		NSW
	Target	Actual	Target	Actual	Target	Actual	Actual
CBD Feeders	n/a	n/a	57	13.0	n/a	n/a	13.0
Urban Feeders	137	114.0	88	77.5	88	66.0	77.4
Short Rural Feeders	332	239.0	380	290.0	292	175.0	233.6
Long Rural Feeders	740	497.0	860	1093.47	n/a	1491.0	514.9
All Feeders	n/a	242.0	n/a	102.0	n/a	94.0	135.1

Figure 33: Performance of the NSW DNSPs for the 2006-07 year (SAIFI)

	Country Energy		EnergyAustralia		Integral Energy		NSW
	Target	Actual	Target	Actual	Target	Actual	Actual
CBD Feeders	n/a	n/a	0.34	0.17	n/a	n/a	0.17
Urban Feeders	1.96	1.36	1.28	0.96	1.28	0.90	0.98
Short Rural Feeders	3.24	2.47	4.2	2.76	2.76	2.00	2.41
Long Rural Feeders	4.9	3.82	8.0	5.64	n/a	3.7	3.87
All Feeders	n/a	2.39	n/a	1.15	n/a	1.20	1.46

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.

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) set performance targets for unplanned SAIFI, unplanned SAIDI and 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.[32] 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.[33]

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 of the distributors.

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

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.

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[32] Details of the S-factor scheme are available from the Electricity Distribution Price Review 2006-10 documents.

[33] Details of the guaranteed service level payments are contained in clause 6 of the Electricity Distribution Code (EDC), available from the ESC's website at http://www.esc.vic.gov.au/public/Energy/Regulation+and+Compliance/Codes+and+Guidelines/

Figure 34: of the Victorian DNSPs for the 2006 Year

		Target				Performance		
		Unplanned interruptions		Planned interruptions				
DNSP	**Feeder**	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	CADI
Alinta AE	**Urban**	73	1.27	6.0	0.03	92.00	1.34	68.60
	Short rural	113	2.25	14.0	0.08	168.50	2.00	84.10
CitiPower	**CBD**	14	0.25	5.9	0.02	20.69	0.296	69.88
	Urban	35	0.80	9.9	0.03	34.47	0.624	55.24
Powercor	**Urban**	98	1.63	16.0	0.09	111.51	1.78	62.65
	Short rural	118	1.80	35.0	0.15	190.09	2.50	76.04
	Long rural	297	3.30	70.0	0.25	374.64	3.65	102.64
SP AusNet	**Urban**	109	1.82	16.0	0.09	216.04	2.46	87.71
	Short rural	185	2.73	35.0	0.15	315.59	3.29	95.95
	Long rural	300	4.28	70.0	0.30	472.79	4.18	113.02
United Energy	**Urban**	59	1.06	16.0	0.10	72.86	0.97	74.94
	Short rural	96	2.03	35.0	0.15	100.32	1.66	60.47

Notes

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

2. No deductions have been made here for the impact on performance of unusual events for which exclusions have been granted for the purpose of the service incentive scheme of Victoria

3. 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/

Queensland

The Queensland Electricity Act 1994 and the Electricity Regulation 2006 define the arrangements for the Queensland DNSPs. The minimum service standards are in Schedule 1 of the Queensland Electricity Industry Code. The Queensland Department of Energy set the existing performance standards for the Queensland DNSPs. The

Queensland Competition Authority (QCA) assumed responsibility for administering the Queensland Electricity Industry Code on 1 July 2007 and is required to review minimum service standards and guaranteed service levels to apply from the beginning of the next regulatory period (begin 1 July 2010).

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 35 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.

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.

Figure 35: Performance of the Queensland DNSPs for the 2006-07 Year

DNSP	Feeder	Target[34]				Performance	
		SAIDI		SAIFI		SAIDI	SAIFI
		2005-06	2006-07	2005-06	2006-07	2006-07	2006-07
Energex	**CBD**	20	20	0.33	0.33	1.273	0.015
	urban	155	145	1.73	1.64	80.679	1.021
	Short-rural	265	255	2.77	2.70	244.559	2.463
Ergon	**urban**	215	205	2.70	2.60	186.66	1.91
	Short-rural	590	570	5.40	5.20	486.54	3.93
	Long - rural	1,150	1130	8.75	8.60	1024.51	7.07

South Australia

The *Electricity Act* requires a distributor to be licensed by the AEMC and to comply with Codes made the Essential Services Commission of South Australia (ESCOSA).

[34] Target figures prior to 2007-08 are available from the second edition of Queensland *Electricity Industry Code* in the website http://www.dme.qld.gov.au/zone_files/Electricity/electricity_industry_code_second_edition.pdf

Performance Standards for the DNSP is primarily established by ESCOSA in clause 1.2.3 of the Electricity Distribution Code.[35] Figure 36 shows the performance targets for the South Australian DNSP.

Figure 36: Reliability Targets of the South Australia DNSP

Feeder	SAIDI	SAIFI
Adelaide CBD	25	0.3
Major Metropolitan Areas	115	1.4
Barossa/Mid-Nth & Yorke Pen./Riverland/Murrayland	240	2.1
Eastern Hills/Fleurieu Peninsula	350	3.3
Upper North & Eyre Peninsula	370	2.5
South East	330	2.7
Kangaroo Island	450	N/A

Network performance is reported to ESCOSA on a quarterly basis pursuant to Electricity Guideline 1[36] and verification of compliance with relevant regulatory obligations and codes is undertaken pursuant to the requirements set out in Guideline 4.[37] In addition, as part of the ESCOSA's periodic audit programme, the reliability and accuracy of operational performance data provided by the DNSP was audited during 2006. The audit concluded that the DNSP maintained, in all material aspects, effective control procedures in relation to the performance reporting obligations as required under Electricity Guideline 1. Figure 37 shows the performance of the South Australian DNSP for the 2006-07 year.

[35] The Electricity Distribution Code is available on the ESCOSA website at http://www.escosa.sa.gov.au/webdata/resources/files/050623-D-ElecDistCodeEDC05.pdf.

[36] Electricity Guideline 1 is available on the ESCOSA website at http://www.escosa.sa.gov.au/webdata/resources/files/060614-ElectricityGuideline1.pdf.

[37] Guideline 4 is available on the ESCOSA website at http://www.escosa.sa.gov.au/webdata/resources/files/050629-M-EnergyGuidleine4Compliance.pdf.

Figure 37: Performance of the South Australia DNSP 2006-07 Year

Feeder	SAIDI	SAIFI	CAIDI
CBD	9	0.14	60
Urban	95	1.28	74
Rural short	302	2.33	130
Rural long	376	2.63	143

ESCOSA's enforcement processes comprise three distinct functions:

- Administrative functions – the exercise of its roles prescribed under legislation or arise in the ordinary course of performing its legislative functions;
- Disciplinary functions – the exercise of powers granted under legislation to suspend or cancel a license; and
- Prosecutorial functions – the exercise of powers granted under legislation to bring punitive action against an entity which does not comply with legislative requirements.

ESCOSA undertook a specific inquiry into the performance of the distributor during a heatwave in January 2006. ESCOSA concluded that whilst the DNSP's practice and procedures for dealing with extreme weather events are generally appropriate, there were some deficiencies at the time of the heatwave and improvements can be made. ESCOSA amended the Electricity Distribution Code increasing payment to customers for outages of more than 24 hours from $160 to $320, commencing 1 January 2007.[38]

In 1 July 2005, ESCOSA established a Service Incentive scheme as part of its Service Standards Framework to provide a financial incentive to the DNSP to improve service to customers that have been receiving poor levels of service. The Service Incentive scheme relates to reliability performance and telephone responsiveness performance. The DNSP is also required to make guaranteed service level (GSL) payments to the worst served customers if there have been excessive sustained supply outages.[39]

[38] ESCOSA's variation to the Electricity Distribution Code is available on its website at http://www.escosa.sa.gov.au/webdata/resources/files/061215-VariationElecDistCodeFinalDec.pdf

[39] ESCOSA's Service Incentive scheme and GSL scheme are discussed in the 2005 - 2010 Electricity Distribution Price Determination which is available on its website at https://www.escosa.sa.gov.au/webdata/resources/files/050405-EDPD_Part_A_StatementofReasons_Final.pdf

Tasmania

The Electricity Supply Industry Act 1995 covers the network performance requirements for the Tasmanian DNSP through the Tasmanian Electricity Code, price determinations and Regulations.

The Office of the Tasmanian Energy Regulator (OTTER) sets the performance standards for the Tasmanian DNSP. This has three parts:

- Minimum and average network performance requirements on CBD, urban and rural feeders (specified in the Tasmanian Electricity Code[40]);
- The current price determination includes S factor for SAIDI and SAIFI that changes the revenue cap by ± $1.6m, or approximately 1.25% of the revenue requirement;[41] and
- The Tasmanian Electricity Code and relevant Guidelines include GSL scheme that provides for a payment of $80 to each affected customer for a long outage or a number of short outages.[42]

Figure 38 shows a summary of the performance of the Tasmanian DNSP. More detailed performance information is available from network performance reports available on the OTTER website.

Figure 38: Performance of the Tasmanian DNSP 2006-07 year

Feeder	Performance		
	CAIDI	SAIDI	SAIFI
CBD	64	45	0.70
Urban	88	92	1.05
Rural	104	305	2.93
System	100	200	2.01

[40] The Tasmanian Electricity Code is available on the OTTER website at http://www.energyregulator.tas.gov.au/domino/otter.nsf/LookupFiles/FullRevisedCode18May2005.pdf/$file/FullRevisedCode18May2005.pdf.

[41] A description of the operation of this S factor is available in section 4.3.1.2 of the "Investigation of Prices for Electricity Distribution Services and Retail Tariffs on Mainland Tasmania Final Report and Proposed Maximum Prices", available on the OTTER website at http://www.energyregulator.tas.gov.au/domino/otter.nsf/LookupFiles/R_ElectPriceInvest_FinalReport.pdf/$file/R_ElectPriceInvest_FinalReport.pdf

[42] A description of the Tasmanian GSL scheme is available on the OTTER website at http://www.energyregulator.tas.gov.au/domino/otter.nsf/LookupFiles/Guaranteed_Service_Level_Principles.pdf/$file/Guaranteed_Service_Level_Principles.pdf.

The DNSP publishes a report that presents performance statistics for its network. This report is independently audited. The performance of the DNSP's network is enforced through the operation of Tasmanian Electricity Code, the S factor and the GSL scheme.

OTTER, together with the Tasmanian Office of Energy Planning and Conservation and Aurora Energy, has developed a new network reliability performance framework that will come into effect on 1 January 2008. The new framework was designed to relate reliability standards more closely to the needs of the communities served by the network. Further details are available from OTTER's website.

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[43] and in the Consumer Protection Code,[44] which also has minimum service standards.

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

Figure 39 shows a summary of the performance of the ACT DNSP including target and actual performance values. More detailed performance information is available from network performance reports available on the ICRC website.

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[43] The ACT Electricity Distribution Supply Standards Code is available on the IRCR website at http://www.icrc.act.gov.au/__data/assets/pdf_file/0016/16630/electricitydistributionsupplystandardscodecw.pdf.

[44] The ACT Consumers Protection Code is available on the IRCR website at http://www.icrc.act.gov.au/__data/assets/pdf_file/0011/47909/Consumer_Protection_Code.pdf.

Figure 39: Performance of the ACT DNSP 2005-06 year[45]

Index	Target	Performance		
		Urban	Rural short	Rural long
SAIDI	91	95.26	85.45	93.6
SAIFI	1.2	0.99	3.1	1.03
CAIDI	74.6	96.2	27.56	90.87

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.[46]

3.2 Transmission network performance

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 Utilities, Energy and Sustainability (now the Department of Water and Energy). 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.

45 Performance figures for 2006/06 were illustrated because the information for 2006/07 is yet to be confirmed. Figures are available in ICRC's website: http://www.icrc.act.gov.au/__data/assets/pdf_file/0004/61780/ACT_distribution_service_performance_2005-06_1.pdf.

46 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/__data/assets/pdf_file/19121/report_16_of_2005_incentive_final.pdf.

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 VCR, associated with transmission constraints. The VCR is currently set at $29,600.[47] However VENCorp also considers a sector specific VCR where the transmission constraint affects only a reasonably distinguishable subset of the Victorian load."

Queensland

The mandated reliability obligations and standards are contained in Schedule 5.1 of the Rules, the Queensland Electricity Act, the transmission licence, and in Connection Agreements with the distribution networks. In addition, the economic regulator (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

[47] VENCorp is currently reviewing the VCR which is scheduled for completion by early 2008.

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.[48] 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 take effect from 1 July 2008 to align with the AER's next price determination for ElectraNet.[49] 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 Tasmanian Reliability and Network Planning Panel (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. A regulation is currently being drafted to give effect to the criteria. Transend will be 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. Until the regulation is in place, Transend is required to use the market benefit limb of the regulatory test or compliance obligations with the Rules to justify network augmentations. 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 National Transmission Plannner

On 13 April 2007, the Council of Australian Governments (COAG) asked the Ministerial Council on Energy (MCE) to request the AEMC to develop a detailed implementation plan for the national transmission planning function. COAG also indicated in its response to the final report of the Energy Reform Implementation Group (ERIG) that it

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[48] The ETC can be found on the ESCOSA website at http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ElecTransCodeET05.pdf.

[49] ESCOSA's final determination is available on its website at http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ReviewReliabilityElectricityTransmissionCodeFinalDec.pdf.

agreed with the ERIG report that the Panel should review the jurisdictional transmission reliability standards and develop a consistent national framework.

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 17 August 2007, the AEMC published the Terms of Reference for the Reliability Panel review into electricity transmission network reliability standards requested by the MCE.

It is anticipated that Panel's review will be completed by September 2008.

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 are for a period of two years. 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

5 Glossary[50]

AEMC	The Australian Energy Market Commission, which is established under section 5 of the Australian Energy Market Commission Establishment Act 2004 (SA).
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).
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. **single credible contingency event** An individual credible contingency event for which it could be reasonably expected, under normal conditions, that the design or

[50] 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.

	operation of the relevant part of the power system would adequately cater, so as to avoid significant disruption to power system security. **critical single credible contingency event** The credible contingency event that would have the most significant impact on the power system. This would generally be the instantaneous loss of the largest generating unit on the power system. **non-credible ("multiple") contingency event** A contingency event whose occurrence is *not* considered "reasonably possible" in the circumstances. Typically a non-credible contingency event involves simultaneous multiple disruptions, such as the failure of several generating units at the same time.
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*
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.
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.
multiple contingency event	see *contingency events*
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*
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.
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.
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%.
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.

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.
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.